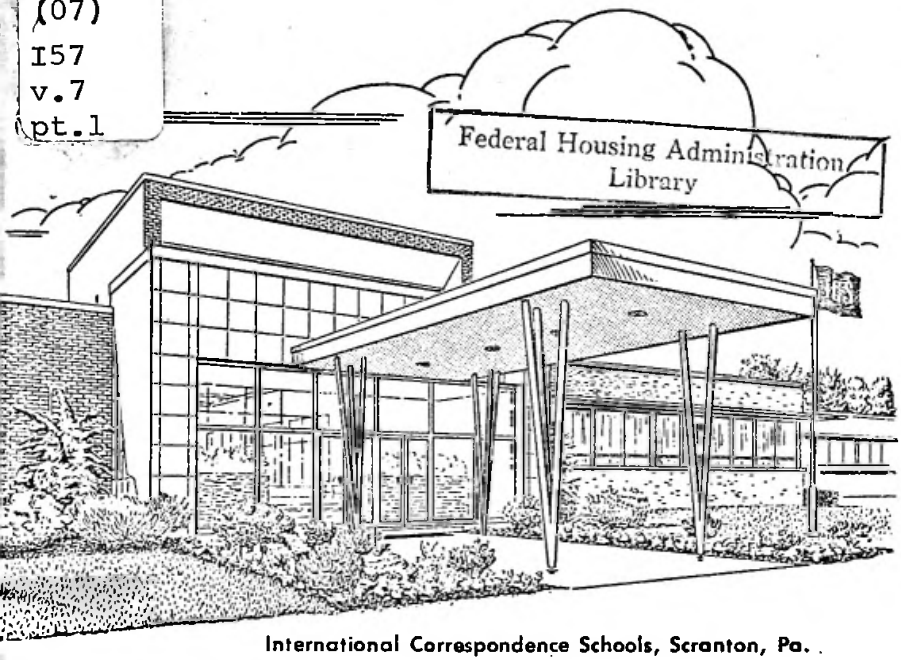

International Correspondence Schools, Scranton, Pa.

Elementary Architectural Drawing

Prepared Especially for Home Study

By

WILLIAM S. LOWNDES, Ph. B., A.I.A.

5893 A-4 **Part 1** **Edition 2**

International Correspondence Schools, Scranton, Pennsylvania

International Correspondence Schools, Canadian Ltd., Montreal, Canada

"Blessed is the man who has some congenial work, some occupation in which he can put his heart and which affords a complete outlet to all the forces there are in him."

—John Burroughs

* * *

Fortunate, indeed, are you, if you've found the work you like. And if you will apply yourself in learning those things which are involved in that work . . . and if you will *keep on learning* . . . Success will surely crown your efforts.

Architecture home study course

ELEMENTARY ARCHITECTURAL DRAWING

PART 1

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Serial 5893 A-4

ICS

International Correspondence Schools
Scranton, Pennsylvania

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What This Text Covers . . .

5893A

ELEMENTARY ARCHITECTURAL DRAWING

PART 1

DEFINITIONS

1. Drawing.—Drawing is the art of representing three-dimensional objects or ideas on a plane surface, such as a sheet of paper, by means of lines, marks, symbols, etc.

2. Architectural Drawing.—Architectural drawing is the art of representing ideas concerning buildings and their parts by means of drawing.

3. Architectural Drawings.—Architectural drawings consist of lines, marks, symbols, and other indications that are drawn to represent buildings or parts of buildings. Every line and mark on an architectural drawing has a definite meaning that must be understood by the architect who designs the building, by the draftsman who makes the drawing, and by the contractor and mechanics who erect the building according to the drawing.

4. Architectural Drawing a Language.—Architectural drawing may be considered as the special language of the architect, who uses this language to convey to the client and to the contractor or builder his ideas regarding a building. Just as a masterpiece of literature is expressed in letters and words, so a masterpiece of architecture is expressed by lines, marks and symbols.

It is essential that the student of architecture learn to draw the elementary lines before he can use these elements to express architectural ideas. The work called for in the subject *Elementary Architectural Drawing* will consist of drawing ele-

mentary lines and figures, as well as letters and numerals that will be used in advanced architectural drawing. A satisfactory completion of this work constitutes a proper preparation for advanced work.

DRAWING EQUIPMENT

GENERAL REMARKS

5. Architectural drawings are drawn upon sheets of paper mounted or laid on drawing boards. The drawings are made with the aid of T-squares, triangles, drawing instruments, pencils, pens, etc.

In the study of Elementary Architectural Drawing, the student should learn to use these instruments and materials skilfully, so that he will be prepared to execute freely the drawings called for later.

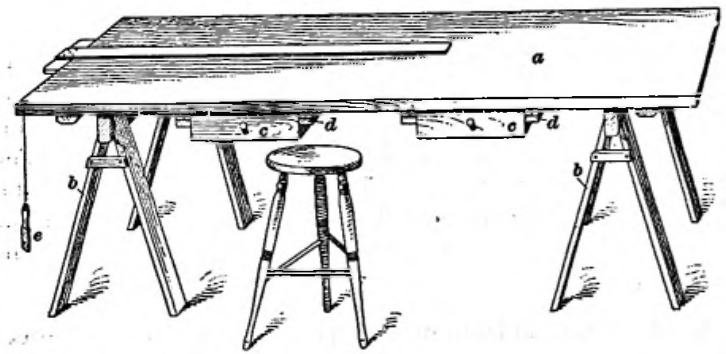


FIG. 1. ARCHITECT'S DRAWING BOARD

DRAWING BOARDS

6. Definition.—Drawing boards are flat slabs of wood varying in size from 12″×17″ to 48″×120″. On these boards are fastened sheets of paper on which drawings are made.

7. Description of Drawing Boards.—In the drafting room of an architect's office, drawing boards of various sizes are used. A standard outfit is illustrated in Fig. 1, in which a large board *a* is shown supported on trestles, or horses, *b*. Boards such as these are from 36 to 48 inches (in.) in width, and from 6 to 10 feet (ft) in length. Large or small drawings may be made on such boards.

A drawing board 16″×22″ is the minimum-sized board that can be used for the plates called for in the lessons on the subject of Elementary Architectural Drawing.

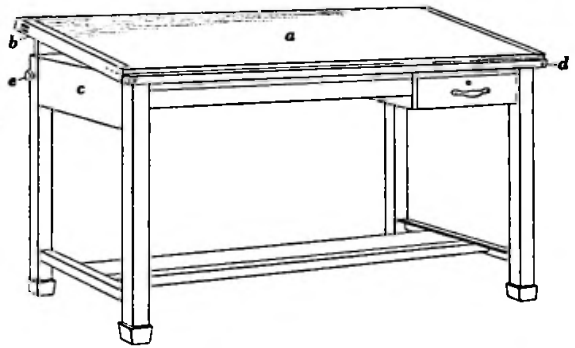


FIG. 2. DRAWING TABLE

The drawing table in Fig. 2 consists of the basswood drawing surface *a* held in zinc-plated steel end cleats *b* and mounted on a steel base *c*. A rounded oak strip *d*, attached to the front edge of the board, forms a slot to receive and protect extra-large sheets of paper that may extend over the edge of the board. The board can be tilted and held in a sloping position by means of the raising device *e* concealed in the rear leg.

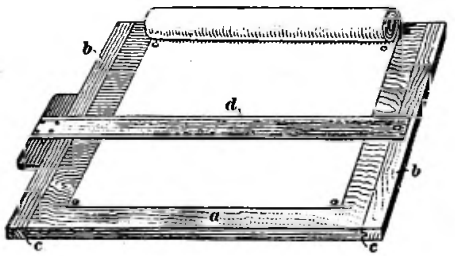


FIG. 3. SMALL DRAWING BOARD

8. Manufacture of Drawing Boards.—Drawing boards should be made of soft white pine that is well-seasoned, straight-grained, and free from knots and other imperfections.

Boards of the smaller sizes are made as shown in Fig. 3. The main body *a* is made of one width of board or is built up of two or more strips of wood glued together. Strips of wood *b* are secured to the ends of the board by the use of tongued-and-grooved joints *c*. The entire surface is planed and sanded so as to form a smooth, even surface to receive the paper.

FIG. 4. BUILT-UP DRAWING BOARD

Drawing boards are also made of several pieces *a*, Fig. 4, of soft white pine glued together to form the required width, and hardwood cleats *b* are screwed to the back. Grooves *c* are cut through half the thickness of the board over the entire back. These grooves take the transverse resistance out of the wood, thus keeping the board from warping, and at the same time leaving the longitudinal strength nearly unimpaired.

The cleats *b* raise the board from the table, making it easier to change the position of the board. When in use, the board is generally placed so that one of the short edges is at the left-hand side.

THE T-SQUARE

9. Definition.—A T-square is a device used in making lines on a drawing, as illustrated in Fig. 5. It consists of a head *a* and a blade *b*. Celluloid edges are shown at *c* and *d*.

10. Description.—T squares are made with blades that are from 17 to 72 in. in length, the thickness and width varying with the length. These blades are made of thin strips of straight-fine-grained hardwood, such as pear, maple, and mahogany, and in most cases are edged with a strip of celluloid, often transparent. The head of the square is frequently made

of ebony or other hardwood, as this part is subject to considerable wear. It is generally fixed rigidly to the blade, with its edge at right angles to the edge of the blade.

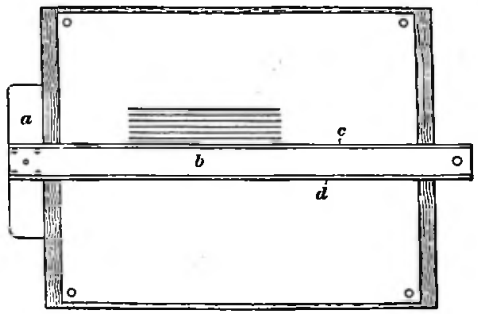


FIG. 5. T-SQUARE

T-squares are also made with swivel heads, which can be turned so as to make different angles with the blades, as shown in Fig. 6. The swivel head also enables the draftsman to make a series of parallel lines at angles with the edge of the board, as illustrated.

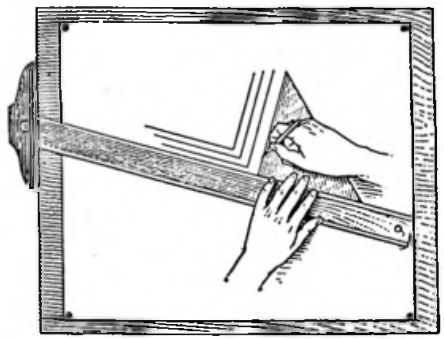


FIG. 6. T-SQUARE WITH SWIVEL HEAD

11. Use of T Square.—The T square is used by placing the head against the edge of the drawing board as in Figs. 1, 3, and 5, and sliding the square up or down against the edge until the desired position is reached. A line may then be drawn by

running the point of a pencil or a pen along the edge of the blade.

When a line is to be drawn, the T square is held in a fixed position by placing the thumb and little finger or the heel of the left hand on the blade of the square and pushing gently toward the right. This leaves the three middle fingers of the left hand free to operate and hold the triangle while lines are being drawn. The right hand is used entirely to hold the pencil or pen and to draw the lines.

THE STRAIGHTEDGE

12. A straightedge is a strip of wood that is similar to the blade of a T-square. It is generally from 4 to 6 ft long and is used in making long straight lines such as occur in perspective drawings. Straightedges are made of selected hardwood and usually have celluloid edges. The blade of a T-square may be used as a straightedge.

TRIANGLES

13. Description.—Triangles are flat pieces of celluloid, triangular in shape, as shown in Figs. 7 and 8. There are two standard forms of triangles. One form, shown in Fig. 7, is known as the 45° triangle, its two smaller angles each measuring 45°. The other form, shown in Fig. 8, has one 30° angle and one 60° angle and is therefore called a 30° or a 60° triangle. The third angle in each of these triangles measures 90°.

Triangles are made in sizes varying from 4 to 16 in., this length being measured on the longer of the two sides other than the hypotenuse. The triangular hole cut in the center saves material and enables the user to pick up the triangle more easily.

14. Use of Triangles.—Triangles are used in drawing lines that are vertical or sloping with reference to lines made with the T-square, as illustrated in Fig. 9. Vertical lines can be made with any triangle having a right angle, and angles of 30°, 45°, and 60° to the edge of the T-square can also be drawn. By the use of the T-square and triangles, almost all lines on an average architectural drawing can be made.

15. To draw a vertical line, the head *a* of the T-square is held firmly against the edge of the board as already described; the triangle is then placed on the edge of the T-square, as

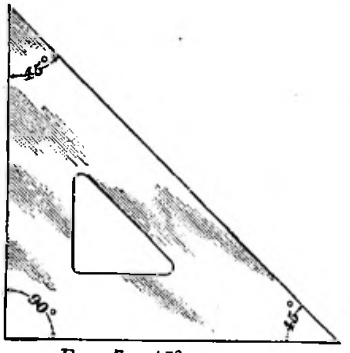


FIG. 7. 45° TRIANGLE

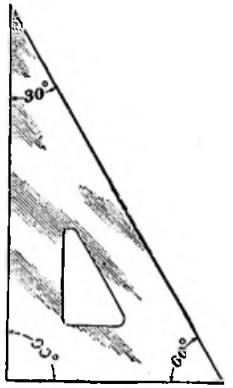


FIG. 8. 30° AND 60° TRIANGLE

shown in Fig. 9, and held in place by the fingers. Since the T-square can be moved up and down and the triangles can be slid along to any point on the edge of the T-square, horizontal

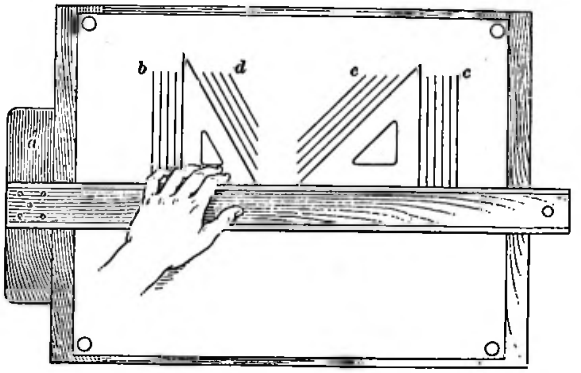


FIG. 9. USE OF TRIANGLES FOR VERTICAL OR SLOPING LINES

and vertical lines can be drawn on any part of the paper. Vertical lines are shown at *b* and *c*; at *d* are shown lines at 60°, and at *e* lines at 45° with the horizontal. By turning the triangles, lines sloping in other directions can be drawn.

16. The triangles can be used without the T-square in drawing parallel lines at any desired angle. This is done by holding one triangle firmly in place on the paper, sliding the other triangle upon it as a base, and drawing the line. For example, let it be required to draw a line parallel to *ab* in Fig. 10 (*a*), through the point *c*. The triangle *A* is placed with one edge against the line *ab*. The triangle *B* is placed with the long edge against the edge *ag* of the triangle *A* and held firmly in place.

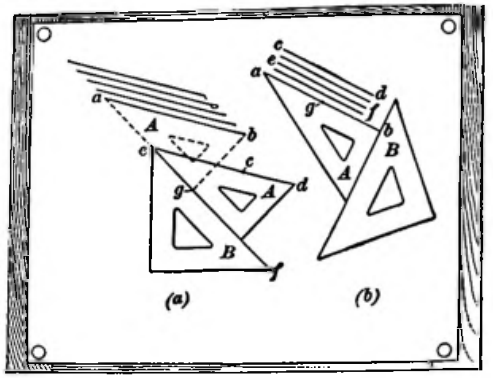


FIG. 10. USE OF TRIANGLE FOR PARALLEL LINES

The triangle *A* is slid along the line *ef* until the edge *ed* cuts the points *c*. Through the point *c* the line *ed* is drawn, which will be parallel to *ab*. Numerous parallel lines can be made while sliding triangle *A* on *B*. The side *ag* of triangle *A* must in all cases have a good bearing on the triangle *B*,

17. Another example is given in (*b*), Fig. 10, where the edge *ab* of the triangle *A* is made to coincide with the line *cd*. The long edge of triangle *B* is placed against the side of the triangle *A* and held firmly. The triangle *A* can then be moved along on the edge of *B* and numerous lines parallel to *cd*, such as *ef*, can be drawn. One of these lines can be drawn through any desired point, such as *g*.

18. Other examples of the use of triangles independently of the T-square are illustrated in Fig. 11. By the use of triangles a line may be drawn at right angles to any given line.

For example, let it be required to draw a line perpendicular to a line *cd* in the left-hand figure. One of the shorter edges *ab* of the triangle *B* is placed so that it will coincide with the line *cd*. With the triangle *B* held in this position, the triangle *A* is placed against it as shown. The triangle *A* is held firmly in place and the triangle *B* is slid to the left until the other short edge crosses the line *cd* as shown by the broken lines. Any line, such as *hi* or *mn* can be drawn against the edge of the triangle *B* and will be at right angles to *cd*.

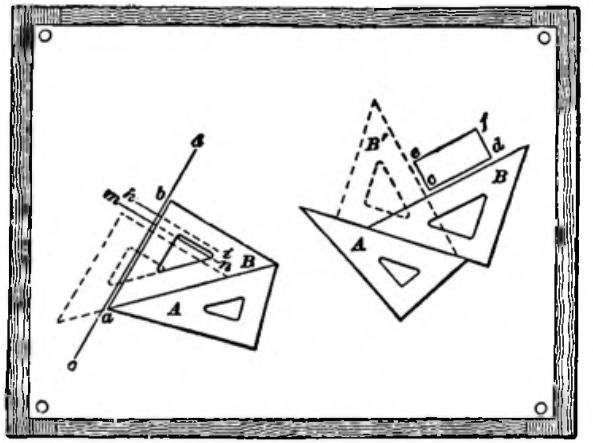


FIG. 11. USE OF TRIANGLES FOR LINES PERPENDICULAR TO GIVEN LINES

In the right-hand figure the lines *cd* and *ef* can be drawn by moving the triangle *B* along the edge of the triangle *A*. Lines *ce* and *df*, perpendicular to *cd* and *ef*, can be drawn by turning the triangle *B* as shown by the dotted lines at *B'*, and sliding it along the triangle *A*, which must be held in the same position for all these lines.

PENCILS

19. A greater variety of pencils is used for architectural drawing than for geometrical or mechanical drawing. Grades 2H, H, F, HB, B, 2B, 3B, 4B, 5B, and 6B are all used by the architect. For general work, the H, F, and HB are very useful.

For laying out work on a small scale where great accuracy is essential, an H or even 2H may be used. For sketching, pencils from H to 6B are used, depending on the personal preference of the draftsman and also on his style of rendering.

20. The selection of a grade of pencil is affected by the surface of the paper to be used. Coarse or rough paper will wear the point of the pencil easily, and blacker and thicker lines will be produced. The same pencil on a smooth or hard-surfaced paper will produce finer lines. Desirable lines are those that are clear and black, and that will not smudge or rub off easily. They should also be easily visible through the cloth or tracing paper when it is required to make a tracing.

FIG. 12. PENCIL POINT

Any reliable brand of pencil may be used, but the shape should be hexagonal rather than round, as round pencils roll off the drawing board, particularly if the board is tilted.

21. The draftsman sharpens his pencil frequently, and uses a long, round point, as shown in Fig. 12, the lead point being generally about $\frac{3}{8}$ in. long. For putting a fine point on a pencil, most draftsmen use a scratch block, which may be attached to the drawing board by means of a cord, as shown at *e* at the lefthand end of the board in Fig. 1. The scratch block consists of layers of fine sandpaper glued to a small wooden handle. On this sandpaper the lead of the pencil is rubbed to a point. As a piece of sandpaper is used up, it is torn off and the clean piece beneath is ready for use. A piece of felt or cloth may be glued to the back of the scratch block and used to remove the black dust adhering to the sharpened point.

22. Skill in the use of the pencil is of great value to the draftsman, and it should be cultivated at every opportunity. The ability to make good, clean lines and to obtain the various effects possible with a pencil is acquired in no other way. A skilful draftsman, when drawing, always turns his pencil so as to wear the point off all around and thus maintain an even thickness of line.

SCALES

23. Use of Scales.—It is obvious that a large object such as a building cannot be drawn conveniently at its actual size on a sheet of paper. Buildings are therefore drawn *to scale;* that is, they are drawn at some convenient fraction of their size. Thus, the floor plans and elevations of a building may be drawn to the scale of $\frac{1}{4}$ in. to the foot, that is, $\frac{1}{4}$ of an inch on the drawing represents 1 ft of actual size. In this case the drawing shows the building at $\frac{1}{48}$ of actual size.

Certain standard scales are used in making architectural drawings. These and also the fractional part of the actual size each represents are shown in Table I.

TABLE I

STANDARD SCALE USED AND FRACTIONAL PART OF ACTUAL SIZE

Standard Scale	Part of Actual Size	Standard Scale	Part of Actual Size
$\frac{1}{8}$ in. to the ft	$\frac{1}{96}$	$\frac{3}{4}$ in. to the ft	$\frac{1}{16}$
$\frac{1}{4}$ in. to the ft	$\frac{1}{48}$	1 in. to the ft	$\frac{1}{12}$
$\frac{3}{8}$ in. to the ft	$\frac{1}{32}$	$1\frac{1}{2}$ in. to the ft	$\frac{1}{8}$
$\frac{1}{2}$ in. to the ft	$\frac{1}{24}$	3 in. to the ft	$\frac{1}{4}$

The scale of $\frac{1}{8}$ in. to the foot is used for drawing the plans and elevations of large- and moderate-sized buildings, and the $\frac{1}{4}$-in. scale for small buildings. The scales of $\frac{3}{8}$, $\frac{1}{2}$, and $\frac{3}{4}$ in. to the foot are used in showing details of portions of the entire building, such as the interior of a room, the details of a chimney, or the details of a porch. When it is desirable to show the construction or detail of a part of a structure with special clearness and still not draw it at full size, the larger scales, such as 1 in, $1\frac{1}{2}$, and 3 in. to the foot, are used. A draftsman will learn by experience which scale is most appropriate for different kinds of work.

The instrument used in measuring off these various scales on a drawing is itself called a *scale*. Thus, a draftsman uses a scale to lay off dimensions on a drawing and also to obtain dimensions from a drawing. Next to the pencil, the scale is the draftsman's most important instrument, and its use should be practiced freely.

FIG. 13. TRIANGULAR SCALE

24. Descriptions of Scales.—Scales differing in style are made to suit different tastes. In Fig. 13 is shown a triangular scale, which is usually made of boxwood, but sometimes of metal, and the various scales or systems of marking mentioned in the preceding article are engraved on the edges. The tri-

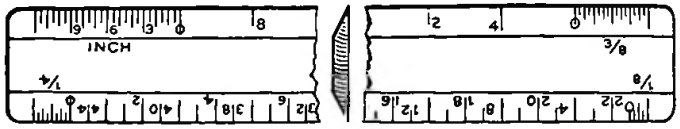


FIG. 14. FLAT SCALE WITH TWO BEVELS

angular scale has six edges. As a rule, two scales are marked on each edge, so that the six edges can accommodate twelve scales. Some of these instruments, however, show only 10 or 11 different scales.

FIG. 15. FLAT SCALE WITH FOUR BEVELS

25. Another type of scale that is more convenient to use than the triangular scale is the flat beveled-edge scale, which consists of a flat strip of boxwood with both edges beveled, as shown in Fig. 14. This type provides two edges, which will accommodate four different scales. A better type is the one shown in Fig. 15, which has four bevels and will accommodate eight scales. It is in general use in architectural offices.

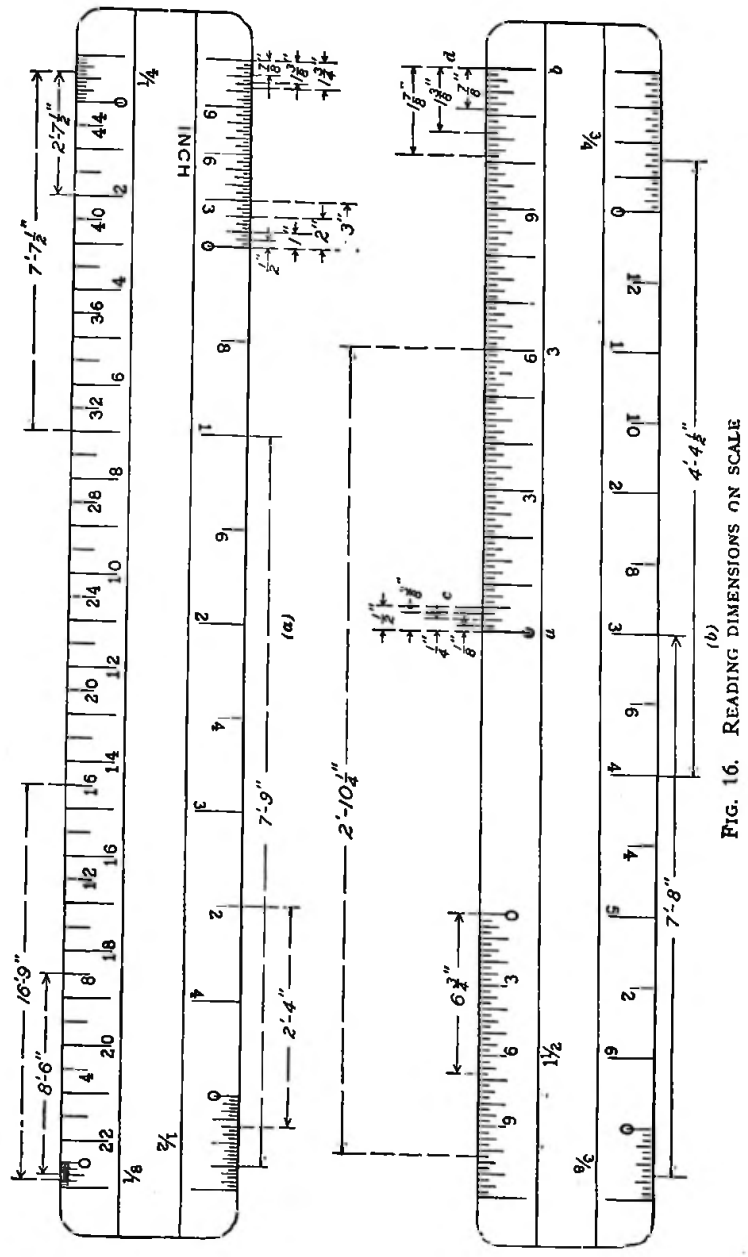


FIG. 16. READING DIMENSIONS ON SCALE

All of these types are commonly made with the bevels faced with white celluloid upon which the markings are engraved. This type of scale and the method of marking facilitate the reading of the marks. The standard length of a scale is 12 in., but scales that are 6 in. and 18 in. in length are also made.

26. Markings on a Scale.—In Fig. 16 is an illustration of both sides of a scale 6 in. long, each side having divisions on two edges. On the side shown in (*a*) are the scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, and 1 in. to the foot. On the side shown in (*b*) are found the scales of $\frac{3}{8}$ and $\frac{3}{4}$ in. to the foot, and also the scales of $1\frac{1}{2}$ and 3 in. to the foot.

The scale of $\frac{1}{8}$ in. to the foot is shown at the left on the upper edge in (*a*). To the left of the 0 mark is $\frac{1}{8}$ of an inch, divided into 12 parts, each of which represents 1 in. if $\frac{1}{8}$ in. represents 1 ft. To the right of the 0 point is a series of $\frac{1}{8}$-in. divisions, each of which represents 1 ft. Every fourth one of these division marks has a number showing the distance in $\frac{1}{8}$-in. divisions or in feet, from the 0 mark.

In order to read a dimension such as 8′ 6″ on this scale, the the 8-ft mark must be at one end of the dimension and the 6-in. marks at the other end, as shown. Likewise, the distance 16′ 9″ is determined by marking a point at the 16-ft mark to the right of 0 and at the 9-in. mark at the left of 0, as illustrated.

The 1-in. scale is shown on the lower edge of (*a*). The inch to the right of the 0 is divided into 12 parts and marked 3, 6, and 9, which will represent inches at the 1-in. scale. These inches are subdivided into halves and quarters. If a draftsman has a very sharp point on his pencil, he can point off $\frac{1}{4}$ in. at this scale. Several small dimensions are shown in the figure, illustrating the way of reading them. If a dimension such as $\frac{7}{8}$ in. is to be drawn, point off three $\frac{1}{4}$-in. spaces and half of the fourth quarter inch, as illustrated, and $\frac{7}{8}$ in. will be obtained. The subdivisions finer than those given on the scale must be *measured by the eye*. The possible error is very small.

The 3-in. scale is shown at the right on the upper edge in (*b*). The 0 point is at the middle of the scale, and the 1 ft from *a* to *b* is divided not only into inches marked by 3, 6, and 9, but also shows $\frac{1}{8}$ in. at the 3-in. scale. Thus, it is comparatively easy to lay off such distances as $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$ in., as shown at *c*. It is also very easy to lay off distances such as $\frac{7}{8}$, $1\frac{3}{8}$, and $1\frac{7}{8}$ in., as shown at *d*. It will be observed that the feet are not all numbered in any of these scales. Thus, in the $\frac{1}{8}$-in. scale every fourth foot is numbered, and in the $\frac{1}{2}$-in. scale every second foot is numbered. This may cause confusion in reading or laying off distances, and must be carefully watched. Thus, in reading 7 ft on the $\frac{3}{8}$-in. scale the 7-ft. point will be marked 3. This 3 refers to 3 feet on the $\frac{3}{4}$-in. scale. The line marked 3 is, however, between the 6 and 8 marks of the $\frac{3}{8}$-in. scale and is, therefore, the 7-ft mark for that scale.

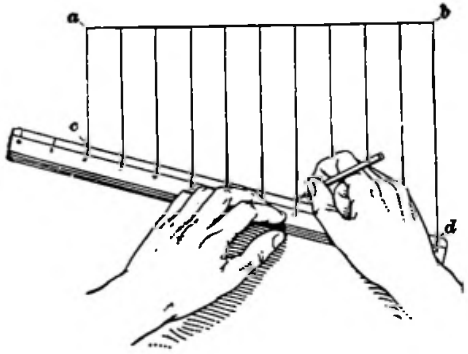


FIG. 17. SPACING BY MEANS OF SCALE

27. Spacing With the Scale.—In addition to its use in scaling distances, the scale is generally used by experienced draftsmen in preference to the dividers in dividing lines and spaces into equal parts. This process is illustrated in Fig. 17. If it is desired to divide the distance between the points *a* and *b* into ten equal parts, two parallel lines *ac* and *bd* are drawn lightly with the T-square and triangle through the points *a* and *b*. Any convenient scale is selected in which ten parts are longer than the distance between *a* and *b*, and the 2 mark is placed on one line and the 12 mark on the other, as shown. The parts between 2 and 12 are marked with the point of a sharp pencil, as shown, and through these points lines are drawn parallel

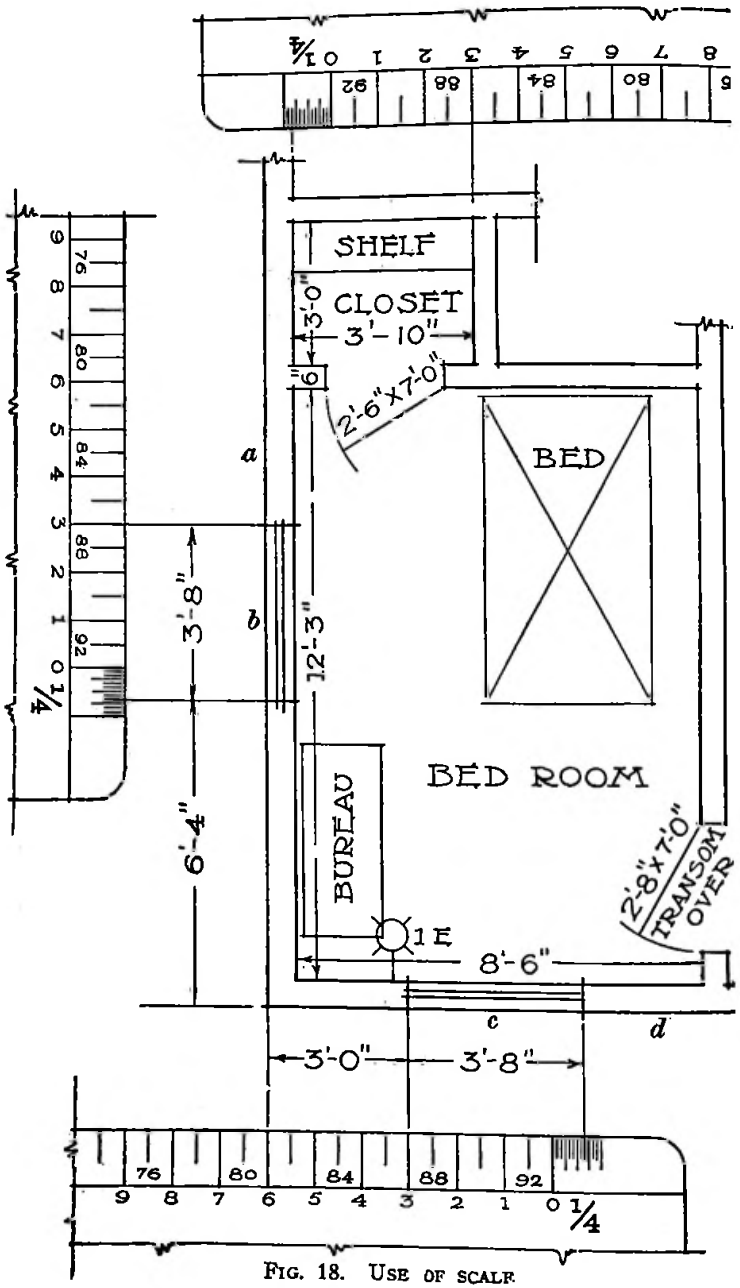


FIG. 18. USE OF SCALE

to *bd*. These will intersect the line *ab*, dividing it into ten equal parts. In dividing this line into an equal number of parts with the dividers, it is often necessary to make several trials before the line can be equally divided.

The process just described is applicable in dividing the distance between any two parallel lines, such as *ac* and *bd*, into equal parts.

28. Method of Using Scale.—In order that the method of using the scale may be clearly grasped, an example of its use is given in Fig. 18. This figure shows the plan of a bedroom that has been drawn to a scale of $\frac{1}{4}$ in. to the foot. The plan of the room, instead of being drawn out to its actual size, is made so that $\frac{1}{4}$ in. represents 12 in. of actual length.

In the wall *d* is shown the window *c*. A scale showing $\frac{1}{4}''$ divisions is shown lying beside this wall. The distance from the corner of the wall to the side of the window is from the *6* mark to the *3* mark on the scale. This shows that this distance is 3 ft. The width of the window shows three $\frac{1}{4}$-in. divisions and eight of the small divisions to the right of the 0 mark. These divisions being twelfths of a quarter of an inch, will represent inches at the scale of $\frac{1}{4}$ in. to the foot. The width of this window is, therefore, 3 ft 8 in. By applying the scale to the window *b* in the wall *a* it also is found to be 3 ft 8 in. in width. The size of the closet may be scaled as shown at the upper part of the drawing and will be found to be 3 ft. 10 in. in width. In actual work the scale is placed close up against the lines to be measured instead of at some distance away from them, as shown in the illustration.

29. A dimension is laid off on a drawing as in the following example:

EXAMPLE.—Lay off a distance of 8 ft 7 in. on a straight line.

SOLUTION.—Mark the point on the line from which the measurement is to be made. At this point place the 8 mark of the scale. The distance from this point to the 0 mark will represent 8 ft. Count off seven of the small inch divisions and make a mark. This will be 8 ft 7 in. from the first mark on any scale that may be used.

To measure off by distance between two points on a plane, such as 6 ft 9 in., the distance to the nearest foot is first measured roughly. In the case under consideration it will be between 6 ft and 7 ft, or the distance will be 6 feet and some inches. The 6-foot mark on the scale is placed at one point, and the number of inches, which will be 9, will be read off at the other point. The distance will then be read 6 ft 9 in.

THUMBTACKS AND SCOTCH TAPE

30. The paper is fastened on the drawing board by means of thumbtacks, which are small tacks having sharp points and large flat heads. In architects' offices a small thumbtack is generally used. One type, stamped out of sheet steel, is shown in

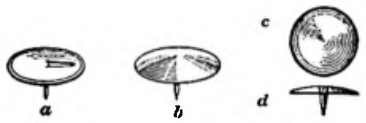


FIG. 19. THUMBTACKS

Fig. 19, at *a*. At b is a type with a solid head. At *c* is shown a top view of the thumbtack in *b*, and at *d* is a section showing the point and the flatness of the head, which allows the T-square to slide over it easily.

When fastening paper on the drawing board, care must be taken to stretch it evenly. This is done as follows: The paper is laid on the drawing board with the edges parallel to the sides. A thumb-tack is inserted in the upper right-hand corner, about $\frac{1}{4}$ in. from the edge of the paper, and pressed in until the head bears evenly on the paper all around. The upper edge of the paper should coincide with the T-square blade. The paper is pulled or stretched by sliding the hand lightly and diagonally toward the lower left-hand corner, and, while the paper is held there, another thumbtack is pressed in. The left hand is laid on the middle of the sheet and is slid lightly toward the upper left-hand corner; then another tack is inserted. The fourth tack is inserted in the same way, except that the left hand is slid from the center to the lower right-hand corner. If the

paper is wrinkled or loose, it has been unevenly stretched, and the preceding operation must be repeated until the sheet lies flat on the board.

31. In damp weather, paper usually swells and becomes loose. In such cases a tack may be put in the middle of each edge, after the paper has been gently and evenly smoothed from the center to the middle of each edge. The tacks in the corners are then taken out and reinserted a little to one side of their former positions, after the sheet is evenly stretched toward

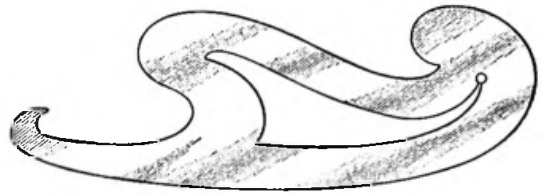


FIG. 20. AN IRREGULAR CURVE

each corner. By putting the four tacks in the middle of the sides first, the drawing will be kept in the same position on the board. This precaution is very important when a drawing has been started.

32. Instead of thumbtacks some offices use small pieces of scotch tape. The scotch tape is usually about 1 in. wide and has an adhesive coating on one side which does not dry out and which allows the tape to be reused. The tape is applied to the corners of the paper in the same manner as thumbtacks. Scotch tape has the advantage that it does not leave holes in the drawing board and the position of the drawing paper can be easily adjusted by releasing the tape.

IRREGULAR CURVES

33. Curves other than arcs of circles are drawn by means of curved rulers, called irregular curves, or French curves. French curves are made of thin slabs of celluloid in a great variety of sizes and shapes. One form of irregular curve is shown in Fig. 20. As an example of its use, let it be required to draw a curved

line through the points *a*, *b*, *c*, *d*, *e*, *f*, and *g* in Fig. 21. A part of the irregular curve must be used that will pass through at least three points. With the curve set in the first position *A*, its edge is found to coincide with four points *a*, *b*, *c*, and *d*. The line may then be drawn against the edge of the curve from *a* around to *d*, or, better, to a point between *c* and *d*, since, by not continuing it quite to *d*, there is less liability of there being an angle where the next section joins.

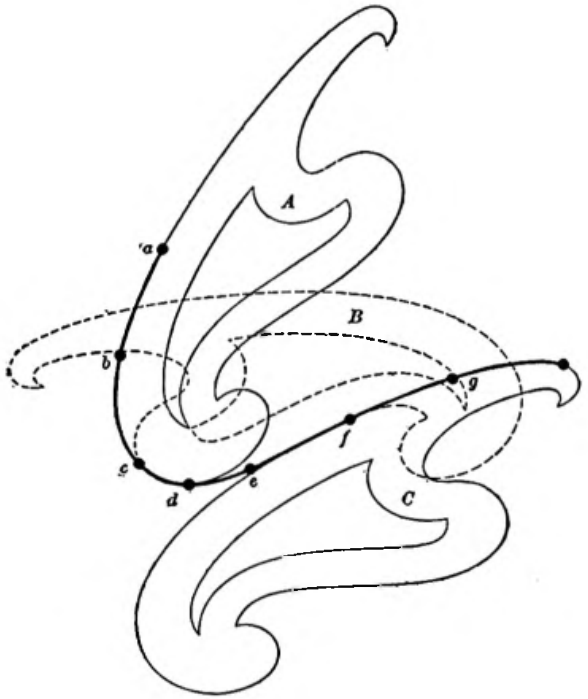


FIG. 21 USE OF THE IRREGULAR CURVE

For the next section of the line, the curve should be adjusted so as to coincide with a part of the section already drawn; that is, instead of adjusting it to points *d*, *e*, *f*, etc., it should be placed so as to pass through the point *c*, the part from *c* to *d* being coincident with the corresponding part of the first line drawn. The irregular curve is shown dotted in this position

at *B*. Its edge passes through four points *c*, *d*, *e*, and *f*, and the line should be made to stop midway between the last two, as before.

The irregular curve is then placed in position *C* with its edge just tangent to the line at the point where the curvature changes and extending through the point *g*.

In inking with the irregular curve, the blades of the pen must be kept tangent to its edge (that is, the inside flat surface of the blades must have the same direction as the curve at the point where the pen touches the paper), which requires that the direction of the pen be continually changed.

It is difficult to draw a smooth, continuous curve. The tendency is to make it curve in or out between the points, thus giving it a wavy appearance, or else to cause it to change direction where the different lines join, making angles at these points. These defects may be avoided by fitting the curve to at least three points, and, when moving to a new position, by setting it so that it will coincide with part of the line already drawn. It will help if the line is first sketched in freehand, in pencil. It can then be penciled over neatly, or inked, without much difficulty, with the aid of the irregular curve, since the original pencil line will show the general direction in which the curve should be drawn. Whenever the given points are far apart, or fall in such positions that the irregular curve cannot be made to pass through three of them, the line must be sketched in freehand. After this, various portions of the line may be drawn in with the curve.

DRAFTING MACHINES

34. Drafting machines take the place of the T-square, triangles, scales, and protractor. The machine shown in Fig. 22 consists of the mast bracket *a*, upper arm *b*, lower arm *c*, and a combination head *d* that includes a handle for positioning the machine, a protractor and two short arms that hold the scales and lock nuts.

The mast bracket contains two clamps that press against the bottom of the drawing board to hold the machine in position. An adjusting handle *e* is used to position the machine in relation

to the surface of the board. Arms *b* and *c* contain steel bands working on pulleys that provide a parallel motion to the scales. The scales are in a fixed position to each other so that they form a right angle. They can be swung together to any direction.

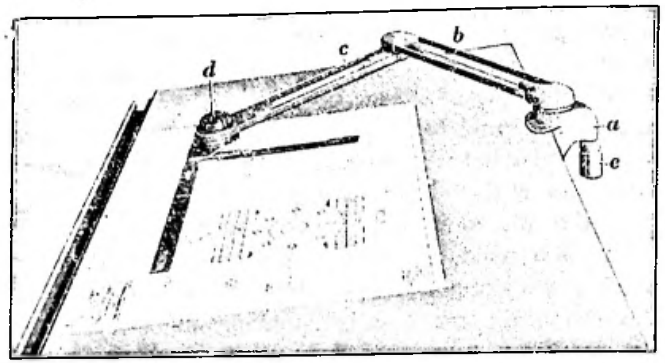


FIG. 22. DRAFTING MACHINE

THE PARALLEL EDGE

35. A parallel edge is a straightedge which, combined with cord and pulleys, may be used in place of a T-square.

It is sometimes difficult to make accurate drawing by means of a T-square. If the edge of the board is untrue or the head of the T-square the least bit loose, these defects will become apparent in drawing; for example, long horizontal lines close together. This difficulty does not occur with a parallel edge, the accuracy of which has no relation to the edge of the board.

The parallel edge requires two parallel guide lines on which the straightedge with its pulleys is able to run. Guide lines may be of thin wire or of cord with a wire center. If the guide cord which confines the straightedge cannot move, it follows that the various positions of the straightedge are parallel.

In Fig. 23 is shown a parallel edge on a drawing board. At *A* is the straightedge with pulleys at *a*. The cord *b*, secured to an eye or post *c*, at the lower right-hand corner of the board, runs up the side of the board and in front of the right-hand pulley on the straightedge, goes across the straightedge and behind the left-hand pulley, up the left-hand side of the board

to an eye *d*, across the top of the board to a corresponding eye *e*, down the board to below the right-hand pulley, across the straightedge and above the left-hand pulley, and down the left-hand side of the board, where it is secured to the lower left-hand post *f*.

There are numerous variations tending to make the parallel edge complicated and expensive. In its simplest form as described it can be made easily, requiring only a straightedge and the necessary pulleys, cord, and eyes.

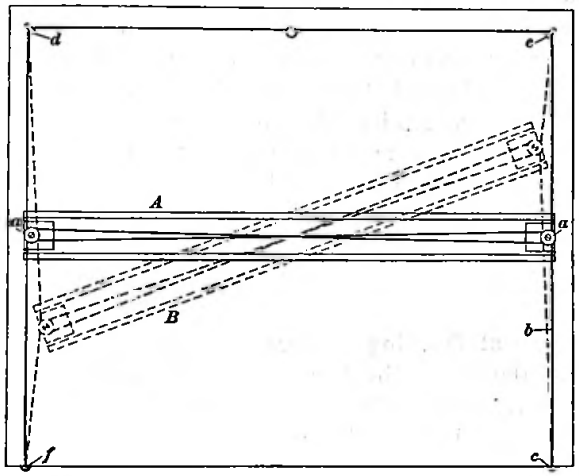


FIG. 23. PARALLEL EDGE

The parallel edge can be turned as desired, so that parallel lines can be drawn at an angle, as shown by the dotted lines for position *B*. When the parallel edge is set in the position required, it is necessary to put a thumbtack or clamp on the cord at the top of the board.

Users of the parallel edge consider it more accurate than the T-square and find that it enables them to work more rapidly. With the parallel edge as with the drafting machine, it is possible to slide the drawing over the left-hand edge of the drawing board and thus make extremely long drawings, such as full-sized inscriptions.

DRAWING INSTRUMENTS

36. General.—The drawing board, T-square, triangles, scale, and pencils are the most important devices used in making architectural drawings. When, however, it is necessary to draw circles or arcs, to divide lines into equal parts, or to ink in the drawing, drawing instruments are used.

37. Description.—Drawing instruments are made of nickel, silver, and steel, with the exception of the handles of the ruling pens, which are sometimes aluminum or wood.

These instruments are generally contained in cases having compartments formed to receive the various instruments. There are many grades of drawing instruments, including those carefully made and adjusted by hand, and those that are made in quantity by machine. It is desirable that the student use only the best instruments, but their cost is often prohibitive, and a cheaper grade may be found that will serve satisfactorily.

38. Care of Drawing Instruments.—Drawing instruments, after each day's use, should be wiped with a piece of chamois and put away carefully in the case. The screw threads, joints, and all points where friction between the parts occurs, should be oiled occasionally to prevent rust and excessive wear. Tarnished surfaces can be cleaned by rubbing with chamois skin or an oiled rag, or by the use of a soft pencil eraser.

39. Compass.—The compass is an instrument used for drawing circles and arcs.

A common form of compass is shown in Fig. 24. It consists of two legs *a* and *b*, joined at the top by means of a fork-shaped brace, and held together by means of a screw. The fork is fitted with a head *c* that is used in turning the instrument. The leg *b* is provided with a socket in which the pencil point *d*, the pen point *e*, or the needle point *f* may be fitted. These points are pushed into the socket *g* and fastened in place by tightening the screw *h*.

A lengthening bar *i* may be used in the socket of the compass. When the pencil point or the pen point is inserted in the socket of the lengthening bar, larger circles may be drawn.

The leg *a* has a needle point *j*, which is held firmly in its socket by the screw *k*. This point is the center about which the compass rotates. The needle point itself is a piece of round steel

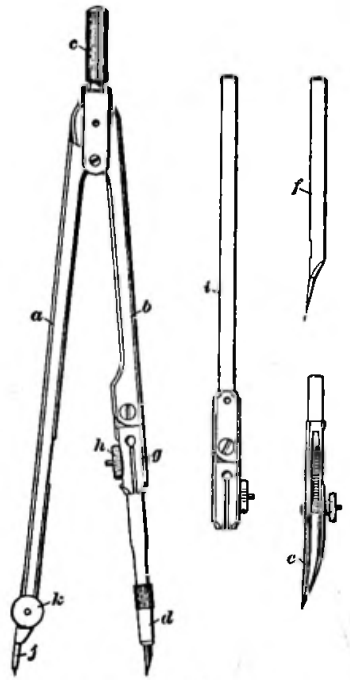


FIG. 24. COMPASS

wire having a square shoulder, below which a fine needlelike point projects. The shoulder prevents the needle from penetrating the paper more than is necessary.

40. Joints are formed in the legs of the compass so that the points may be made perpendicular to the surface of the drawing, as shown in Fig. 25. The pen point, in particular, must be perpendicular to the paper, or the ink will not flow from it freely.

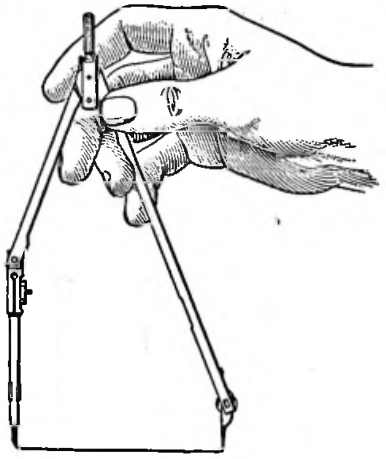


FIG. 25. ADJUSTING COMPASS

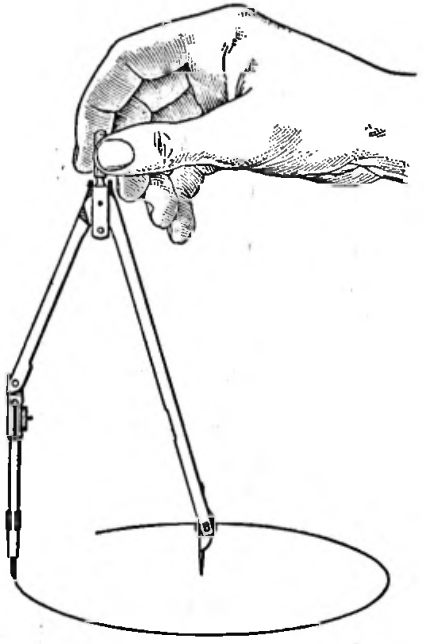


FIG. 26. USE OF COMPASS

The joint at the top of the compass should be stiff enough to hold the legs fixed in any position, and also permit of their being opened and closed freely. This joint may be tightened or loosened by turning the screw in the head by means of the screwdriver that is furnished with the compass.

41. Manipulating Compass.—Methods of handling the compass are illustrated in Figs. 25 and 26. In Fig. 25 is shown the manner of opening and closing the instrument. The needle-point leg is held between the third and fourth fingers and the

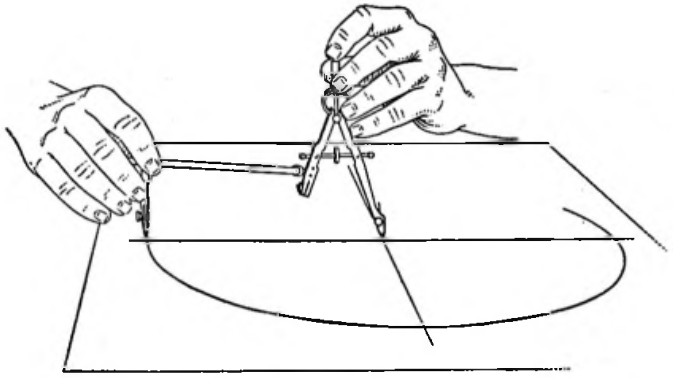


FIG. 27. USE OF LENGTHENING BAR

thumb. The other leg is held between the first and second fingers. The needle point is then applied accurately to the center on the paper. The other leg is opened or closed until the pencil is at the desired point. These motions should be made delicately so as not to strain the instrument or tear the paper. The grip is then transferred to the head, and the compass is rotated as shown in Fig. 26.

When arcs larger than can be made with the compass are required, the lengthening bar is used. It is generally necessary to use both hands when working with the compass in this case, as illustrated in Fig. 27.

42. The point of the pencil in the compass may be round or wedge-shaped. If it is wedge-shaped, the edge should be in the line of the arc that is being drawn.

When the arc is drawn, the pencil should make a firm black line of uniform thickness. The point may be tested by drawing through the arc in both directions. If the pencil has been properly shapened and is firmly fixed in the compass, the

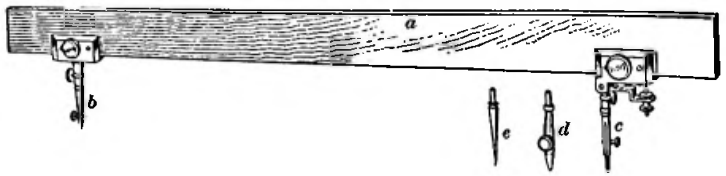


FIG. 28. BEAM COMPASS

lines will coincide. The lead used in the pencil point should be similar to that in the pencil that is used for the straight lines, so that all the lines will have the same strength.

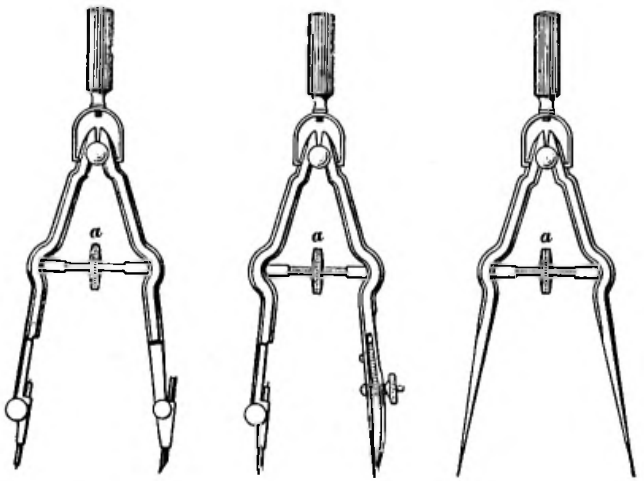


FIG. 29. BOW-PENCIL, BOW-PEN, AND BOW-DIVIDERS

43. Beam Compass.—The beam compass is used for describing circles or arcs of large radii. The instrument consists of a strip of wood called a beam, as shown at *a* in Fig. 28. A needle point *b* and a pencil point *c* are secured to clamps that slide along the beam. These clamps are provided with screws by which they can be fixed on the beam at any point. By sliding the clamps along the beam the instrument may be set at any

radius. For inking lines, a pen point *d* may be substituted for the pencil point. The needle point *e* may replace the pencil point *c* and the beam compass may be used in laying off distances.

44. Bow-Pencil, Bow-Pen, and Bow-Dividers.—The bow-pencil and bow-pen shown, respectively, in Fig. 29 (*a*) and (*b*) are small compasses convenient for describing small circles. Ordinarily, the points of the instruments must be adjusted so that both legs are of the same length; but, when very small circles are to be drawn, the needle point must be slightly longer than the pen or pencil, so that when the point is in the paper the part of the leg above the paper is of the same length as the other leg.

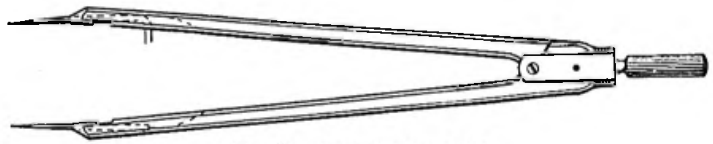


FIG. 30. LARGE DIVIDERS

To draw a circle of a given diameter, the instrument is adjusted approximately to the required radius. It is then placed in an upright position with the needle point resting on the proposed center, and the final adjustment is made by turning the adjusting screw *a* until the proper radius is obtained. The instrument remains at a fixed radius until the screw *a* is turned.

45. Bow-dividers, shown in (*c*), are small dividers made in the same style and size as the bow-pencil and bow-pen, but with two steel points. They are used in making very fine divisions of lines. They can be set at any distance apart by turning the screw *a* and will stay fixed until the screw is turned again.

46. Dividers.—One type of large dividers, shown in Fig. 30, is used for laying off distances on a drawing, or for dividing straight or curved lines into parts. The points of the dividers should be very sharp, so that they will not punch holes in the

paper larger than is absolutely necessary to be visible. Compasses are sometimes furnished with two steel divider points besides the pen and pencil points, so that the instrument may be used either as compasses or dividers. A steel divider point is illustrated at *f* in Fig. 24, and in Fig. 31. When using the

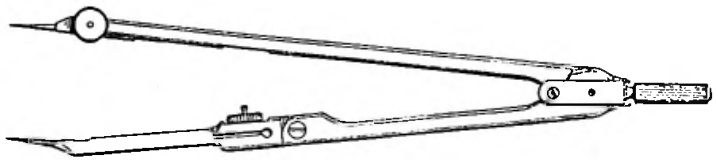


FIG. 31. COMPASS WITH DIVIDER POINTS

dividers to space a line or circle into a number of equal parts, proceed as follows: Hold them at the top between the thumb and forefinger, as when using the compasses, and step off the spaces, turning the instrument alternately to the right and left.

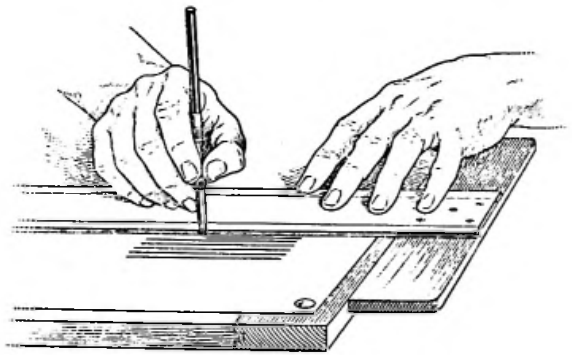


FIG. 32. HOW TO HOLD RULING PEN

If the line or circle does not space exactly, vary the distance between the divider points and try again; so continue until it is spaced equally. When spacing in this manner, great care must be exercised not to press the divider points into the paper so as to make large holes. Instead of dividers, most architectural draftsmen prefer to use the scale as shown in Fig. 17.

47. Ruling Pens.—For drawing ink lines other than arcs of circles, a ruling pen, such as shown in Figs. 32 and 33, is used. It is formed of a handle and two flat, pointed metal

blades with a small space between them. The blades can be brought together or separated by turning a screw head and screw. Ink is placed between the pointed ends of the blades as shown in Fig. 34 (*a*) and flows out between the points, as

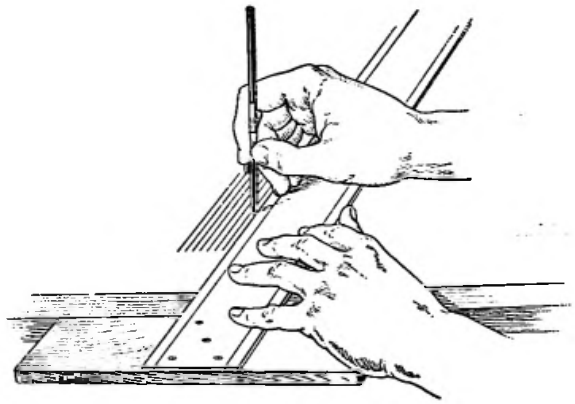
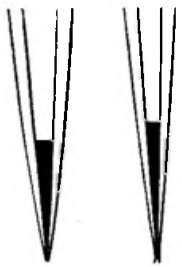


FIG. 33. RULING PEN IN PROPER, OR VERTICAL, POSITION

illustrated in Figs. 32 and 33. The proper adjustment of the blades is shown in Fig. 34 (*a*) and the improper adjustment in (*b*). It will be noticed that in (*a*) there is a greater volume of ink at the point of the nibs, which is a good feature, as the ink does not dry as fast as when there is a thin film at the points. If the nibs are brought very close together as shown in (*b*), the points are spread so that they stand apart as shown in the illustration and are, therefore, liable to be injured, the flow of ink is retarded, and ragged, gray lines of irregular thickness will be formed.



(*a*) (*b*)

FIG. 34. PROPER AND IMPROPER ADJUSTMENT OF RULING PEN

When drawing pens become dull, the best plan is to send them to the dealer to be sharpened. The sharpening of pens is highly expert work, and dealers are generally willing to do it at a reasonable price.

48. The ruling pen should be held as nearly perpendicular to the board as possible; the hand should be in the position shown in Figs. 32 and 33 and should press the pen only lightly against the edge of the T-square or triangle. If the pen is pressed hard against the edge, the blades will close, with the result that uneven lines will be made. The edge of the T-square or triangle should serve simply as a guide for the pen. It will be found that considerable practice is required to make smooth lines. If the pen is held so that only one blade bears on the surface of the paper, the line will almost invariably be ragged on the edge on which the blade does not touch. When the pen is held at right angles to the paper, as shown in Fig. 33, both blades will rest on the paper, and if the pen is in good condition smooth lines will result.

FIG. 35. ADJUSTING PEN FOR LINES OF DIFFERENT STRENGTH

The ruling pen should always be kept clean. If lint or dust collects on the nibs, thick lines or blots will result. Dust that may have accumulated on the drawing paper should be brushed off before lines are drawn. A thickness of blotting paper may be drawn between the nibs and the ink cleaned off the insides of the blades. If the ink has dried in the pen, it must be removed by the use of a knife blade. All ink should be removed from the pen before laying it down after using it. The pen point of the compass should receive the same treatment.

49. Ink lines of different thickness are used in drawings, and since the differences between these thicknesses are very small it is well to be able to adjust the pen so as to obtain a line of a certain thickness whenever it is required. The following is a good method for that purpose: First, the two blades are brought close together and a small amount of ink is placed between them. The ink is held in the pen by capillarity, and should not fall out of the pen when the pen is slightly jolted. A line is drawn. If the line is too thin, the screw should be

turned to increase the space between the blades. If the line is too thick, the blades should be brought closer together.

The following method is a good one for always obtaining the same thickness of ink-line. Having set the nibs of the pen at a proper distance apart to produce a satisfactory line, make a scratch as shown at *a*, on the screw head *b*, Fig. 35. If the pen is opened for cleaning, it can always be set again with the line *a* in the same position and the same thickness of line obtained. If a thinner line is desired, turn the screw head sufficiently to make such a line, and note where the line *a* points, as at *c* for

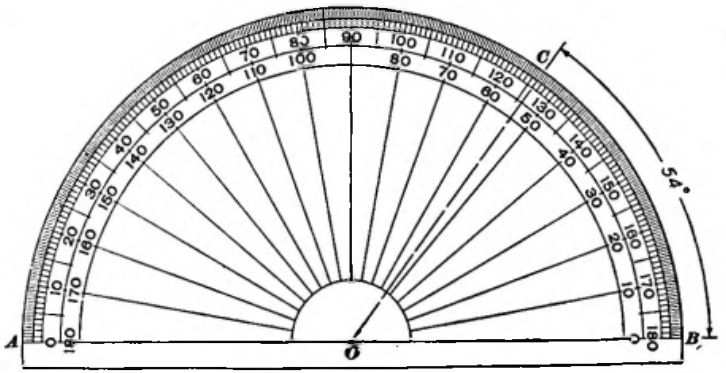


FIG. 36. PROTRACTOR

instance. This thickness of line can always be obtained by turning the head until the line points as at *c*. The thickest lines may be obtained with the scratch at *a*, the medium lines with the scratch at *c*, and the thinnest lines with the scratch at *d*. The position of these lines may not be exactly as shown in the figure, but must be determined by the learner, who will thus remember just where to have the scratch to produce the various lines.

50. Protractors.—A protractor is an instrument used for laying off or measuring the degrees of an arc. It is commonly semi-circular, is made of celluloid or metal, and is usually graduated to half degrees. The graduations are numbered from each side up to 180, the number of degrees in a half circle, for convenience in laying off degrees on either the right or the left. A pro-

tractor with 360 divisions, representing half degrees, is shown in Fig. 36. In laying off angles, the protractor must be placed so that the line AB coincides with the line forming one side of the angle, and the center O is the vertex of the angle.

For example, let it be required to draw a line making an angle of 54° with the line OB. The protractor is placed on the line OB, with the center at O. With a sharp-pointed pencil, a mark is made on the paper at the 54° division, as indicated at C, and a line is drawn passing through O and C. This line will make an angle of 54° with OB. Greater exactness will be secured by producing the base line OB to the left so that the zero mark on each end of the protractor will rest on it.

51. The Adjustable Triangle.—The adjustable triangle is a combined protractor and 45° triangle with the long side of the triangle adjustable. This permits increasing the acute angle at the base of the triangle from 45° to 90°. Since the sum of the two acute angles in a right triangle is always 90°, as one angle increases the other decreases. Thus, if one angle is increased to 70° the other becomes 20°. The protractor reads from 0° to 45° and back to 90°. By keeping the base of the triangle against the T-square, angles from 45° to 90° may be obtained and, by turning the triangle on its side, angles from 0° to 45°.

An adjustable triangle is shown in Figure 37. At a is a flush pivot that allows the long side to move on the slotted track b, below the protractor c. The screw d, when tightened, keeps the long side at the required angle.

The adjustable triangle makes a separate protractor unnecessary and provides facility in drawing parallel lines at any desired angle.

52. Instruments for Guide Lines.—Various devices are used in drawing guide lines for lettering. A convenient and inexpensive device for drawing both horizontal and inclined guide lines is the Ames lettering instrument shown in Fig. 38. The instrument consists of a circular disc inserted in a suitable frame. Disc and frame are of transparent plastic. Countersunk holes in the disk into which a pencil point can be inserted are used for spacing the lines. The disc can be rotated to obtain different

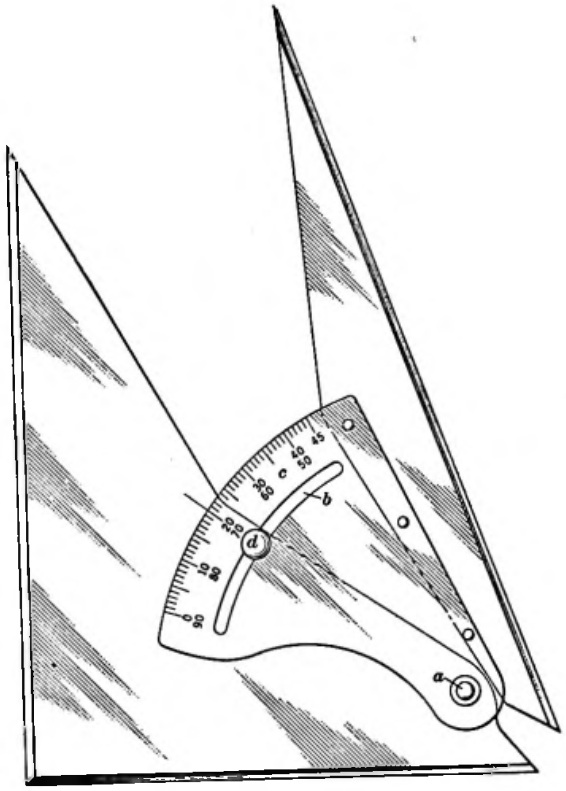


FIG. 37. ADJUSTABLE TRIANGLE

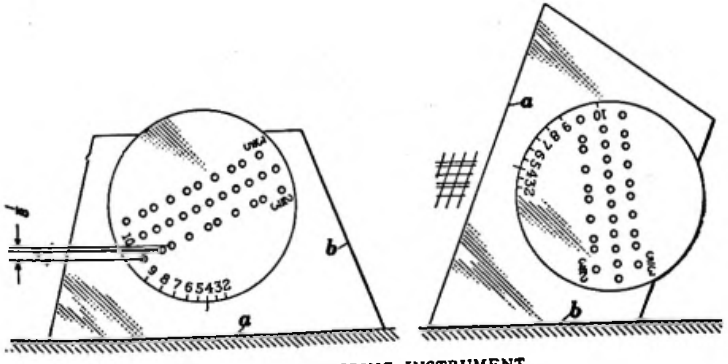


FIG. 38. AMES LETTERING INSTRUMENT

spacings. The numerals on the rim of the disc represent the distance in thirty-seconds of an inch between the top and bottom guide lines. The fractions $\frac{2}{3}$ and $\frac{3}{5}$ indicate the proportionate heights of the two lower guide lines.

To draw horizontal guide lines, the instrument is placed with the base *a* against the blade of the T-square. The point of the pencil is inserted in one of the holes and the instrument is moved across the paper by the pencil which draws the required line at the same time. Guide lines for letters varying in height from $\frac{1}{16}$ in. to $1\frac{1}{2}$ in. may be readily drawn in this manner.

If the instrument is placed with the side *b* in contact with the blade of the T-square, as shown at the right of Fig. 38, the edge *a* will have the proper slant for drawing inclined guide lines with a 68° slope. Turning the instrument over and placing the opposite edge along the blade of the T-square will give a 75° slope to the guide lines.

53. Instruments for Mechanical Lettering.—Lettering is done freehand in most architectural offices. However, the student should be familiar with the instruments that are available for producing mechanical lettering. One type is the Leroy lettering instrument. It consists of a scriber fitted with a pen and a template. Various pens that produce different weights of lines and templates that give different sizes of letters are available. In operation, as the tracer point of the scriber follows the outline of a letter in the template, the pen reproduces the letter on the drawing above the instrument. The scriber holds the pen in exact alignment and controls its motion as the tracer pin glides through the character grooves of the template to produce letters of uniform accuracy.

Another type of lettering guide, called the Wrico, is in the form of a template containing cutouts of letters and numerals. The pen is inserted in the appropriate cutout, which guides the pen in the formation of the letter desired. Uniform mechanical lettering can be obtained by the use of this simple device.

54. Guards for Drawing.—The lower part of the drawing can be kept free from elbow smudges, wrinkles, and torn edges

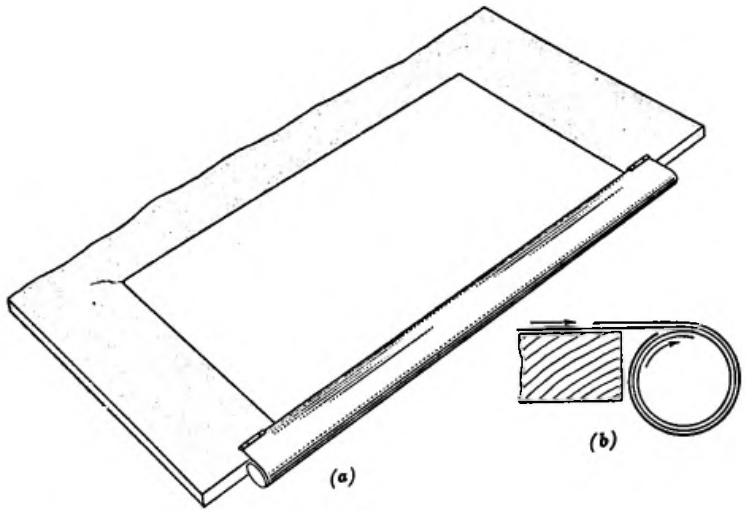


FIG. 39. GUARD FOR DRAWINGS

by using a guard similar to that shown in Fig. 39. This is a tube-shaped device of plastic or metal attached to the lower edge of the drawing board by hinges at both ends. When it is necessary to work on the upper part of the drawing, the paper is loosened from the board and the lower part is rolled into the guard as shown in (*b*). Thus the upper part of the drawing is brought into position on the lower part of the drawing board without the danger of the draftsman leaning against the drawing and creasing it on the edge of the board.

If a drawing is too large to fit on the drawing board, the roll of paper may be mounted in a holder at the top edge of the drawing board. The paper is pulled down over the surface of the board to begin the drawing. As the drawing is developed, the lower part can be rolled into the guard.

55. Pens.—For lettering and freehand work, a number of good pens are obtainable. Those generally used are the Joseph Gillott No. 404 and No. 303, and for finer work, No. 170 and No. 290, or Crow Quill pens, although Esterbrook's fine line and lettering pens may be preferred. Ball-pointed pens are useful for drawing heavy lines of even thickness. A few pen points of

different styles may be purchased and tried, and the most suitable ones adopted for use.

56. **Erasers.**—Erasing plays an important part in making good drawings. For pencil drawings the soft erasers are the most serviceable, art gum, the kneaded rubber, and the pliable pink rubbers being extensively used.

Art gum, shown in Fig. 40, may be purchased in small squares, but it is more economical to buy it in large cakes and cut it up as required. The kneaded rubber that comes in small flat cakes

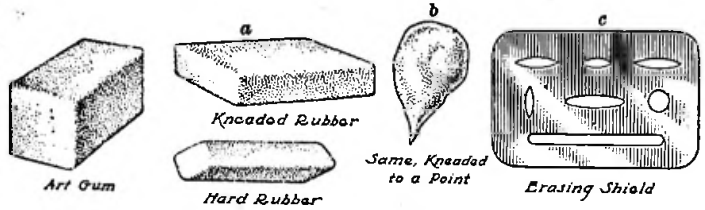


FIG. 40. ERASERS

sealed in waxed paper or tin foil is shown at *a*. Kneaded rubber may be kneaded into any desired shape, such as a fine point, as shown at *b*, and is of great value in erasing light pencil lines and in keeping drawings clean. Kneaded rubber has the advantage that it leaves no crumbs of rubber. There are also a number of pliable pink rubbers that give very good results.

For erasing ink and pencil lines, a hard rubber eraser may be used.

In making erasures, a shield, as shown at *c*, is used. The shield, which is of a metal, has holes of various shapes cut in it, so that the rubber can erase only a limited part of the drawing.

DRAWING MATERIALS

57. **Ink.**—Black liquid waterproof India ink is the ink used most frequently by architectural draftsmen. This ink is sold in bottles having a quill, which extends down into the ink, attached to the cork of the bottle. To fill the ruling pen, the cork and quill are removed. The point of the quill, which is wet with ink, is passed between the blades of the ruling pen,

and leaves a quantity of ink in the pen. Too much ink should not be put in the pen; otherwise it is liable to drop and blot the paper, or make a thick irregular line.

India ink is made so that it will dry rather rapidly, which is a great convenience to the draftsman, but it will also dry quickly between the blades of the pen. The pen should therefore be wiped out before it is laid down.

If the pen is filled and will not make a mark, draw it across a piece of blotter or press the blades together with the fingers for an instant, and the ink will probably flow.

Sometimes the ink will get too thick, especially if left uncorked, and it will not flow freely from the pen. The addition of a few drops of water will overcome this. If the ink is too fluid and thin, it may be improved if allowed to stand uncorked for a short time. As a rule, however, the bottle should always be corked.

If the pen is not in good condition there is likely to be trouble in inking in drawings.

In order that the bottles may not be upset and the ink spilled, the bottles may be set in blocks of wood, either singly or in groups.

58. **Papers.**—For making drawings in architects' offices, many different kinds of papers are used, such as detail paper, tracing paper, cold-pressed and hot-pressed papers, tinted papers, and illustration board.

Detail paper is a heavy buff-colored paper that is sometimes used for making large details. It is used also for covering drawing boards. Upon this cover other papers are tacked, to receive the actual drawings.

Tracing paper, transparent bond paper and vellum are used in laying out scale drawings of plans. Their value lies in their transparency. There are many different qualities, varying in toughness, transparency, and color. They are made in rolls 10 or more yards in length, and from 30 to 48 in. in width.

Cold-pressed drawing papers are papers made especially for receiving water colors. Hot-pressed drawing papers are of a smoother texture and are used for pen-and-ink work. Both

cold- and hot-pressed papers are made in rolls, but the finer grades are sold in sheets of standard sizes.

Gray, brown, or other shades of tinted-papers are frequently employed in making sketches of buildings.

59. Illustration Board.—A fine paper is mounted on stiff cardboard and sold as illustration board. This material is convenient for making fine ink drawings or water-color renderings. It takes pencil, ink, or water color readily, and saves time required for stretching paper for water-color work.

60. Tracing Cloth.—Tracing cloth is a cloth that has been made transparent by a special process. It is transparent as well as tough, which makes it valuable when a tracing is to be handled a great deal or kept as a record. One side of this cloth is generally shiny or glossy, and is called the *face*. The other side is dull in appearance, and is called the *back*. Drawings are commonly made on the dull side. Tracing cloth is of two types; one is suitable for finished pencil drawings, the other is prepared for ink drawings.

HOW TO CLEAN DRAWINGS

61. Drawings become soiled from the rubbing of the T-square and triangles, from the draftsman's sleeves, and from dust. This may be partly prevented by covering the drawing, except the part on which work is being done, with paper thoroughly secured at the edges so as not to interfere with the operation of the triangles and T-square. One of the most frequent causes of dirt on a drawing is the sliding of the instruments over the pencil lines on the surface. Triangles are especially apt to accumulate dirt, which is transferred to the drawing when these instruments are moved over the paper. It is good practice, before commencing a drawing, to clean carefully the scales, triangles, and T-square. The drawing board should be dusted before the drawing paper is tacked in place on it, as particles under the drawing paper raise small hills that interfere with the drawing of lines.

After a drawing has been inked in, all soiled spots and pencil lines should be removed with a soft-rubber eraser. This

will not injure the ink lines. Before applying the rubber to the drawing, it is a good plan to test it by rubbing it on another sheet of paper to remove any dirt that may adhere to it. If an inked-in line or an ink blot is to be removed, a hard pencil eraser should be used whenever possible. If the blot cannot be removed with a pencil eraser, an ink eraser may be used, together with the shield shown in Fig. 40. Care should be taken not to rub too long on one spot, as heat will be generated and the paper weakened.

A pencil drawing is often difficult to clean, as the changes made while studying the drawing will involve frequent erasures. In attempting to clean a pencil drawing, the main lines are apt to be erased. A kneaded eraser is often useful in this respect.

Ink tracing on cloth may be cleaned by rubbing the surface of the cloth with benzene or naphtha applied with a soft cloth with as little rubbing as possible.

Elementary Architectural Drawing

Serial 5893A-4 PART 1 Edition 2

Examination Questions

Notice to Students.—Study this instruction text thoroughly before you answer the following questions. Read each question carefully and be sure you understand it; then write the best answer you can. You will profit most if you answer the questions in your own words. When you complete your work, examine it closely, correct all the errors you can find, and see that every question is answered; then mail your work to us. DO NOT HOLD IT until another examination is ready.

1. What are the common uses of the following materials? Vellum, cold-pressed paper, detail paper, tracing cloth, hot-pressed paper.

2. When drawing pencil lines, how would you maintain an even thickness of lines?

3. *a*) You are required to make the elevation drawings for a residence that has a large number of gables and dormers. The angle which the gables and dormers make with the horizontal is 51° 30′. What instrument would you use in drawing the many parallel lines required by these gables and dormers?
   b) You are required to make a drawing that will require a sheet of paper 18 in. wide and 12 ft long. What instrument would be advantageous in making this drawing?

4. How would you draw a curved line through a series of points that do not lie on an arc of a circle?

5. *a*) How would you clean an ink tracing on cloth?
   b) Which eraser is particularly suited for cleaning between the lines of a pencil drawing?

6. In the room shown in Fig. 18, what is the length of the wall,
   a) between the right hand edge of the closet door and the upper right hand corner of the room?
   b) between the upper edge of the window *b* and the corner near the closet? Use your architect's scale to measure the drawing.

7. Draw a 6-inch horizontal line on your paper.
   a) From the midpoint *o* of this line, draw a 4-inch line *oa* at an angle of 32° to the horizontal line.
   b) From *o* draw a second 4-inch line *ob* at an angle of 78° to the horizontal line.

8. What type of instrument would you use in drawing inked circles of very small radius? For drawing a circle with a 2 ft radius?

9. *a*) What is the purpose of drawing objects to scale?
   b) What proportion exists between drawings at full size and drawings at scale of $\frac{1}{8}$ inch equals one foot?

10. How should drawing instruments be taken care of and cleaned?

DATE	ISSUED TO


IGS