ME 101 ENGINEERING GRAPHICS

CHAPTER 1

INSTRUMENTS AND THEIR USE

1.0. INTRODUCTION

Engineering drawing is the Universal Language in all phases of industrial and engineering work, therefore, all engineering and technical personnel must have a good knowledge of drawing techniques.

Engineering-technical drawing has two vital functions:

A: It is a means to communicate ideas to others quickly and vividly.

B: It is a tool whereby intangible ideas theories may be developed into tangible goods and products by graphical methods.

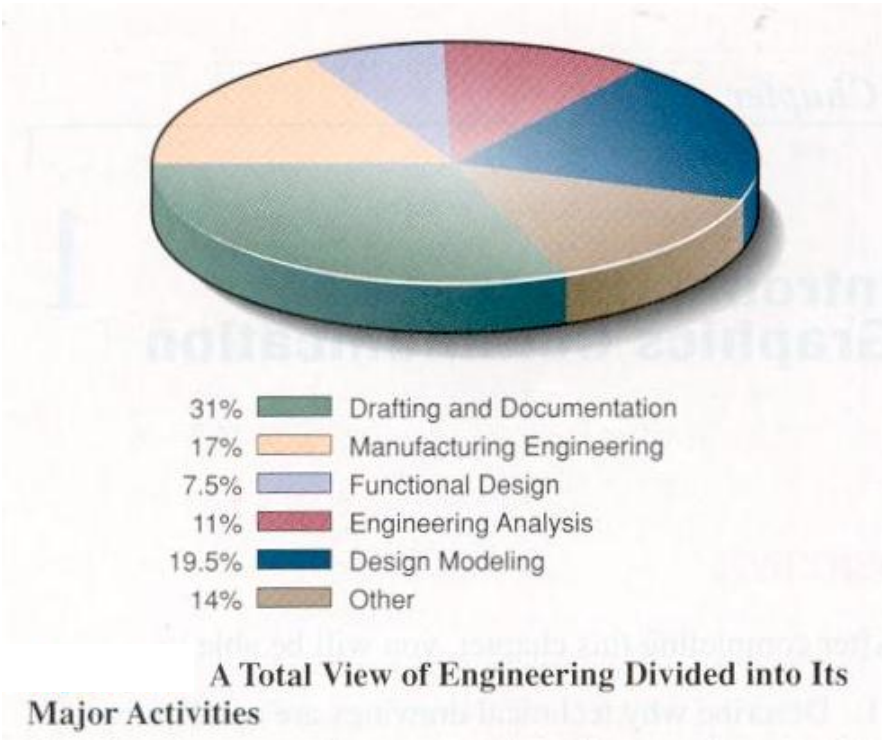
In short, engineering graphics is a language that expresses and conveys ideas of shape, size and construction of parts and mechanisms.

To have optimum value, Engineering drawings must be neat, clear concise and subject to only one interpretation. Furthermore, they should conform to accepted standards, conventions and practices.

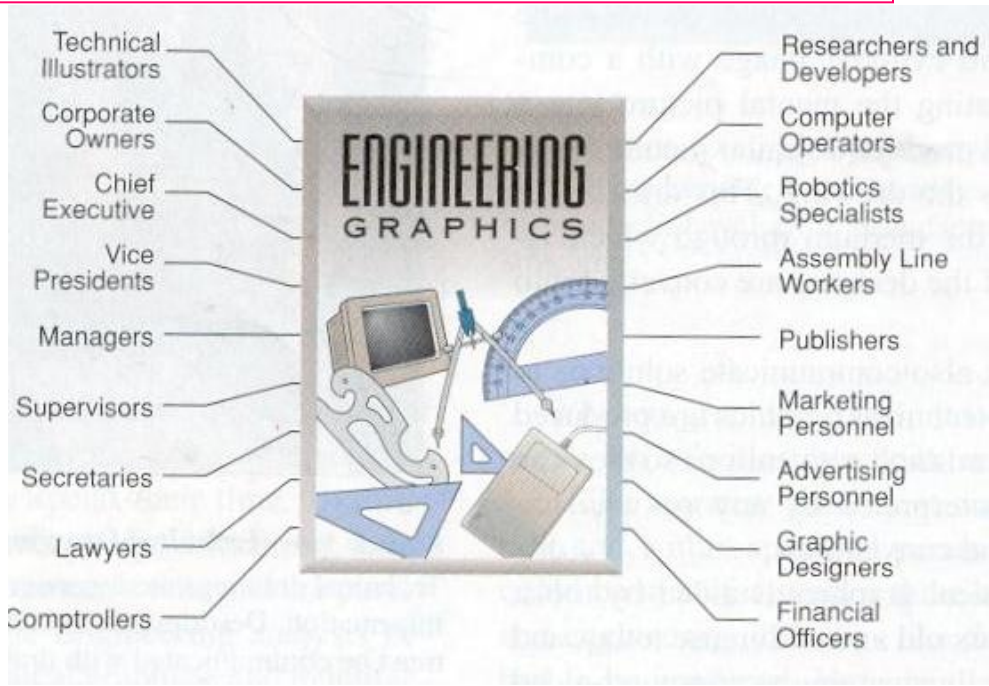
As with any Language, skill and understanding in technical drafting can be obtained only by practice. Therefore, students should not only work-out the problems assigned by the instructor but should also solve the problems provided in the textbook and the hand-out sheets in free-hand style in their free time.

Importance of technical graphics

- Technical drawings: A language used in the design process for communicating, solving problems, quickly and accurately visualizing objects, and conducting analysis
- A graphical representation of objects and structures and is done using freehand, mechanical, or computer methods

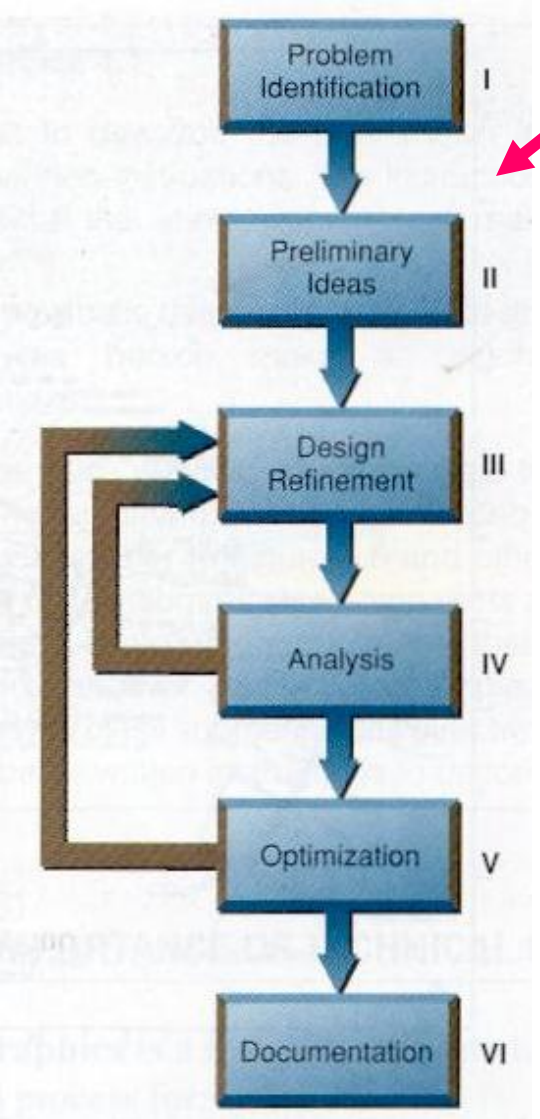


A Total View of Engineering Divided into Its Major Activities

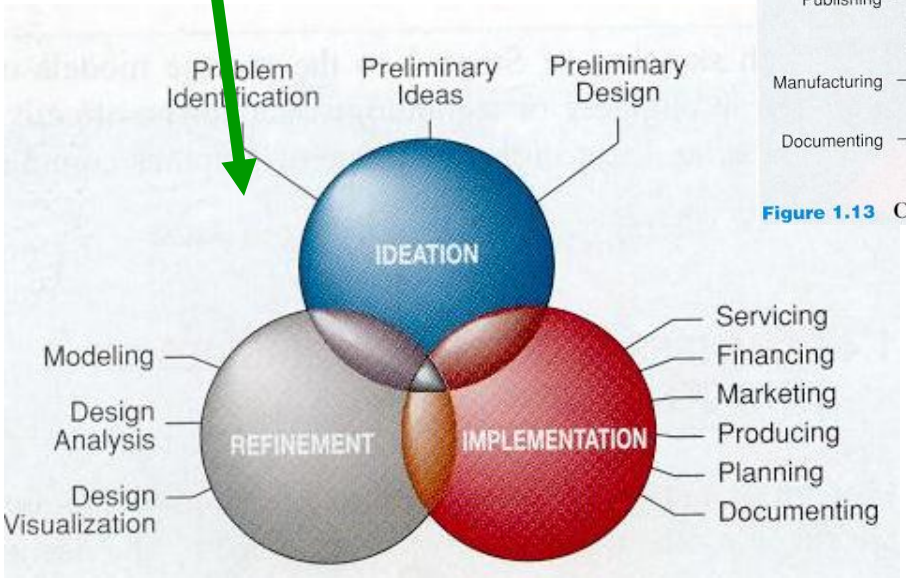


Users of engineering and technical graphics in industry

From traditional “linear” design process to new“concurrent” design process



- Traditional: A linear, segmented activity involving problem identification, preliminary ideas, design refinements, analysis, optimization, and documentation
- Concurrent: A team activity involving coordination of the technical and non-technical functions of design and manufacturing within a business



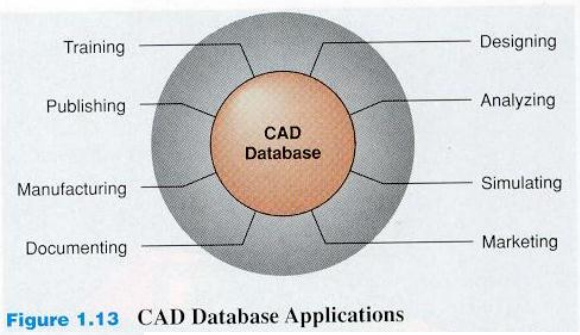
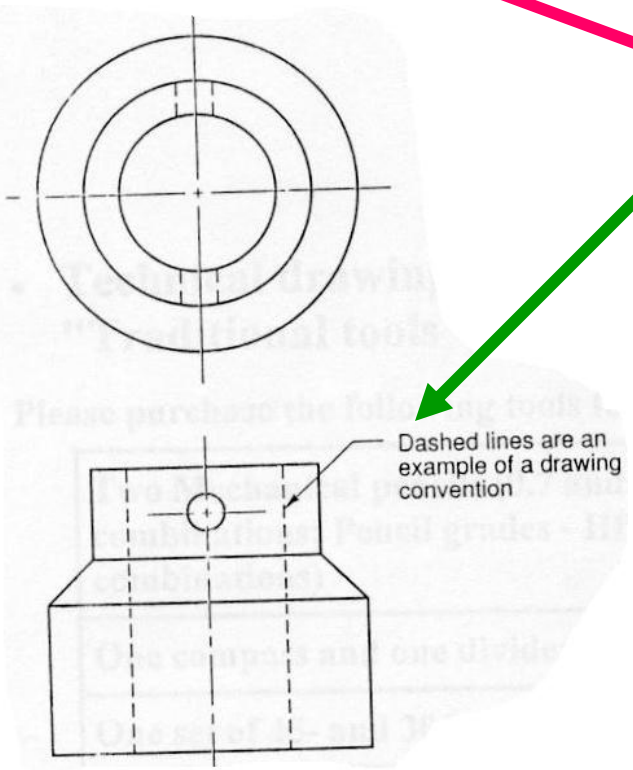
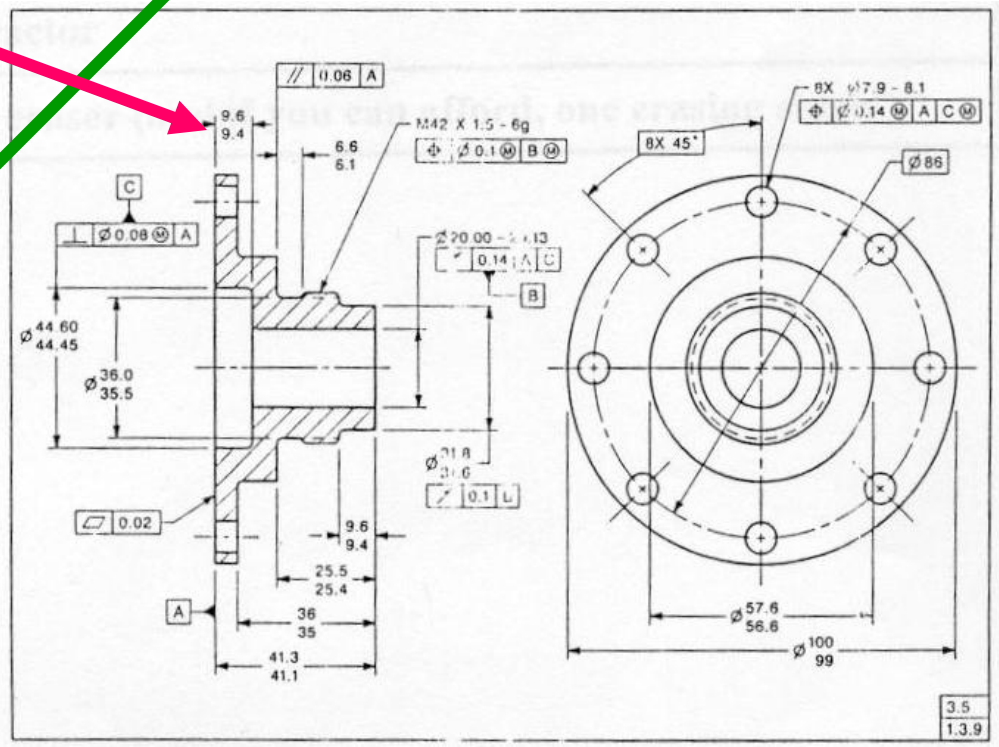


Figure 1.13 CAD Database Applications

The CAD database becomes a communication medium.

Samples of drawing conventions and standards





1.1. INSTRUMENTS

The instruments and materials to be used in this course are listed below. In selecting instruments and materials for drawing, secure the best you can afford, and keep well for a long use. The following is a list of instruments and materials necessary for pencil drawings.

Drawing board (Supplied by the university)
T-Square
45^o and 30^o-60^o triangles
Drawing paper (35 x 50 cm's. unless otherwise stated)
Pencils (3H and HB or F)
Case Instruments (Compass lead HB or F)
Scale (Mechanical engineers scale in mm's.)
French curves
Pencil and, lead sharpener
Sand paper
Soft eraser
Dusting brush
Scotch tape

Manual drafting tools for technical drawing

Mechanical pencils: 0.7 and 0.5 mm, or 0.5 and 0.3 mm combinations; Pencil grades – HB and H, or F and 2H combinations)

Compass and one divider

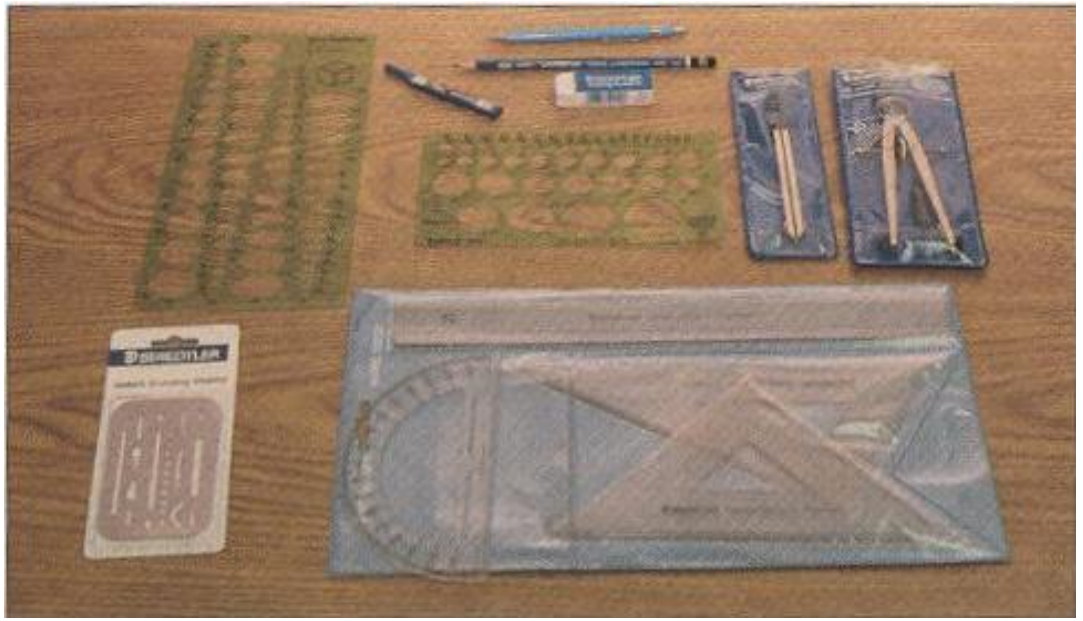
One set of 45- and 30/60-degree triangles

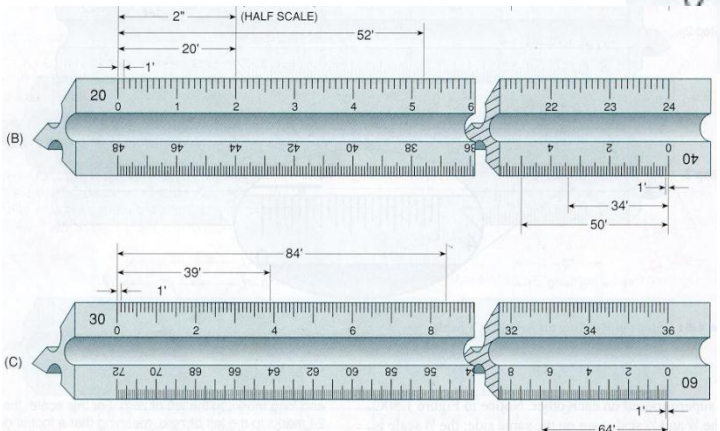
Scales (one English unit and one Metric unit)

Irregular curve (French curve)

Protractor

One good eraser





1.2. THE DRAWING BOARD

The drawing board (Fig.1.1) is a platform for engineering drawing, on which the drawing paper is placed and by means of the instruments drawing is made. The drawing surface may be the tabletop itself or a separate board. The left side edge of the board is called the “working edge” (for the right-handed).

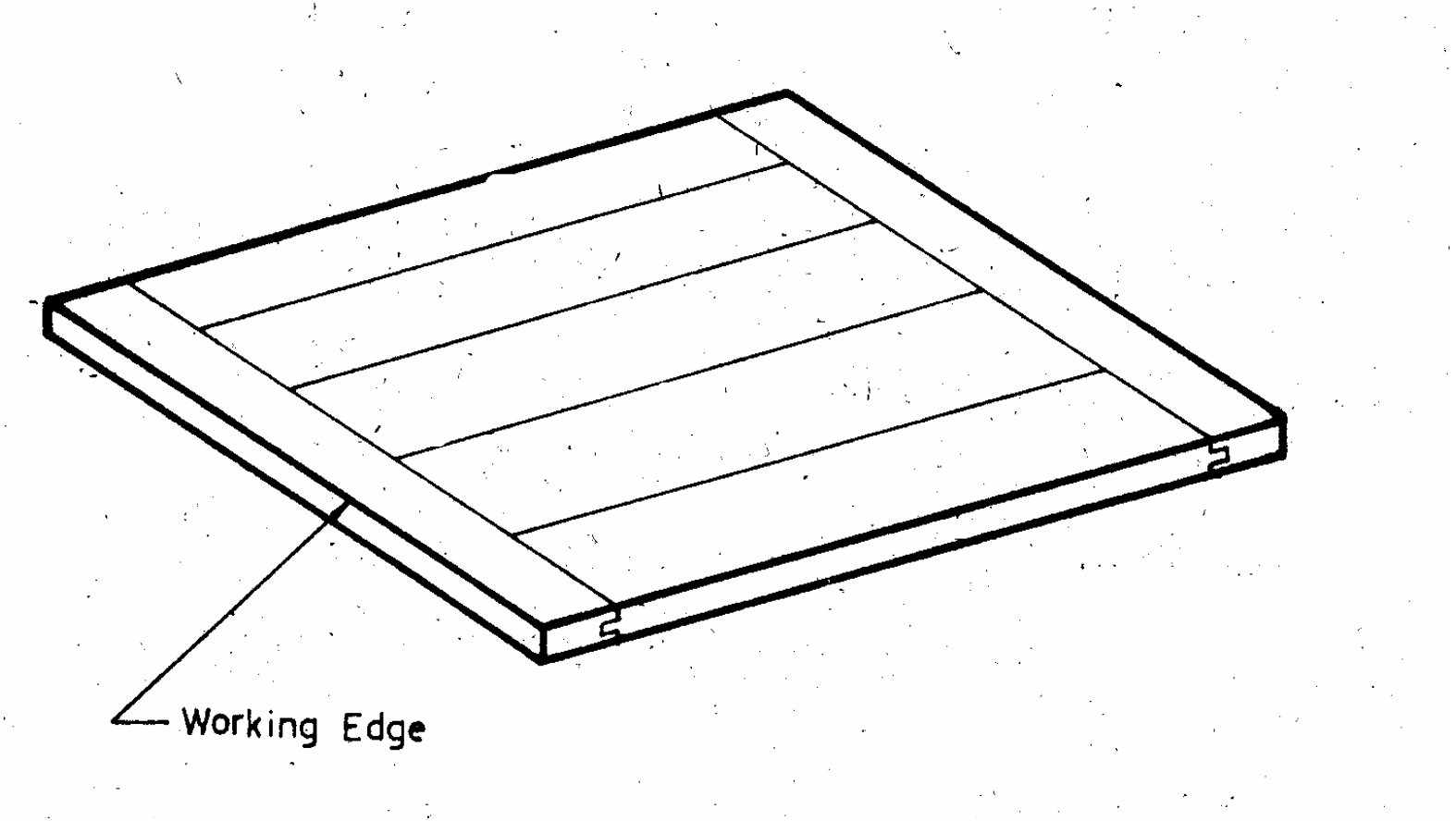
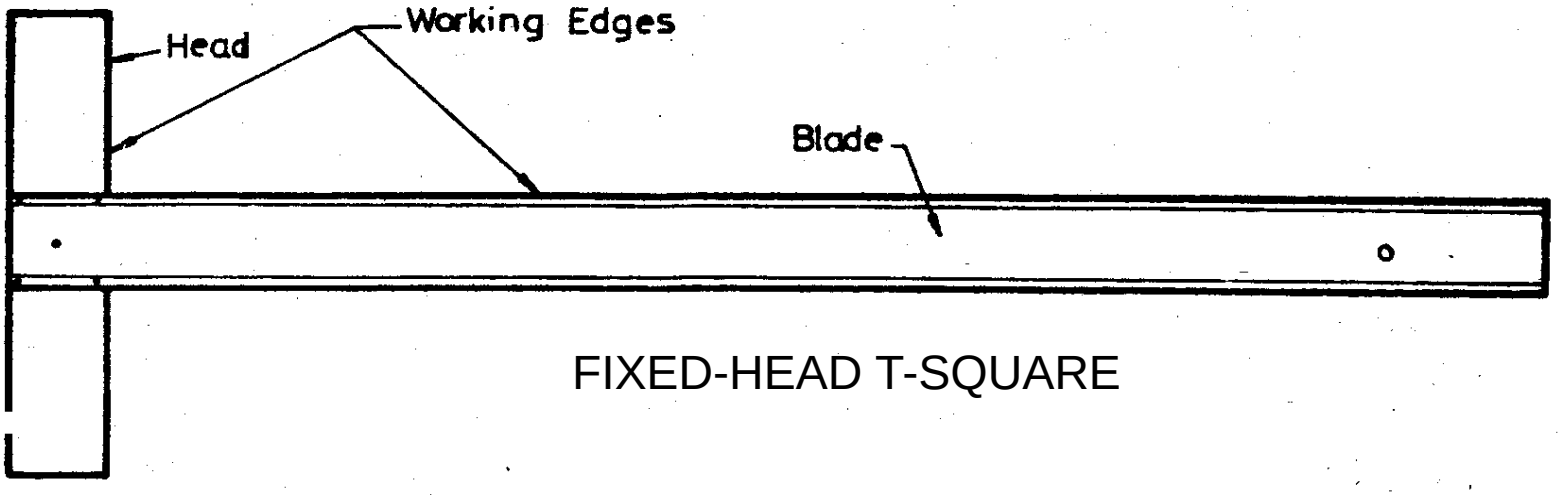


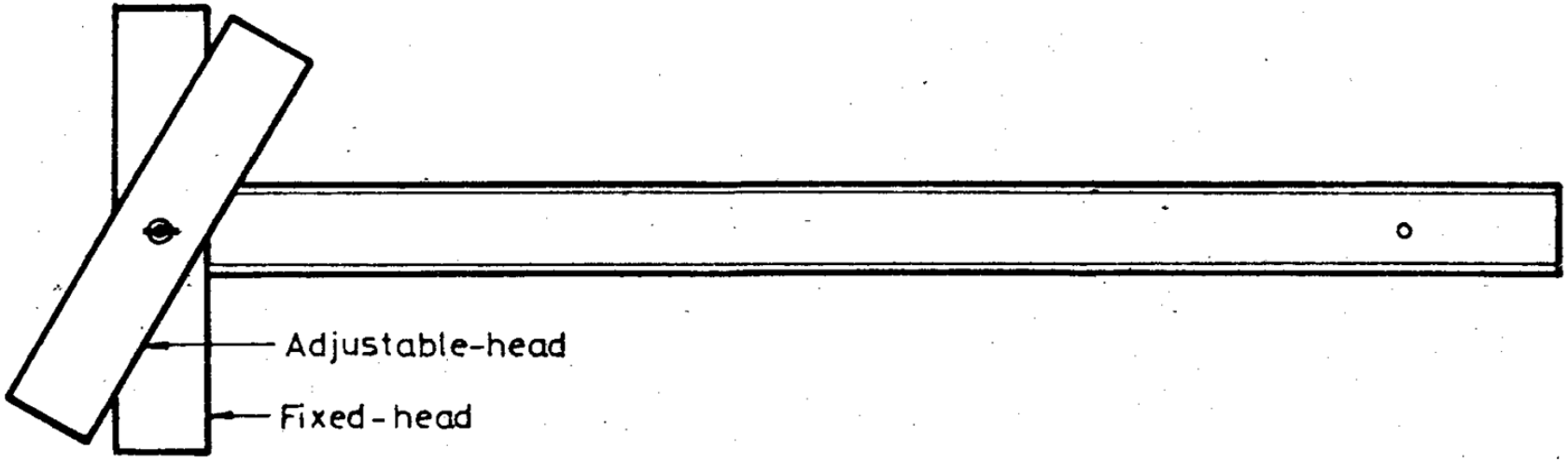
Fig.1-1 Drawing board

1.3. T-SQUARE

T square (Fig.1.2) is an instrument used to draw horizontal lines also guides the triangles when drawing vertical and inclined lines. It can have a fixed or a movable head



FIXED-HEAD T-SQUARE



ADJUSTABLE-HEAD T-SQUARE

Fig.1-2 T-squares

1.4 TRIANGLES

45^0 and 30^0-60^0 triangles (Fig.1.3) are used to draw vertical and inclined lines. They are made of wood or transparent plastic materials. Plastic triangles are preferable.

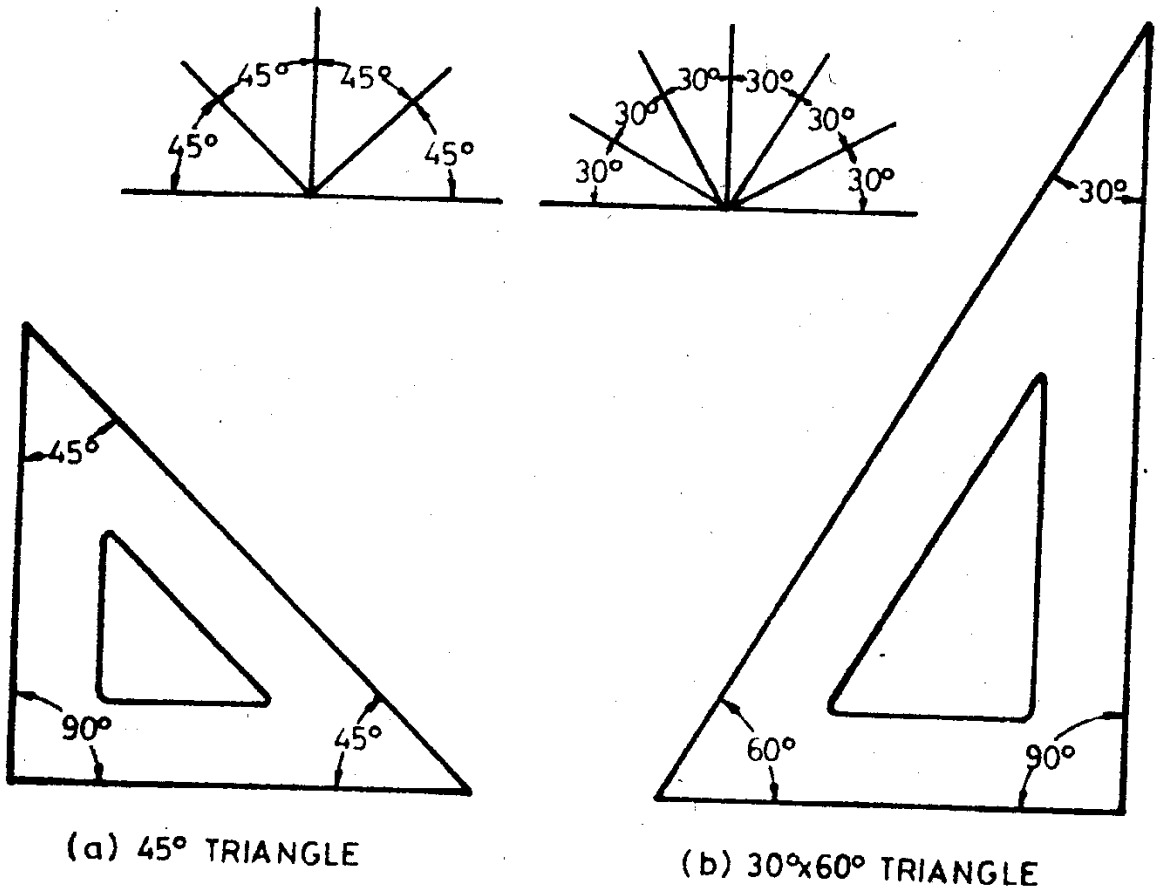


Fig.1-3 Triangles

1.5. DRAWING PAPER

The drawing is made on drawing paper. Its surface must be hard enough so that the pencil will not easily groove it, and it must have good erasing qualities.

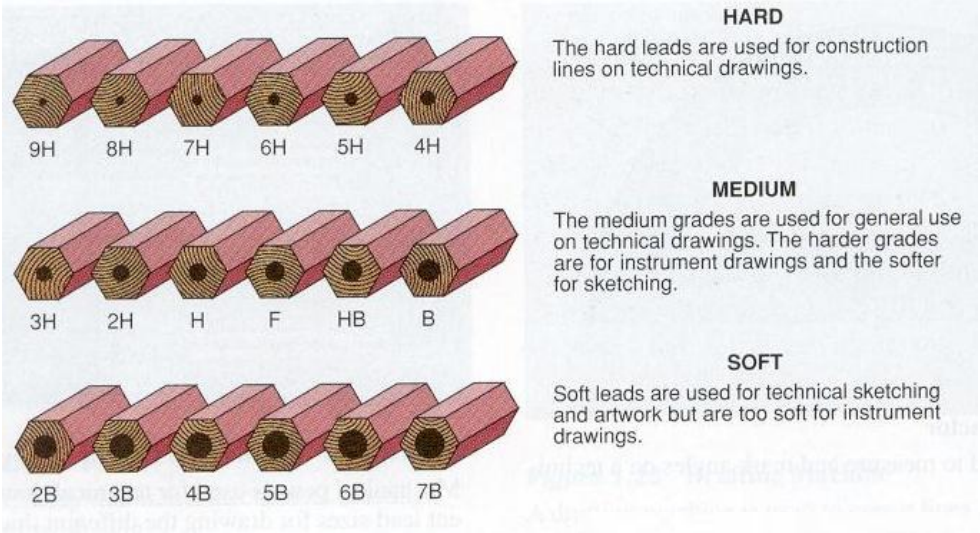
1.6 PENCILS

The basic instrument is the graphite lead pencil made in various hardness. Drawing pencils are graded by numbers and letters from 6B, very soft and black, through 5B, 4B, 3B, 2B, B, and HB to F, the medium grade. Then H, 2H, 3H to 9H, the hardest. The soft (B) grades are used primarily for sketching and rendered drawings, and the hard (H) grades for instrument drawings.

The grade of the pencil must be selected carefully, with reference to the surface of the paper as well as the line quality desired.

Pencil points must always be kept sharp.

Pencil grades and Line weight



HARD

The hard leads are used for construction lines on technical drawings.

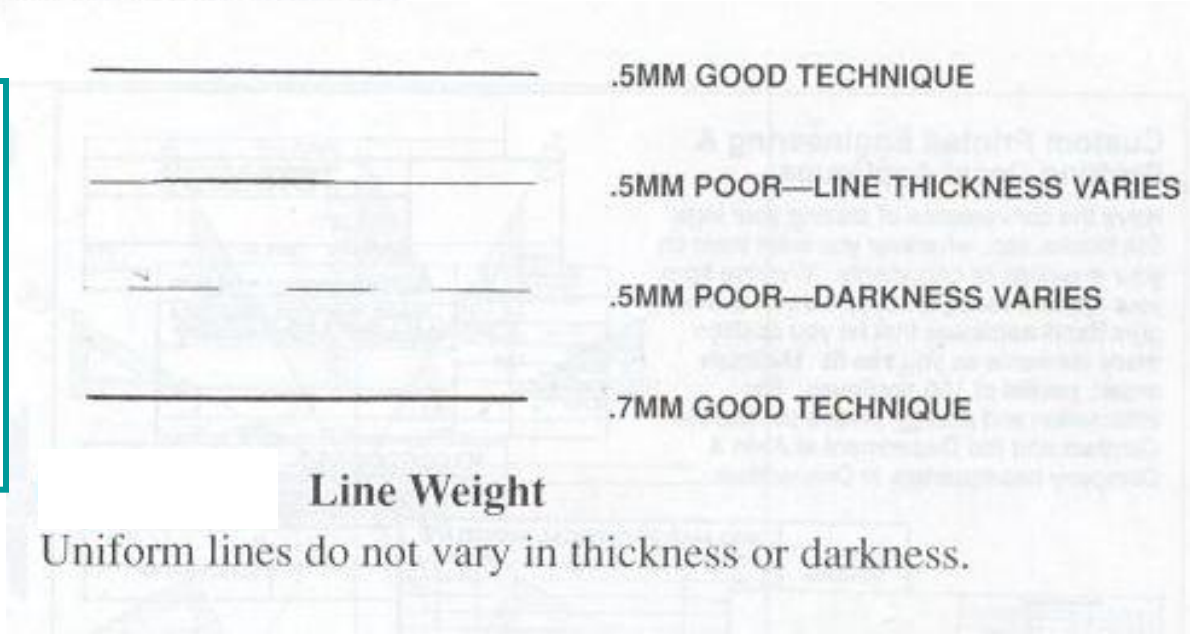
MEDIUM

The medium grades are used for general use on technical drawings. The harder grades are for instrument drawings and the softer for sketching.

SOFT

Soft leads are used for technical sketching and artwork but are too soft for instrument drawings.

Remember that Accuracy, Neatness, and Speed count in technical drawing



1.7. CASE INSTRUMENTS

A major portion of any drawing is likely to be circles and arcs, and the case instruments are used to draw these.

The large compass (Fig.1.4) with its lengthening bar is the main instrument for drawing circular arcs.

The bow instruments (Fig.1.5) are used for smaller work

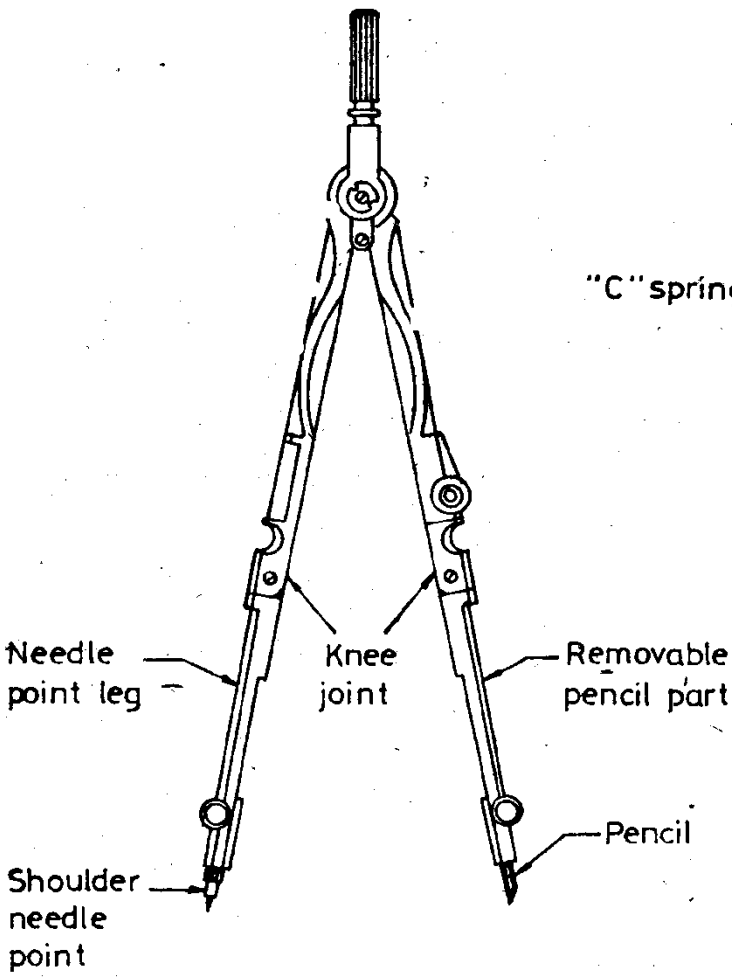


Fig.1-4 A compass

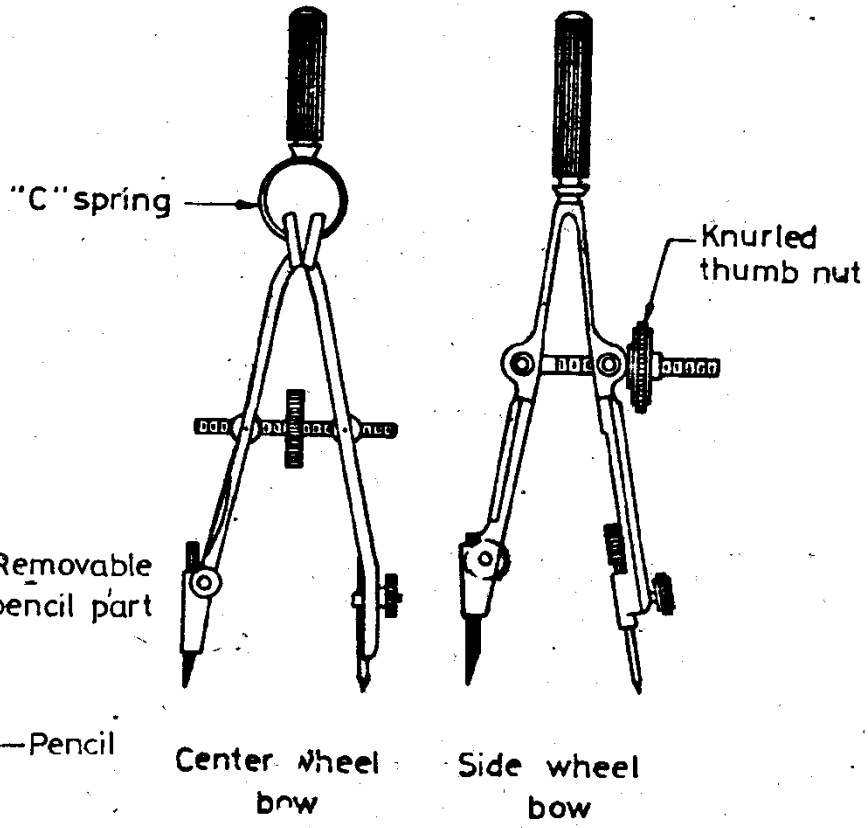


Fig.1-5 Bow pencils

The 15 cm compass (Fig.1.6) covers practically a whole set in one instrument. With the steel point installed in place of pencil point, it becomes a divider, used for lying off or transferring distances

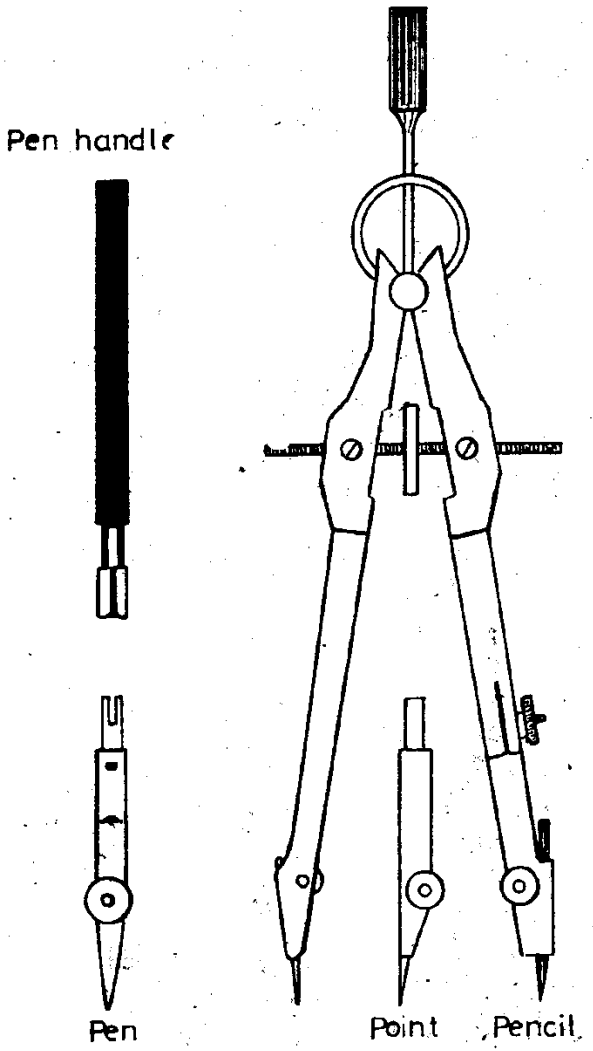


Fig.1.6 A 15 cm compass

Adjusting the lead of a compass is shown in Fig. 1.7.

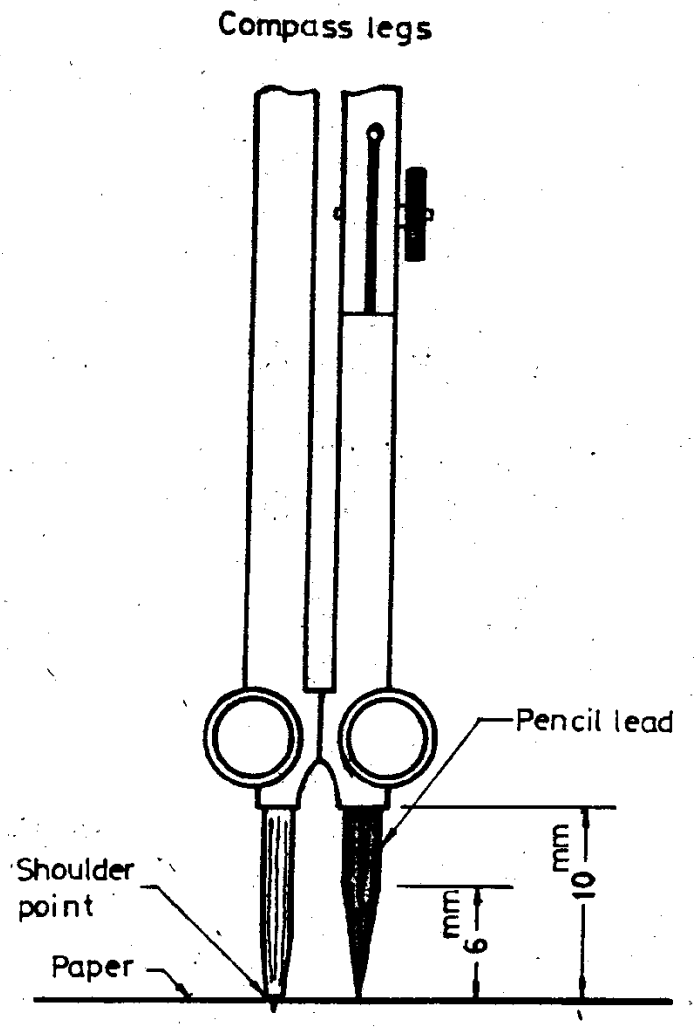


Fig.1.7 Adjusting the lead to point

1.8. MECHANICAL ENGINEERS SCALE (Fig.1.8)

These are divided and numbered so those fractions of inches represent inches. Ranges are 1/32, 1/16, 1/8, 1/4, 1/2, and 1 in. to twelve inches. The other edge of the scale is in millimetres.

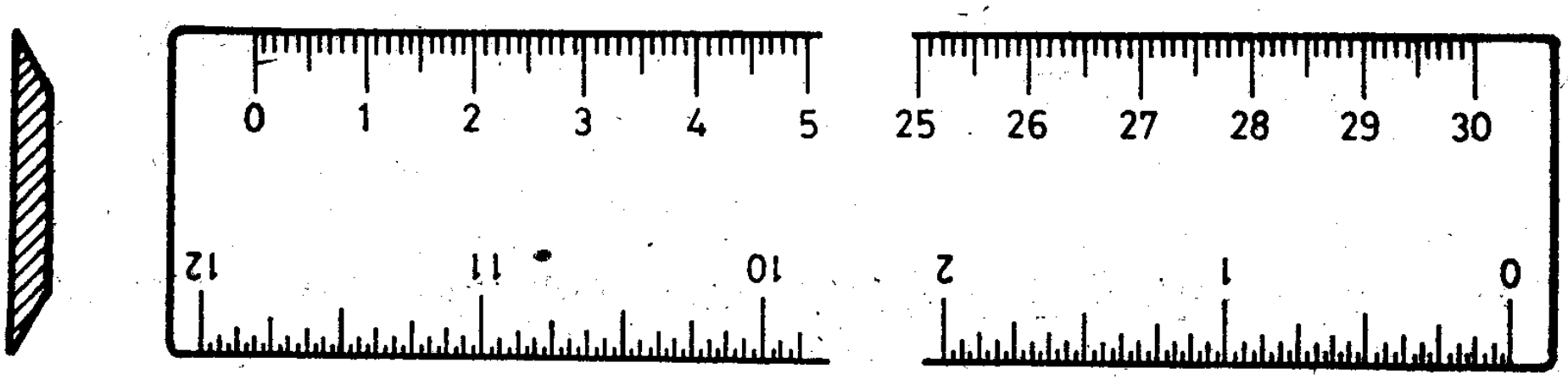


Fig.1.8 Metric and fractional-division inch scale

1.9. FRENCH CURVES

Irregular curves or french curves (Fig. 1.9) are used for curved lines other than circular arcs.

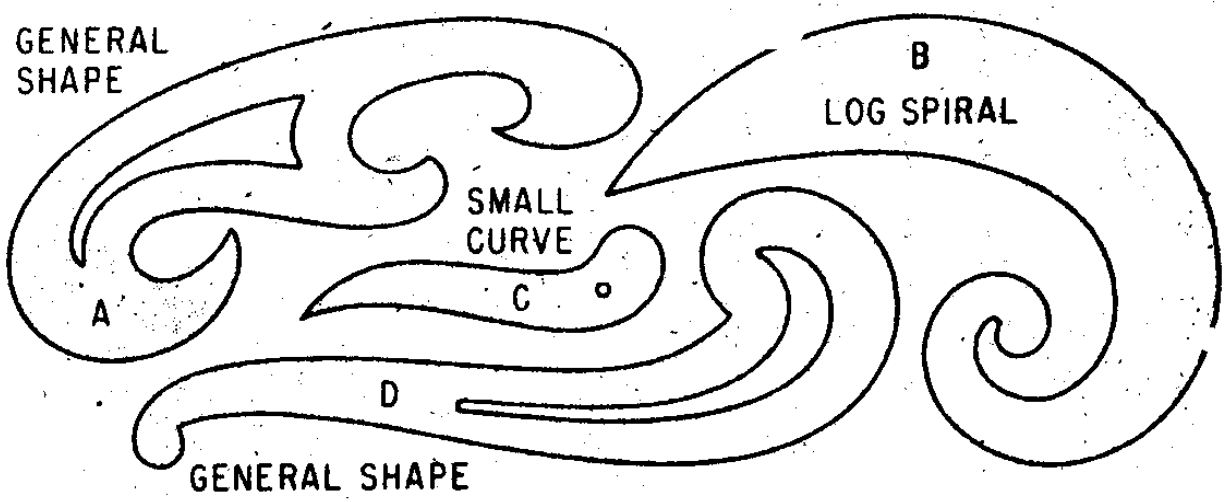


Fig. 1.9 Irregular curves. These are used for drawing curves where the radius of curvature is not constant

1.10. PENCIL AND LEAD SHARPENER

Sharpening the pencil (Fig. 1.10) wood is removed first, then the point is made with sandpaper or a special lead sharpener is used.

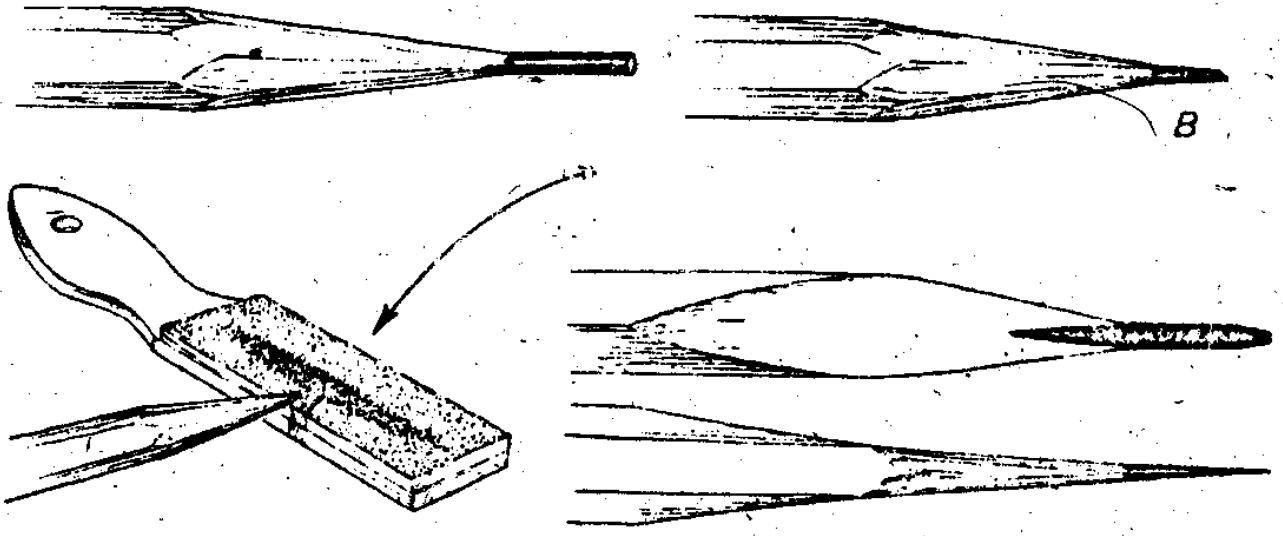


Fig.1.10 Sharpening the pencil. Wood is removed first, then the point is made with sandpaper or a file or special lead sharpener. For semiautomatic pencils, adjust the lead to the proper or a file.

1.11. PLACING THE PAPER

Since the T square blade is more rigid near the head than towards the outer end, the paper should be placed close to the left edge of the board about 5 cm's. Placing of the lower edge of the paper is shown in Fig.1.11.

With the T-square against the working edge of the board, square the top of the paper, and tape it. Then move the T-square down over the paper to smooth out possible wrinkles, and fix the lower corners accordingly.

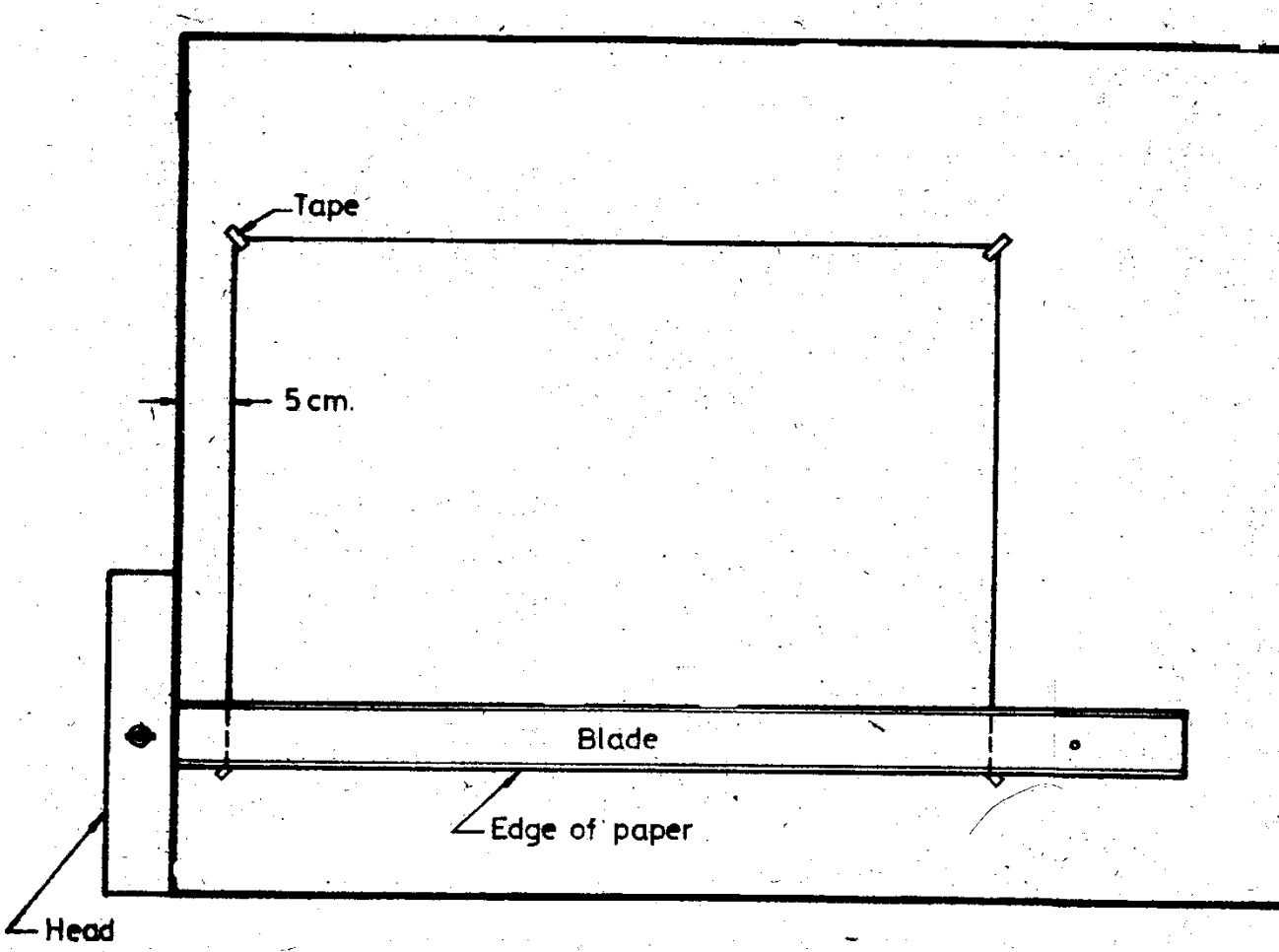


Fig.1-11 Placing and fastening the paper

1.12 USE OF T-SQUARE

The T-square and the triangles have straight edges and are used for drawing straight lines. Horizontal lines are drawn with the T-square which is used its head against the working edge of the drawing board, and used as shown in Fig.1.12.

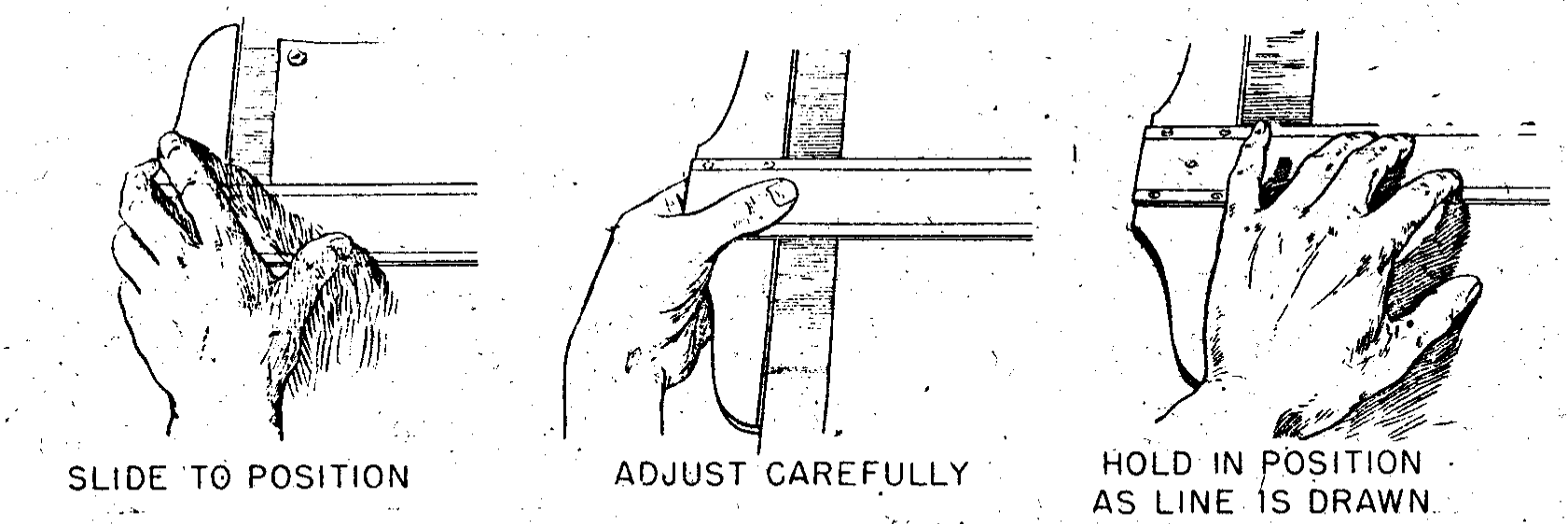


Fig.1.12 Manipulating the T-square. The head must be firmly against the straight left of the board

In drawing lines, take care to keep them accurately parallel to the guiding edge of the T-square. The pencil should be held lightly, but close to the edge, and the angle should not vary during the progress of the line (Fig.1.13). Horizontal lines should always be drawn from left to right.

Note that the pencil is inclined in the direction the line is drawn, that is towards the right, and also slightly away from the body, so that the pencil point is as close as possible to the T square.

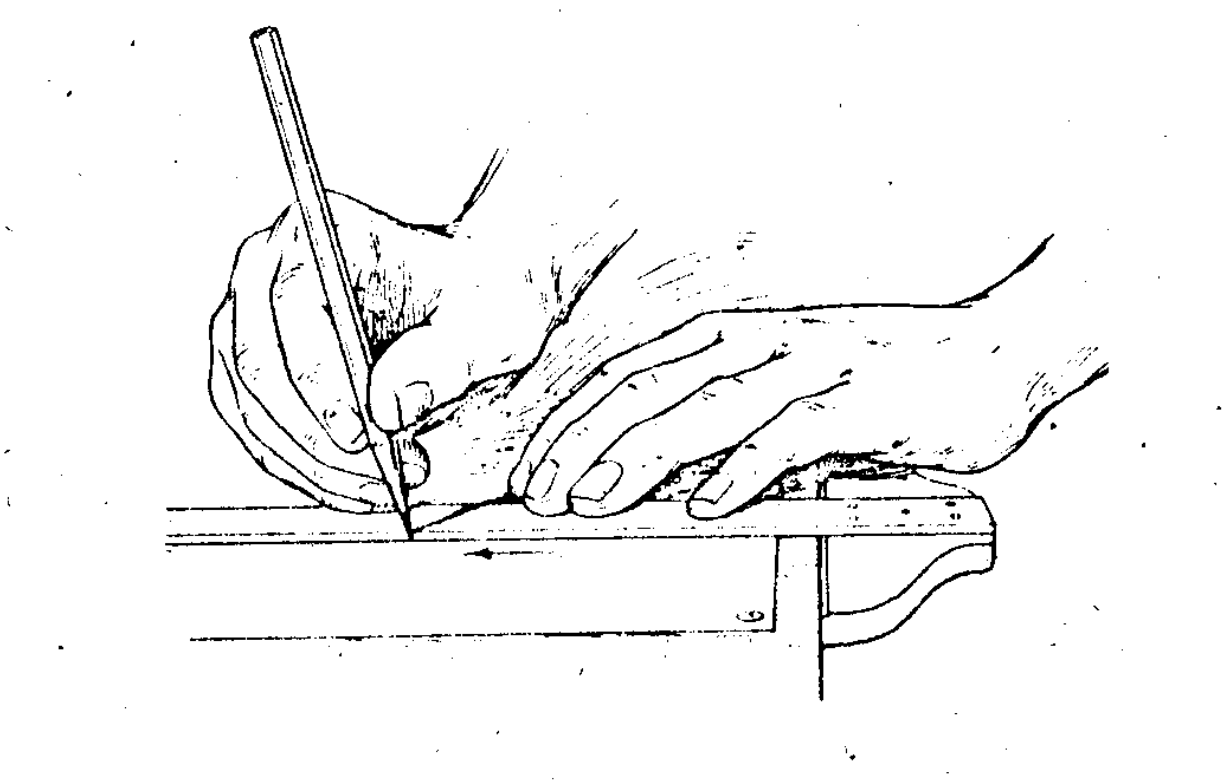


Fig.1.13 Drawing a horizontal line. Hold the t-square with the left hand; draw the line from left to right; incline the pencil in the direction of stroke, so that the pencil "slides" over the paper.

1.13. USE OF TRIANGLE

Vertical lines are drawn with the triangle, which is set against the T square with perpendicular edge nearest the head of the T square (Fig. 1.14). These lines are always drawn upwards. The pencil is inclined upwards and to the left.

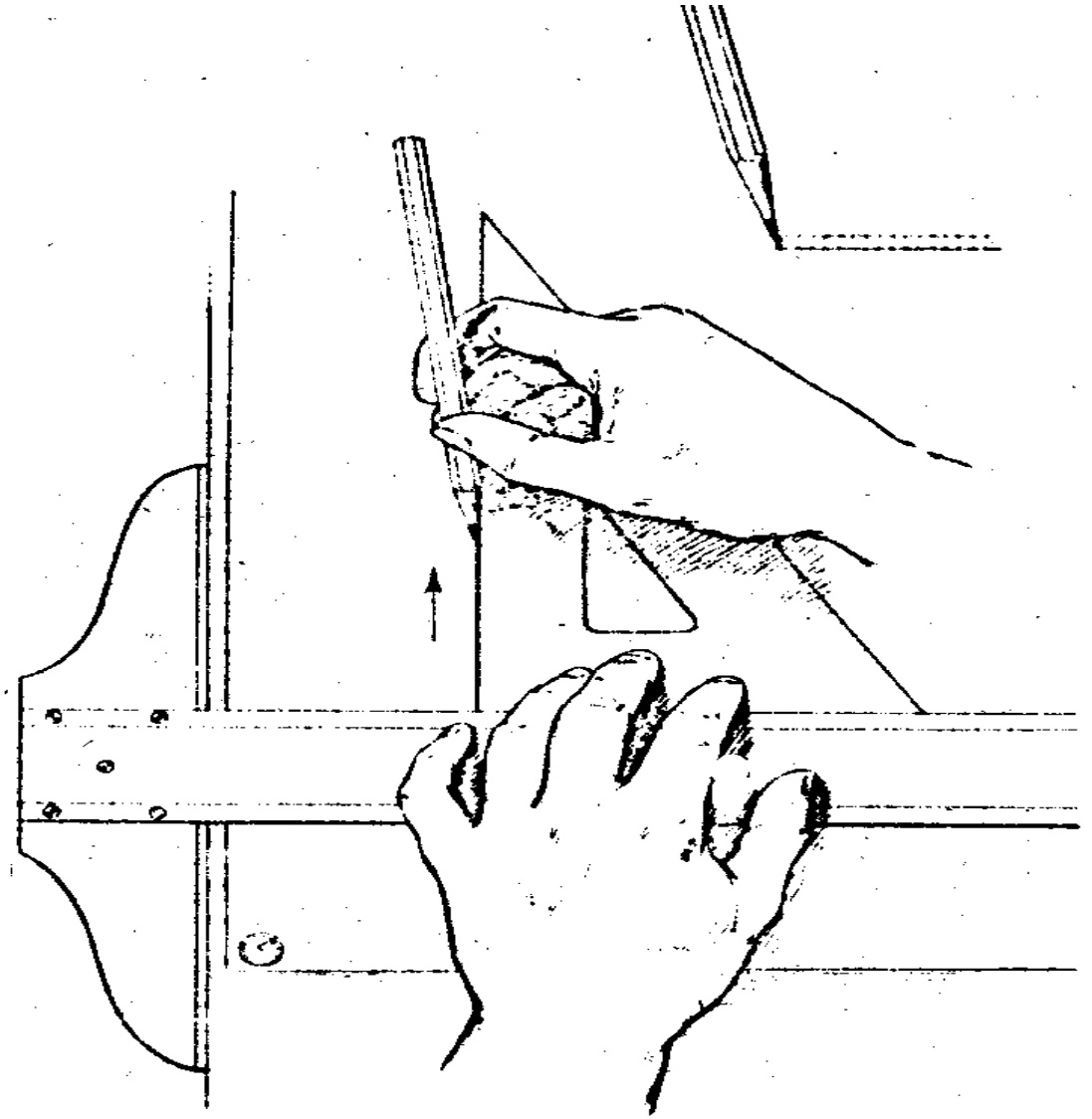


Fig.1.14 Drawing a vertical line. With the t-square and triangle in position, draw the line from bottom to top always away from the body.

The T square against the edge of the board, 30^0, 60^0 and 45^0 Fig.1.15 To draw angles of 30º,45º,60º angle, multiples of 45º triangle. Multiples of 30º are drawn with the 30-60º triangle.

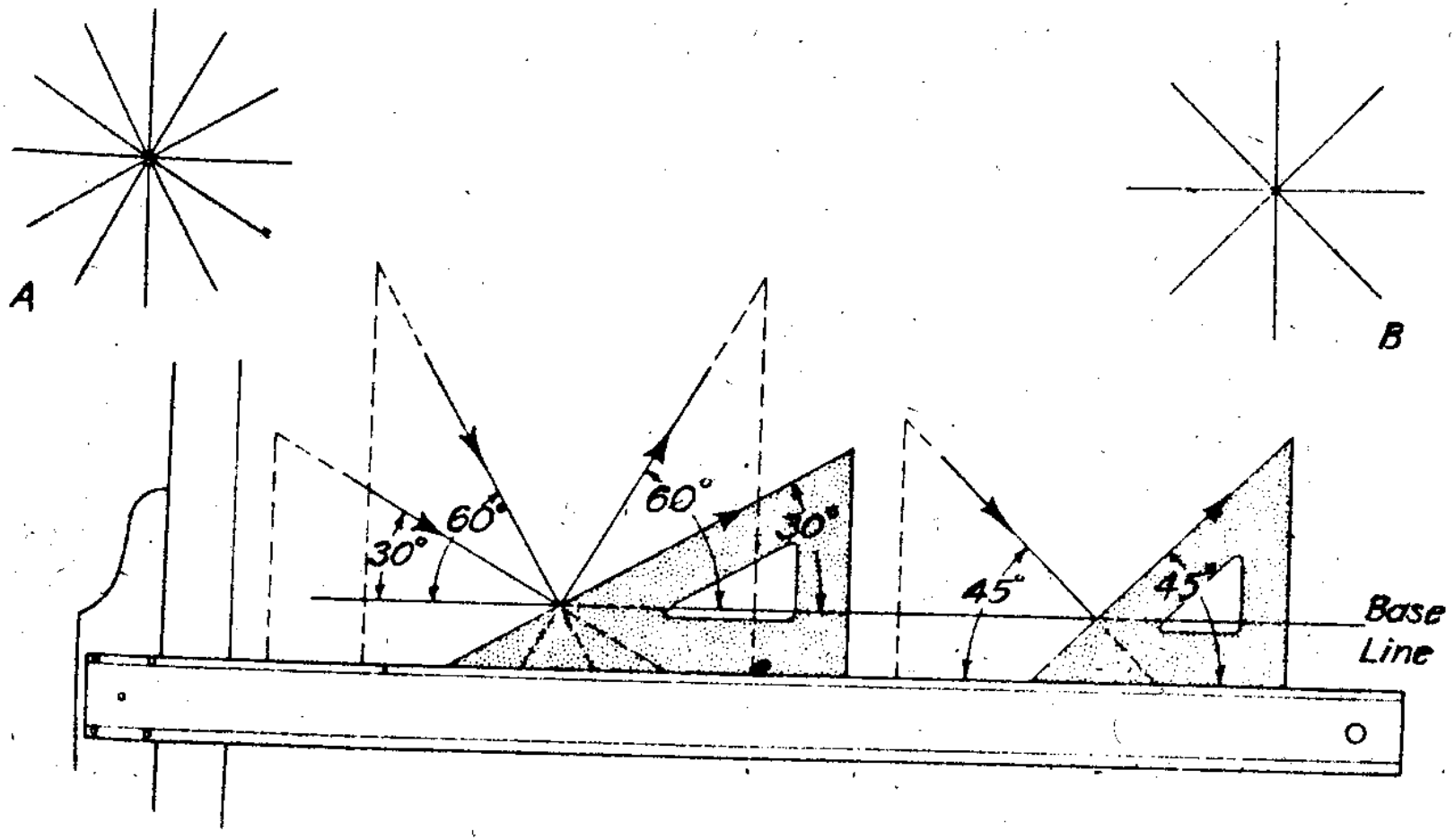


Fig 1.15 To draw angles of 30°, 45°, 60°, angle; multiplies of 45° with the 45° triangle. Multiplies of 30° are drawn with the 30-60° tri.

15^0 and 75^0 lines can also be drawn by using the two triangles together as shown in Fig 1.16.

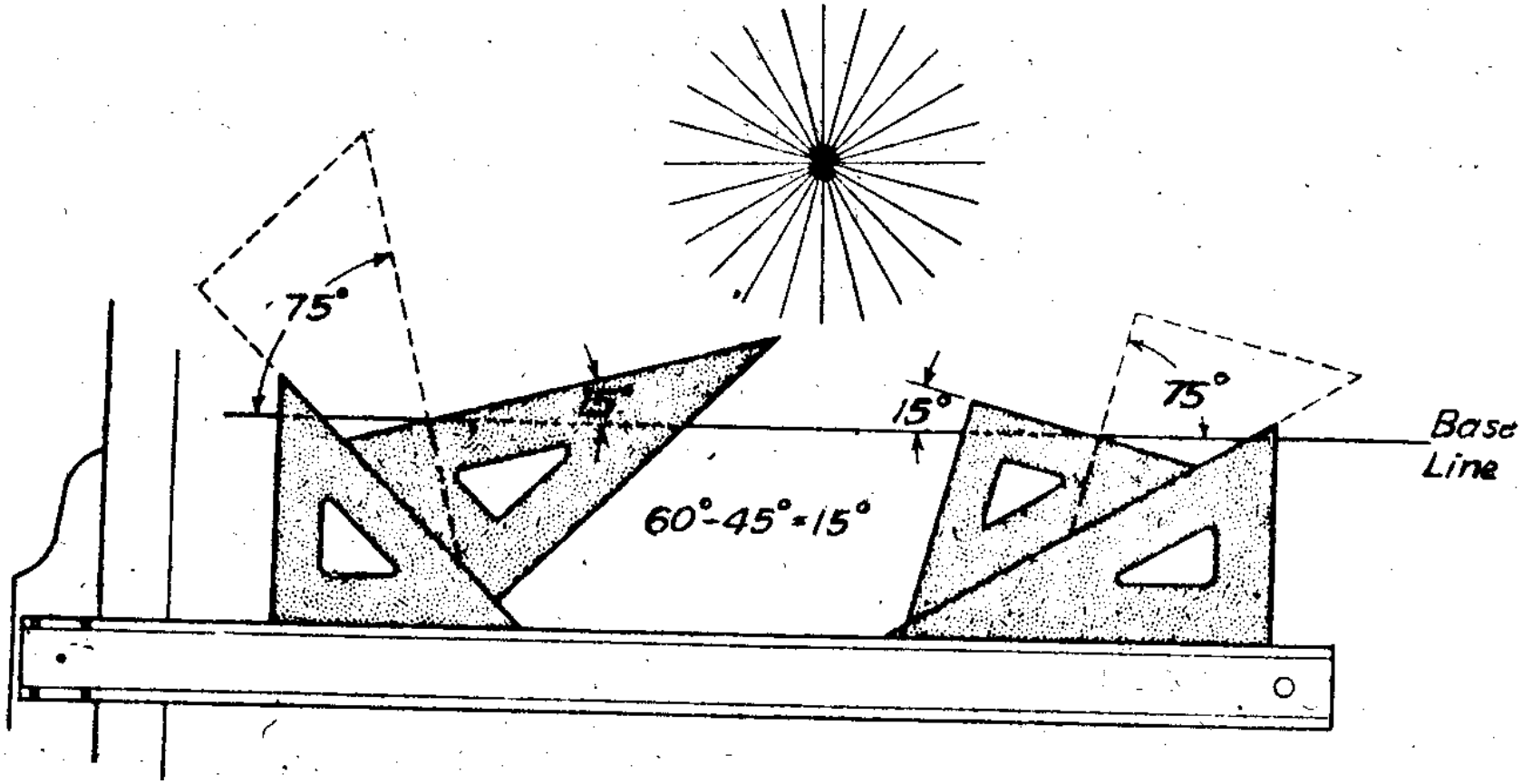


Fig.1.16 To draw angles of 15° and 75°. Angles in increments of 15° are obtained with the two triangles in combination.

Drawing parallel lines are shown in Fig 1.17. Drawing perpendicular lines are shown in Fig 1.18 by using two 30^0-60^0 triangles. A 45^0 triangle can also be paired with 30^0-60^0 triangles.

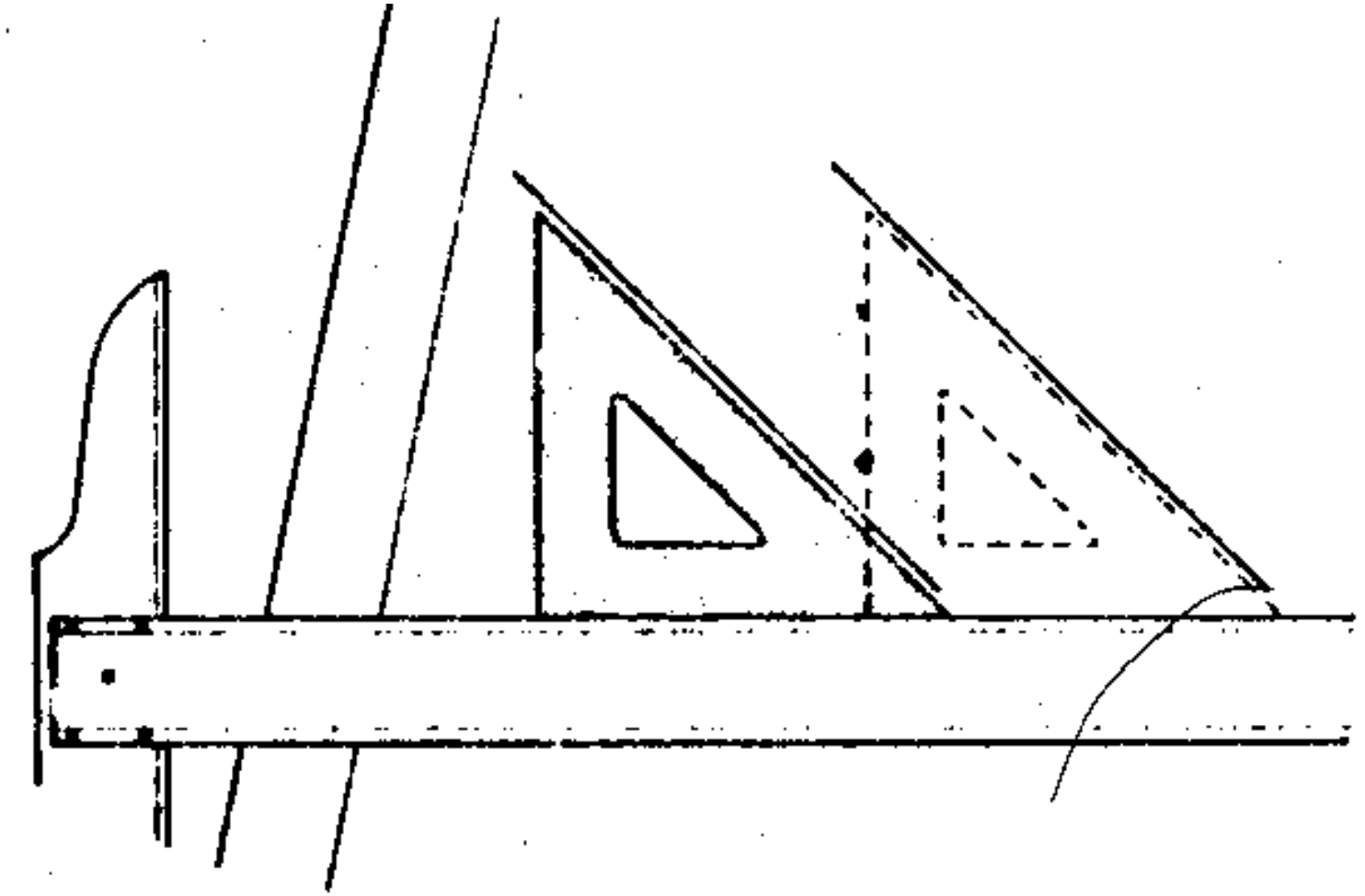


Fig.1.17 To draw parallel lines. With the T-square as a base, the triangle is aligned and then moved to the required position.

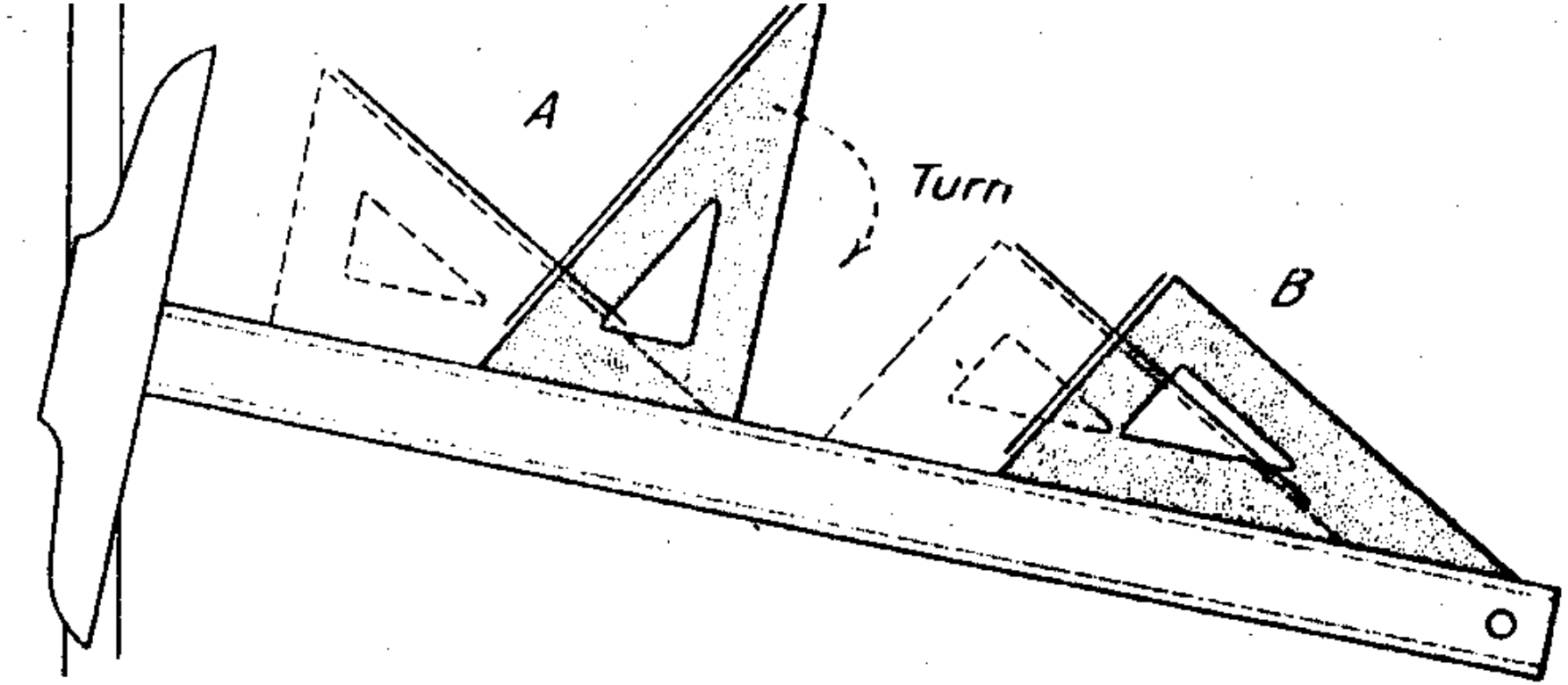


Fig.1.18 To draw perpendicular lines. With the T-square as a base and the triangle in position A, the triangle is aligned, then rotated and moved to perpendicular positions; for position B, the triangle is only moved

1.14. USE OF THE COMPASS

To draw a circle, set the compass on the scale as shown in Fig 1.19 and adjust the radius needed. Then follow the procedure shown in Figs. 1.20, 21, 22, and 23.

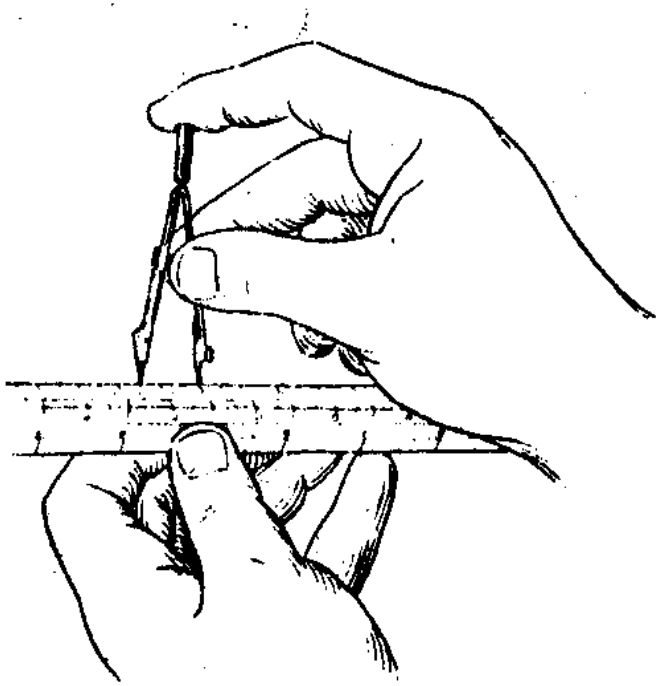


Fig.1.19 Setting the compass to radius size. Speed and accuracy are obtained by adjusting directly on the scale.

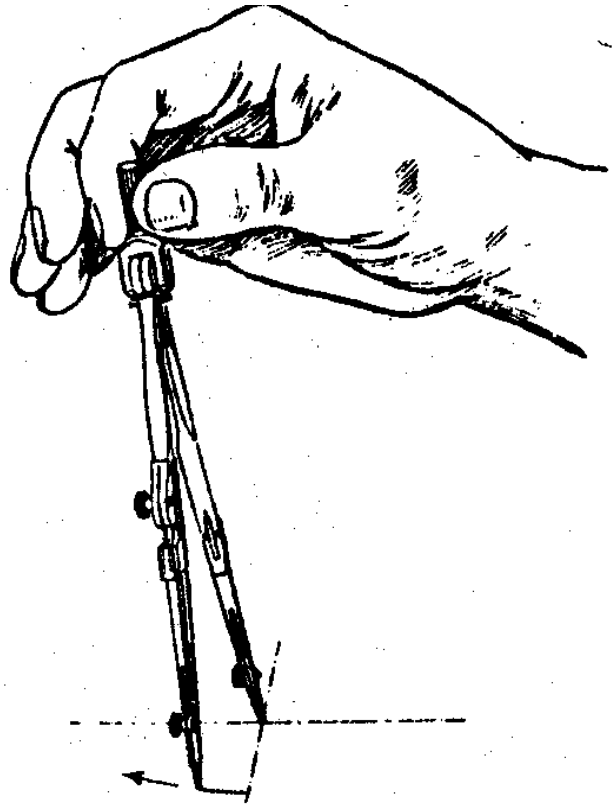


Fig.1.20 Setting the compass to radius size. Speed and accuracy are obtained byadjusting directly on the scale.

Fig.1.21 Completing a circle. The stroke is completed by twisting the knurled handle in the fingers.

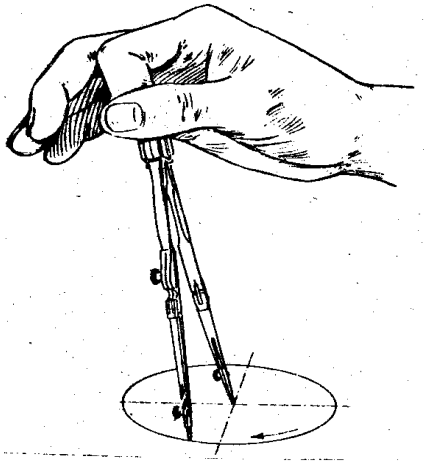
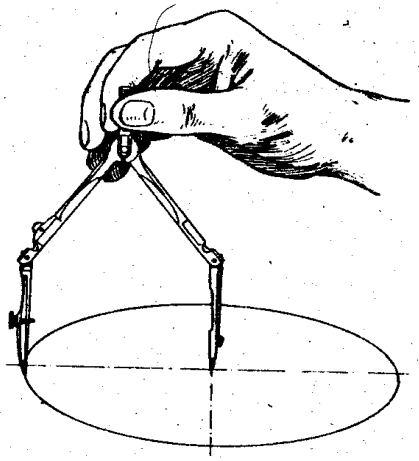
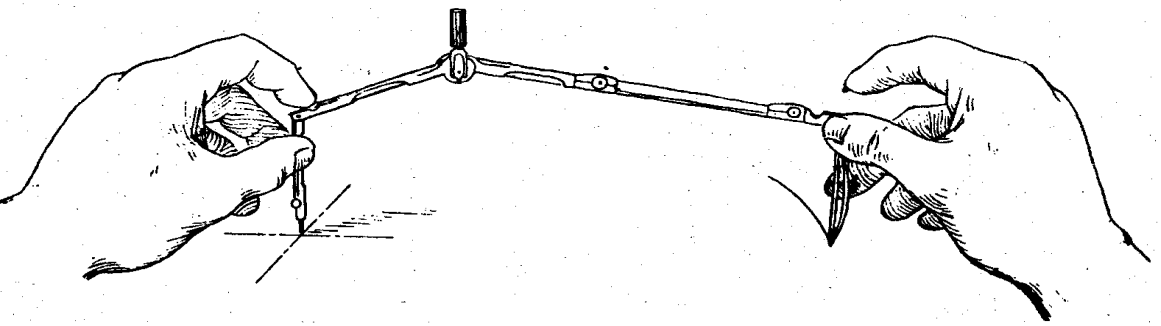


Fig 1.22 Drawing a large circle. Knuckle joints are bent to make the legs perpendicular to the paper.



Knuckle joints are bent to make the legs perpendicular to the paper.



The joints must be bent to bring the legs perpendicular. Usually two hands are used because the handle is off centre

Fig. 1.23 Use of the lengthening bar.

1.15. THE ALPHABET OF LINES

As the basis of drawing is the line, a set of conventional symbols covering all the lines needed for different purposes are given in Figs. 1.24, and 25.

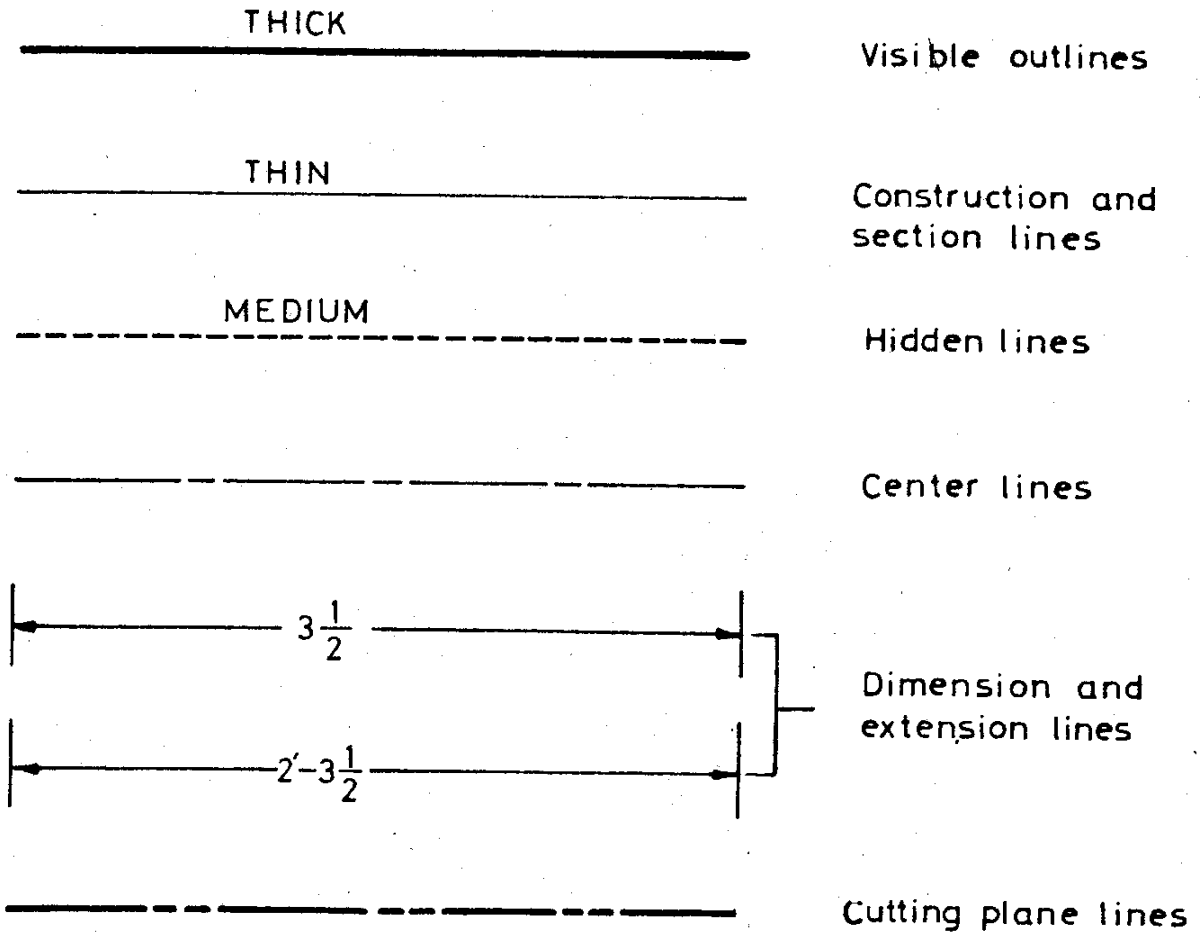
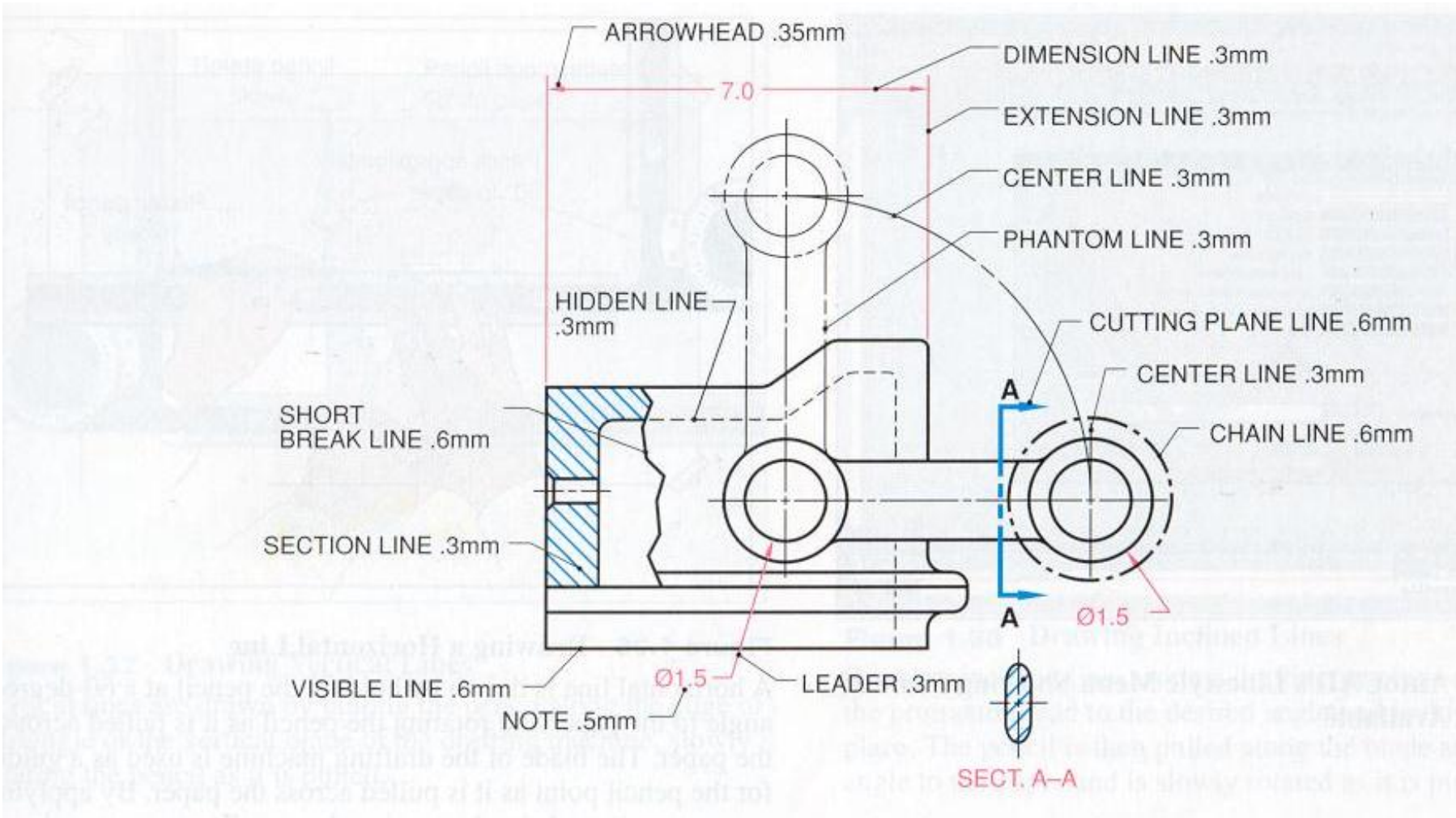


Fig.1.24 Width and character of lines (ASA)

Three widths of lines for finished drawing are recommended. Thick for visible outlines, and cutting plane lines. Medium for hidden outlines, and Thin for section, centre, extension, dimension and construction lines. Lighter construction lines can be used as guide lines, especially in lettering practice (Fig.1.26).

In pencil drawing try to have all straight and curved lines uniform in width and colour or thickness and density.

Alphabet of lines



1.16. USE OF THE FRENCH CURVE

The french curve is a guiding edge for non-circular curves. It use can be followed in Fig.1.27.

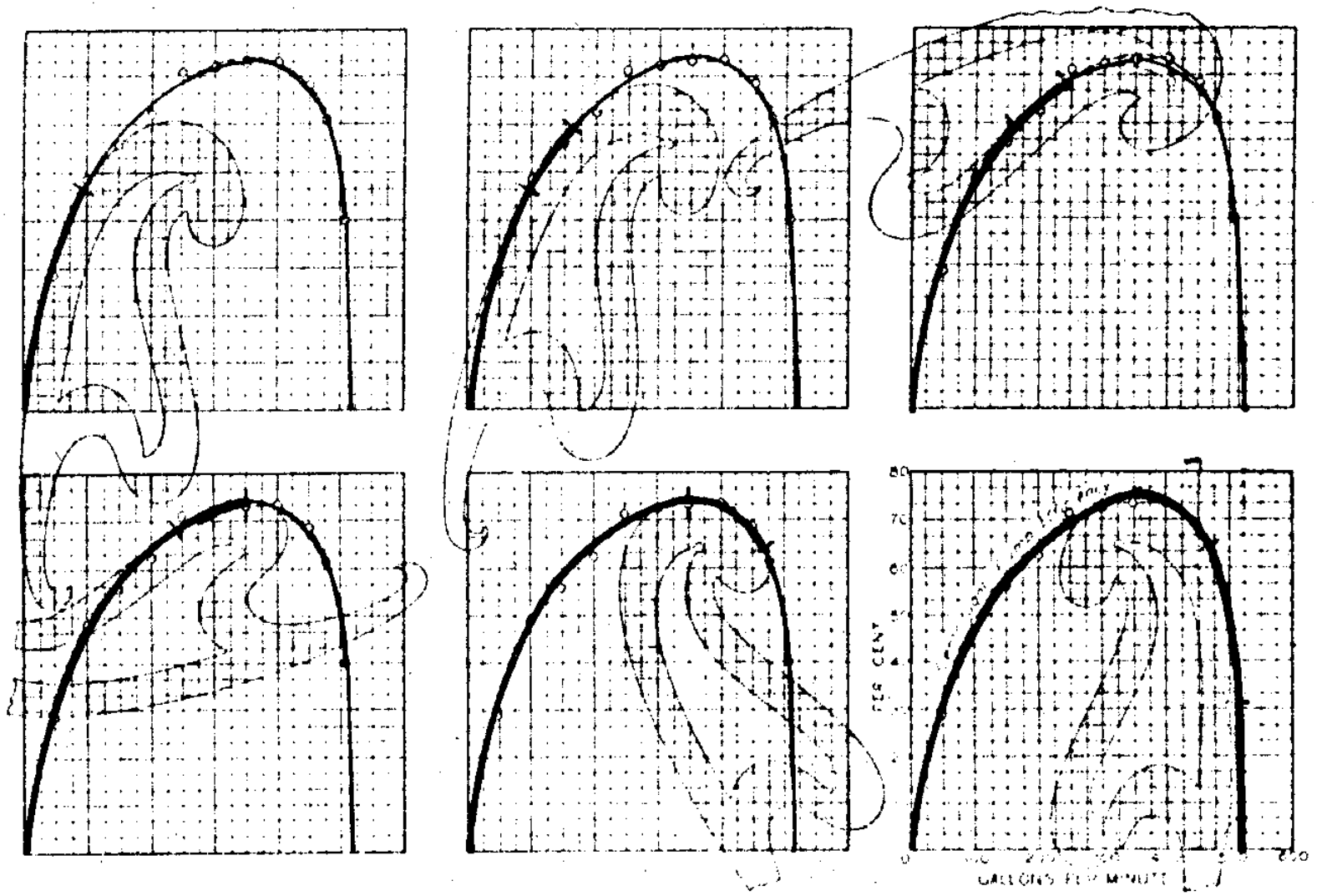
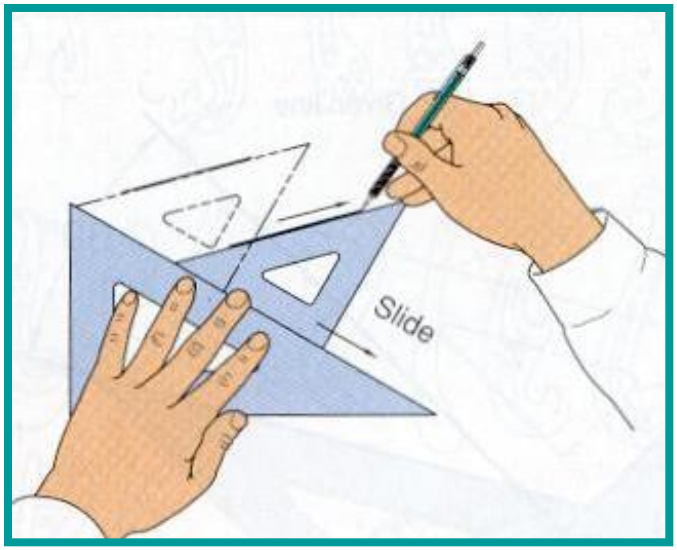
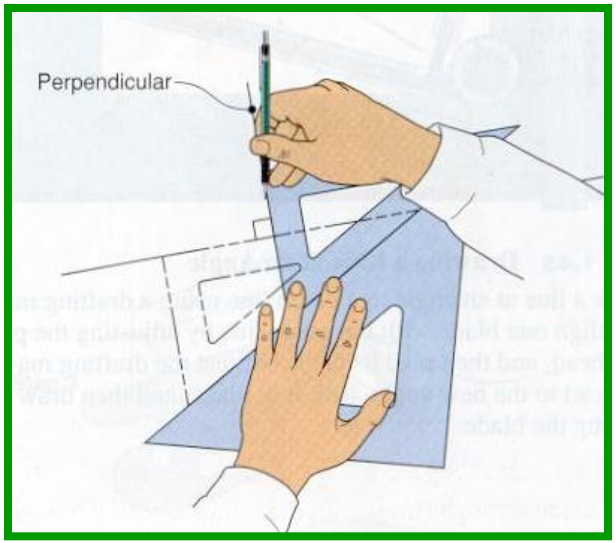
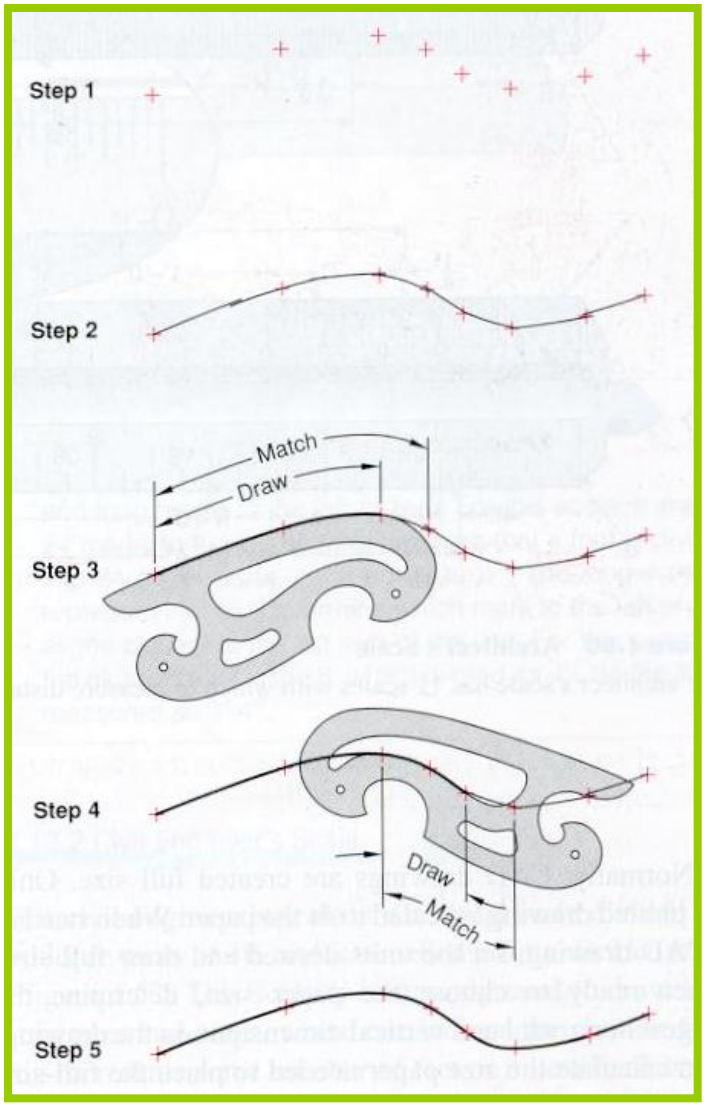


Fig.1.27 Use of the french curve. The changing curvature of line and curve must match.

Use of drafting tools – a few examples







THE END