

Lecture 1 (Lab)

ENGINEERING GRAPHICS

INTRODUCTION

Department of Civil Engineering

Indian Institute of Technology (ISM) Dhanbad

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Civil Engineering Department**

Philosophy:

- **Drawing is the language of Engineers, Details of complex engineering components are better understood with the help of detailed drawing and sectional views.**

Objective of Course: To provide knowledge about the basic concepts of engineering drawing and the methods of generating Engineering drawing using CAD software.

Course Content

Class No.	Name of the topic	Syllabus	Usage in multi-disciplinary subjects
1	Introduction	Codal Guidelines for Drawing, Lettering, Scale, Types of lines,	Drawing techniques and ISO conventions
2	Curves used in engineering practices	Conic sections, Cycloid, Involute, Spiral	Lines for Engg drawing, Conic section- Structure, components Cycloid- Gear System and pumps, turbines Involute- Gear Tooth Spiral- Staircase
3	Projection of points and lines	Projection of points in different quadrants, projection of line inclined to one plane, Orthographic projection of lines inclined to both the reference planes	Visualization for drawing 3D object in 2D surface

Course Content

Cla ss No.	Name of the topic	Syllabus	Usage in multi- disciplinary subjects
4	Projection of planes	Orthographic projection of planes inclined to one plane and inclined to both the planes	Features of plane/Lamina/Plate
5	Introduction to CAD tools	Introduction to Layout, co- ordinate system, lines, polygons, curves, dimensioning. Editing of existing drawings.	Basic drawing tools in CAD environment
6	Projection of solids	Orthographic projection of solids inclined to one plane and inclined to both the planes	Multi-view projection of 3D Engg components
7	Section of Solids	Section of Regular solids	Internal features of 3-D objects

Course Content

Cla ss No.	Name of the topic	Syllabus	Usage in multi- disciplinary subjects
8	Development of surface	Prism, Cylinder/Cone, Pyramids and truncated solids	Manufacturing of 3D Engg system from 2D sheets via rolling/folding
9	Isometric	Isometric scale,	Creating 3D view of
10	Projection - Examples	Orthographic to Isometric Projection- Real Examples	objects from multiview 2D projection
11	Isometric Projection – Examples- Continued	Isometric to Orthographic Projection- Real Examples	Creating 2D layouts for 3D objects

Text Book

TEXT BOOKS:

1. Bhatt, N. D. and Panchal V. M.,
“Engineering Drawing”, Charator Publishing House
2. Ryan D. L. “Computer-aided graphics and design”, CRC press

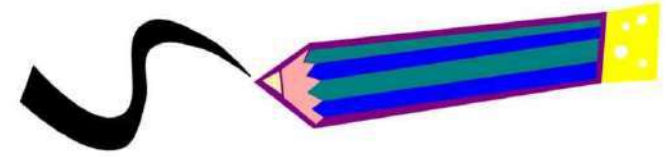
REFERENCE BOOKS:

1. Chandra, A. M. and Chandra, Satish, “Engineering Graphics”,
Narosa Publishing House, New Delhi 2011
2. Giesecke, Mitchell, “Technical Drawing”, Spencer, Hill, Dygdon
and Novak, Macmillan Publishing Company. 2003
3. Venugopal K., “Engineering Drawing And Graphics
+ Autocad”, New Age International Publishers

Pattern of Evaluation

- 1. Continuous Assessment: 20 Marks**
- 2. Midsemester Examination: 30 Marks**
- 6. End-Semester: 50 Marks**

Engineering Drawing



- Drawing is an art of representing objects or forms on a flat surface or a canvas mainly by means of lines, using any of a wide variety of tools and techniques.
- Engineering Drawing is a graphical way to convey an unambiguous and accurate description necessary for engineered items.
- Engineering Drawing is made in accordance with the standard conventions for layout, nomenclature, interpretation, size etc.
- Purpose of Engineering Drawing is to provide exact geometrical configuration for the construction or analysis of machines, structures or systems.

Drawing Instruments and their Usage: Drawing Board

Drawing board is rectangular in shape and is made of strips of well-seasoned soft wood about 25 mm thick. It is cleated at the back by two battens to prevent warping. One of the edges of the board is used as the working edge, on which the T-square is made to slide. It should, therefore, be perfectly straight.

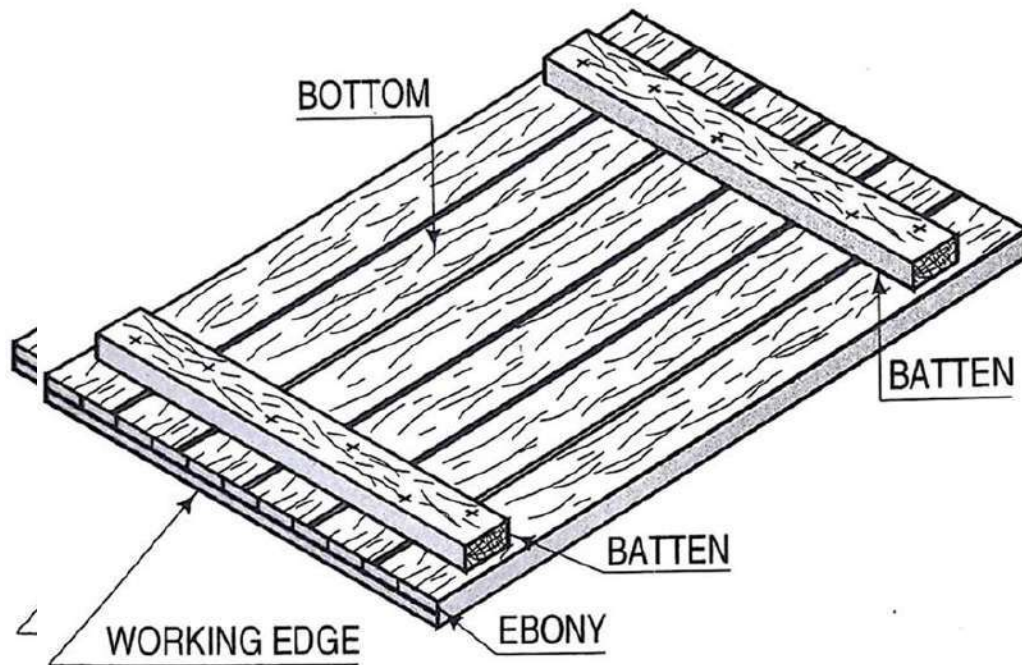
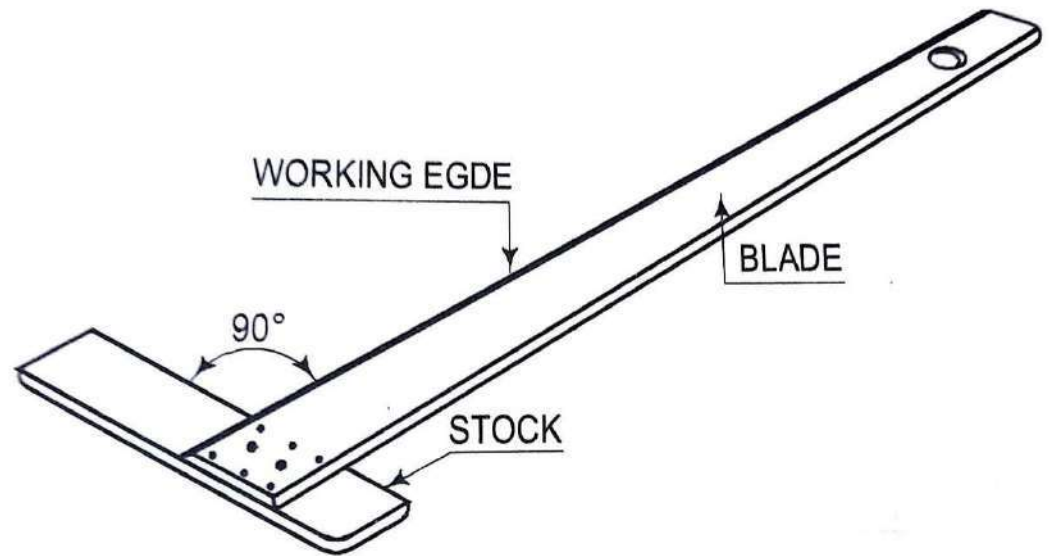


TABLE 1-1
SIZES OF DRAWING BOARDS

Designation	Size (mm)
B0	1000 × 1500
B1	700 × 1000
B2	500 × 700
B3	350 × 500

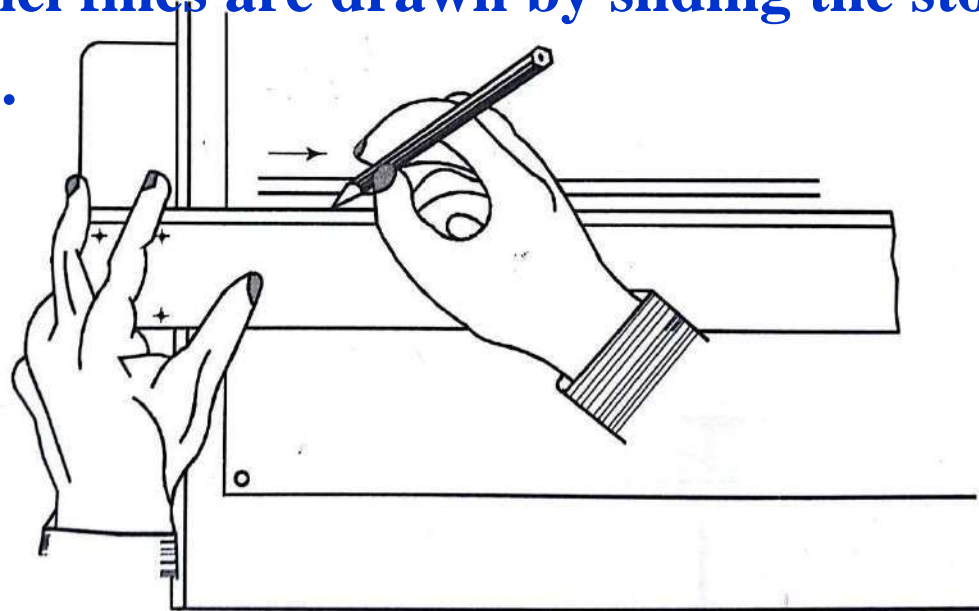
Drawing Instruments and their Usage: T-square



A T-square is made up of hard-quality wood, celluloid or hard plastic. It consists of two parts - the stock and the blade - joined together at right angles to each other by means of screws and pins. The stock is placed adjoining the working edge of the board and is made to slide on it as and when required. The blade lies on the surface of the board. Its distant edge is used as the working edge and hence, it should be perfectly straight. The nearer edge of the blade is never used.

Drawing Instruments and their Usage: T-square

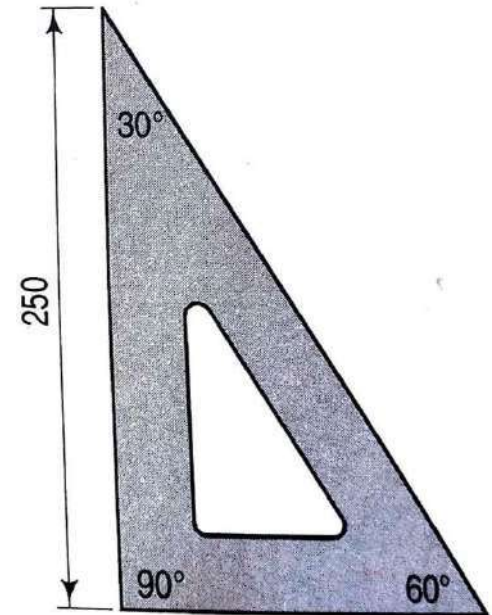
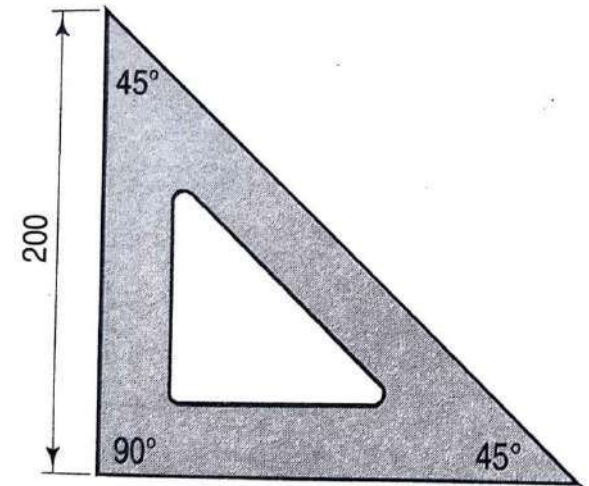
T-square is used for drawing horizontal lines. The stock of the T-square is held firmly with the left hand against the working edge of the board and the line is drawn from left to right. Horizontal parallel lines are drawn by sliding the stock to the desired positions.



Ref video: <https://www.youtube.com/watch?v=nA-mCsVLXy8>

Drawing Instruments and their Usage: Set-squares

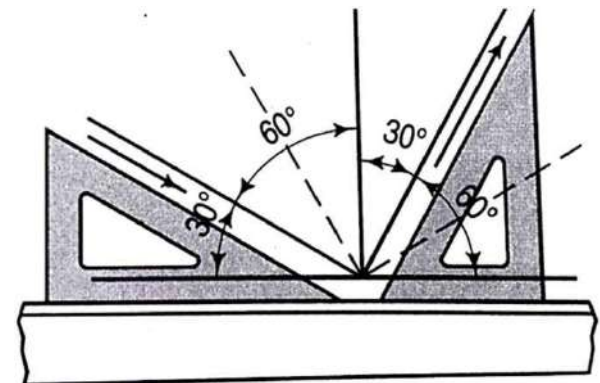
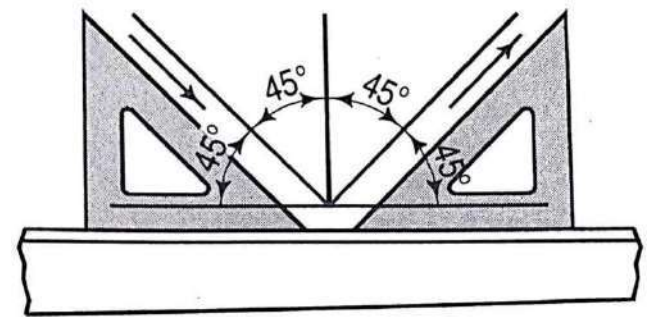
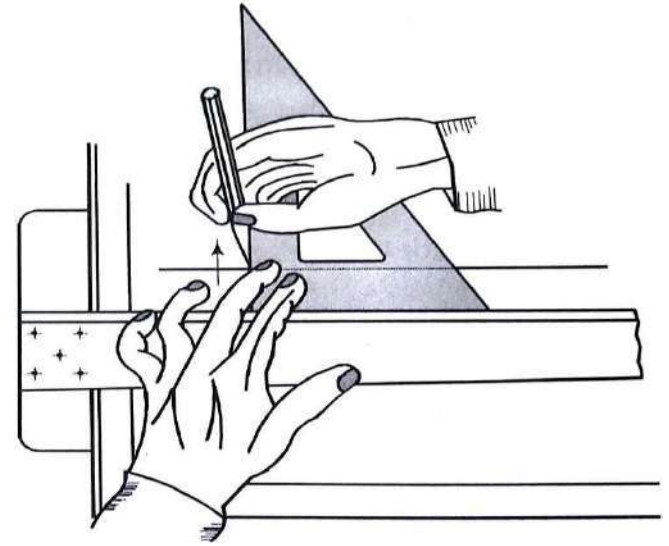
Two forms of triangular shaped set-squares with one of the angle as right angle are in general use. The 30° - 60° set-square of 250 mm length and 45° set-square of 200 mm length are convenient sizes for use in schools and colleges.



Drawing Instruments and their Usage: Set-squares

Set-squares are used for drawing all straight lines except the horizontal lines which are usually drawn with T-square. Vertical lines can be drawn with the T-square and the Set-square.

In combination with T-square, lines at 30° or 60° angle with vertical or horizontal lines can be drawn with 30° - 60° Set-square and 45° angle with 45° Set-square.



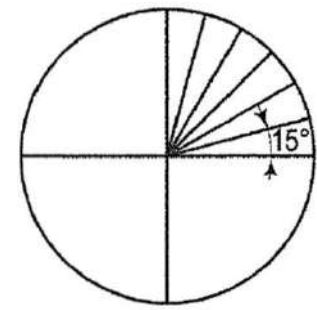
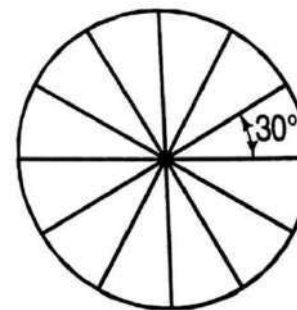
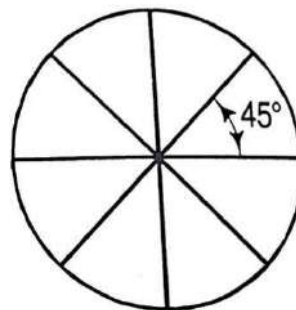
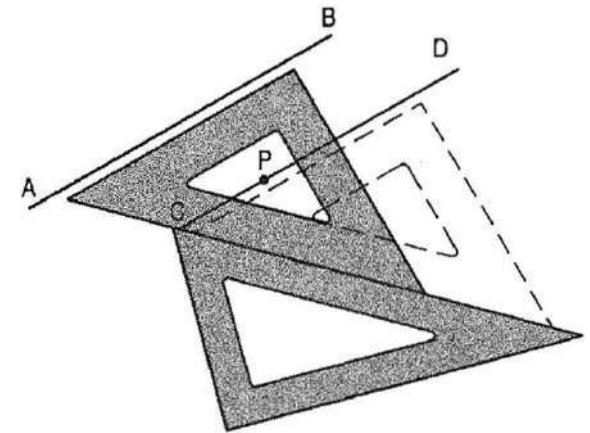
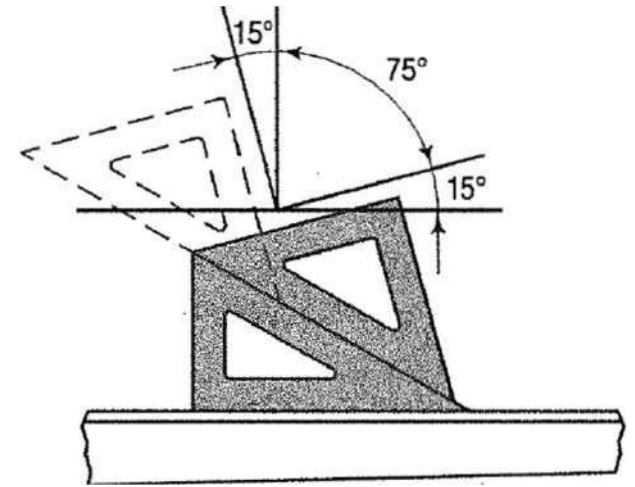
Drawing Instruments and their Usage:

Set-squares

Two set-squares used simultaneously along with T-square will produce lines making angles of 15° , 75° , 105° etc.

A circle can be divided in six, eight, twelve and twenty four equal parts by using Set-squares and T-square.

A straight line parallel to a given line can be drawn using set-squares.

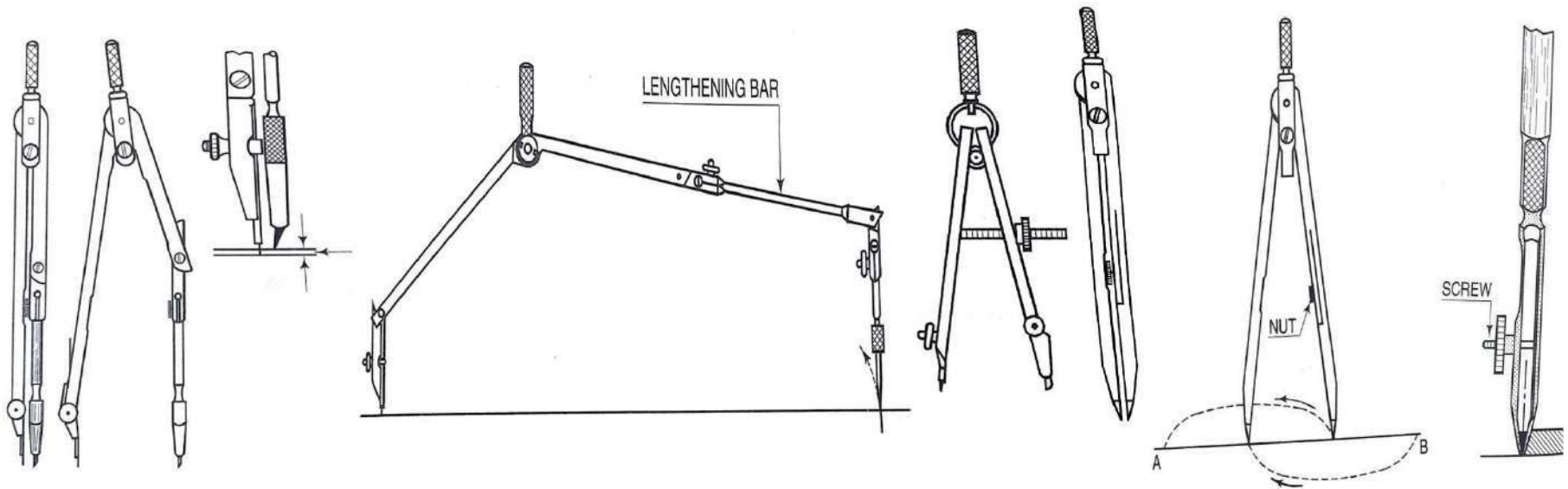


Drawing Instruments and their Usage:

Drawing Instrument Box

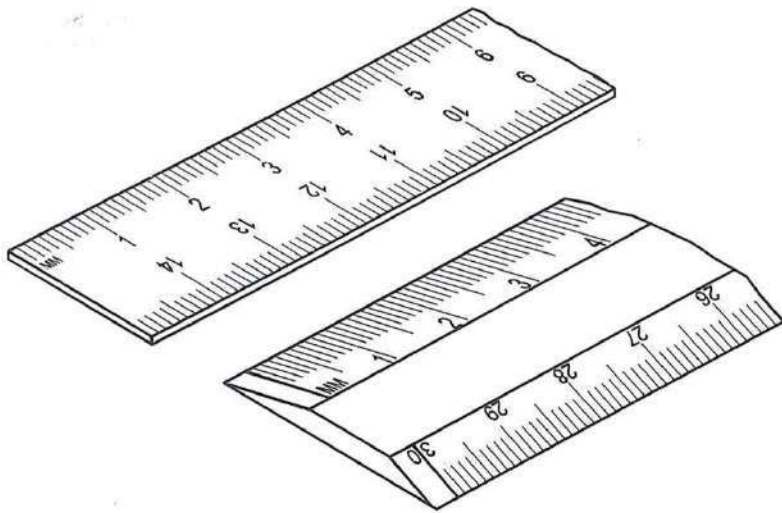
The drawing instrument box contains:

- (1) Large-size compass with interchangeable pencil and pen legs
- (2) Lengthening bar; (3) Small bow compass;
- (4) Large-size divider; (5) Small bow divider;
- (6) Small bow ink-pen; (7) Inking pen.



Drawing Instruments and their Usage: Scale

Scales are made of wood, steel, celluloid or plastic or card board. Stainless-steel scales are more durable. Scales may be flat or of triangular cross-section. 15 cm long 2 cm wide or 30 cm long 3 cm wide flat scales with 1 mm thickness are in common use. Scales are used to measure true or relative dimensions of an object.

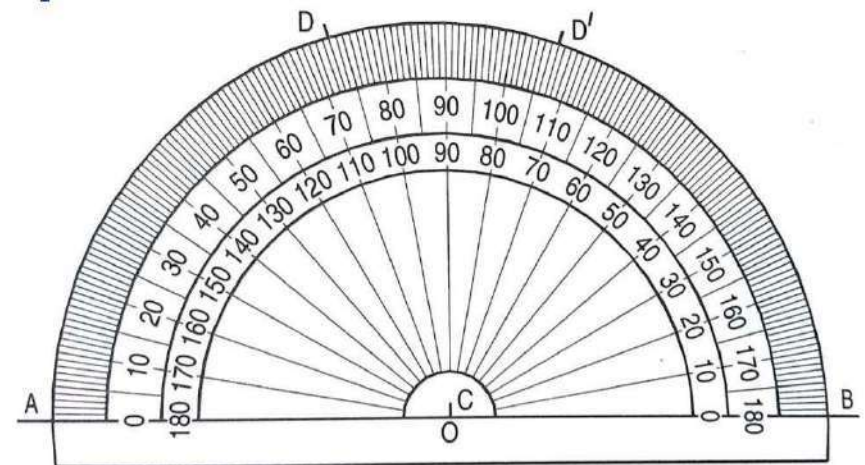
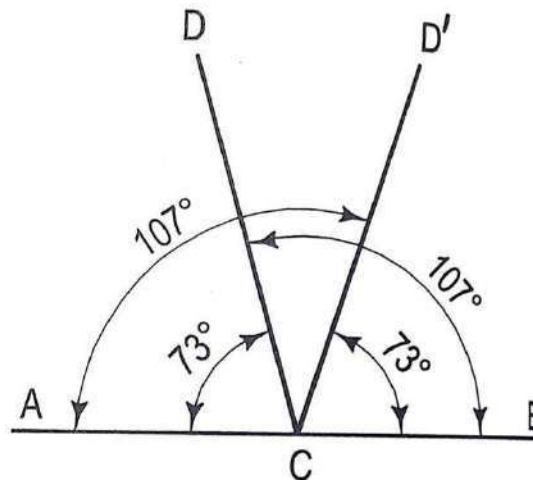


Drawing Instruments and their Usage:

Protractor

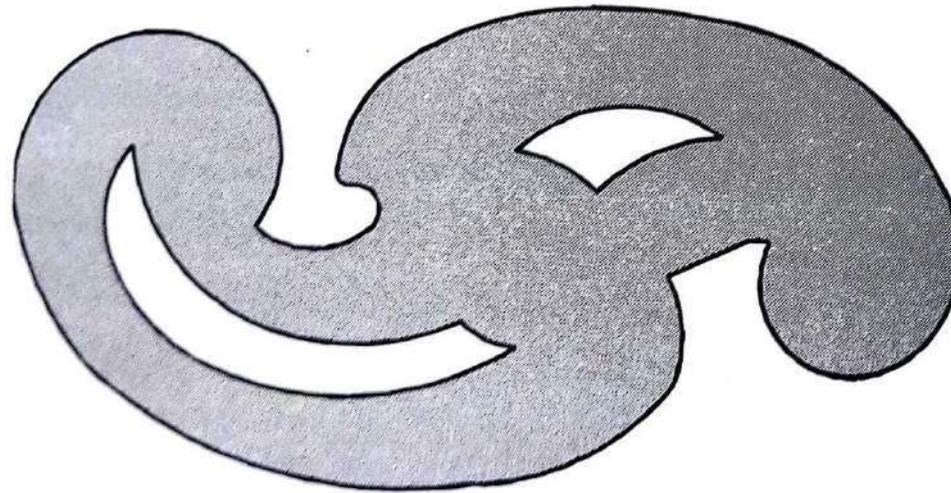
Protractor is made of wood or transparent celluloid. They are flat and circular or semi-circular in shape. A semi-circular protractor of transparent celluloid of 100 mm diameter is most common. Its circumferential edge graduated to 1° divisions, is numbered at every 10° interval and is readable from both the ends.

Diameter of the semi-circle i.e. the straight line (0-180°) is called the base of the protractor and its center O is marked by a line perpendicular to it. The protractor is used to draw or measure such angles that cannot be drawn with set-squares.



Drawing Instruments and their Usage: French Curves

French curves are made of wood, plastic or celluloid. They are made in various shapes. French curves are used for drawing curves which cannot be drawn with a compass.

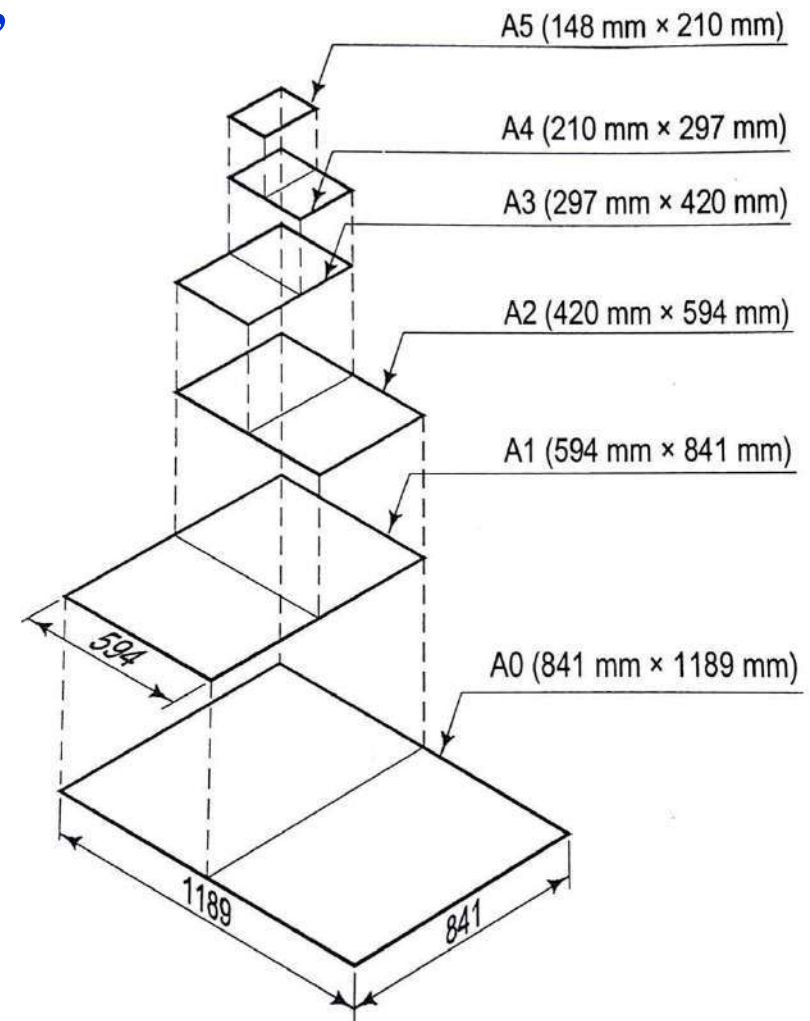


Ref video:

<https://www.youtube.com/watch?v=sALid2hk0lg>

Drawing Instruments and their Usage: Drawing Papers

Drawing papers are available in many varieties. For ordinary pencil-drawings, the paper selected should be tough and strong. It should be uniform in white thickness and as possible. When the rubber eraser is used on it, its fibres should not disintegrate. Good quality of paper with smooth surface should be selected for drawings which are to be inked and preserved for long time. It should be such that the ink does not spread.



recommended by Bureau Standard sizes of drawing papers Indian Standards (BIS) are given.

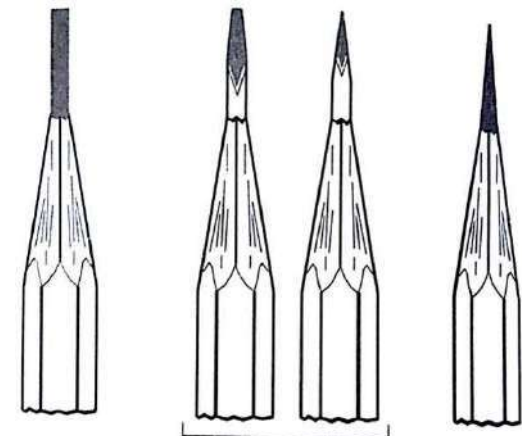
Drawing Instruments and their Usage: Drawing Pencils

The accuracy and appearance of a drawing depend very largely on the quality of pencils used. With cheap and low-quality pencils, it is very difficult to draw lines of uniform shade and thickness.

Grade of a pencil lead is shown by figures and letters marked at one of its ends. Letters HB denote medium grade. Increase in hardness is shown by the value put in front of the letter H, i.e. 2H, 3H, 4H etc. Similarly, the grade becomes softer according to the figure placed in front of the letter B, i.e. 2B, 3B, 4B etc.

Beginning of a drawing should be made with H or 2H pencil so that the lines are faint and unnecessary or extra lines can be easily erased. The final fair work may be done with harder pencils e.g. 3H.

The lead may be sharpened to two different forms i.e. Conical point and Chisel edge.



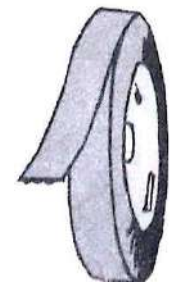
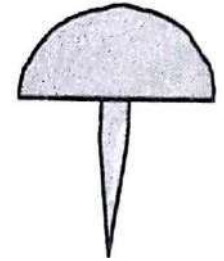
Drawing Instruments and their Usage: Erasers, Drawing Pins, Clips and Adhesive

Tapes

Soft India-rubber is the most suitable kind of eraser for pencil drawings. It should be such as not to spoil the surface of the paper. Frequent use of rubber should be avoided by careful planning.

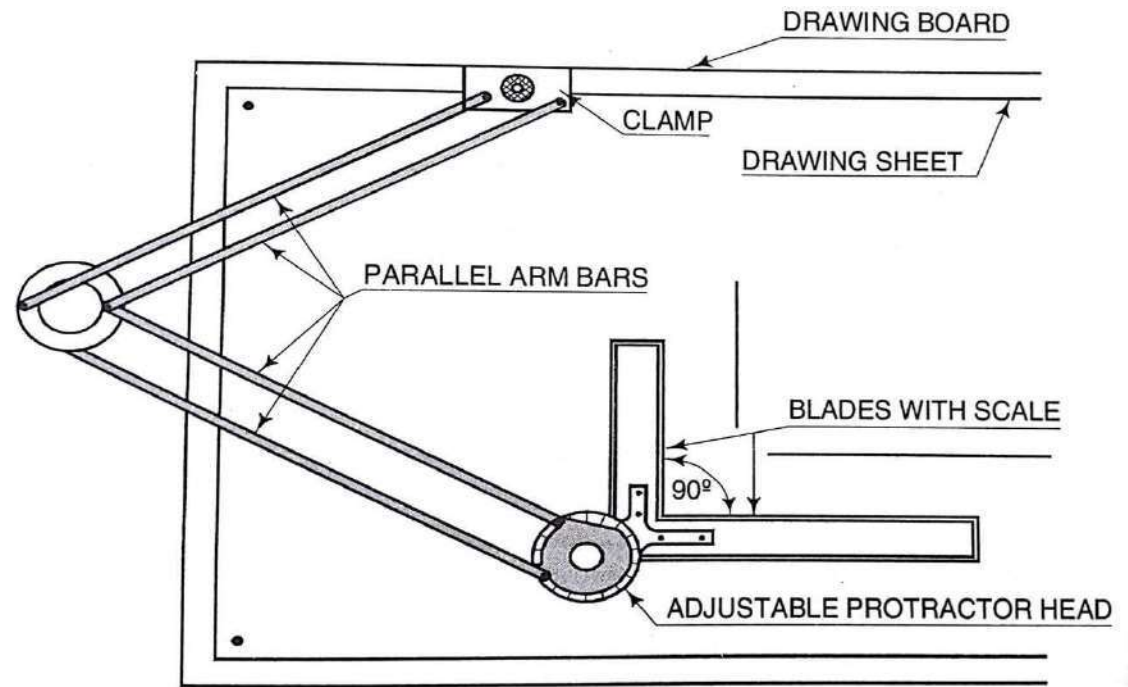
Drawing Pins, Clips and Adhesive Tapes are used to fix the drawing paper on the drawing board. The needle part of the pin is generally made of steel, while the head may be of plated mild steel or brass. Pins of about 15 mm to 20 mm diameter and about 1 mm thick flat heads made of brass are quite convenient, as they do not rust. Pins should be so inserted that the heads sit on the surface of the paper.

Clips or adhesive tapes are often used instead of the pins.



Drawing Instruments and their Usage: Drafting Machine

The uses and advantages of the T-square, set-squares, scales and protractor are combined in drafting machine. Its by one clamped screw, to the distance along is edge of the drawing board. At its other end, an adjustable head having protractor markings fitted. is



<https://www.youtube.com/watch?v=eqqMKPx6koA>

Two blades of transparent celluloid accurately set at right angles to each other are attached to the head. By means of this machine, horizontal, vertical or inclined parallel lines of desired lengths can be drawn easily at less time.

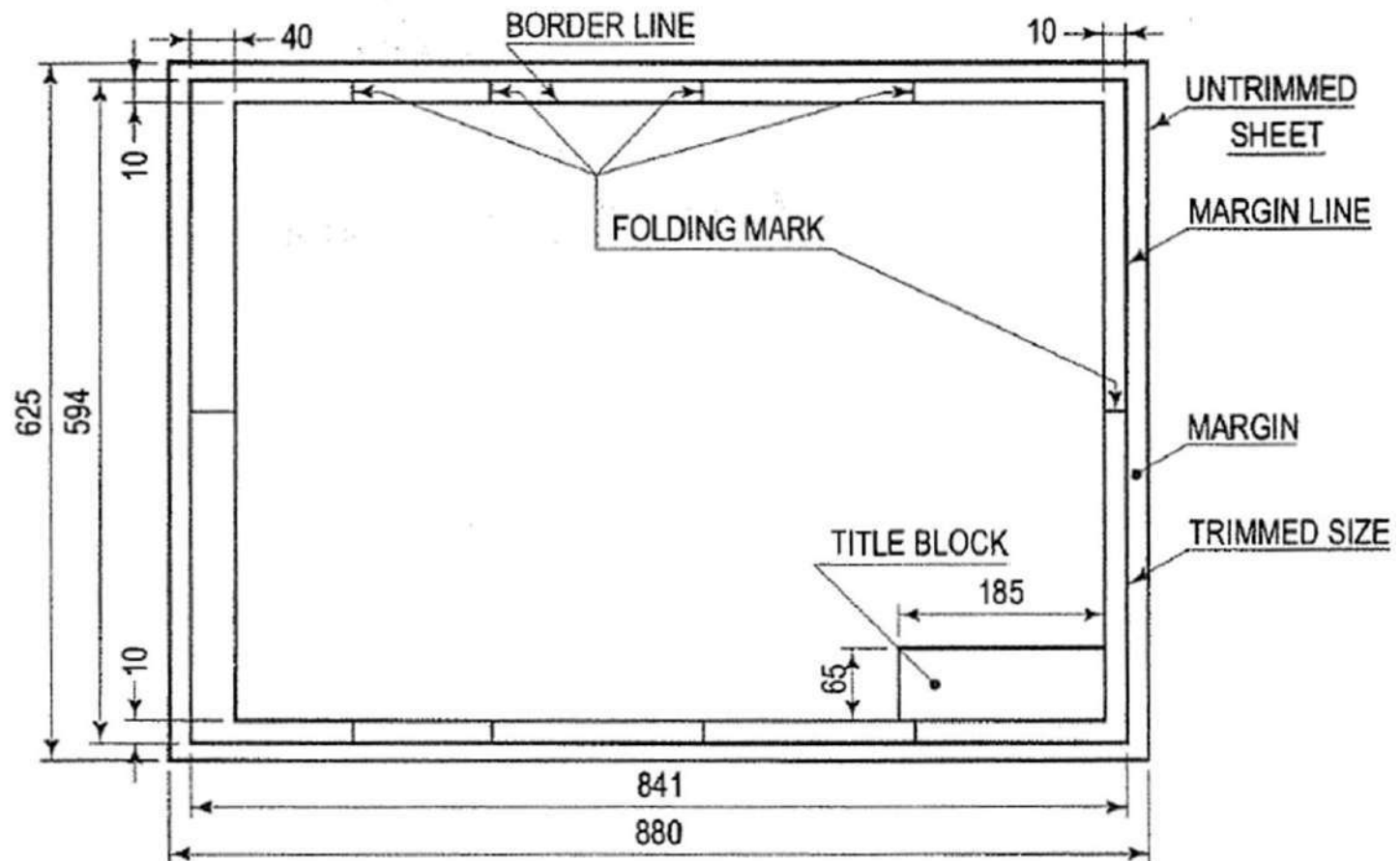
Drawing Sheet Size

Preferred sizes of the drawing sheets recommended by the Bureau of Indian Standards (BIS) are given below as per SP:46 (2003).

Sheet designation	Trimmed size (mm)	Untrimmed size (mm)
A0	841 × 1189	880 × 1230
A1	594 × 841	625 × 880
A2	420 × 594	450 × 625
A3	297 × 420	330 × 450
A4	210 × 297	240 × 330
A5	148 × 210	165 × 240

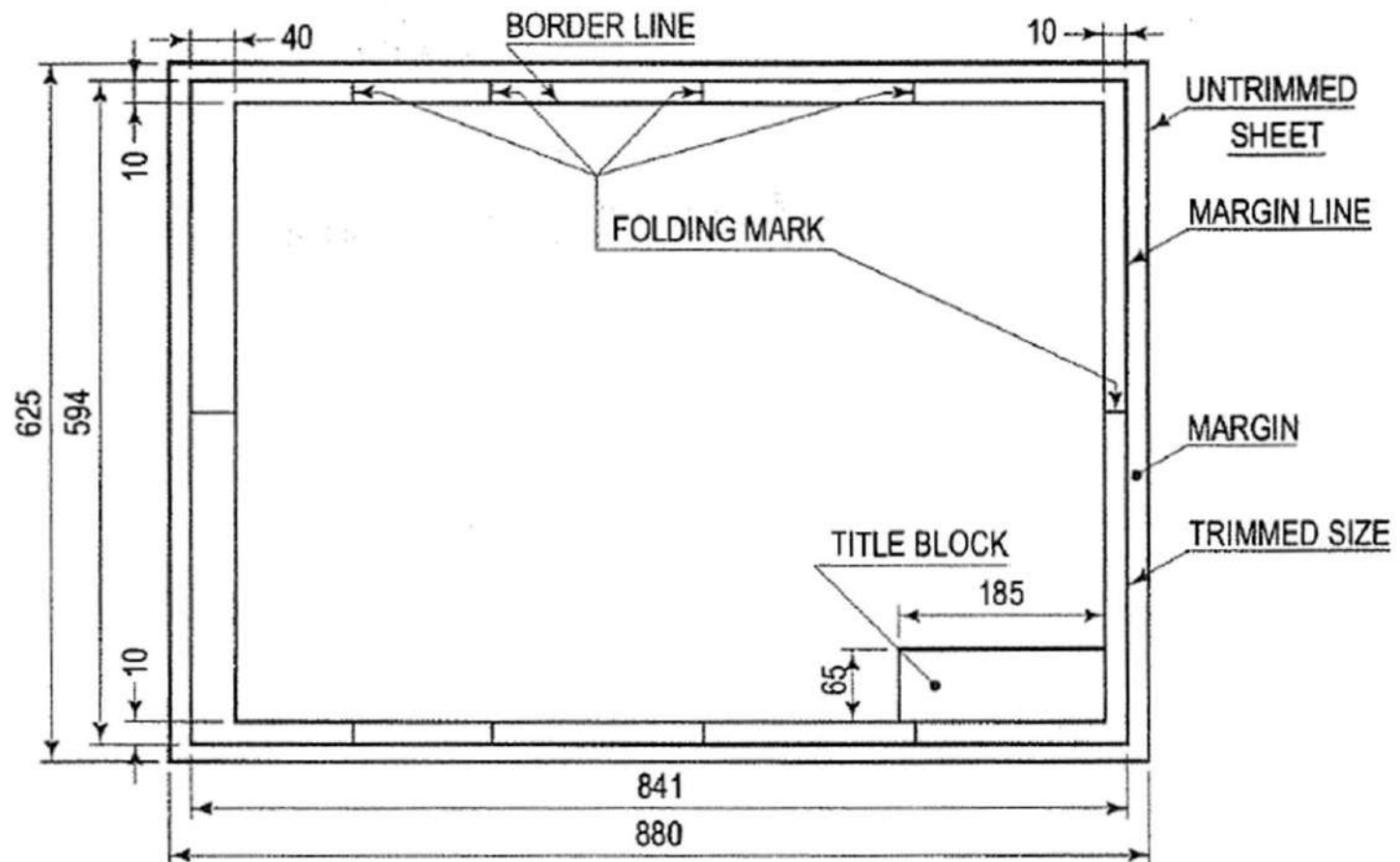
Drawing Sheet Layout

Border lines: Clear working space is obtained by drawing border lines. More space is kept on left for filing or binding if necessary. When sheets are stored in a cabinet without filing, equal space may be provided on all sides.



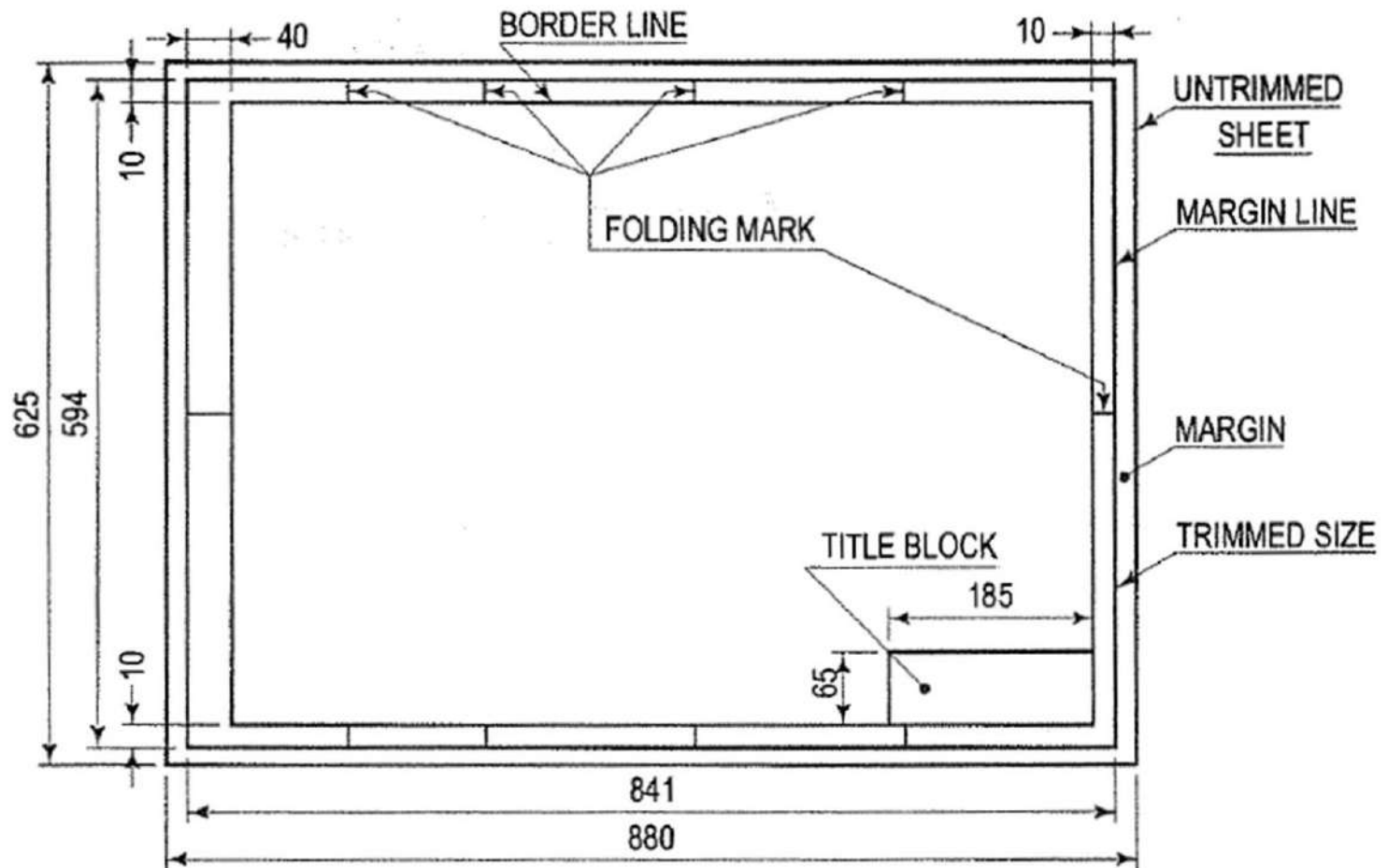
Drawing Sheet Layout

Borders/ Frames: SP: 46 (2003) recommends the borders of 20 mm width for sheet sizes A0 and A1 and 10 mm for the sizes A2, A3, A4 and A5. Frame shows clear space available for drawing purpose.



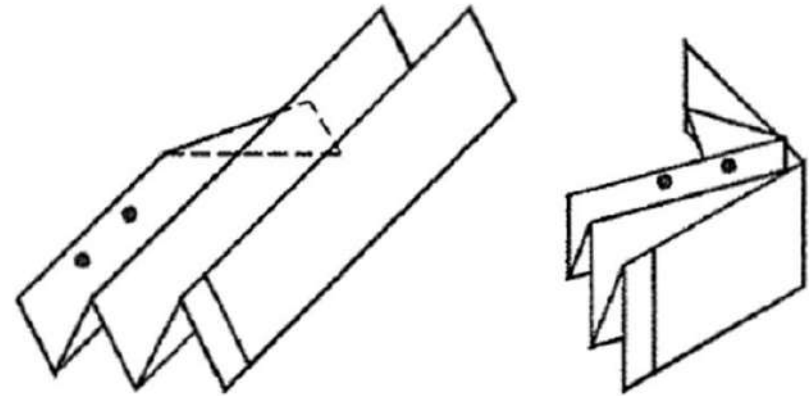
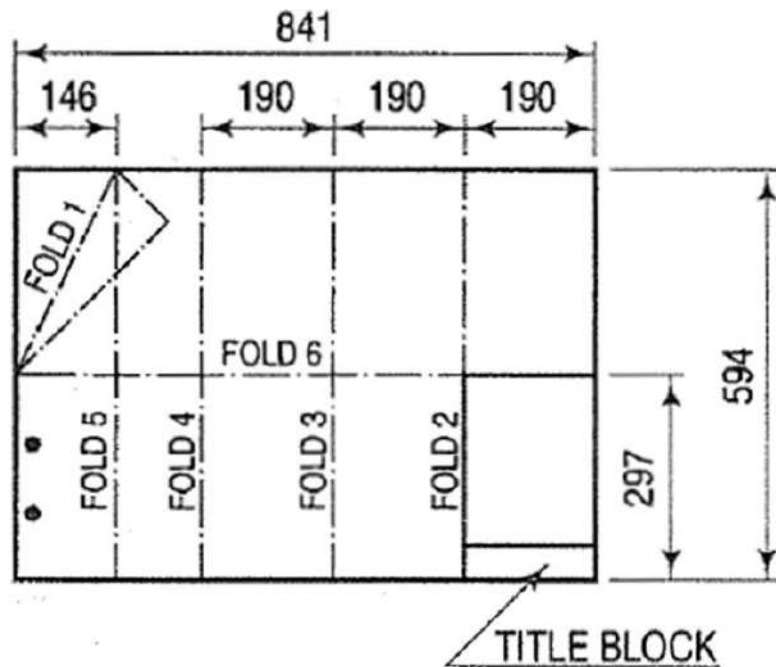
Drawing Sheet Layout

Folding marks: Folding marks are made in the drawing sheet to aid in folding of sheets in proper and easy manner. Two methods of folding of sheets are in general use.



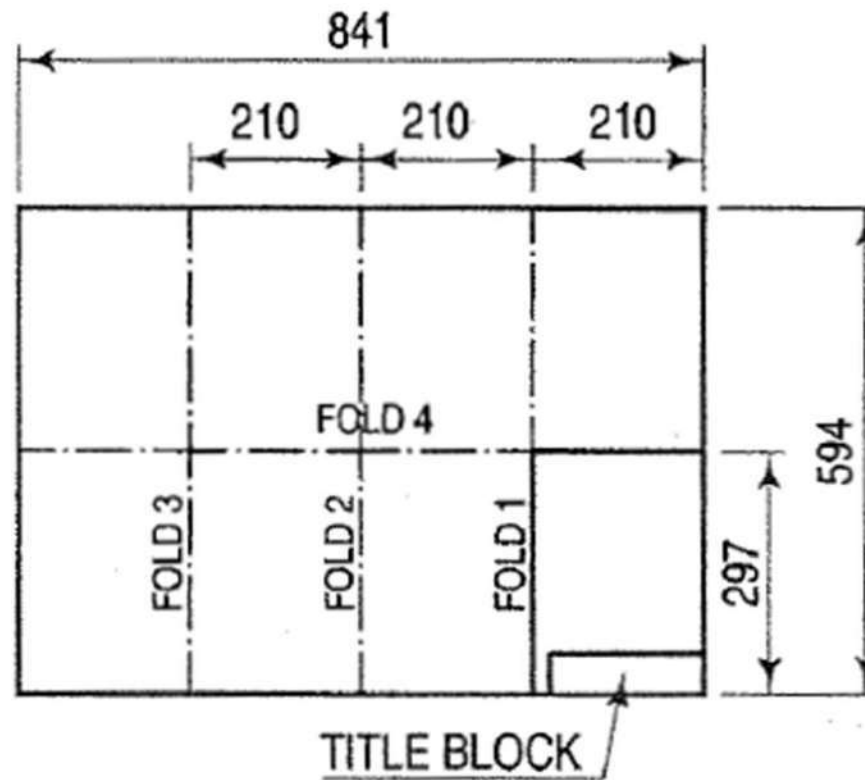
Drawing Sheet Layout

Folding marks: Method I is suitable for sheets which are to be filed or bound. It allows them to be unfolded or refolded without removing them from the files.



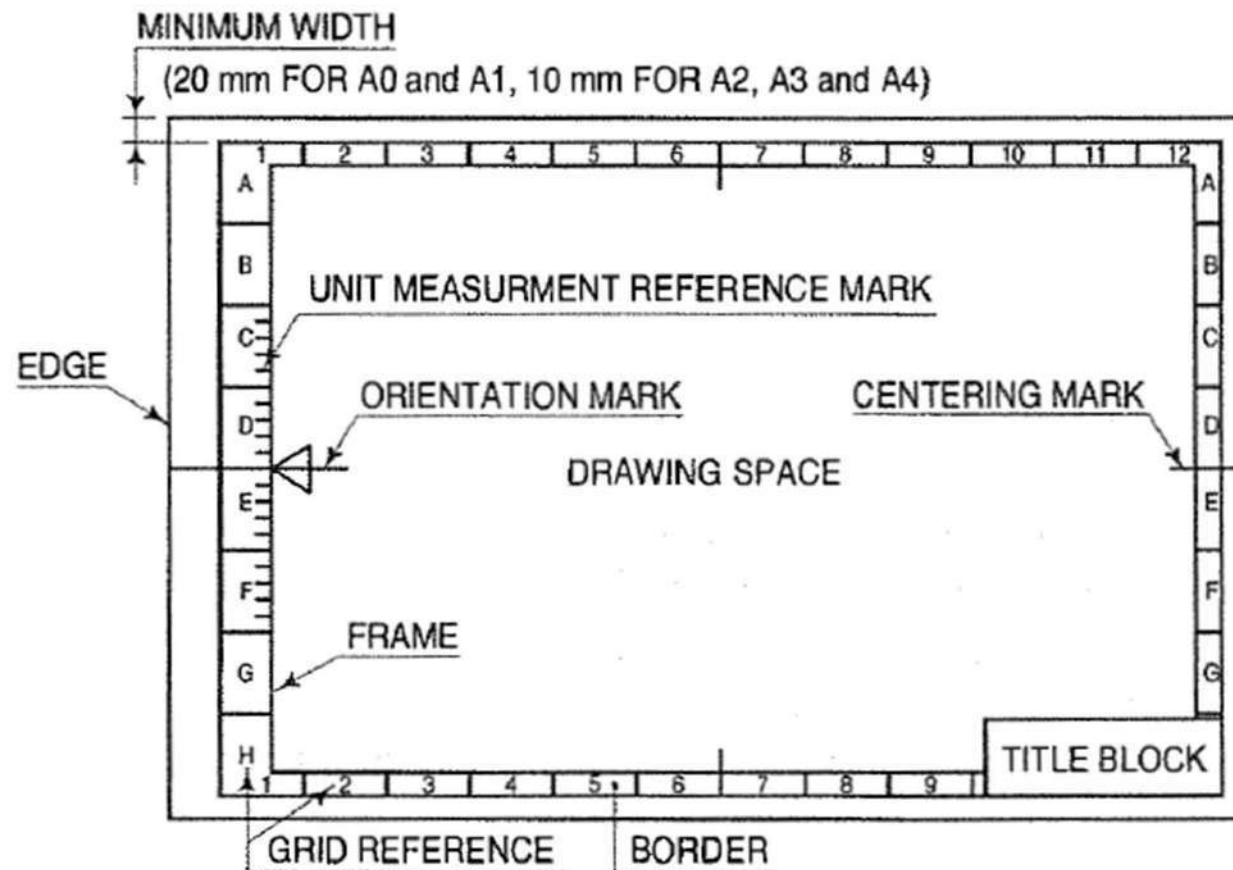
Drawing Sheet Layout

Folding marks: When sheets are to be stored and preserved in cabinets, they are folded by method II.



Drawing Sheet Layout

Orientation mark: Four centring marks are drawn to facilitate positioning of the drawing for the reproduction purpose. The orientation mark will coincide with one of centring marks which can be used for the orientation of drawing sheet on the drawing board.



Drawing Sheet Layout

Grid reference system (zones system): The grid reference system is drawn on the sheet to locate details, alterations or additions. The rectangle of grid along the length should be referred by numbers 1, 2, 3 etc. and along the width by capital letters A, B, C, D etc.

