21285



Pre Vocational Series

TECHNICAL DRAWING

21285

Pre-Vocational Series.....

TECHNICAL DRAWING

STANDARD IX AND X

DEPARTMENT OF GENERAL EDUCATION

GOVERNMENT OF KERALA

1986

PREPARED
BY
THE STATE INSTITUTE OF EDUCATION
KERALA

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Government of Kerala
1986

PREFACE

Our present system of education does not help to cultivate a proper outlook, attitude and character, nor does it prepare the children for participation in a social life. We cannot progress towards national integration, secularism or socialism with this kind of education. Our education is still book-centred, climaxed by a system of formal examinations promoting an attitude of looking down upon normal work and on those who live by such work namely the workers in our farms and in our factories. The situation has come to such a stage that even the children of workers, after entering into the world of Education, begin to avoid the world of work. In fact, education alienated them from their own people, and the irony in that even their aspiration to get a petty white collar job often remains unfulfilled. Thus millions of people are uprooted from rural areas only to join the multitude of unemployed youth in cities. This is partly due to the defective system of Education through which they have passed.

It is obvious that only a basic transformation of the educational system can remedy this situation. The task is particularly difficult because most of the educated persons are unaware of the malady, and since they have been the beneficiaries of the system as it is, they really feel no urgency to rectify it. On the other hand, the country is in the midst of far-reaching socio-economic and political changes which require the full partnership of a proper system of education. It is realized that education, which is in tune with the needs and aspiration of our people, could be a powerful instrument of social change and national development.

In view of what has been said above, it is our duty as educationists to work out an appropriate system of education and to implement it energetically. A new frame-work of the curriculum for the 10–year school has already been accepted, and we are to put it into practice.

A major strategy for the creation of proper attitude towards work and the problems of real life among student is the introduction of pre-vocationalization in the High School curriculum and vocationalization of Higher Secondary Education. This has the potential of substantially changing in the attitude of the educated towards manual work and the working class. It can be a true and effective source of learning about materials and human relationships involved in productive processes, since it would provide personal experience rather than the views of a teacher in this sensitive field; and it can also lead to the development of necessary and desirable skills to meet the needs of the society in the age of Science and Technology. The implementation of pre-vocationalization is likely to lead to the demolishing of barriers between the school and the community, a development we very much desire. Pre-vocationalization has several other advantages as well.

For instance, it is a foundation for the vocationalization of the next stage of education, which is a combination of education and practical skills corresponding to the aptitudes of the individuals and the needs of the socio-economic development of the region in which he lives.

Commissioner for Educational Development and Research, State Institute of Education.

Trivandrum
Dated 26-4-1986

21285

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GENERAL INFORMATION

Drawing is the language of Technicians. Technicians should be able to communicate their ideas through properly made drawings conforming to standards and conventional symbols. The standards have been prepared with a view to have a uniform practice for general Engineering drawing in the country. For precise communication accepted standards should be used in preparing drawings. In our country standards are formulated by "The Indian Standards Institution". The Indian standard code of practice for general Engineering drawing is "I S. 696—1972". The principles indicated in this standard cover the preparation of general Engineering drawing for various purposes. It is formulated to go in line with recommendations published by "ISO/TC—10" Technical drawings of the international Organisation for standardisation. The study of I. S. Code enables people to read, understand and make drawings according to National and International standards.

Questions to be answered:

1. Name the standard code that we follow in Technical Drawings.
2. Give the number of code containing standards used in Engineering Drawing.
3. Name the International Code of practice for Techinical drawings.
4. What is the object of preparing a standard code?
5. What ability is imparted to pupil through the study of codes?

Answers to Questions:

1. Indian standard code of practice for general engineering drawing
2. I. S. 696—1972
3. ISO TC-10. Technical Drawing of the International Organsation for Standardistaion
4. The standards are prepared to have uniform practice for general engineering drawings.
5. The study of code of practice enables pupil to make drawings according to National and International levels.

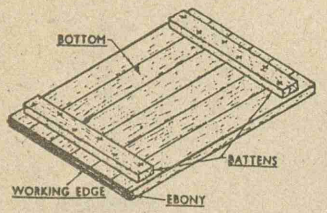
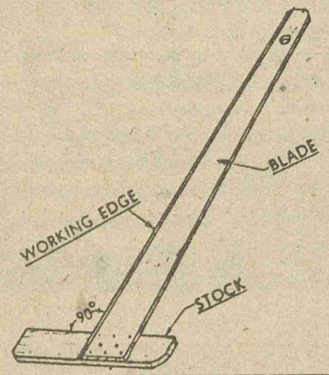
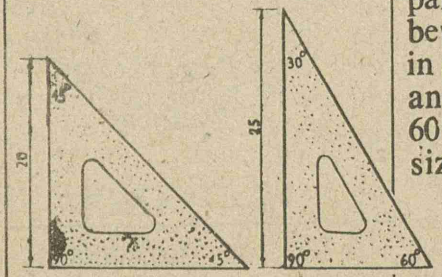
TOOLS FOR DRAWING

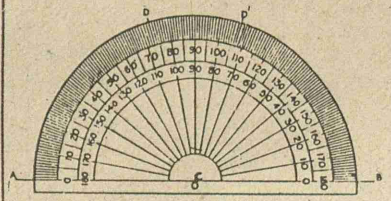
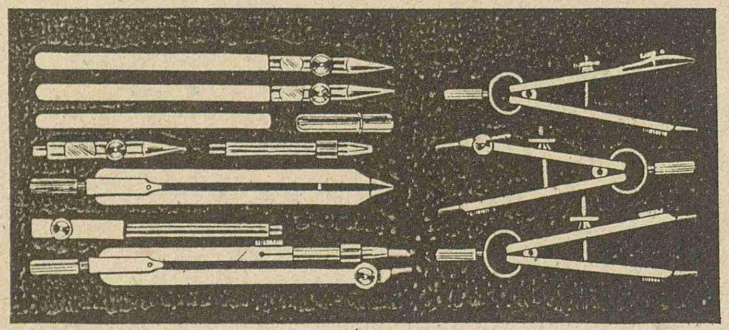
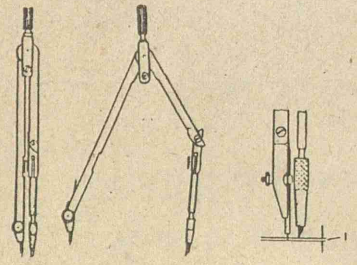
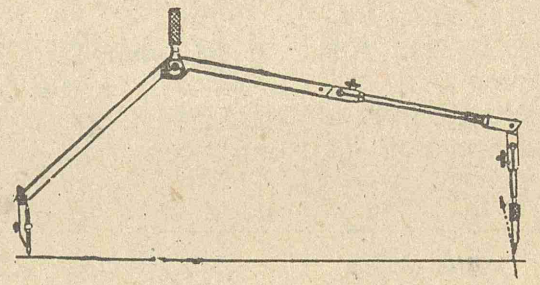
Drawing instruments are used to prepare drawings. For a drawing to be accurate precise and easier to be read, competent use of instruments in their preparation becomes imperative.

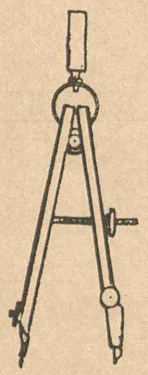
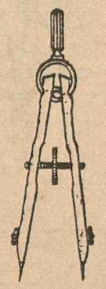
The instruments fall into the following classification in accordance with their uses.

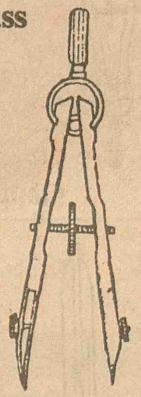
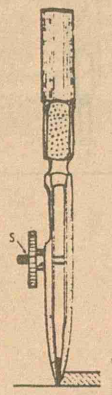
Sl. No.	*Classification*	*Name of Instument*
1.	Basic tools	Drawing board, Drawing paper, pencil, Eraser and Drawing pins
2.	Tools for drawings straight lines	T-square and set-squares
3.	Tools for drawing curved lines	Compass and french curves
4.	Tools for measuring	Dividers, Scales and protractors
5.	Special tool	Drafting Machine

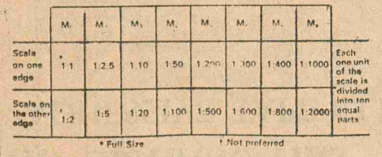
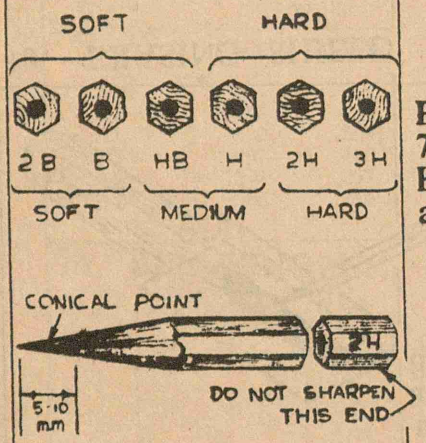
TOOLS FOR DRAWING

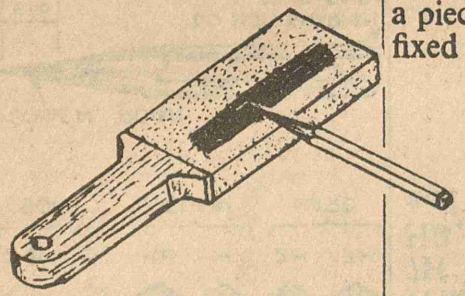
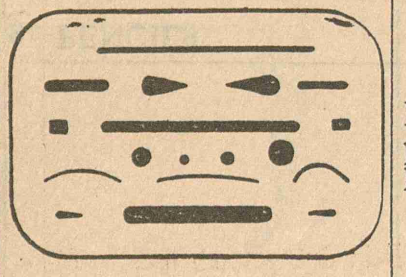
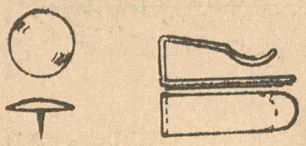
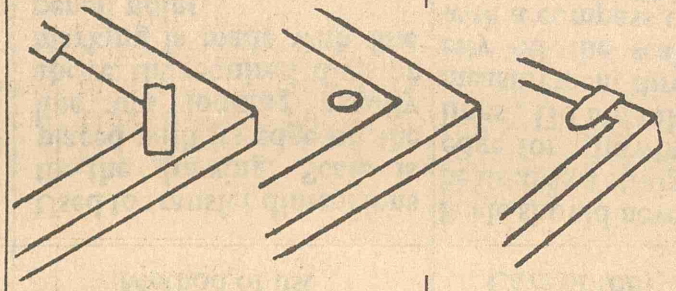
Name of tool	*Brief description*	*Method of use*	*Care of tool*	*Observation*
1. DRAWING BOARD 	Made of narrow strips of some soft wood glued together and mounted on transverse battens. Working edge is straight and made of hard wood. Following sizes are recommended B_0 1000 × 1500 B_1 700 × 1000 B_2 500 × 700 B_3 350 × 500	Placed on a table and paper is fixed on the board.	Top face and working edge should be kept clean and undamaged.	Fir or blue pine is used for making the board and ebony or rose-wood is used for the working edge. Battens are provided to prevent warping of the board.
2. T-SQUARE 	Made of wood or transparent plastic. Consists of head or stock and blade. The top edge of blade is bevelled and used for drawing horizontal lines. Length of blade slightly greater than length of the board.	Head slides over the working edge of the board. Head is pressed against the working edge of the board and the blade rests on the board during drawing. Main use is to draw horizontal lines. It also acts as a base for set squares to draw vertical or inclined lines.	Never use T-square as a hammer to drive pins. Never cut paper along its working edge.	Never draw lines along the lower edge of the T-square. Clean using art gum.
3. SET-SQUARES 	Made of Celluloid or transparent plastic and have bevelled edges Available in pairs. One is 45°–45°–90° and of 200 size, the other is 60°–30°–90° and of 250 size.	Used along with T-square to draw verticals and inclined lines. Combination of the two set-squares may be used to draw parallel lines and to set out any angle which is a multiple of 15°.	Protect the edges from cuts and dents.	Clean using art gum and not with water.

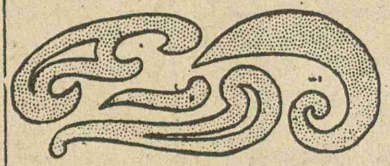
Name of tool	Brief Description	Method of use	Care of tool	Observations
4. PROTRACTOR 	Made of celluloid or transparent plastic. Nearly 100 mm diametre full crircle or semi-circle. Can be read up to 1°.	Placed on the given line with 0—180° line coinciding with the centre Point on the point on the line. Mark the required angle on the periphery with pencil.		—Do—
5. INSTRUMENT SET 		A set of drawing instruments are available in a velvet lined box.		
(i) **Compass** 	Two legs about 150 mm long pivoted at one end. The end of one leg is pointed and the other leg has a split socket end to receive pencil point. Both legs are provided with knee joint to facilitate easy drawing. A lengthening bar attachment is also provided.	The pointed end is used as a pivot around which the pencil point revolves. Circles upto 120 mm ⌀ can be drawn with legs straight. With the attachment of lengthening bar circles upto 400 mm ⌀ can be drawn.		

Name of tool	Brief Description	Method of use	Care of tool	Observation
(ii) Bow Compass 	Similiar to compass but smaller in size. It has a screw and head arrangement for seperating the legs giving fine adjustment. More rigid and will be used when radius is under 25 mm.	As above		
(iii) Deviders 	Similar to compass except that both the legs are provided with needle point.	Used to set off given distance from scale to drawings and to transfer dimensions from one part of the drawing to another part.		Do not press the points hard into the paper to avoid pin holes.
(iv) Bow Deviders 	Similar to bow compass but both the legs are provoded with needle point.	Used to take small measurements accurately.		

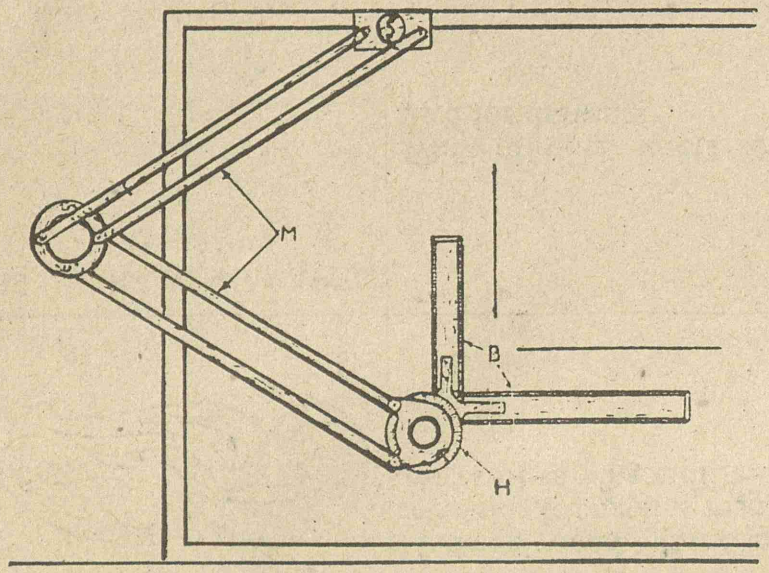
Name of tool	Brief Description	Method of use	Care of tool	Observations
(v) Bow Pen or Ink bow Compass 	Similar to bow compass with one leg fitted with a pair of steel nibs to receive ink instead of pencil point.	Used to draw circles of radii less than 25 mm using ink.		
(vi) Inking Pen 	It consists of a pair of steel nibs fitted to a holder of metal or ivory.	Ink is filled in between nibs by means of quill to about 6 mm length. The gap between nibs is adjusted using screws to the desired thickness of the line. Pen should be kept sloping at about 60° with the paper in the direction of drawing.	The inside of the nibs should be frequently cleaned for the ink to flow freely. Ink should never be allowed to dry within the pen. Pen should never be dipped in ink.	As the ink dries rapidly the pen should be used immediately after it is filled. The end of the nibs should be slightly away from the edge of the T-square or set-square.
6 . ERASER	Good quality medium hard India rubber is used to erase unwanted lines.	Lines to be erased should be rubbed repeatedly with light pressure	Frequent use of rubber should be avoided by careful planning.	Rubber crumblings must be blown away with the help of a clean cloth and never with hand.

Name of tool	Brief Description	Method of use	Care of tool	Observation
7 SCALES  	It is a measuring device made of card board or plastic, eight in numbers with Nos. M_1 to M_8.	Used to transfer dimensions to the drawing. Scale is placed with its edge on the line and looking exactly above, the required division marking is made with fine pencil point.	Scale should never be used as a straight edge for drawing lines . Do not take measurement directly off the scale with a compass or deviders. This will mark the subdivisions on the scale.	
8. PENCILS  	Pencils of grade 9H, 8H, 7H, 6H, 5H, 4H, 3H, 2H, H, HB, B, 2B, 3B, 4B, 5B, 6B and 7B are available.	Hard pencils such as 3H, 2H and H are used for technical drawings. But for lettering and sketching soft pencils such as HB and B are used.	Do not use pencils with blunt lead tips. Do not use pencil stubs shorter than 75 mm. Use a pencil holder in such cases.	Always have a sharpend of the lead.

Name of tool	*Brief description*	*Method of use*	*Care of tool*	*Observation*
9. SAND PAPER BLOCK 	It is a wooden block 150 mm × 50 mm × 12 mm with a piece of 'zero' sand paper fixed on it.	Sharpen the pencil point frequently on it.	Should be kept outside the board but within easy reach for frequent use.	Sand paper should be replaced by another when it becomes dirty or worn out.
10. ERASING SHIELD 	Made of thin metal sheet or plastic. It has a number of holes of different shape.	Used to protect adjacent lines when some part of a line being erased.		
11. DRAWING PINS ADHESSIVE TAPE CLIPS 	Small steel pins with one or three legs are available. Adhessive tapes known as cello tape available in rolls Steel spring clips available.			Pin marks makes holes on the board and thus damages the working surface of the board Clips are useful only when sheets are of the same size as the board When sheet is small all corners cannot be fixed.

Name of tool	*Brief description*	*Method of use*	*Care of tool*	*Observation*
12. FRENCH CURVES 	Made of wood plastic or celluloid. It contains many curves of varying radii.	Used to draw curves other than circular curves. Edge of french curve is lined up by trial and error so that it passes through at least three points on the required curve.		See that the curve drawn is smooth without overlapping patches or sudden change in direction.
13. DRAWING PAPER SHEET DESIGNATION / TRIMMED (Width, Length) / UNTRIMMED (Width, Length) A0: 841, 1 189, 880, 1 230 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	White drawing sheets are used for drawing	Paper is fixed on the board with the help of pins, clips, or cello -tape.	Neatly fold the finished sheet and place its in an envelope.	Do not roll the the sheets.
14. DRAWING INK	Black drawing ink known as Indian Ink or Chinese ink is available. It is a colloidal solution of fine particles of carbon and gum.	Filled in between nibs of inking pen for drawing.	The bottle of Ink should be carefully covered to prevent drying of the ink.	

Name of tool	Brief Description	Method of use	Care of tool	Observation
SPECIAL TOOL 15. DRAFTING MACHINE	It is a devise that can be mounted on the drawing board and combines the functions of the T-square, set squares, scale and protractor.	One end is clamped by means of a screw to the distant longer edge of the board. By means of this machine horizontal, vertical, inclined and parallellel lines can be drawn.	When not in use it should be folded and kept in a leather Case.	Many commercial varieties are being used in Industry A mini-drafter is a convenient form of drafting machine for students.



EXERCISES

1. Match the drawing instruments with their application in the blocks provided against them.

A. Scale	(1) To protect lines from erasing	☐
B. Compass	(2) To draw vertical lines	☐
C. Set Squares	(3) To draw circles	☐
D. T-squares	(4) to measure Angles	☐
E. Protractor	(5) To measure distance	☐
F. French curve	(6) To draw irregular curves	☐
G. Erasing shield	(7) To erase un wanted lines	☐
H. Eraser	(8) To draw Horizontal lines	☐

2. Fill up the blanks with appropriate words selected from the list given below:

(a) The edge of the board on which T-square is made to slide is called its—.

(b) To prevent warping of the board —are cleated at its back.

(c) The two parts of the T-square are —and—

(d) Angles in multiples of 15° are constructed by the combined use of — and —.

(e) For drawing large-size circles — is attached to the compass.

(f) Circles of small radii are drawn using —.

(g) The scale should never be used as a —for drawing straight lines.

(h) For setting off short equal distances —is used.

(i) —are used for drawing curves which cannot be drawn by a compass.

(j) To remove unnecessary lines —is used.

(k) Uses of the T-square sets squares scales and protractor are combined in the—

List of words for exercise 2

1. T-square
2. Set squares
3. Bow Compass
4. Bow deviders
5. Battens
6. Blade
7. Compass
8. Lengthening bar
9. Stright edge
10. French curves
11. Stock
12. Parallel
13. Eraser
14. Drafting machine
15. Working edge
16. Straight lines

3. Indicate whether the following statements are true or false by placing a tick mark "✓" in the appropriate blocks.

	True	False
A. Scale will be used as ruler for drawing lines	☐	☐
B. The legs of the compass will be set apart in distance equal to the diameter of the circle when drawing a circle.	☐	☐
C. French curves are used to draw circular curves.	☐	☐
D. T-square can be used to drive the drawing pins on the drawing board	☐	☐
E. Same grade pencil should not be used to draw different types of lines in a drawing.	☐	☐
F. Drafting machine does more than what the combination of T-square and set squares does.	☐	☐

Answers

Exercise 1

(1) G (2) C (3) B (4) E
(5) A (6) F (7) H (8) D

Exercise 2

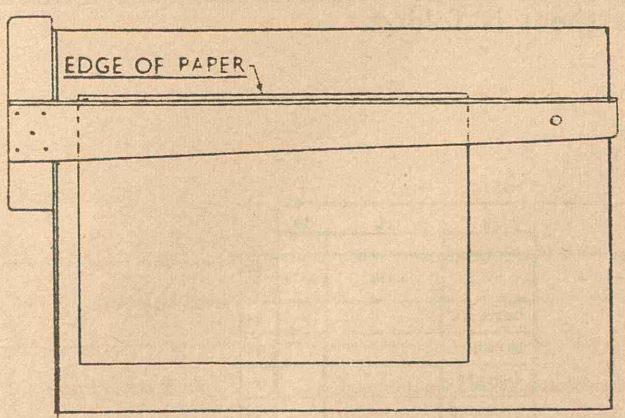
(a) 15 (b) 5 (c) 11,6 (d) 1, 2 (e) 8 (f)3
(g) 9 (h) 4 (i) 10 (j) 13 (k) 14

Exercise 3

A false
B false
C false
D false
E true
F true

DRAWING PROCEDURE

3.1. Clean the drawing board and T-square and place them on the table with the working edge of the board on your left hand side. The stock of the T-square is placed attached to the working edge of the board. Clean all the instruments and place them on a piece of paper by the side of the board.

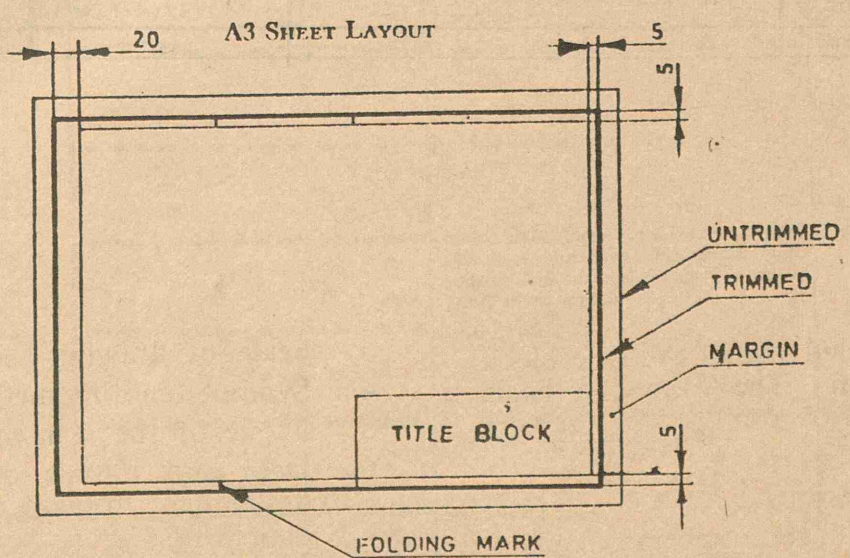


3.2. Fixing paper on the board:

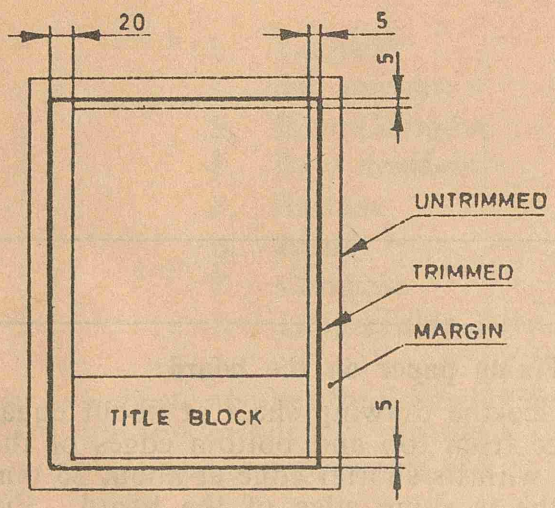
Place the drawing sheet at about equal distance from top and bottom edges of the board, with its shorter edge at about 25 mm from the working edge of the board. Fix the left hand top corner of the sheet using drawing pin or cello-tape.

Place the T-square over the board. Swing the sheet and bring the upper edge of the sheet in line with the working edge of the T-square. Stretch the paper gently with hand and fix the righthand bottom corner. Then fix the other two corners also.

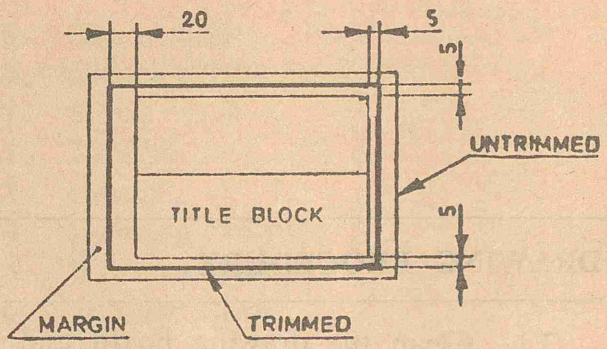
3.3. Bordering : Sheet available is of untrimmed size. Trimmed size is arrived at by drawing border lines. The border line defines the working space of the sheet.



A4 Sheet Layout

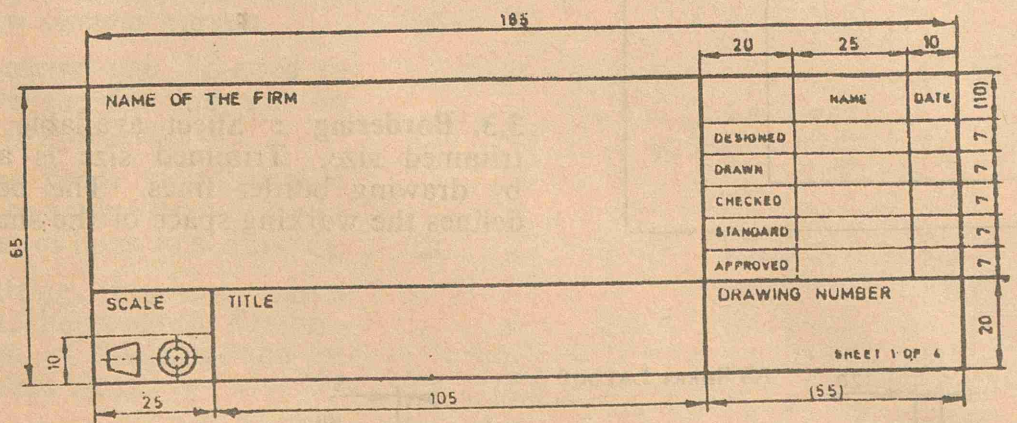


A5 Sheet Layout



3.4. Lay out of Drawing sheet : Layout facilitate a standard arrangement of informations included in the sheet. A margin 20 mm vide is to be drawn on the left hand side. Provide folding marks as shown in the figure for easy folding of the sheet.

3.5. Title block : is an important feature of a drawing and should be placed at the bottom right hand corner where it is readily seen when the sheet is folded.



The recommended size of the title block is 185 mm × 65 mm. The following basic informations should be provided in the title blocks.

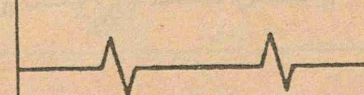
1. Title of the drawing
2. Drawing and sheet numbers
3. Scale of drawing
4. Symbol denoting method of projection
5. Name of the firm and
6. Date and initials of staff members designing, drawing, checking and approving.

3.6. Scales: All drawings should be drawn to scale. The scale of drawing should be indicated in the appropriate place in the title block. Scales recommended for Technical Drawings are given below:

Full scale	Reduced Scale	Enlarged scale
1:1	1:2	10:1
	1:2.5	5:1
	1:5	2:1
	1:10	
	1:20	
	1:50	
	1:100	
	1:200	

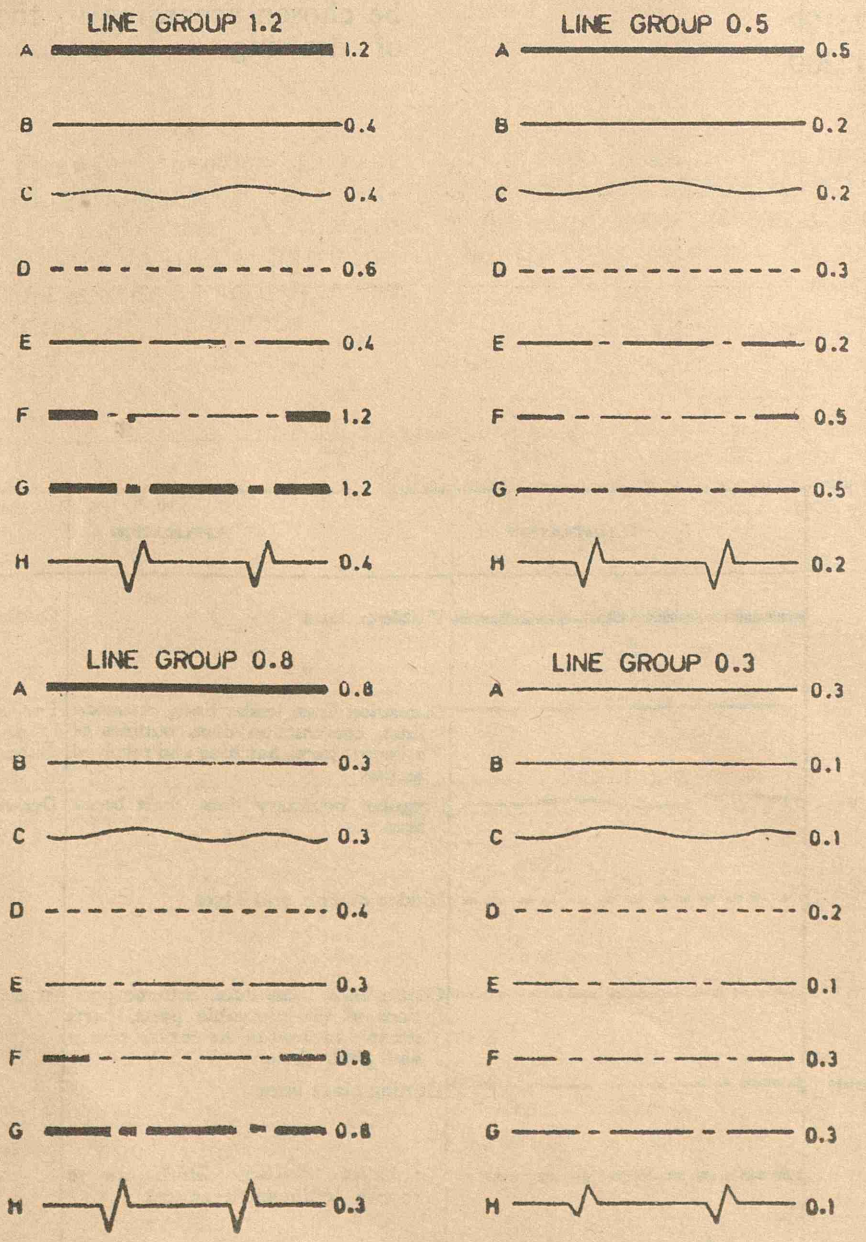
The left hand number always represent the dimensions on the drawing and the right hand number represents the true scale or actual dimension of the object.

3.7. Lines: For general engineering drawings the types of lines recommended by the code should be used. All lines should be sharp and dense. The thickness of lines should be chosen according to the size and type of drawing.

Types of Lines	Illustration	Application	Remarks
A Continuous thick		Visible outlines	Outlines to be bold and dark
B Continuous thin		Dimension lines, leader lines, extension lines, construction lines, outlines of adjacent parts, hatching and revolved section	For hatching, lines should be spaced evenly to give a shaded effect
C Continuous thin—wavy		Irregular boundary lines, short break lines	Drawn free hand
D Short dashes medium		Hidden outlines and edges	
E Long chain thin		Centre lines, locus lines, extreme positions of the moveable parts, parts situated in front of the cutting planes and pitch circles	Alternate long and short dashes
F Long chain thick at ends and thin elsewhere		Cutting plane lines	
G Long chain thick		To indicate surfaces which are to receive additional treatment	
H Ruled line and short zigzag thin		Long break lines	

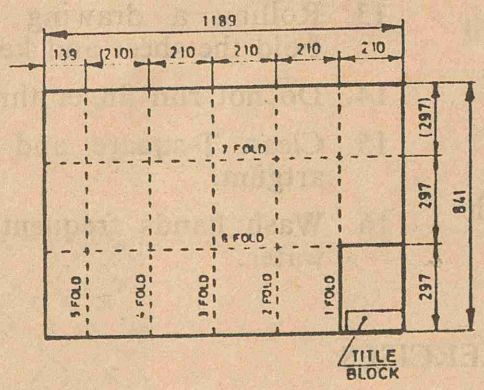
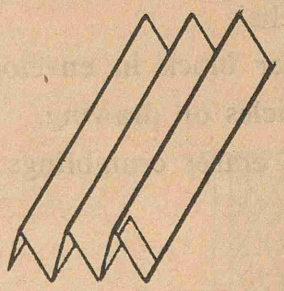
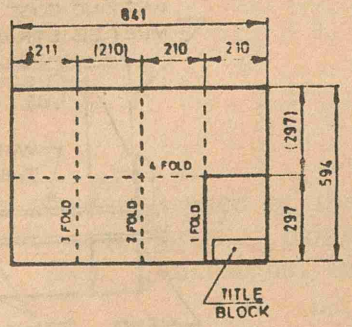
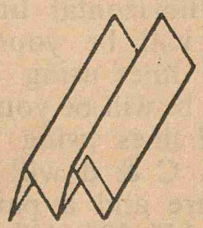
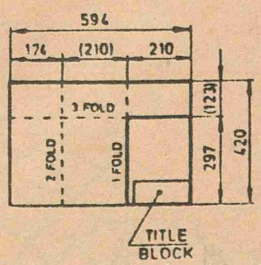
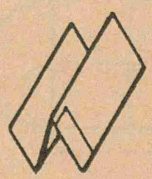
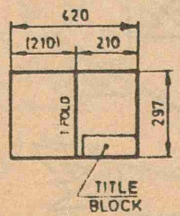
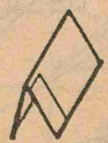
The line group is identified by the thickest line.

COMPARATIVE THICKNESS IN mm OF VARIOUS TYPES OF LINE GROUPS



3.8. Folding of sheets : Sheets are folded to suit filing. This enables us to unfold and refold the sheets without the necessity of removal from the file. With these methods of folding the title block is visible on top of the folded print.

FOLDING OF PRINTS FOR STORING IN FILING CABINET

SHEET DESIGNATION	FOLDING DIAGRAM	LENGTHWISE FOLDING	CROSSWISE FOLDING
A0 841 x 1189			
A1 594 x 841			
A2 420 x 594			
A3 297 x 420			—

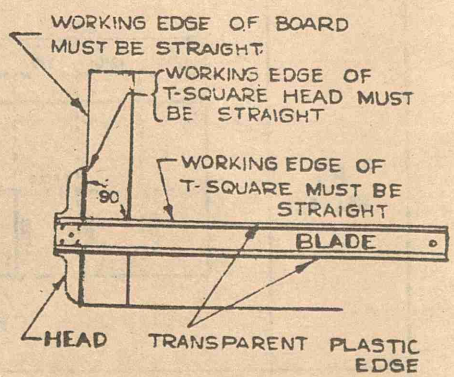
3.9. Neatness : Neatness is a personal habit which should be developed. The following hints will be helpful in making your drawing neat.

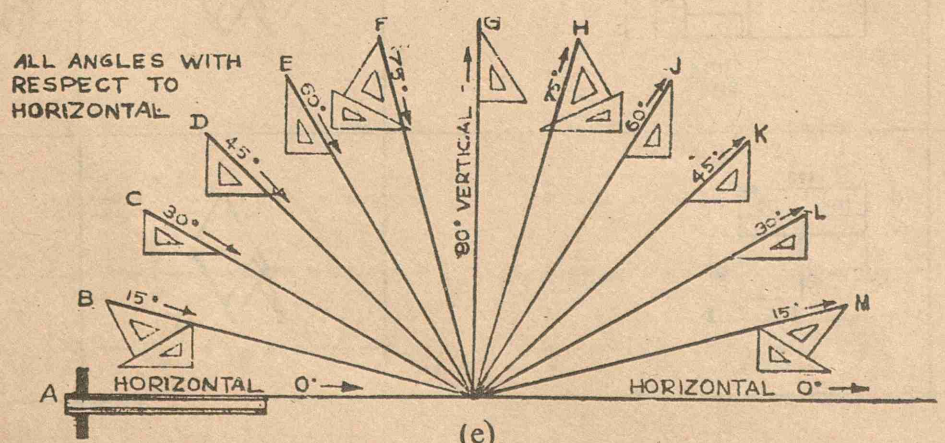
1. To remove T-square tilt blade up.
2. To remove set squares pick up with finger nailes.
3. Never sharpen pencil over drawing board or sheet
4. Remove graphite powder from pencil with clean cloths.
5. Keep sand paper block in envelope.
6. Never place articles on drawing.
7. Do not rub off eraser crumblings with hand
8. Use a dusting brush or flick with clean cloth
9. Avoid perspiring on drawing
10. When discussing, touch drawing only with back of finger nails.
11. When not drawing, cover board with a sheet of paper or cloth.
12. When writing, place paper under hand.
13. Rolling a drawing smears the lines. Fold the sheet and keep in an envelope.
14. Do not run finger through hair.
15. Clean T-square and set squares with artgum.
16. Wash hands frequently with soap and water.

EXERCISES

1. Provided A_3 sheet. Fix the sheet on the board. Draw border lines. Provide title block. Draw a set of horizontal lines using T-squares (Figure a. will be your guide). Draw a set of vertical lines using T-square and set squares. (Fig. b. will be your guide). Draw a set of Inclined lines using T-square and Set-squares (Fig. C & d will be your guide). Using T-square and a pair of set squares set out angles 15°, 30°, 45°, 60°, 90°, 105°, 120°, 135°, 150°, 165°, & 180°. (Fig. e will be your guide)

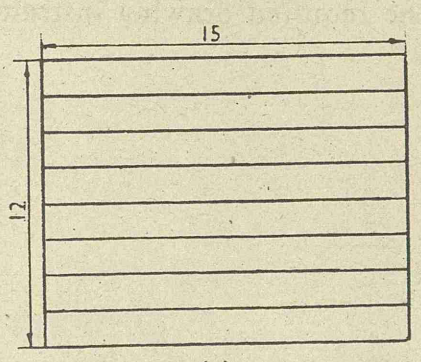
Remove the sheet from the board and fold it neatly.



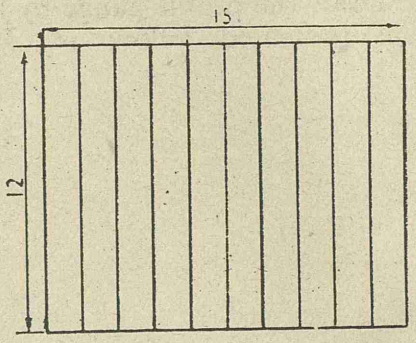


(e)

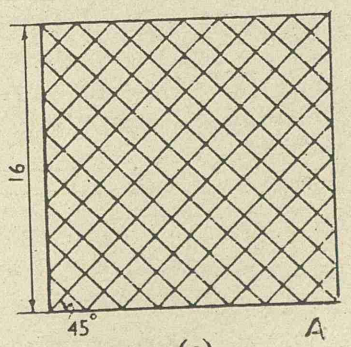
21285



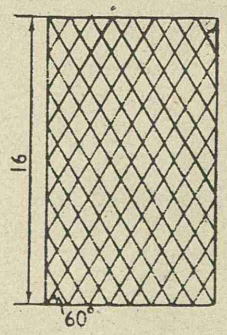
(a)



(b)

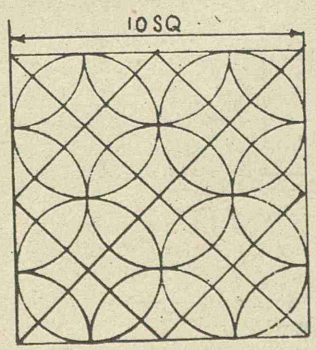


(c)

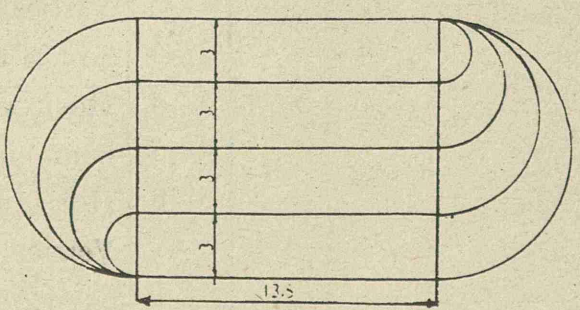


(d)

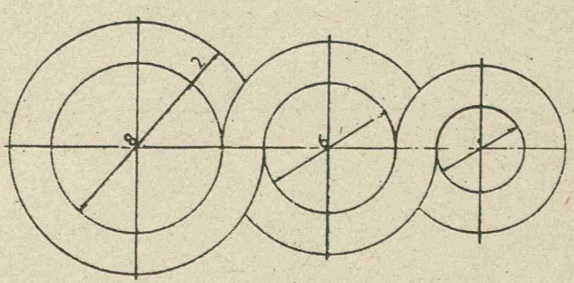
2. Draw in the working space of the given A_3 sheet the following profiles using proper instruments. (All dimensions in Centimetres).



(a)



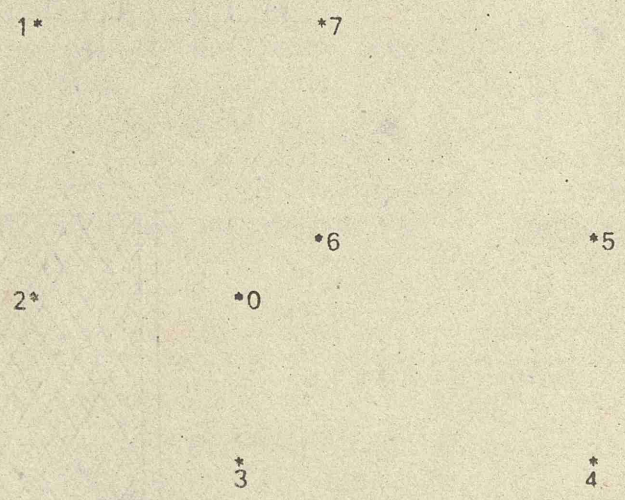
(b)



(c)

GT-174-4.

3. Draw the profile gauge by joining the points as indicated below in Fig. using the required drawing instruments.



Points	Nature of the line
1—2	Vertical straight line
2—3	Arc of a circle with 'O' as centre
3—4	Horizontal straight line
4—5	Semi-circle (external)
5—6	Horizontal straight line
6—7	Vertical straight line
7—1	Semi-circle (internal)

LETTERING

A drawing to be complete, in addition to lines and numbers, some written specifications are essential. Materials to be used, finish of the surface and other necessary informations are given in the form of notes by lettering. The main requirements for lettering on technical drawing are legibility uniformity ease and rapidity in execution.

General notes:

4.1. All letters should be capitals except for internationally accepted abbreviations.

4.2. Letters may be upright or inclined at 75° to the horizontal.

4.3. Lettering should be done on the drawing in such a manner that it may be read when the drawing is viewed from the bottom except when it is used for dimensioning.

4.4. Letters and numerals are designated by their heights.

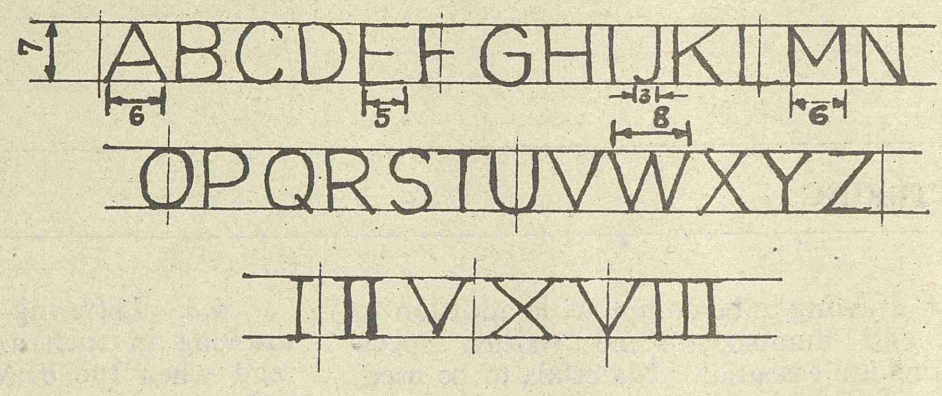
Recommended sizes of letters and numbers to suit different purposes are given in the following tables.

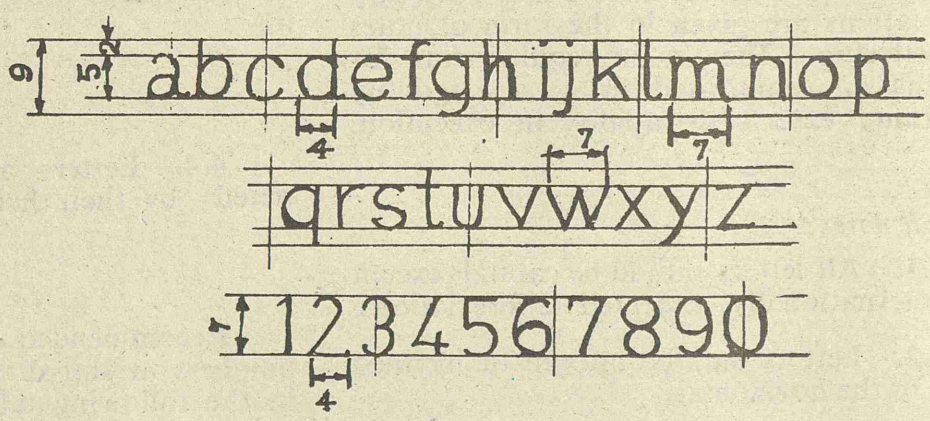
USL	Size of letters and Numerals (Height in mm).
Main title and Drawing No.	6, 8, 10 and 12
Sub title and headings	3, 4, 5 and 6
Notes, such as legends, schedules, materials and dimensions	3, 4, and 5.

Table 1: Recommended size for letters and numerals on drawing.

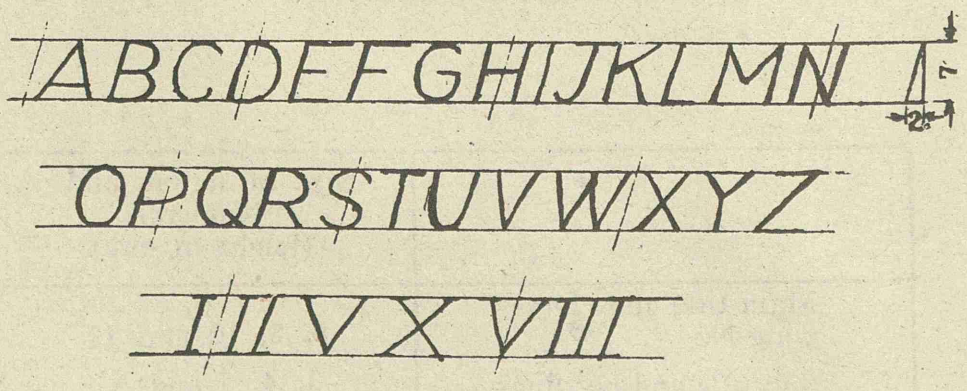
SPECIMENS OF LETTERS & NUMERALS

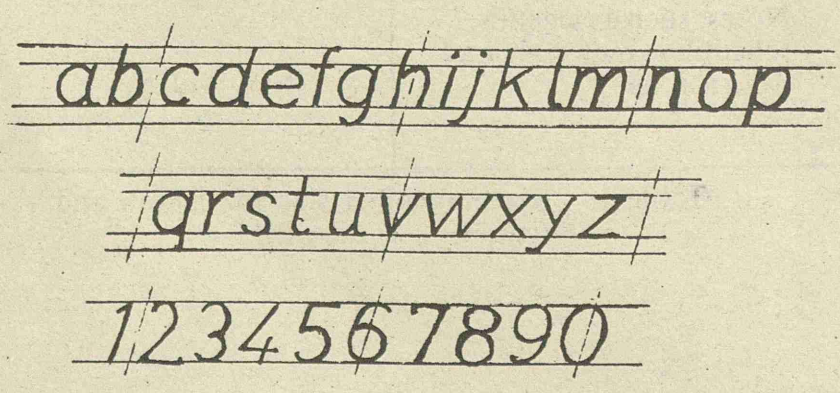
VERTICAL





INCLINED

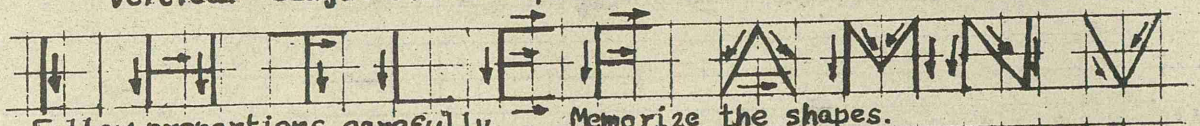




Student Exercise No. 1

PRACTICE IN LETTERING

Vertical single stroke capitals; Draw letters Free hand.

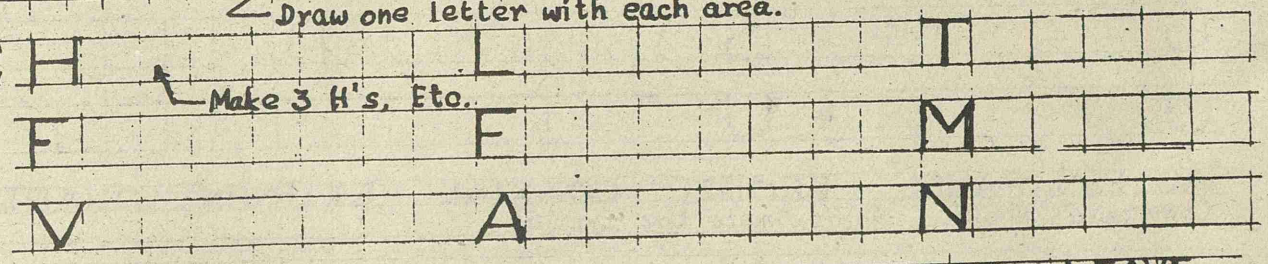


Follow proportions carefully. Memorize the shapes.

10mm

Draw one letter with each area.

5mm



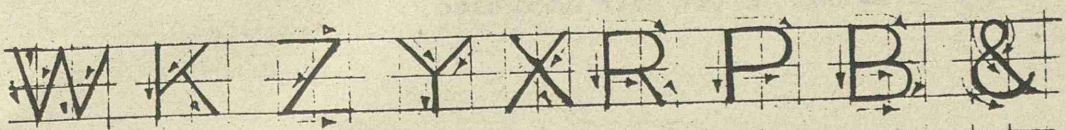
Make 3 H's, Etc.

3mm

HAT LINT FIN VALVE MELT MAN FILE LEAVE

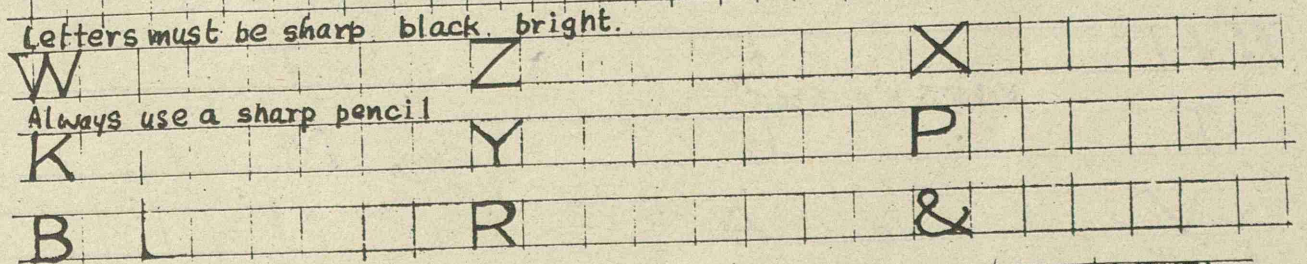
Areas between the letters approximately equal

Copy words shown. Approximate the spacing.



Letters must be sharp black bright.

Always use a sharp pencil

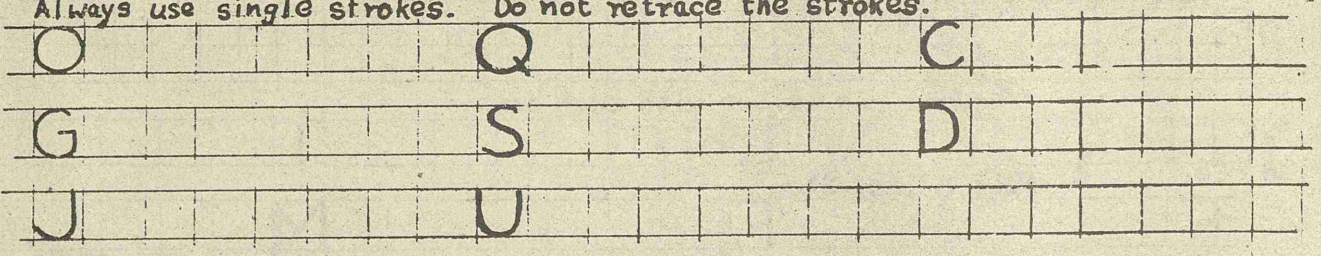


ZERK AXLE LAX WEAR BARK KEY WIN BEVEL

Copy words shown. Approximate the spacing.



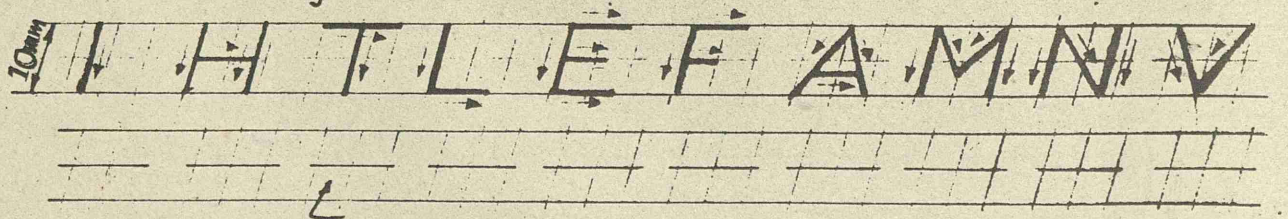
Always use single strokes. Do not retrace the strokes.



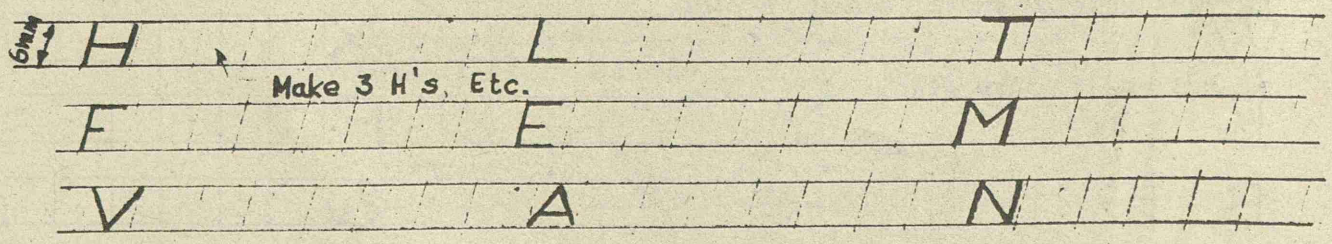
ACCESS PANEL BRONZE COAXIAL EXTRUDE QUARTZ

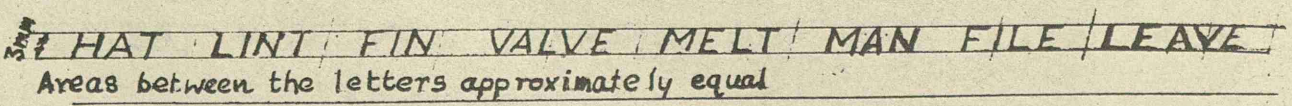
Copy words shown. Approximate the spacing.

Inclined single stroke capitals: Draw letters free hand.



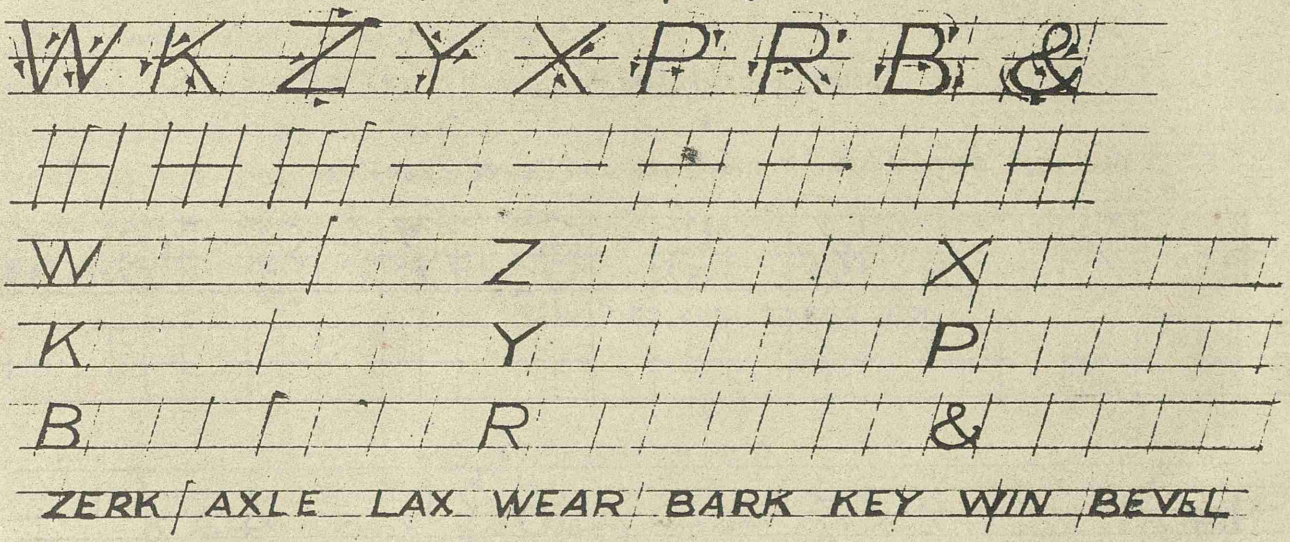
Draw one letter with each area.



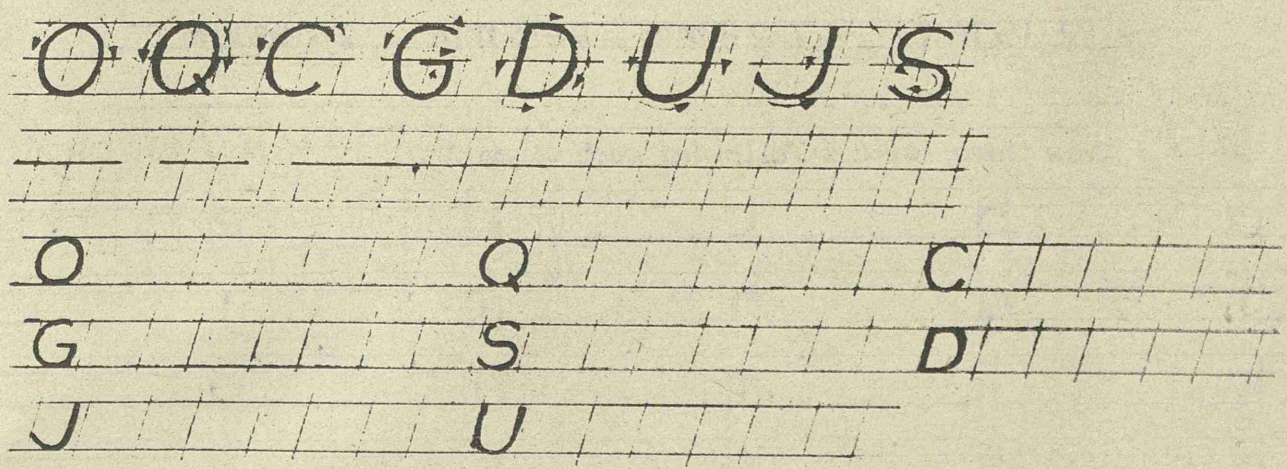


Areas between the letters approximately equal

Copy words shown. Approximate the spacing.



Copy words shown. Approximate the spacing.



Copy words shown. Approximate the spacing.

Student Exercise No. 2

Vertical single stroke numerals and lower case:

1 2 3 4 5 6 7 8 9 0

Note proportions carefully

$14\frac{1}{8}$ $27\frac{3}{4}$ $96\frac{5}{16}$ $45\frac{7}{8}$

12·15mm 47·25mm 98·5mm 26·03mm

Draw three letters following each example

a b c d e

f g h i j

k l m n o

p q r s t

u v w x y

z Sandblast before plating

Copy the above words directly beneath.

Copy the matter given in the space provided.

An ampere is that value of current through a conductor, lying with in and at right angles to a magnetic field of one line per square centimeter, such that each centimeter of length of the conductor will have a force upon it of 0·1 dyne

Student Exercise No.3.

Write drawing titles using inclined letters.

Copy the drawing titles using inclined letters and numbe in the space below:

5mm LATHE TOOLPOST-LATHE

4mm SCALE 1:25

6mm ACCESS DOOR SUPPORT

5mm SCALE 5:1

6mm ZIRCON FIRE EXTINGUISHER

3mm SCALE 1:2·5 DRAWN BY - SELF

Student Exercise No.4

Write drawing titles using vertical letters.

Copy the drawing titles using vertical letters and numbers in the space below:

8mm ONE TON ARBOR PRESS

6mm SCALE 1:2·5

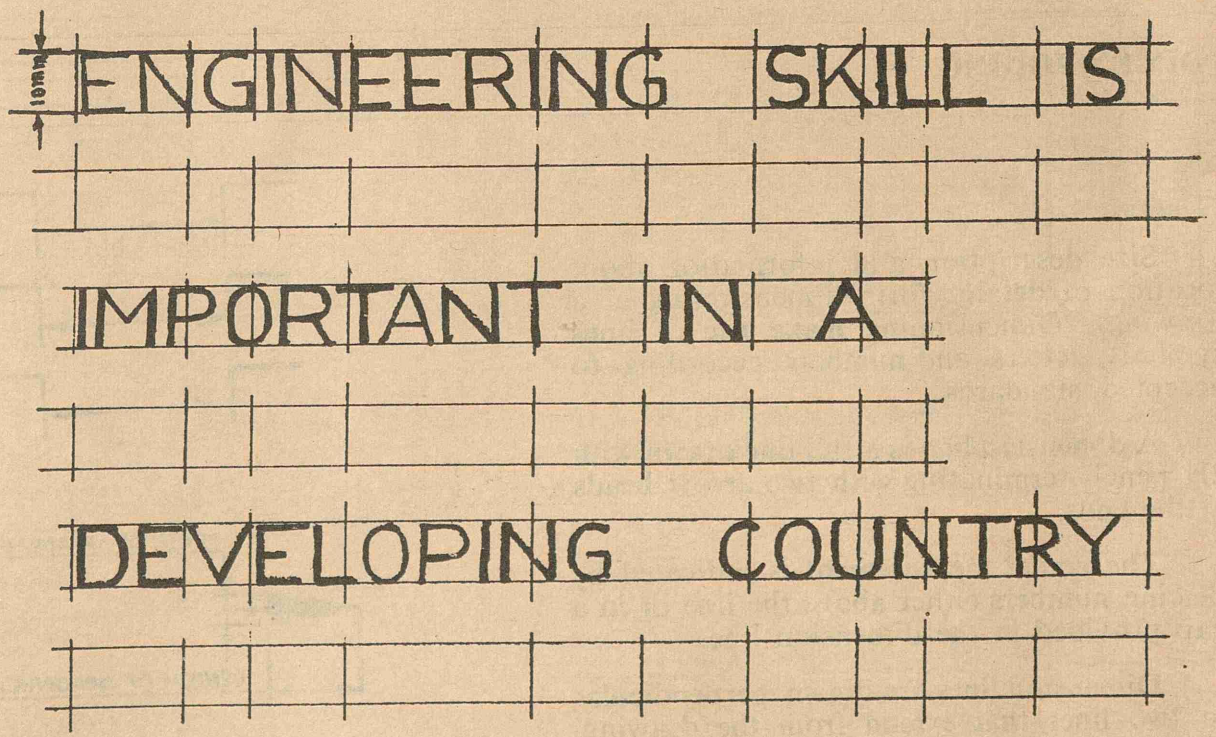
6mm ENGINEERS VISE

3mm SCALE = FULL SIZE

6mm HIGH TENSION COIL MOUNT

3mm SCALE = 2:1 DRAWN BY - SELF

Copy the words shown in the spaces provided.



ENGINEERING SKILL IS IMPORTANT
IN A DEVELOPING COUNTRY

DIMENSIONING

General:

Size description and information about location of details. form dimensioning of a drawing. Dimensioning make use of lines symbols, letters and numbers according to accepted standards.

A dimension line is a full line drawn with 2H pencil terminating with two arrow heads at the ends.

The actual measurement is indicated by placing numbers either above the line or in a gap provided in the dimension line.

Dimension lines are drawn perpendicular to two lines that extend from the drawing. These are known as extension lines or projection lines.

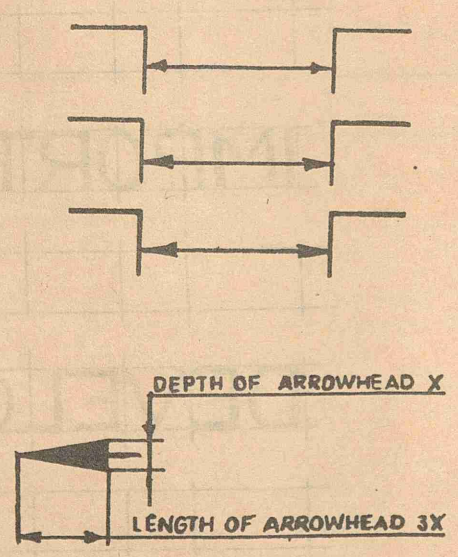
Informations in the form of notes is connected to the feature by drawing a leader line.

All dimensions in one drawing should be expressed in one unit only. The recommended unit being millimetre.

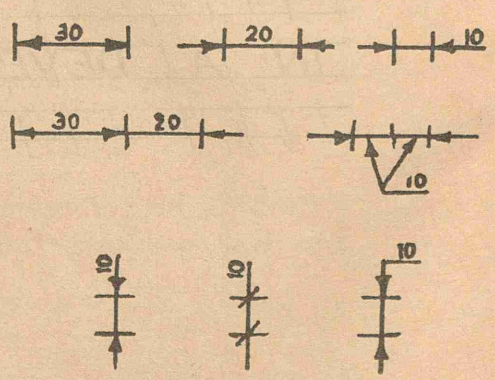
It is not necessary to write the unit along with all dimensions, but remember to make a note such as "ALL DIMENSIONS IN MILLIMETRES" in a prominent place.

Method of Execution :—

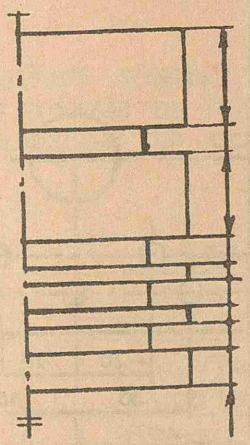
Length of arrow head should be three times its depth. Space in the arrow head should be filled in. The size of the arrow head should be proportionate to the thickness of the line.



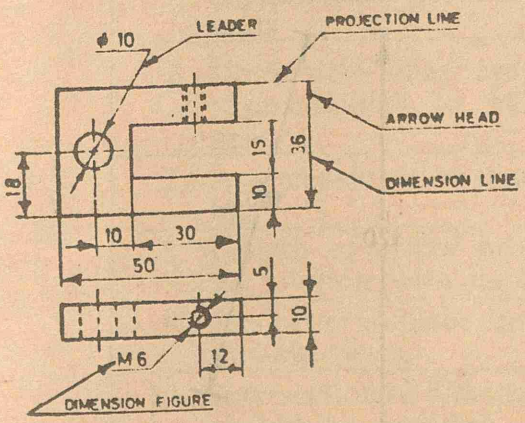
Instead of arrow heads the ends of dimension lines may be marked by a dot or an oblique dash.



Leader lines should not be inclined at an angle less than 30° to the features. It must not be vertical or tangitial to the surface.

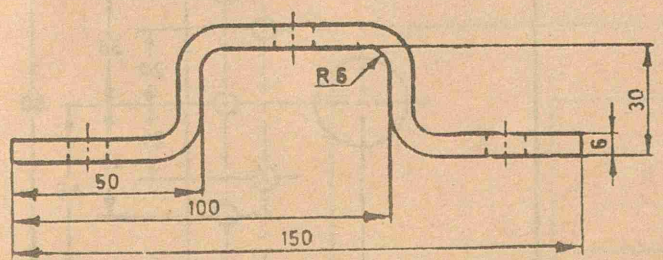


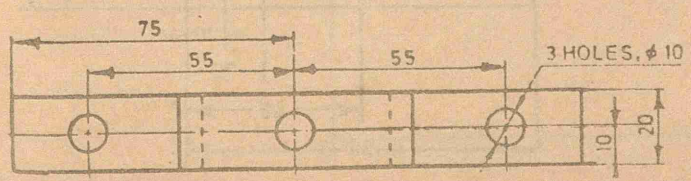
Leaders should not be unnecessarily long. It is terminated by an arrow head or dot. Projection lines should extend slightly beyond dimension lines.



As far as possible dimensions should be placed outside the views.

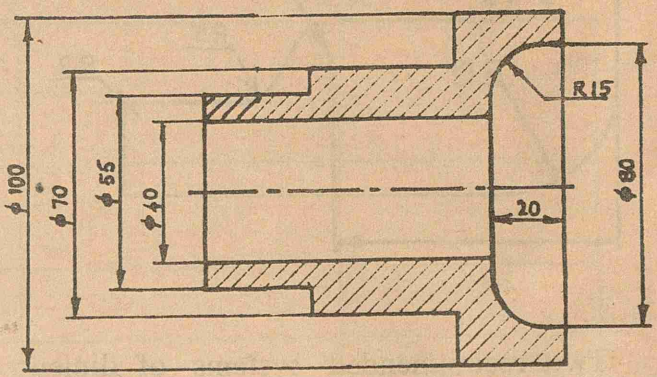
Dimensions are to be given from visible outlines rather than from hidden lines. Intersection of dimension lines should be avoided.



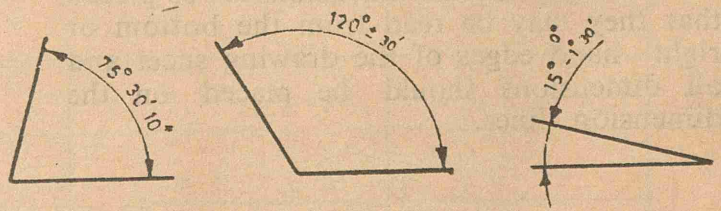


Overall dimensions should be placed outside the intermediate dimensions.

Dimension lines are drawn maintaining a gap of 12 mm from the object line and a gap of 10 mm between adjacent dimension lines.



Angular measurements should be made between radii as shown in the figure.



Circles should be dimensioned by one of the methods shown in the figure.

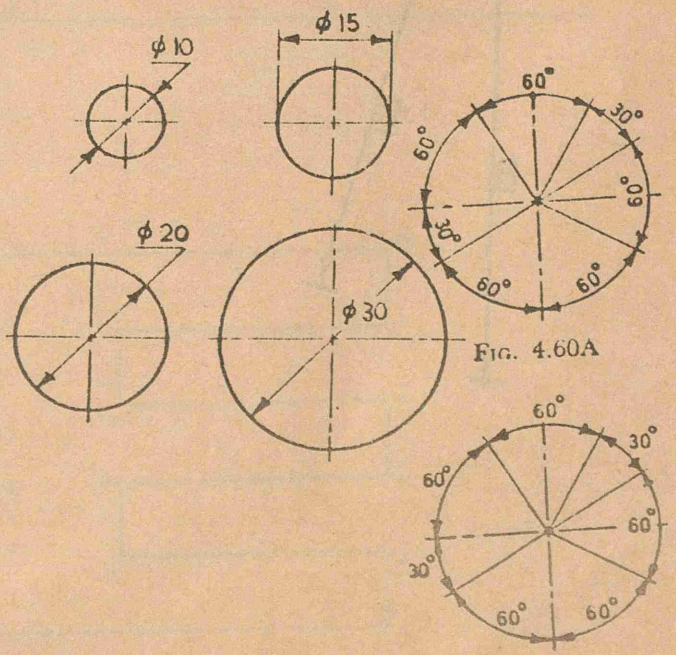
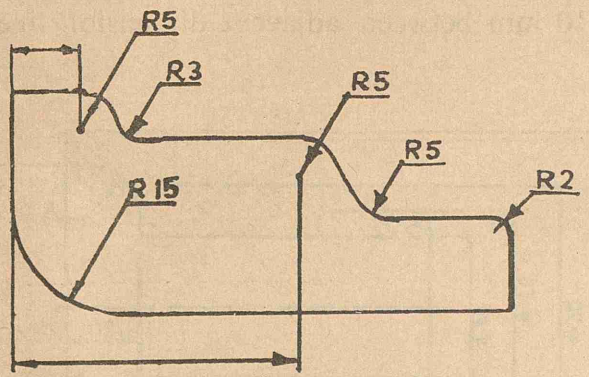


Fig. 4.60A

As far as possible the dimension line of a radius shall pass through the centre of the arc.

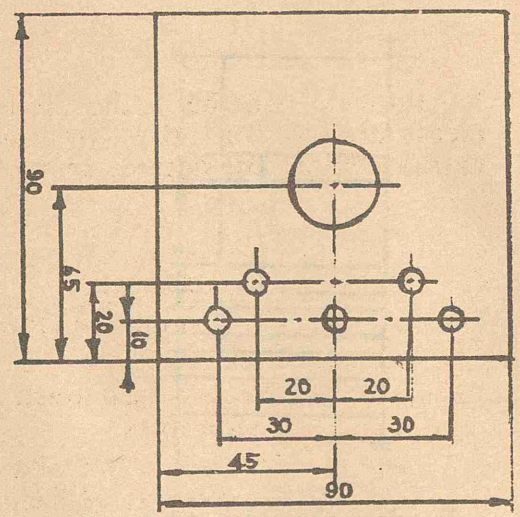


Two recommended systems of dimensioning are :—

Aligned system.

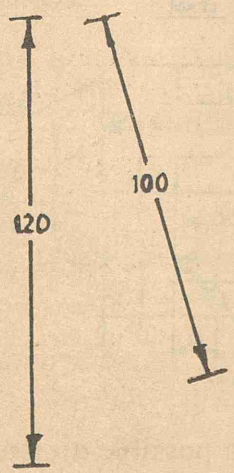
In this system all dimensions are so placed that they may be read from the bottom or right hand edges of the drawing sneet and all dimensions should be placed on the dimension lines.

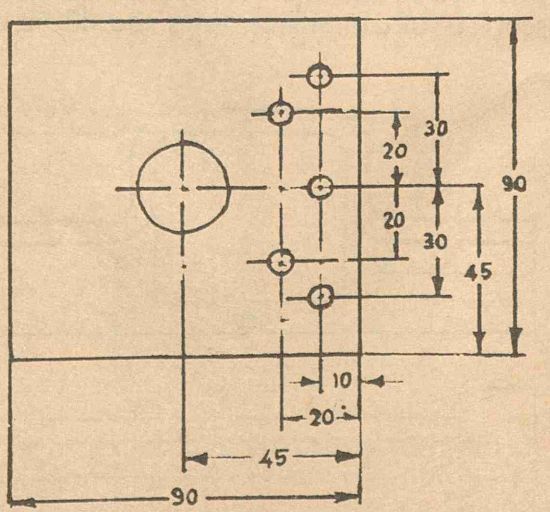




Unidirectional system:

In this system all dimensions are so placed that they may be read from the bottom edge of the drawing sheet.





21285

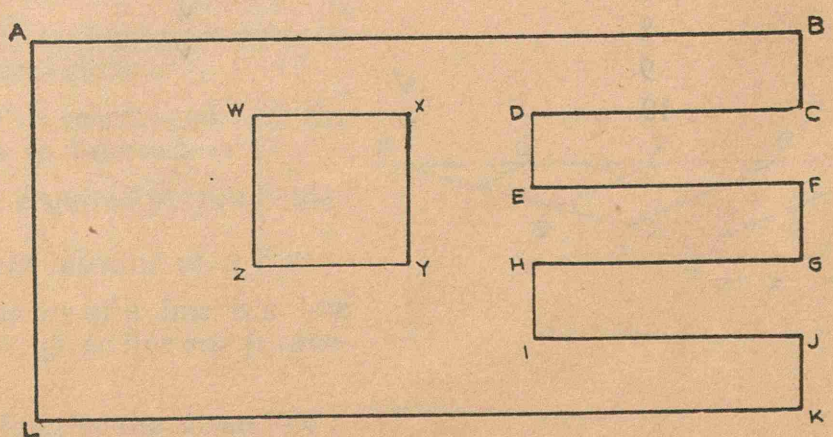
EXERCISES

1. Indicate whether the following sta.. ments are true or false by placing a tick marks against the correct answer.

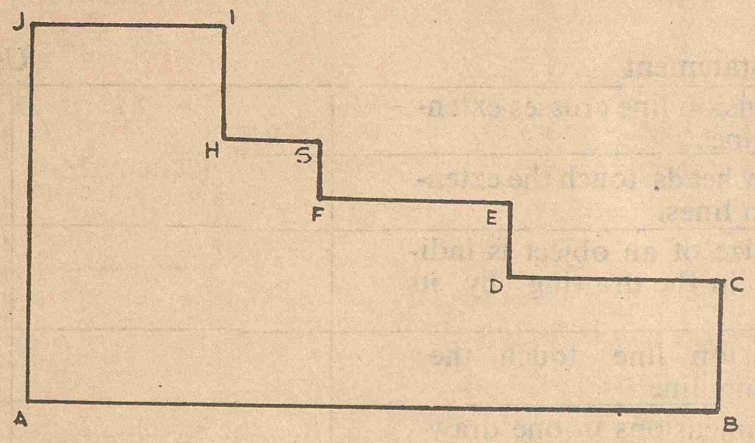
Statement	Use	
1. Dimension line crosses extension line		
2. Arrow heads touch the extension lines.		
3. The size of an object is indicated in the drawing by its scale		
4. Extension line touch the drawing line		
5. The dimensions in one drawing can be expressed in various units		
6. Dimension lines are drawn perpendicular to extension line		
7. A dimension line is a dotted ine		
8. Length of arrow head bears no relation with its depth		
9. It is better to place dimensions outside views.		
10. Intersection of dimension lines should be avoided		

Exercise:

II. Place the dimensions in the given drawing after measuring the distances.
Use Aligned system. Scale: full size.



III. Place dimensions in the given figure after measuring distances. Use unidirectional method. Scale: full size



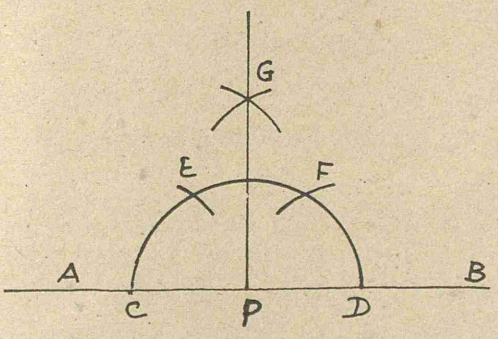
Answers:

	T	F
1		√
2	√	
3	√	
4	√	
5		√
6	√	
7		√
8		√
9	√	
10	√	

GEOMETRIC CONSTRUCTIONS

6.1 To draw a perpendicular to a given line at a given point.

Let AB be the given line and P the given point.



Procedure

(a) With P as centre and with a convenient radius describe a semi - circle to cut AB at C and D.

(b) With C and D as centres cut arcs to get E and F on the semi-circle

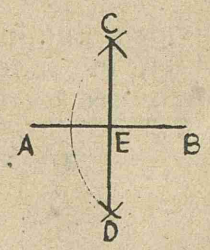
(c) With E and F as centres and with the same radius cut arcs to intersect at G.

(d) Join PG, the required perpendicular

6.2 To draw the right bisector of a line.

Note: The right besector of a line is a line which bisects the given line and perpendicular to it.

Let AB 30 mm long be the given line.



Procedure

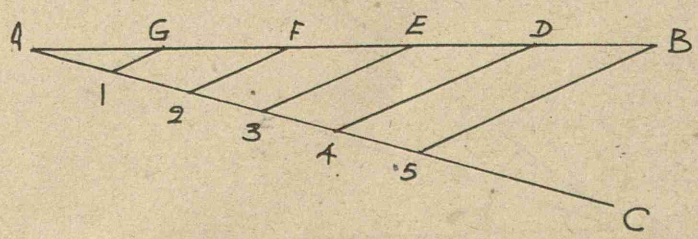
(a) With A as centre and more than half of AB as radius draw an arc reaching both sides of the line.

(b) With B as centre and with the same radius draw an arc to cut the first arc at two points C and D

(c) Join CD the required right bisector

6.3 To devide a line into any number of equal parts.

Let the length of the line be 80 mm and number of divisions required be 5.



Procedure

(a) Draw line AB 80 mm long.

(b) Draw another line AC at a convenient angle.

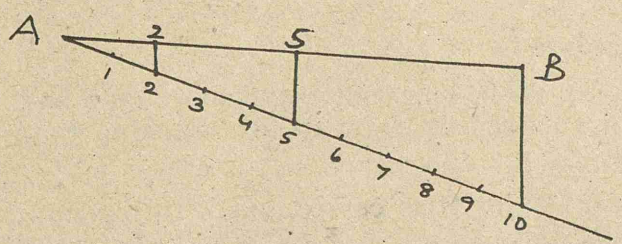
(c) Using dividers mark off five equal spaces on the line A.C.

(d) Join 5 B.

(e) Through 4, 3, 2 and 1 draw lines parallel to 5B to meet AB at D, E, F and G.

(f) The points D, E, F and G divides AB into five equal parts.

6.4 To divide a line in the given proportion.
Let AB 60 mm long be the given line and it is required to divide the line in the ratio 2:3:5.



Procedure

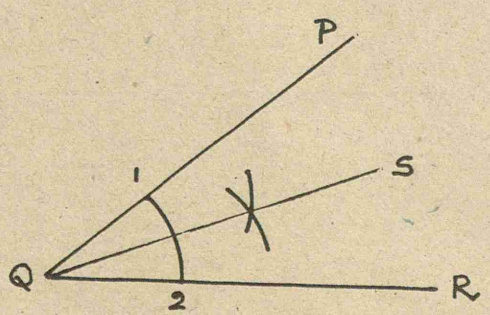
(a) Draw AB 60 mm long.

(b) Divide the line into 10 (2+3+5) equal parts.

(c) Points 2 and 5 divides the line into three parts in the ratio 2:3:5.

6.5 To bisect an angle.

Let $\hat{PQR}$ be the given angle.



Procedure

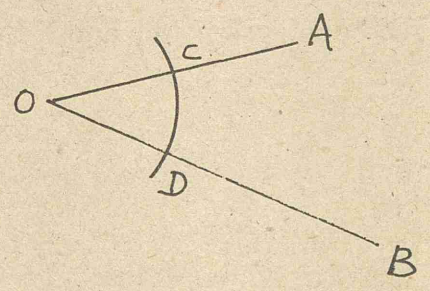
(a) With Q as centre and with a convenient radius draw an arc to cut PQ at 1 and QR at 2.

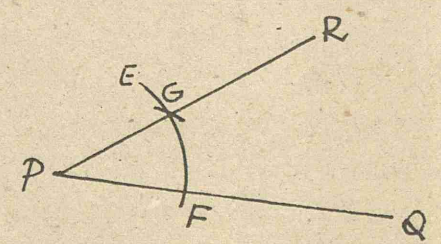
(b) With 1 and 2 as centres and with the same radius cut arcs to intersect at S.

(c) Join QS, the required bisector.

6.6 To set out an angle, equal to a given angle on a given line.

Let PQ be the given line and AOB the given angle.





Procedure

(a) With O as centre and with a convenient radius draw an arc cutting OA at C and OB at D.

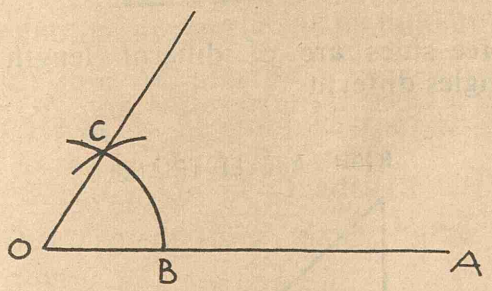
(b) With the same radius and centre P draw an arc EF cutting PQ at F.

(c) With F as centre and radius equal to CD draw an arc cutting arc EF at G.

(d) Join PG and produce to R

(e) Now angle $\hat{RPQ} = \hat{AOB}$

6.7 To set out 60° using compass.



Procedure

(a) Draw OA any line.

(b) With O as centre and with a convenient radius draw an arc to cut OA at B.

(c) With B as centre and with the same radius draw another arc to cut the first arc at C.

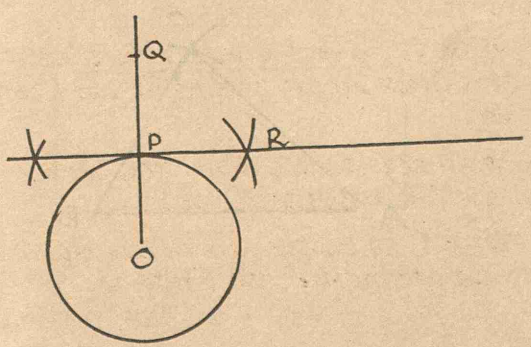
(d) Join OC

(e) Now Angle $\hat{COA}$ is 60°.

6.8 To construct a tangent to a circle at a point on the circle.

Note: Tangents are lines touching a circle at one point only.

Let O be the centre and 20 mm be the radius of the given circle. Let P be a point on the circle.



Procedure

(a) With centre 'O' draw the given circle.

(b) Mark point P on the circle.

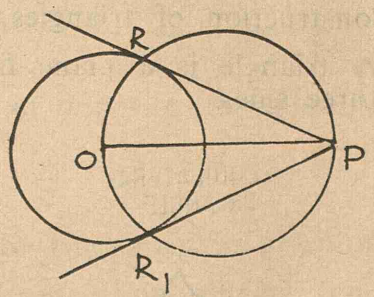
(c) Join OP and produce it to Q so that OP = PQ

(d) With centres O and Q and with a convenient radius draw arcs intrsecting each other at R

(e) Draw line PR which is the required tangent

6.8.1 To draw a tangent to a circle from an outside point.

Let O be the centre of the given circle radius 20 mm and P the given point outside the circle.



Procedure

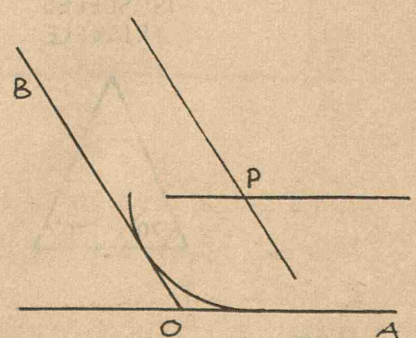
(a) Join OP

(b) With OP as diameter draw a circle cutting the given circle at R and R_1.

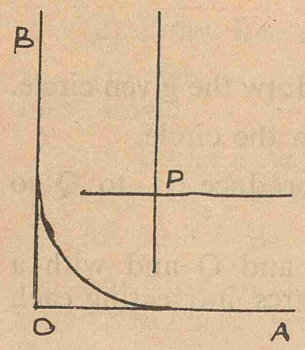
(c) Join PR and PR_1, the required tangents.

6.9 To draw a tangent arc of given radius to two straight lines.

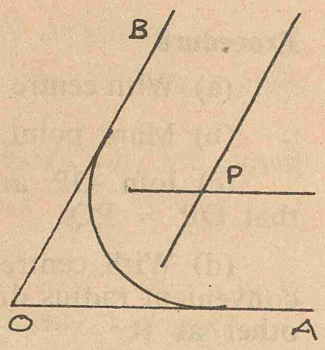
Let OA and OB be two straight lines and 15 mm be the given radius.



CASE I



CASE 2



CASE 3

Procedure

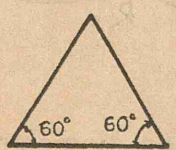
(a) Draw lines parallel to OA and OB at a distance of 15 mm from them to meet at P.

(b) With P as centre 20 mm as radius draw arcs to touch the lines.

6.10 Construction of triangles.

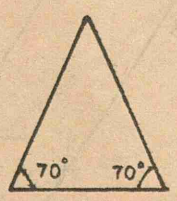
Note: A triangle is a plane figure having three sides.

EQUILATERAL TRIANGLE



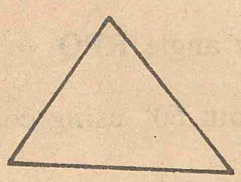
Three sides are equal and three angles are equal.

ISOSCELES TRIANGLE



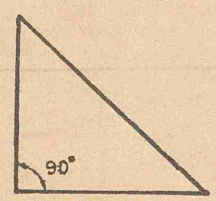
Two sides are equal and two angles are equal.

SCALENE TRIANGLE



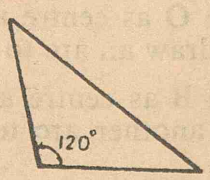
Three sides are of differnt length and three angles differnt

RIGHT-ANGLED TRIANGLE



One angle 90°

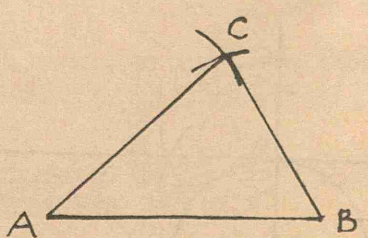
OBTUSE ANGLED TRIANGLE



One angle greater than 90°.

6.10.1 To construct a triangle given three sides.

Let the length of three sides be 35 mm, 30 mm & 25 mm



Procedure

(a) Draw AB 35 mm long

(b) With A as centre and 30 mm radius draw an arc

(c) With B as centre and 25 mm radius draw another arc to cut the first arc at C

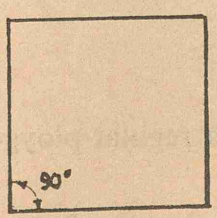
(d) Join AC and B C

(e) ABC is the required triangle

6.11 Construction of Quadrilaterals.

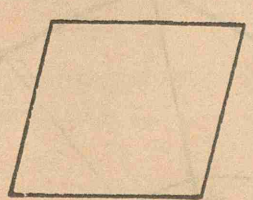
Quadrilateral is a plane figure having four sides.

SQUARE



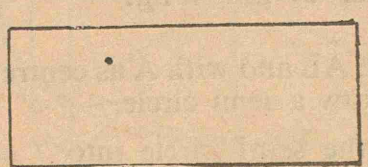
All sides are equal
All angles are right angles.

RHOMBUS



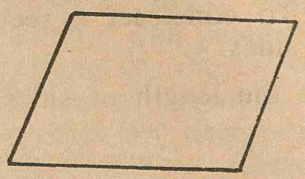
All sides are equal.
Opposite sides parallel.
Opposite angles equal.

RECTANGLE



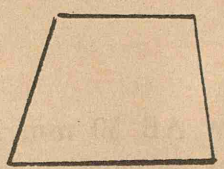
Opposite sides are equal
All angles are right angles.

PARALLELOGRAM



Opposite sides are equal and parallel.
Opposite angles are equal.

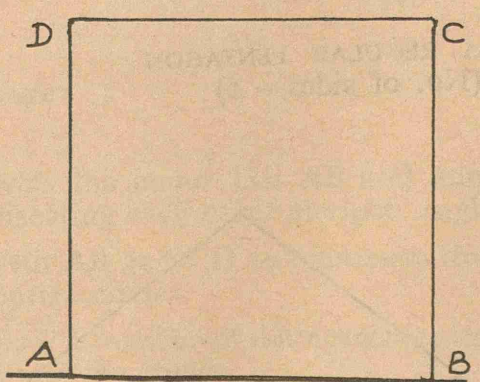
TRAPEZIUM



A pair of opposite sides parallel.

6.11.1 To construct a square given one side.

Let the length of one side be 30 mm.



Procedure

(a) Draw AB 30 mm long using T-square

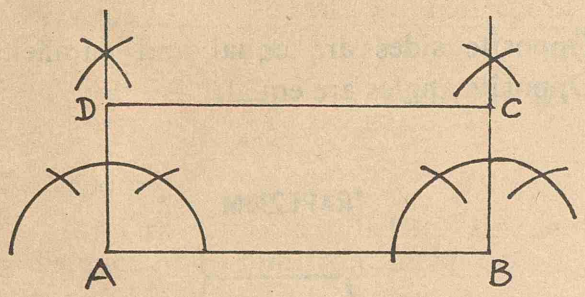
(b) Erect perpendiculars at A and B using set squares.

(c) Mark points D and C, measuring 30 mm from A and B respectively using a scale.

(d) Join DC to complete the square ABCD.

6.11.2 To construct a rectangle given two sides:

Let the length of sides be 30 mm and 20 mm.



Procedure

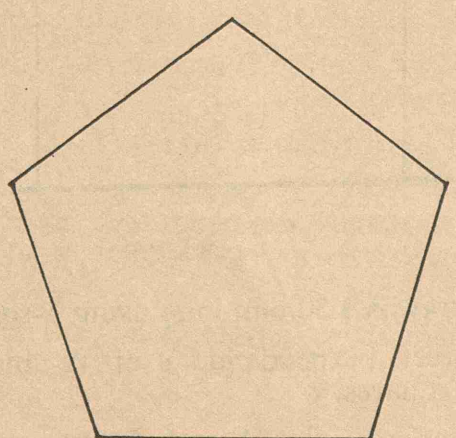
(a) Draw AB 30 mm long.
(b) Erect perpendiculars at A and B.
(c) Mark AD = BC=20 mm.
(d) Join DC.
(e) ABCD is the required rectangles.

6.12 Construction of polygons.

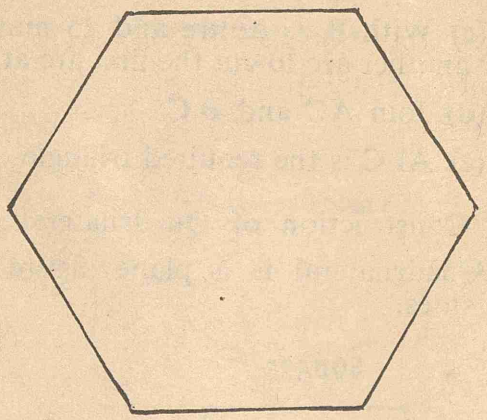
Note: A polygon is a plane figure having more than four sides.

When the sides are of equal length it is called a regular polygon.

A REGULAR PENTAGON
(No. of sides – 5)



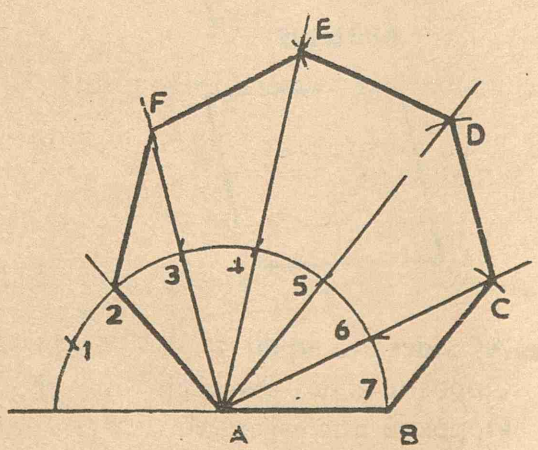
A REGULAR HEXAGON
(No. of sides – 6)



6.12.1 To construct a regular ploygon given one side.

Let 20 mm be the length of one side and number of sides of polygon be 7.

(HEPTAGON)



Procedure

(a) Draw AB 20 mm long.

(b) Produce AB and with A as centre and AB as radius draw a semi circle.

(c) Divide the semi circle into 7 equal parts.

(d) Mark the division points as shown in the figure.

(e) Draw lines from A through points 2, 3, 4, 5, & 6.

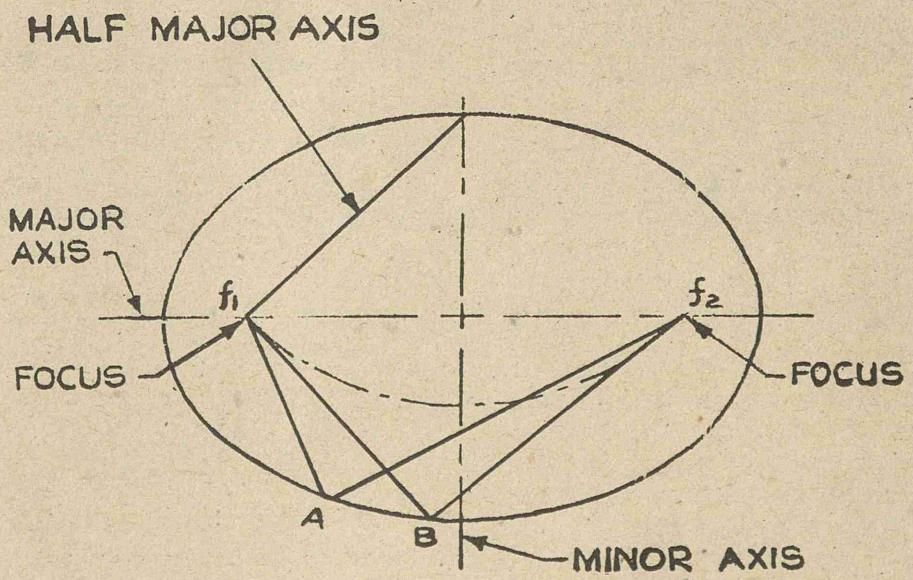
(f) Line A 2 is one side of the polygon.

Note: (1) Divide the semi circle into as many equal parts as the number of sides of the polygon.

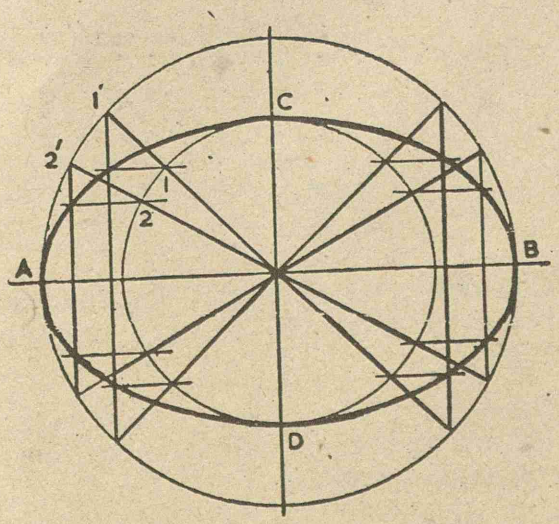
(2) A2 always give one side of the polygon.

6.13 Construction of Ellipse

Ellipse is the fore-shortened view of a circle. It is symmetrical about two axes which bisect each other. The longer axis is called the major axis and the shorter one the "minor axis". The sum of distances of any point on the ellipse, from two fixed points on the major axis is a constant. These fixed points are called the "foci".



6.13.1 To construct an ellipse given the major and minor axes.



Procedure:

(a) Draw the major axis AB and minor axis CD bisecting each other at right angles.

(b) With AB and CD as diameters draw two concentric circles.

(c) Draw a number of diameters (at least 8) cutting both the circles.

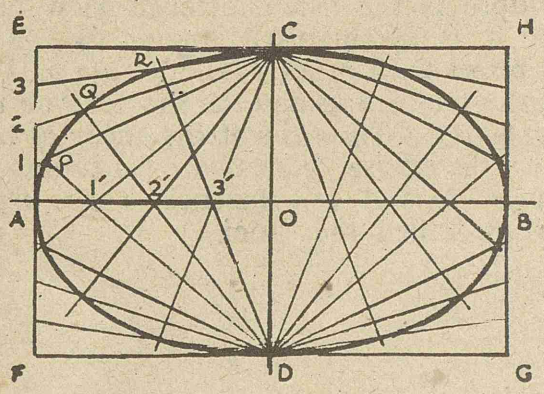
(d) Where these diameters cut the outer circle draw verticals using T-squares and set squares.

(e) Where these diameters cut the inner circle draw horizontals using T-square to intersect the verticals as shown in the figure.

(f) Join the points of intersection by a smooth curve.

Alternate method:

6.13.2



(a) Draw the two axes AB and CD bisecting each other at right angles at O.

(b) Through the extremities of the axes draw the rectangle EFGH.

(c) Divide AE into convenient number of equal parts, say 4, by points 1, 2 and 3

(d) Join these points to C.

(e) Divide AO into the same number of equal parts by 1′, 2′ and 3′.

(f) Join these points to D and produce.

(g) The intersection point of C_1 and D_1', P is a point on the ellipse.

(h) Similarly C_2 and D_2' intersect at Q, and C_3 and D_3' intersect at R.

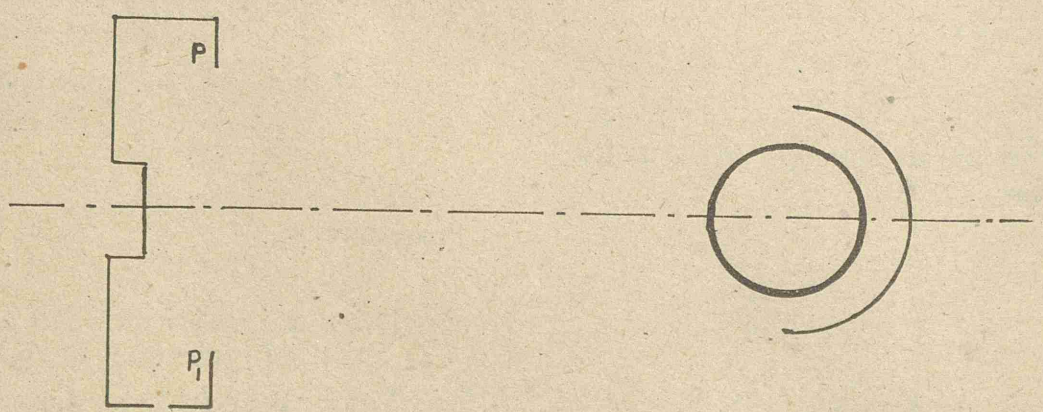
(i) Join APQRC by a smooth curve to form one quarter of the required ellipse.

(j) Follow the same procedure in the other quadrants and complete the ellipse.

EXERCISES

1. Draw a circle 50 mm diametre. Divide it into 6 parts by dividing the central angle. At these division points on the circumference draw tangents to intersect each other and form a hexagon.

2. Complete the drawing given below by drawing tangents from P and P_1 to the incomplete circle.



3. Draw a line AB 40 mm long. At B erect a perpendicular BC 30 mm long. Draw a line joining A and C and measure it. Construct a square on each line as a side.

4. Construct a rectangle of sides 65 mm and 40 mm long.

5. Construct a regular octagon (8 sides) of 30 mm side.

6. Construct a parallelogram, length of sides being 40 mm and 25 mm, and one angle 75°.

7. Draw an ellipse whose major axis is 100 mm and minor axis 60 mm by concentric circles method.

ORTHOGRAPHIC PROJECTION

Projection of an object is the method of obtaining a picture of the outline of the object on a plane as seen by an observer.

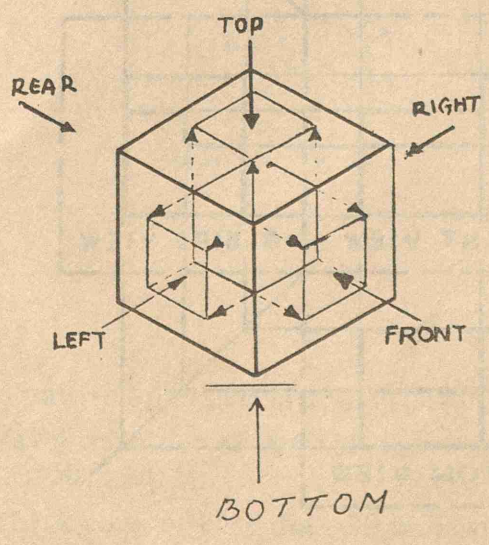
In order to get this, projection lines called "projectors" or "rays" are assumed to be drawn from the eye of the observer to the outline of the object to meet the plane.

If the points of intersection of the projectors and the plane are marked, an out line of the object is obtained on the plane.

This figure is called the "projection" or "view" of the object and the plane is called the "picture plane".

The projection in which projectors are drawn perpendicular to the pictureplane is called "orthographic projection."

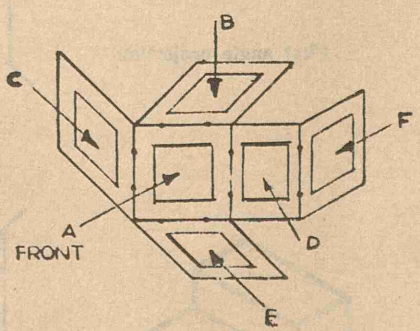
In order to obtain views it is convenient to imagine the object enclosed in a transparent box called "the viewing box".

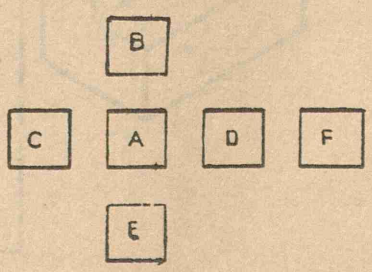


Looking through the six faces of the box, six views of the object can be drawn on the faces of the box.

When the six faces have been unfolded into a single plane surface, we get six orthographic views of the object.

Thus six views of the object can be drawn on a sheet of paper.

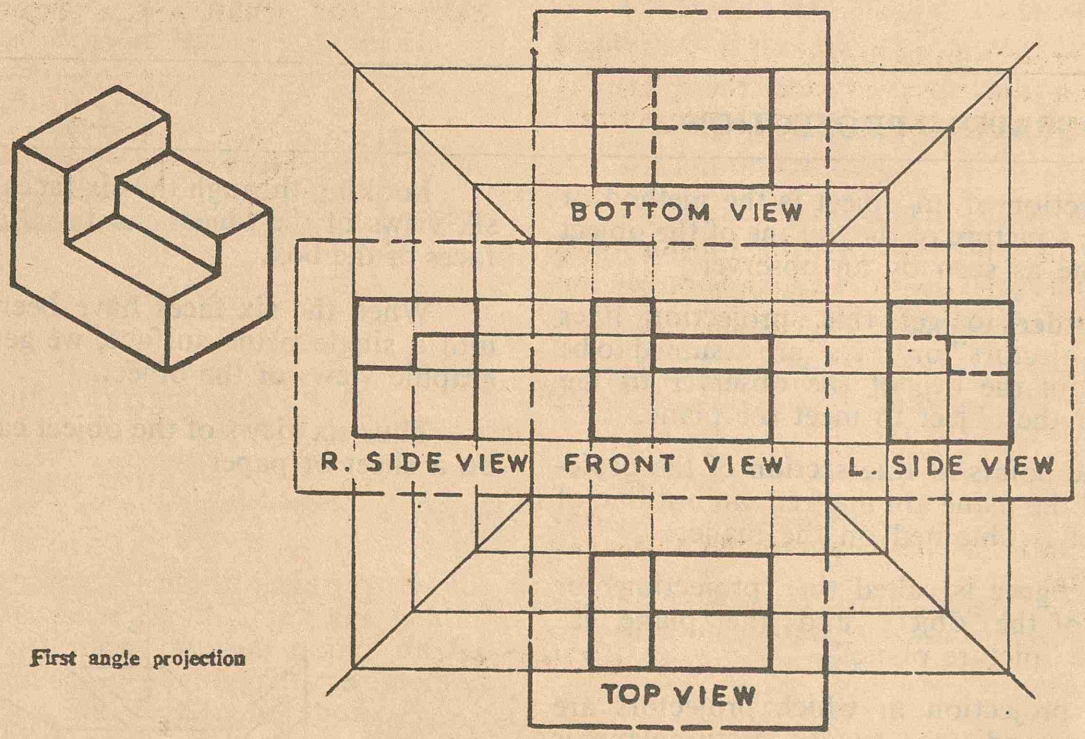




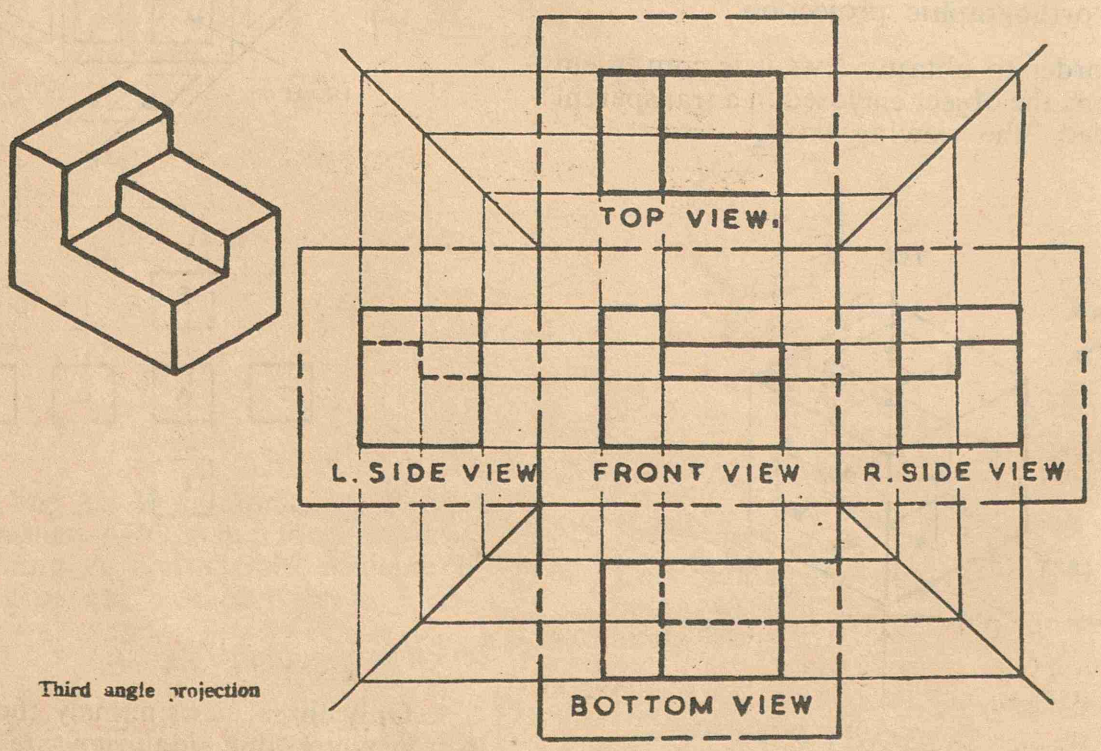
Only three views namely the front views top view and one side view are essential to understand an object completely.

The front view is also called "Elevation"
The top view is also called "Plan".

The side view is also called "end view"



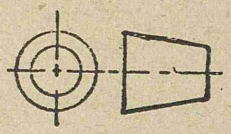
First angle projection



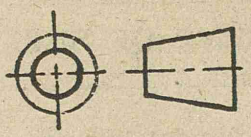
Third angle projection

The projections obtained by the viewing box method are the "third angle projections" of the object. In third angle projection the picture plane is between the object and the observer.

SYMBOL FOR FIRST ANGLE PROJECTION



SYMBOL FOR THIRD ANGLE PROJECTION

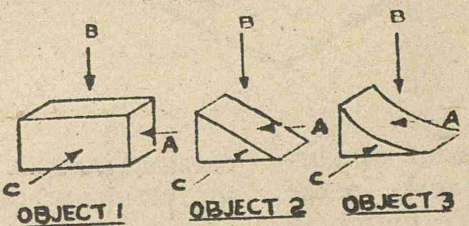


The projection obtained when the object is between the observer and the plane of projection is called the "first angle projection"

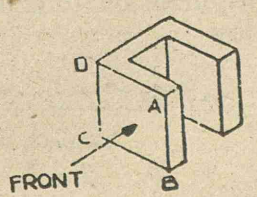
The Indian standards institution have recommended the use of third angle projection method for general engineering drawing.

1. Draw all the six views of the following objects:

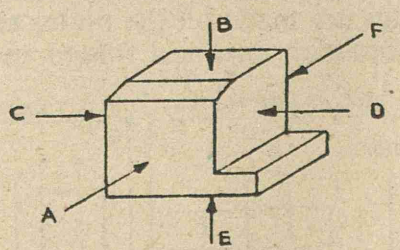
EXERCISES



OBJECT 1 OBJECT 2 OBJECT 3



OBJECT 4



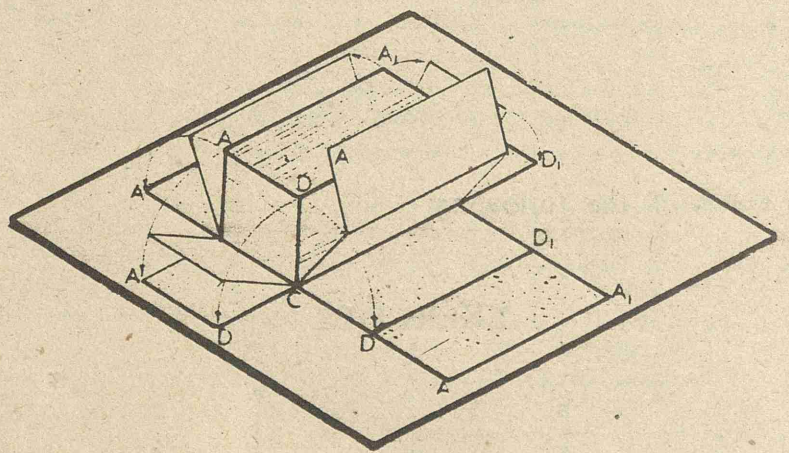
OBJECT 5

2. Draw the plan, elevation and side view of:
   (a) A cylinder of dia- 30 mm and height 50 mm.
   (b) A cone of base dia - 30 mm and height 40 mm.
   (c) A square prism side of base 20 mm & height 40 mm.
   (d) A square pyramid side of base 20 mm height & 40 mm.

DEVELOPMENT OF SURFACES

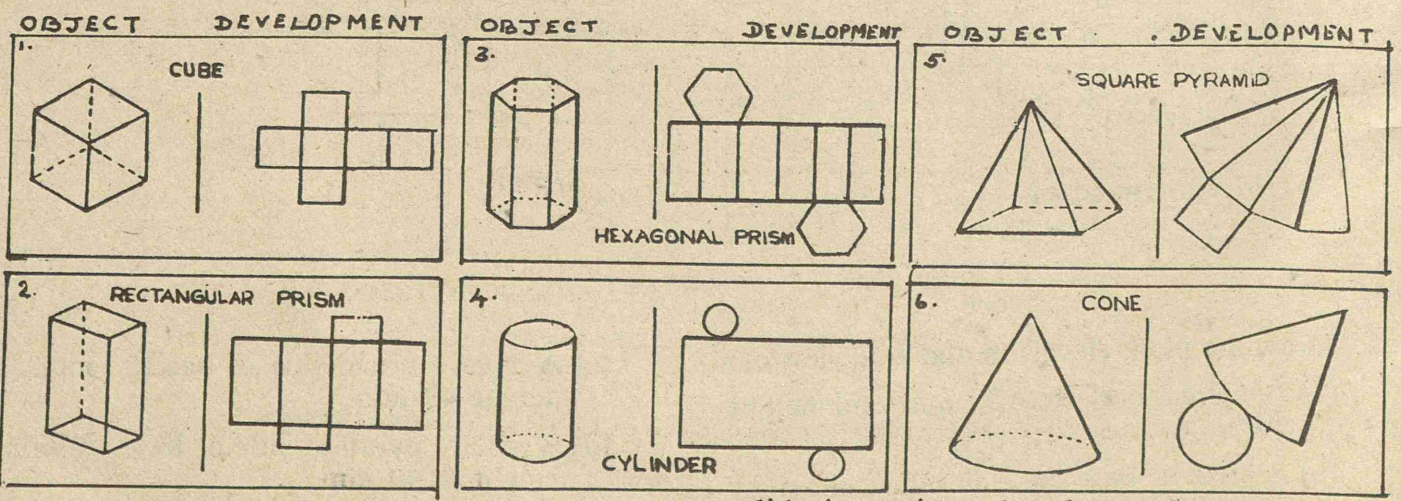
The development of an object is the lateral surface of the object, laid. out on a plane.

Fo example:–if a small cardboard box is unfolded and laid out on a plane the result is the development of the box.



The knowledge of development of surfaces is essential in sheet metal work, in the construction of boilers funnels, chimneys etc. Markings are made on the plate, according to development, cut, and folded to form desired objects. The development is usually drawn from orthographic projection.

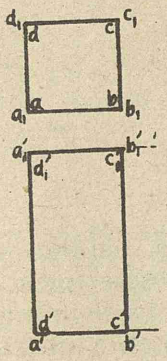
The development of some common solids are shown below.



Draw the developments of the above solids in a given A_3 sheet. Select suitable size.

Exercises

1. Draw the development of a square prism whose views are given below:



side of base 20 mm

Height 40 mm

2. Draw the development of a triangular prism side of base 30 mm, height 40 mm

3. Draw the development of a cylinder diameter of base 30 mm, height 40 mm.

PICTORIAL DRAWINGS

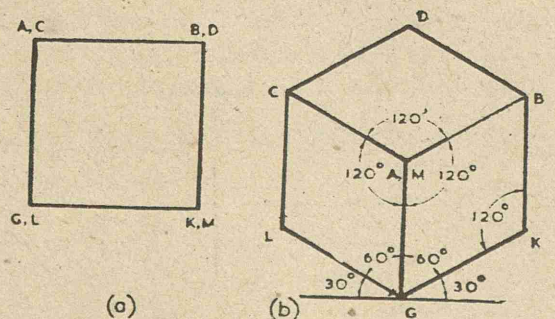
Orthographic projection of an object requires at least three views to define its shape. Only people who are trained in the field can imagine the actual shape of the object. A pictorial drawing of an object helps any person to visualise the actual shape of the object.

There are three main kinds of pictorial drawings.

1. Isometric projection
2. Oblique projection
3. Perspective projection

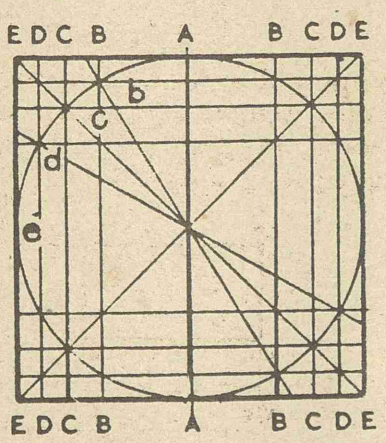
9.1. Isometric Projection:

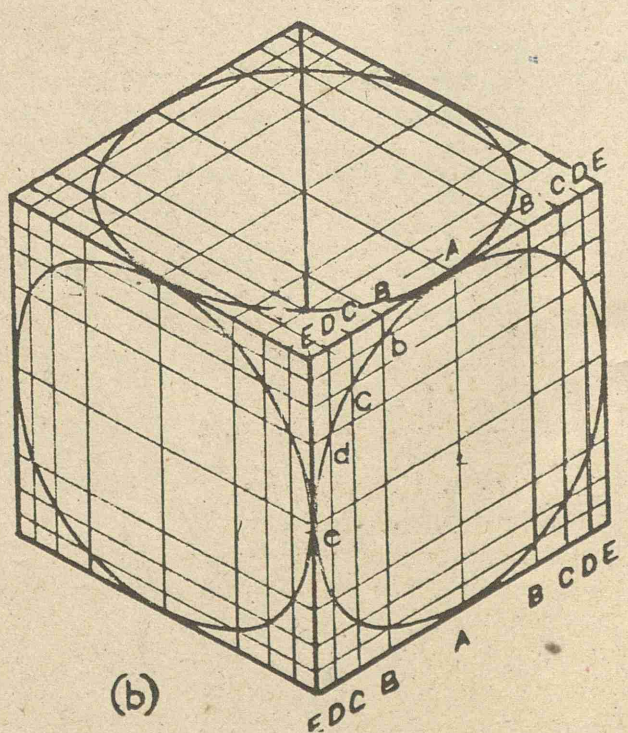
It gives a three dimensional pictorial view of an object. Consider a cube. Its elevation can be drawn by projecting it on the plane in the front. The cube is then rotated and tilted so that the three edges are equally inclined to the plane. The front view of the cube in this position is its isometric projection.



The edges of the cube in this position namely AB, AC and AE are called isometric axes. The three edges appear 120° apart. The length, breadth and height of the object is measured along AB, AC and AE respectively.

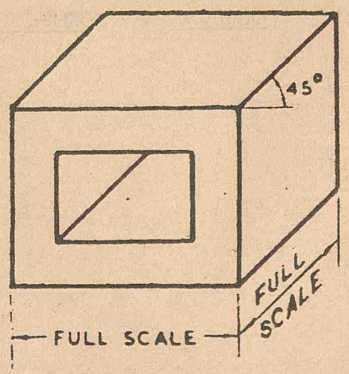
All other lines are drawn parallel to these three lines or relative to these lines. Circles and curves may be drawn by locating several points of the curve on isometric lines and then drawing smooth curve through them.



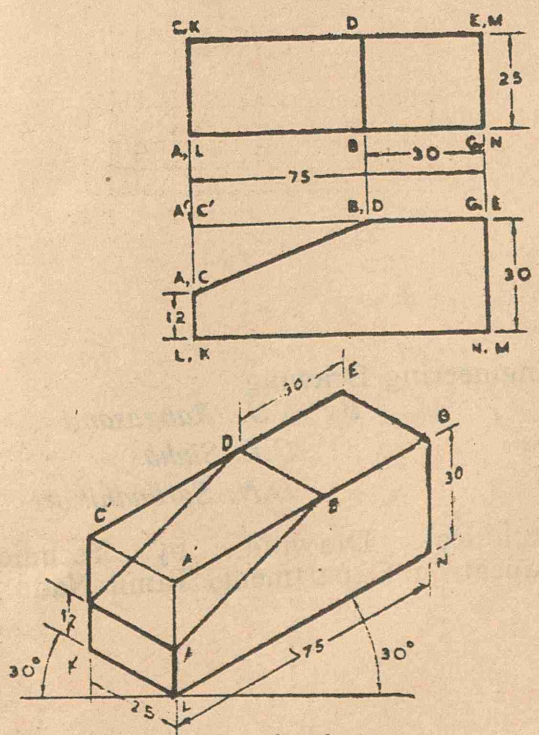


9.2. Oblique Projection:

In oblique projection one face near the observer is placed parallel to the picture plane. Hence its projection is true shape as in orthographic view. The other two faces are usually drawn inclined at 45° to the picture plane.

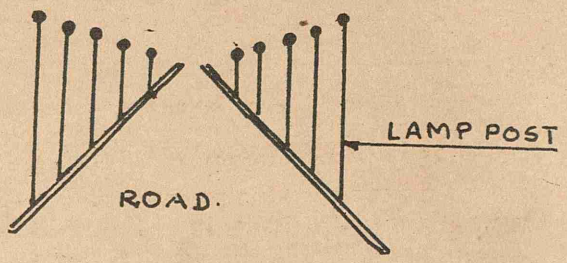


Orthographic views and isometric projection of a wedge are given below. Copy these views on your drawing sheet. Add an oblique projection of the wedge.

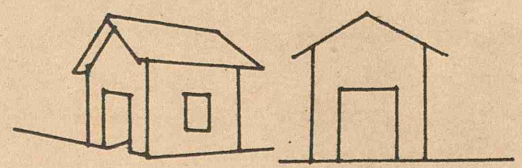


9.3. Perspective projection:

A perspective view shows an object as it would appear to the eye of an observer. In this method of projection, nearer objects are seen bigger and the farther ones proportionately smaller, in the same drawing and this produces a photographic effect. Perspective is mainly used in architecture. By means of perspective the architect is able to show how a building would appear when constructed. Some perspective drawings are shown below for information.



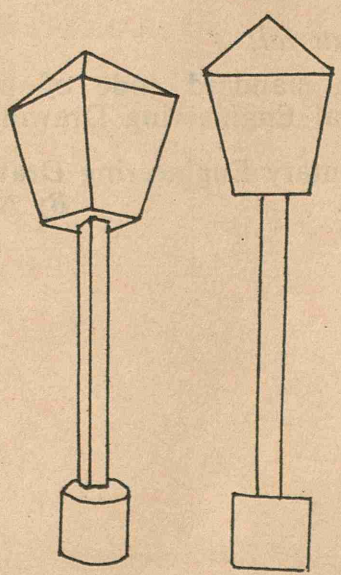
Note: The road of constant width seems tapering. Lamp posts of the same height appears of different height. It seems shorter as it goes farther.



A HUT

The front elevation and perspective view of a hut with a door and a side window are shown above.

A LAMP POST

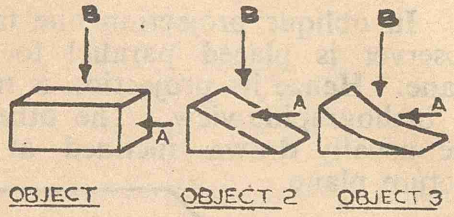


The front view and perspective projection of a Lamp post are given in the figure.

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Exercise:

1. Draw free hand isometric and oblique views of the following objects.



Source Material:

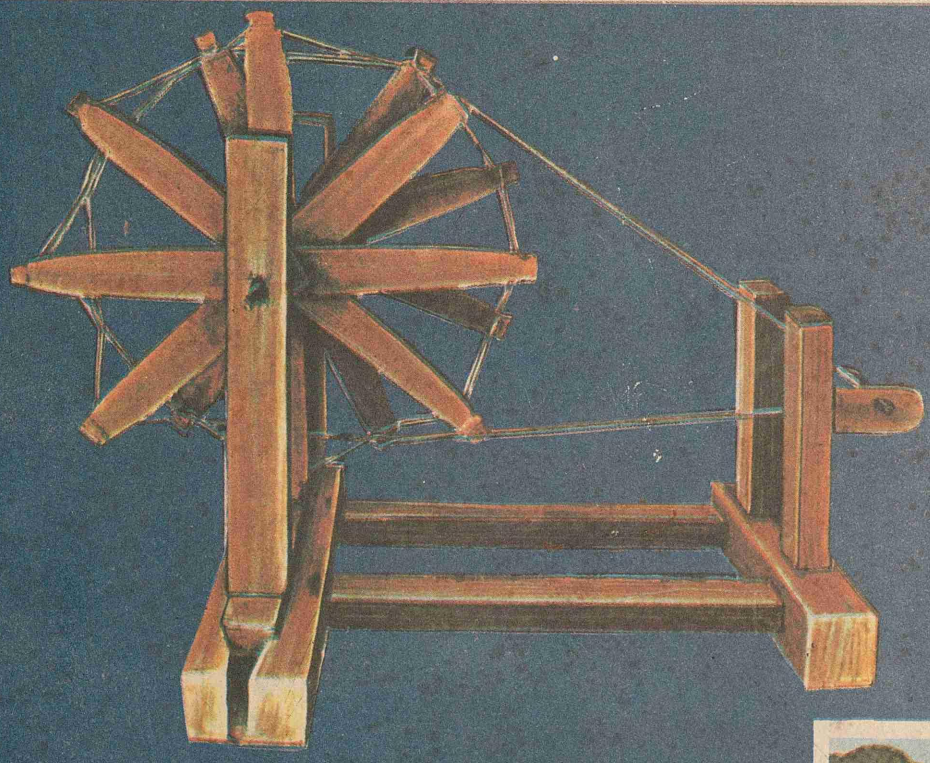
1. Indian standard code of practice for General Engineering Drawing

2. Elementary Engineering Drawing
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3. Engineering Drawing
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