MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
Accredited by NBA and NAAC with 'A' Grade & Recognized Under Section2(f) & 12(B)of the UGC act,1956

DEPARTMENT OF MECHANICAL ENGINEERING

COMPUTER AIDED ENGINEERING GRAPHICS

LAB MANUAL

SUBJECT NAME	**COMPUTER AIDED ENGINEERING GRAPHICS**
SUBJECT CODE	**2420371**
COURSE-BRANCH	**B. Tech – Mechanical Engineering**
YEAR-SEMESTER	**I-II**
ACADEMIC YEAR	**2024-2025**
REGULATION	**MLRS-R24**

Mission and Vision of the Institute

OUR VISION

To be as an ideal academic institution by graduating talented engineers to be ethically strong, competent with quality research and technologies.

OUR MISSION

To fulfil the promised vision through the following strategic characteristics and aspirations:

Utilize rigorous educational experiences to produce talented Engineers

- Create an atmosphere that facilitates the success of students
- Programs that integrate global awareness, communication skills and Leadership qualities
- Education and Research partnership with institutions and industries to prepare the students for interdisciplinary research.

QUALITY POLICY

1.The management is committed in assuring quality service to all its stake holders, students, parents, alumni, employers and the community.

2.Our commitment and dedication are built into our policy of continual quality improvement by establishing and implementing mechanism and modalities ensuring accountability at all levels, transparency in procedures and access to information and actions.

Department of Mechanical Engineering

Vision Statement:

“The **Mechanical Engineering Department** strives for immense success in the field of education, research and development by nurturing the budding minds of young engineers inventing sets of new designs and new products which may be envisaged as the modalities to bring about a green future for humanity”.

Mission Statement:

- Equipping the students with manifold technical knowledge to make them efficient and independent thinkers and designers in national and international arena.
- Encouraging students and faculties to be creative and to develop analytical abilities and efficiency in applying theories into practice, to develop and disseminate new knowledge.
- Pursuing collaborative work in research and development organizations, industrial enterprises,
- Research and academic institutions of national and international, to introduce new knowledge and methods in engineering teaching and research in order to orient young minds towards industrial development.

List of Programme Outcomes:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

societal and environmental contexts, demonstrate the knowledge and need for sustainable development. **PO8: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO9: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instruction

PO10: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO11: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUT COMES

PROGRAM SPECIFIC OUT COMES (PSO):

PSO1: Students acquire necessary technical skills in Mechanical Engineering that make them employable graduate.

PSO2: An ability to impart technological inputs towards development of society by becoming an entrepreneur.

COURSESTRUCTURE, OBJECTIVES & OUTCOME

COURSE STRUCTURE:

The Mechanical Engineering Laboratory will have a continuous evaluation during I & II semester for 40 sessional marks and 60 marks End semester examination marks.

Out of the 40 marks for internal evaluation, day-to-day in the laboratory shall be evaluated for 15 marks and internal practical examination shall be evaluated for 25 marks conducted by the concerned Laboratory Teacher.

The End semester examination shall be conducted with an external examiner and internal examiner.

Computer Aided Engineering Graphics
(Common to All Branches)

I Year I/II Semester	**L**	**T**	**P**	**C**
	1	**0**	**4**	**3**

Course Code: 2420371

Course Overview:

Engineering Graphics is a foundational course designed to introduce first-year engineering students to the principles and practices of technical drawing and computer-aided design (CAD). This course covers essential topics such as geometric construction, orthographic projection, isometric drawing, lettering and dimensioning. Students will develop skills to create and interpret engineering drawings and gain proficiency in using CAD software for engineering applications.

Prerequisite: NIL

Course Objective: The students will be able to

1. Understand the importance of engineering graphics in the engineering design process.
2. Apply principles of dimensioning and lettering in engineering drawings
3. Develop the ability to create and interpret technical drawings.
4. Master geometric constructions and projections.
5. Gain proficiency in computer-aided design (CAD) software.

Course Outcomes: Upon successful completion of this course, students will be able to:

1. Explain the role of engineering graphics in the engineering design and manufacturing process.
2. Understand the fundamental concepts of Auto CAD.
3. Perform basic geometric constructions and create accurate technical drawings.
4. Develop skills to create 2D and 3D drawings.
5. Use CAD software to create, modify, and manage engineering drawings.

Module-I: **Introduction to Engineering Graphics:**
[12]

The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line, The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

Module-II: Conic Sections and Engineering Curves
[10]

Construction of Ellipse, Parabola, Hyperbola (General Method Only)
Engineering Curves: Cycloids, Epicycloid and Hypocycloid

Module -III: Orthographic Projections
[12]

Introduction to Projections: Assumptions, Principles and Different angles of projections.
Projections of Points: Located in all Quadrants
Projections of Lines: Parallel, Perpendicular, Inclined to one plane.

Module -IV: Projections of Planes and Projection of Solids
[12]
Projections of Planes: Introduction to planes, Regular lamina- Orientations- Surface parallel to HP, Surface parallel to VP, inclined to HP, Inclined to VP.
Projections of Solids: Introduction to solids, Right Regular Solids- Orientations- Axis perpendicular to HP, Axis perpendicular to VP, Axis inclined to HP, Axis inclined to VP.

Module –V: Isometric Drawing and Conversions
[14]

Principles of Isometric projections, Isometric View and Isometric Scale, Isometric view of: Planes and Solids, Conversion: Isometric to Orthographic and Vice Versa

Text Books:

1. **“Engineering Drawing",** N.D. Bhatt,Charotar Publishing House Pvt. Ltd, 53rd Edition, 2014, ISBN: 978-9380358173
2. **"Textbook of Engineering Drawing",** K. Venkata Reddy, BS Publications, Revised Edition, 2013, ISBN: 978-9381075994
3. **"Engineering Graphics**", K.R. Gopalakrishna, Subhas Stores, 32nd Edition, 2014, ISBN: 978-9353460206
4. “**Engineering Drawing and Computer Graphics”,** M B Shah & C. Rana, Pearson Edition 2010.

Reference Books:

1. "**A Textbook of Engineering Drawing**”, R.K. Dhawan, S. Chand Publishing, Revised Edition, 2012, ISBN: 978-8121914311
2. "**AutoCAD 2024: A Problem-Solving Approach, Basic and Intermediate**", Sham Tickoo, CADCIM Technologies, 1st Edition, 2023, ISBN: 978-1640571577
3. "**Engineering Drawing and Graphics Using AutoCAD**", T. Jeyapoovan, Vikas Publishing House 2nd Edition, 2015, ISBN: 978-9325982417

Computer Aided Engineering Graphics
(Common to All Branches)

I sat Year I/II Semester | **L P T C** | **1 0 4 3**

Course Code: 2420371

List of Lab Exercises for Computer-Aided Engineering Graphics (CAEG)

S. No.	Exercise No.	Title	Description
1	**Exercise No.1**	**Construction of Conic Sections**	Drawing Ellipse, Parabola, and Hyperbola using the general method in Auto CAD.
2	**Exercise No.2**	**Construction of Engineering Curves – Part 1**	Creating Cycloid and Epicycloid using precise CAD techniques.
3	**Exercise No.3**	**Construction of Engineering Curves – Part 2**	Developing Hypocycloid with accurate geometric methods.
4	**Exercise No.4**	**Orthographic Projections of Points**	Projecting points in different quadrants using standard projection techniques.
5	**Exercise No.5**	**Orthographic Projections of Lines**	Visualizing and drawing lines that are parallel, perpendicular, or inclined to reference planes.
6	**Exercise No.6**	**Orthographic Projections of Planes**	Constructing projections of regular lamina (triangle, square, pentagon, hexagon) in various orientations (parallel, perpendicular, inclined).
7	**Exercise No.7**	**Orthographic Projections of Solids**	Representing right regular solids (prism, pyramid, cylinder, cone) in different orientations with respect to reference planes.
8	**Exercise No.8**	**Isometric Projection of 2D Planes**	Creating isometric projections of fundamental 2D geometrical shapes with accurate scaling.
9	**Exercise No.9**	**Isometric Projection of 3D Solids**	Developing isometric views of prisms, pyramids, cylinders, and cones for three-dimensional visualization.
10	**Exercise No.10**	**Conversion of Isometric to Orthographic Views**	Translating isometric projections into detailed orthographic views, maintaining proportional accuracy.
11	**Exercise No.11**	**Conversion of Orthographic to Isometric Views**	Generating isometric drawings from given orthographic projections to develop spatial understanding.
12	**Exercise No.12**	**Final Exercise – Comprehensive Projection and Conversion**	Integrating isometric and orthographic projections to create a complete technical drawing.

CO – (PO, PSO) MAPPING:

Course Outcomes(COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	3	2	1									2		
CO 2	3	2	1		3									1	
CO 3	3	2			3									3	
CO 4	3	3	3	1	3									3	
CO 5	3	3	3	1	3				1	1					2
TOTAL	**15**	**13**	**9**	**3**	**12**				**1**	**1**			**2**	**7**	**2**
AVERAGE	**3**	**3**	**2.25**	**1**	**3**				**1**	**1**			**2**	**2.3**	**2**

Department of Mechanical Engineering
Computer Aided Engineering Graphics

MODULE NO I

CONIC SECTIONS: ELLIPSE, PRABOLA and HYPERBOLA

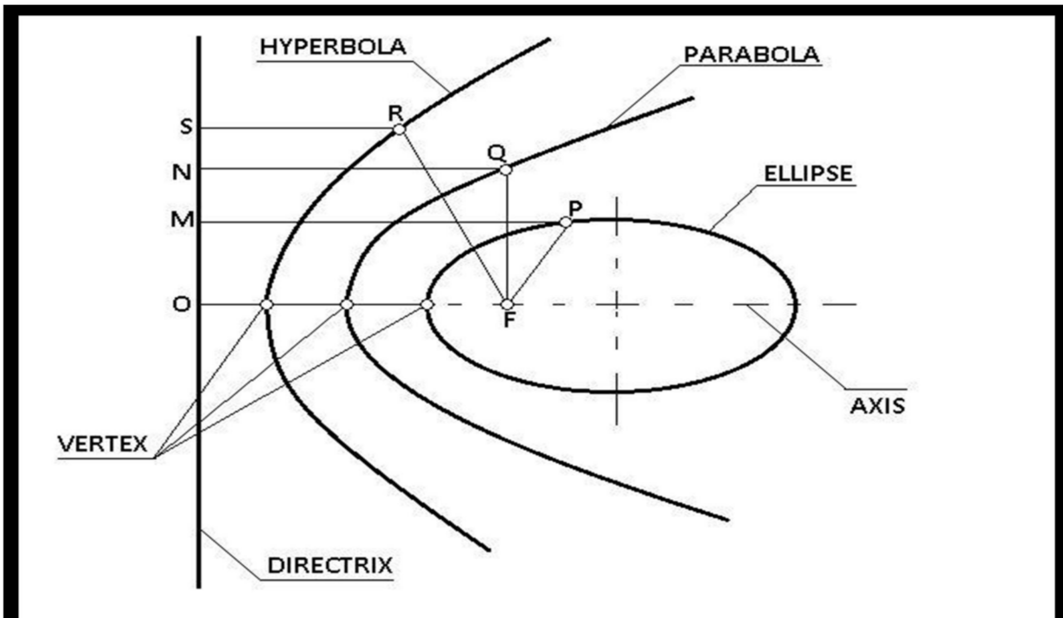
Conic sections are mathematically defined as the curves formed by the locus of a point which moves a plant such that its distance from a fixed point is always in a constant ratio to its perpendicular distance from the fixed-line.

The three types of curves sections are

1. Ellipse
2. Parabola
3. Hyperbola.

The curves, Ellipse, Parabola and Hyperbola are also obtained practically by cutting the curved surface of a cone in different ways.

The profiles of the cut-flat surface from these curves hence called conic sections.



Conic Sections - Terminology

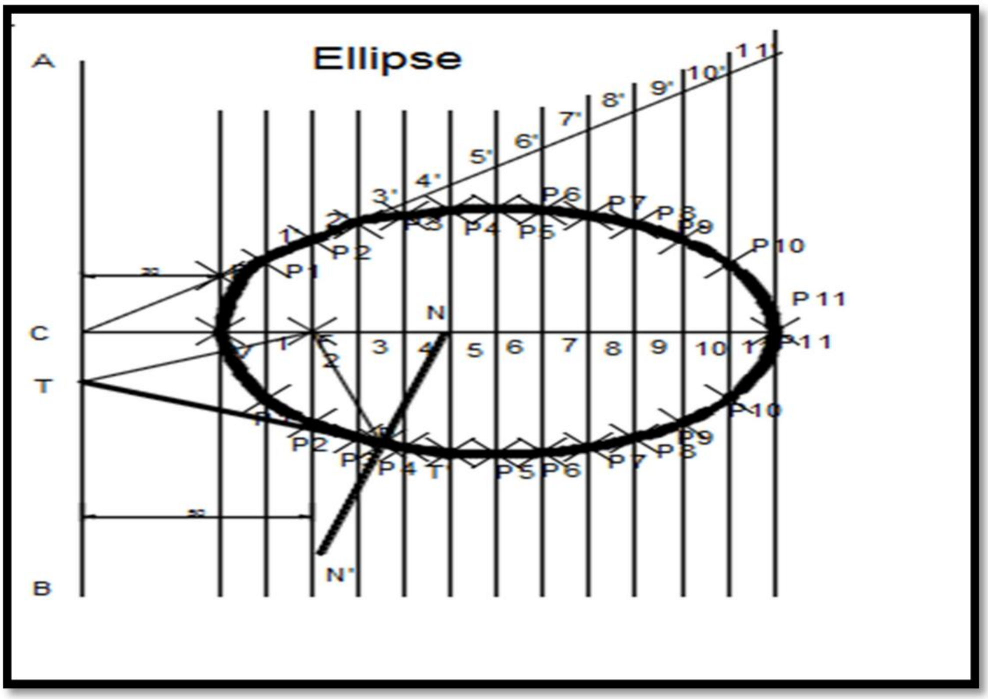
These are the loci of points moving in a plane such that the ratio of its distances from a fixed point and a fixed line always remains constant.
The Ratio is called ECCENTRICITY. €
A) For Ellipse E<1
B) For Parabola E=1
C) For Hyperbola E>1

SHEET NO 1

1. A fixed point is 50mm away from a fixed line. Draw the path traced by a point P moving such that its distance from the fixed point is
i) 2/3 times its distance from the fixed line (E=2/3; ellipse)
ii) Equal to its distance from the fixed line (E=1; Parabola)
iii) 3/2 times its distance from the fixed line. (E=3/2; Hyperbola)

1. TO CONSTRUCT ELLIPSE

SOLUTION: ELLIPSE



PROCEDURE

1. Draw a vertical line AB as Directrix.
2. At mid-point of AB mark, it as C, draw the axis perpendicular to AB (Directrix).
3. Mark a focus F on the axis such that CF=50mm.
4. Divide CF into 5 equal divisions
5. Mark the vertex V on the third division-point from C (e=2/3)
6. At V, draw a perpendicular VE equal to VF. Draw a line joining C & E. Thus, in the triangle CVE, (VE/VC) = (VF/VC) = 2/3.

7. Mark any point 1 on the axis & through it, draw perpendicular to meet CE-produced at 1’

8. With centre F and radius equal to 1-1’, draw arcs to intersect the perpendicular through 1 at point P_1 and P'_1

9. These are the points on the Ellipse, because the distance of P_1 from AB is equal to C1, P_1 F= 1-1’, similarly mark points 2,3 etc on the axis and obtain points P_2 and P'_2, P_3 and P'_3 etc.

10. Draw the ellipse through these points. It is a closed curve having two foci and two directrices

To Draw the tangent and Normal

11. Join P with F.
12. From F, draw a line perpendicular to PF to meet AB at T.
13. Draw a line through T and P. This line is the tangent to the curve.
14. Through P, draw a line NM perpendicular to TP. NM is the normal to the curve.

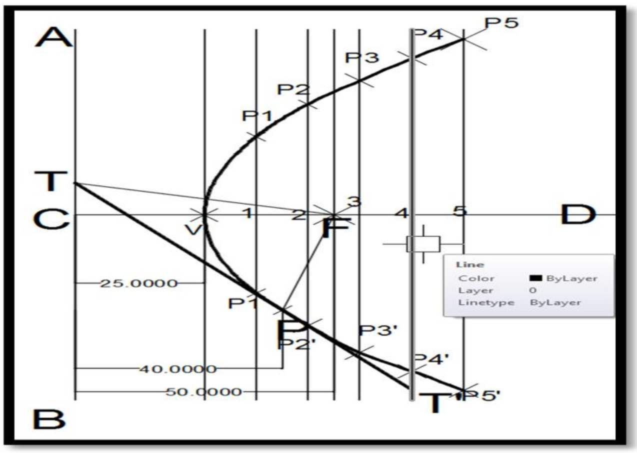
AUTOCAD COMMANDS

1. **Line**
2. **Line division**
3. **Spline**
4. **Arc/ Circle**
5. **D text**
6. **Rotate**
7. **Dimlin/ Dimalign/Dimang**

2. TO CONSTRUCT THE PARABOLA

SOLUTION: PARABOLA

Equal to its distance from the fixed line (E=1; Parabola)



PROCEDURE

1. Draw the directrix AB and the axis CD
2. Mark focus F on CD, 50 mm from C.
3. Bisect CF in V the Vertex (E=1)
4. Mark a number of points 1,2,3 etc on the axis and through them, draw the perpendiculars to it
5. With centre F and radius equal to C1, draw arcs cutting the perpendicular though 1at P1 and P'1
6. Similarly locate points P2 and P'2, P3 and P'3 etc. on both sides of axis.
7. Draw a smooth curve through these points. This curve is required Parabola. It is an open curve.

To Draw Tangent & Normal

8. Join P with F.
9. From F, draw a line perpendicular to PF to meet AB at T.
10. Draw a line through T and P. This line is the tangent to the curve.
11. Through P, draw a line NM perpendicular to TP. NM is the normal to the curve

AUTOCAD COMMANDS

1. **Line**
2. **Offset**
3. **Spline**
4. **Arc/ Circle**
5. **Dtext**
6. **Rotate**
7. **Dimlin/ Dimalign/Dimang**

3. TO CONSTRUCT THE HYPERBOLA

SOLUTION: HYPERBOLA

3/2 times its distance from the fixed line. (E=3/2; Hyperbola)

PROCEDURE

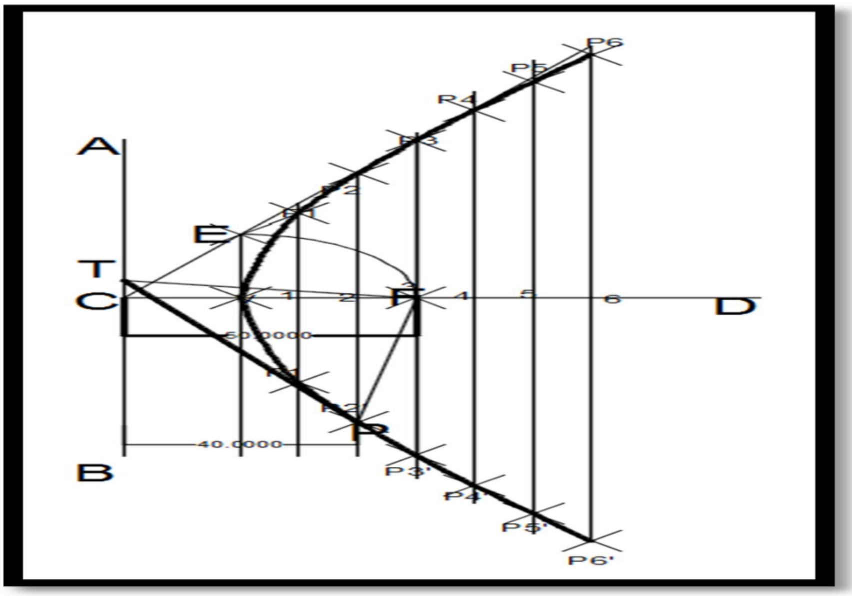
1. Draw the directrix AB and the axis CD
2. Mark the focus F on CD and 65mm from C
3. Divide CF into 5 equal divisions and mark V the vertex, on the second division from C.Thus, eccentricity = VF /VC= 3/2
4. To construct the scale for the ratio, draw a line VE perpendicular to CD such that VE=VF. Join C with E.Thus, in triangle CVE, VE/VC=VF/VC=3/2.
5. Mark any point 1 on the axis and through it, draw a perpendicular to meet CE-

produced at 1 '.

6. With centre F and radius equal to 1-1 ', draw arcs intersecting the perpendicular through 1 at P1 and P'1·
7. Similarly, mark a number of points 2, 3 etc. and obtain points P2 and P'2 , P3 and P'3 etc.
8. Draw the hyperbola through these points.

To draw tangent & normal:

1. Join P with F.
2. From F, draw a line perpendicular to PF to meet AB at T.
3. Draw a line through T and P. This line is the tangent to the curve.
4. Through P, draw a line NM perpendicular to TP. NM is the normal to the curve



AUTOCAD COMMANDS

1. **Line**
2. **Offset**
3. **Spline**
4. **Arc/ Circle**
5. **Dtext**
6. **Rotate**
7. **Dimlin/ Dimalign/Dimang**

SHEET NO 2: CYCLOID, EPICYCLOID and HYPOCYCLOID

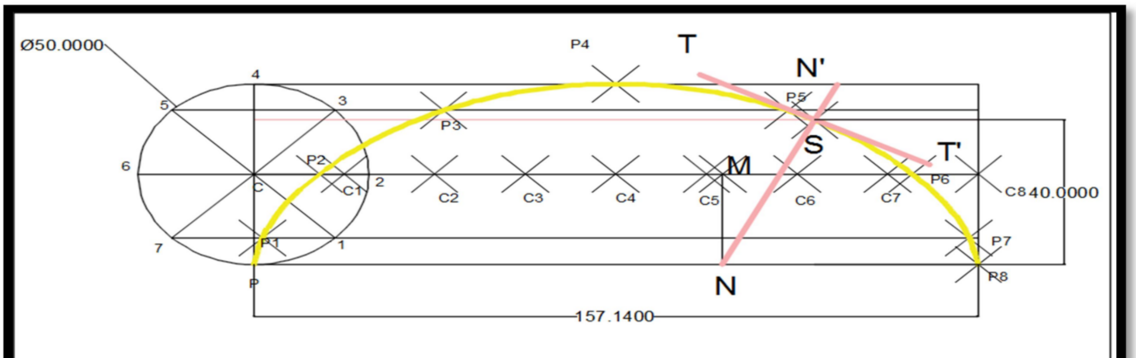
These curves are generated by a fixed point on the circumference of a circle, which rolls without slipping along a fixed straight line or a circle. The rolling circle is called generating circle and the fixed straight line or circle is termed directing line or directing circle. Cycloidal curves are used in tooth profile of gears of a dial gauge.

- ✓ CYCLOID: It is a locus of a point on the periphery of a circle which rolls on a straight line path.
- ✓ EPI-CYCLOID: If the circle is rolling on another circle from outside
- ✓ HYPO-CYCLOID: If the circle is rolling from inside the other circle
- ✓ INVOLUTE: It is a locus of a free end of a string when it is wound round a circular pole

QUESTION NO 1:

A circle of 50 mm diameter rolls along a straight line without slipping. Draw the curve traced out by a point P on the circumference, for one complete revolution of the circle. Name the curve. Draw a tangent to the curve at a point on it 40 mm from the line.

SOLUTION : CYCLOID



Cycloid

PROCEDURE:

1. With centre C and given radius R, draw a circle. Let P be the generating point.
2. Draw a line PA tangential to and equal to the circumference of the circle.
3. Divide the circle and the line PA into the same number of equal parts, say 12, and mark the division-points as shown.
4. Through C, draw a line CB parallel and equal to PA.
5. Draw perpendiculars at points 1, 2 etc. cutting CB at points C1, C2 etc.
6. Assume that the circle starts rolling to the right.

7. When point 1' coincides with 1, centre C will move to C1
8. In this position of the circle, the generating point P will have moved to position P1 on the circle, at a distance equal to P'1 from point 1.

9. It is evident that P1 lies on the horizontal line through 1' and at a distance R from C1.
10. Similarly, P2 will lie on the horizontal line through 2' and at the distance R fromC2
11. Through the points 1 ', 2' etc. draw lines parallel to PA.
12. With centres C1, C2 etc. and radius equal to R, radius of generating circle, draw arcs cutting the lines through 1 ', 2' etc. at points P1, P2 etc. respectively.
13. Draw a smooth curve through points P, P1, P2 •••• A. This curve is the required cycloid.

Tangent and Normal

1. With centre N and radius equal to R, draw an arc cutting CB at M.
2. Through M, draw a line MO perpendicular to the directing line PA and cutting it at 0 is the point of contact and M is the position of the centre of the generating circle, when the generating point P is at N.
3. Draw a line through N and 0. This line is the required normal.
4. Through N, draw a line ST at right angles to NO. ST is the tangent to the cycloid.

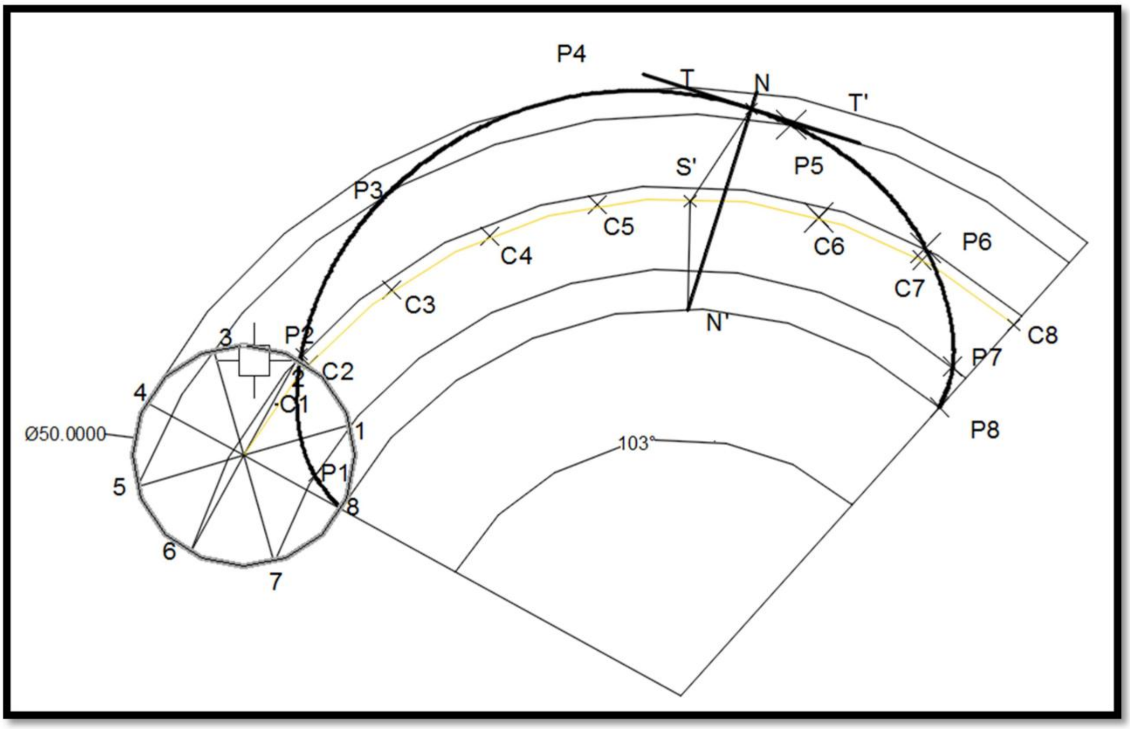
AUTOCAD COMMANDS

1. **Units**
2. **Limits**
3. **Line**
4. **Dtext**
5. **Spline**
6. **Dimlin/ Dimalign/ Dimangle**
7. **Ptype**
8. **Point**
9. **Division**
10. **Circle**
11. **Polar Array**
12. **Copy**
13. **Rotate**

QUESTION NO 2:

A circle of 50 mm diameter rolls on the circumference of another circle of 150 mm diameter and outside it. Trace the locus of a point on the circumference of the rolling circle for one complete revolution. Name the curve. Draw a tangent and a normal to the curve at a point 85 mm from the centre of the directing circle.

SOLUTION: EPICYCLOID



PROCEDURE:

1. With centre O and radius R, draw the directing circle (only a part of it may be drawn). Draw a radius OP and produce it to C, so that CP = r.
2. With C as centre, draw the generating circle. Let P be the generating point.
3. In one revolution of the generating circle, the point P will move to a point A, so that the arc PA is equal to the circumference of the generating circle.
4. The position of A may be located by calculating the angle subtended by the arc PA at centre 0, by the formula,
5. Set-off this angle and obtain the position of A.
6. With centre O and radius equal to OC, draw an arc intersecting QA-produced at B. This arc CB is the locus of the centre C.
7. Divide CB and the generating circle into twelve equal parts.
8. With centre 0, describe arcs through points 1\ 2', 3' etc.
9. With centres C1, C2 etc. and 2 TC r 2 TC R radius equal to r, draw arcs o r = R M cutting the arcs through 1 ', Hypocycloid 2' etc. at points P1, P2 etc. FIG. 6-35
10. Draw the required epicycloid through the points P, P1, P2. A.

Tangent and Normal

1. With centre N and radius equal tor, draw an arc cutting the locus of the centre C at a point D.
2. Draw a line through O and D, cutting the directing circle at M.
3. Draw a line through N and M. This line is the normal.
4. Draw a line ST through N and at right angles to NM. ST is the tangent.

AUTOCAD COMMANDS

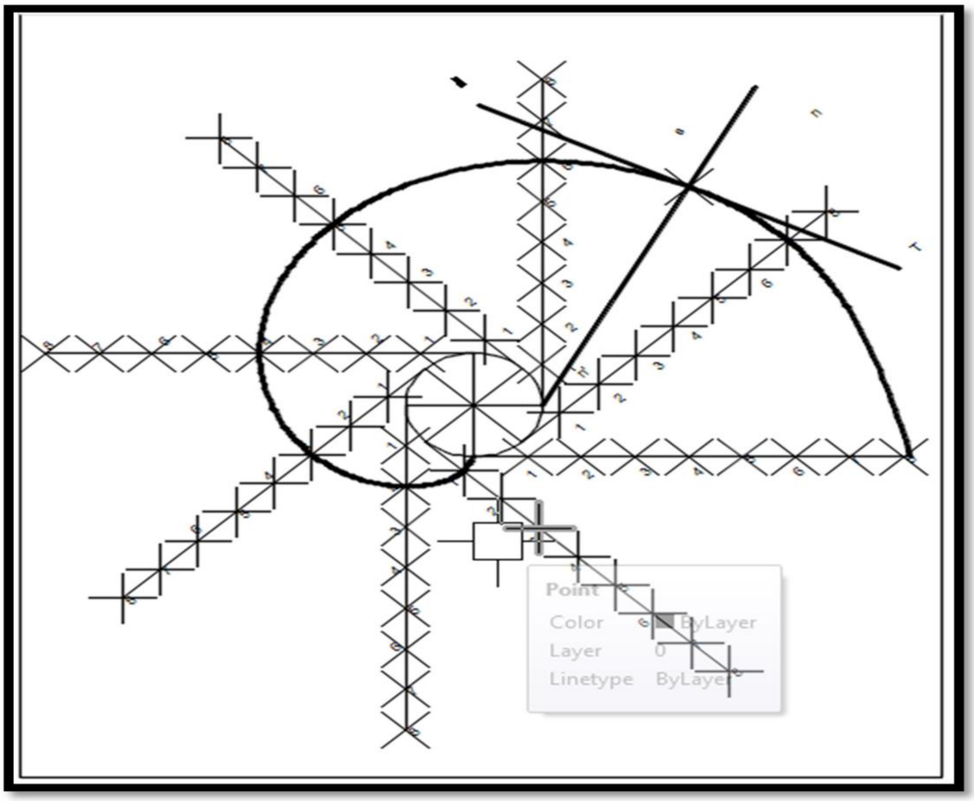
1. **Units**
2. **Limits**
3. **Line**
4. **Dtext**
5. **Spline**
6. **Dimlin/ Dimalign/ Dimangle**
7. **Ptype**
8. **Point**
9. **Division**
10. **Circle**
11. **Polar Array**
12. **Copy**
13. **Rotate**

SHEET NO 3: INVOLUTES

QUESTION NO 1

1. Draw the Involute of the following:
a. Circle of 50mm diameter
b. Square of 30mm sides

SOLUTION: FOR A CIRCLE



PROCEDURE

1. Draw a line PQ, tangent to the circle and equal to the circumference of the circle.
2. Divide PQ and the circle into 12 equal parts.
3. Draw tangents at points 1, 2, 3 etc. and mark on them points P_1, P_2, P_3 etc. such that $1P_1 = P_1'$,
   $2P_2 = P_2'$, $3P_3 = P_3'$ etc.
4. Draw the involute through the points P, P_1, P_2 •... etc.

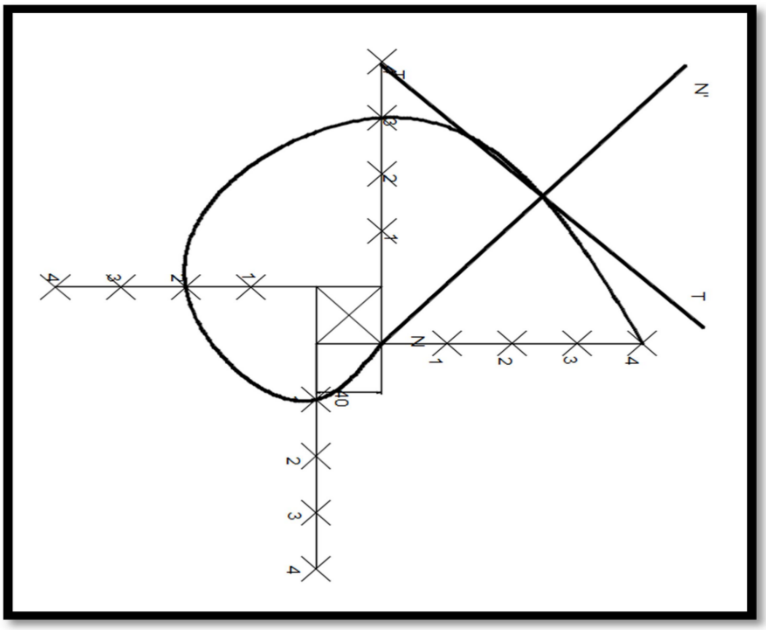
Tangent and Normal

1. Draw a line joining C with N.
2. With CN as diameter describe a semi-circle cutting the circle at M.
3. Draw a line through N and M. This line is the normal. Draw a line ST, perpendicular to NM and passing through N. ST is the tangent to the involute.

AUTOCAD COMMANDS:

1. **Units**
2. **Limits**
3. **Line**
4. **Dtext**
5. **Spline**
6. **Dimlin/ Dimalign/ Dimangle**
7. **Ptype**
8. **Point**
9. **Division**
10. **Circle**
11. **Polar Array**
12. **Copy**
13. **Rotate**

SOLUTION: FOR A SQUARE



PROCEDURE:

1. let ABCD be the given square.
2. With centre A and radius AD, draw arc to cut the line BA-produced at a point P_1.
3. With centre B and radius BP1 (i.e. BA + AD) draw an arc to cut the line CB-produced at a point P2.
4. Similarly, with centres C and D and radii CP2 (i.e. CB + BA + AD) and DP3 (i.e. DC
5. + CB + BA + AD = perimeter) respectively, draw arcs to cut DC-produced at a point P3 and AD-produced at a point P_4.
6. The curve thus obtained is the involute of the square.

AUTOCAD COMMANDS:

1. **Units**
2. **Limits**
3. **Line**
4. **Dtext**
5. **Spline**
6. **Dimlin/ Dimalign/ Dimangle**
7. **Ptype**
8. **Point**
9. **Division**
10. **Copy**
11. **Rotate**

OPEN ENDED QUESTIONS:

1. Explore how to construct a rectangular hyperbola when a point on the curve is located at specific distances from both asymptotes. How would you approach this task if the point is 40 mm away from one asymptote and 50 mm from the other? What geometric principles and techniques would be useful in this construction?
2. Investigate the process of constructing a hypocycloid when a smaller circle rolls inside a larger circle. If the smaller circle has a diameter of 50 mm and the larger circle has a radius of 90 mm, how would you go about constructing this hypocycloid? What variations might occur if the dimensions were altered?
3. Consider the steps involved in drawing the involute of a pentagon with 30 mm sides. What methods could be used to accurately create this involute? How would the construction change if the number of sides or the length of the sides of the polygon were different?

Department of Mechanical Engineering
Computer Aided Engineering Graphics

Projections of Points
MODULE NO II

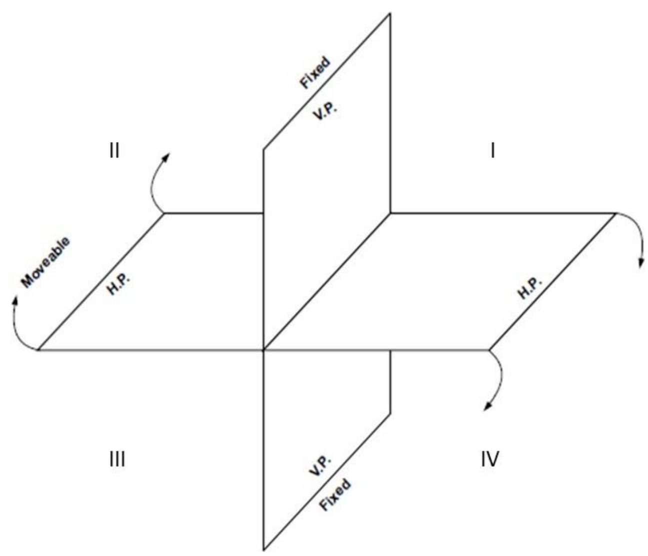
Point

A point usually represented by a dot is a dimensionless geometrical entity that has a position but no magnitude. Whereas in computer aided engineering drawing the point has dimension but it is not considered or neglected. A point is obtained wherever two straight or curved lines intersect each other.

Projection of Points

Projection of points in various quadrants is the basis for projection of lines, projection of planes and projection of solids. In a conventional coordinate system, the position of a point in space is denoted by its three coordinates i.e., x, y and z.

In projections, two principal planes are used to get the projection of an object that is vertical plane and horizontal plane, the vertical plane denoted by (V.P.) and horizontal plane denoted by (H.P.) as shown in Fig. They intersect each other at right angles and the line of intersection is known as axis of the plane. The vertical plane of projection is always infront of the observer and the projection on this plane is known as front view or elevation. The other plane is the horizontal plane of projection and the projection on this plane is called the top view or plan.

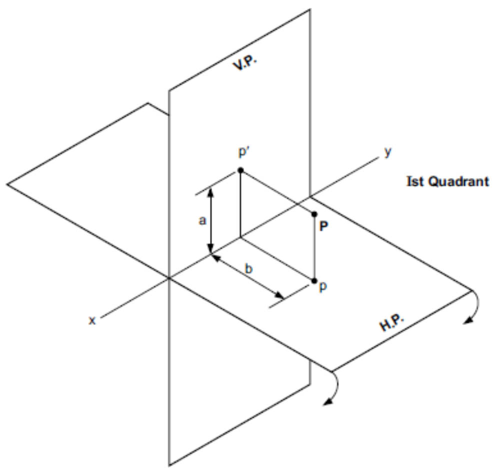


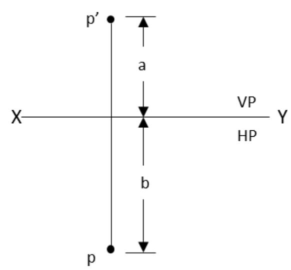
Pictorial view of Principal Planes

The view obtained by viewing object form right side is called right side view or right end view. A plane perpendicular to both H.P. and V.P. is called profile plane (P.P). The right side view is always on the right to the front view. If the object is viewed from left on profile plane then the view is known as left side view or left end view.

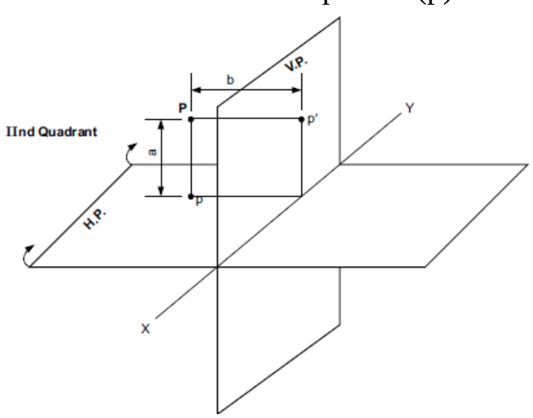
Position of Points in Various Quadrants

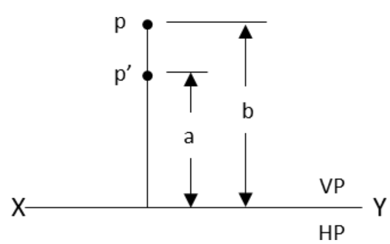
1. When point is in First Quadrant
   When a Point P is situated in I quadrant i.e., above H.P. and in front of V.P. , Its front view (p') will be above XY line and its top view (p) will be below the XY line.



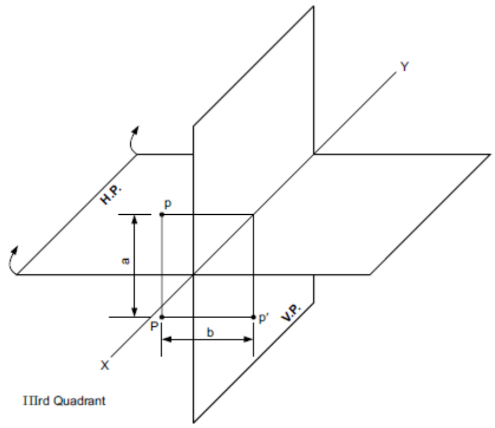


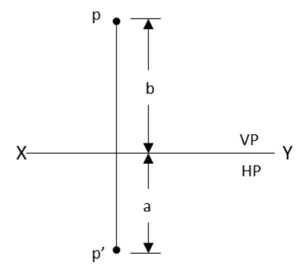
2. When point is in Second Quadrant
   When a Point P is situated in II quadrant i.e., above H.P. and behind V.P. , Its front view (p') will be above XY line and its top view (p) will also be above the XY line.



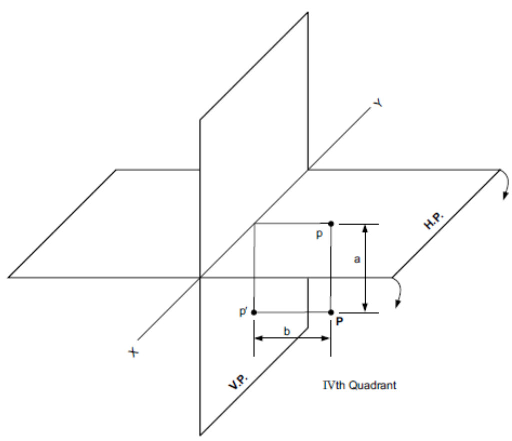


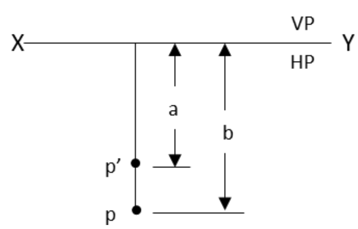
3. When point is in Third Quadrant
   When a Point P is situated in III quadrant i.e., below H.P. and behind of V.P. , Its front view (p') will be below XY line and its top view (p) will be above the XY line.





4. When point is in Fourth Quadrant
   When a Point P is situated in IV quadrant i.e., below H.P. and infornt V.P. , Its front view (p') will be below XY line and also its top view (p).





Positions of geometrical entities in various quadrants of the projections

When	Position		Quadrant	Front View	Top View
	VP	HP			
Point is	Infront	Above	I	Above XY	Below XY
Point is	Behind	Above	II	Above XY	Above XY
Point is	Behind	Below	III	Below XY	Above XY
Point is	Infront	Below	IV	Below XY	Below XY
Point is	Infront	In or on	I or IV	On XY	Below XY
Point is	In or on	Above	I or II	Above XY	On XY
Point is	Behind	In or on	II or III	On XY	Above XY
Point is	In or on	Below	III or IV	Below XY	On XY
Point is	In or on	In or on	I, II, III, or IV	On XY	On XY

System of Notation

1. The actual points in space are denoted by capital letters A, B, C etc.
2. The front view (FV) of the points are denoted by their corresponding lower-case letters with dashes as a', b', c', etc.
3. The top view (TV) of the points are denoted by their corresponding lower-case letters without dashes as a, b, c etc.
4. The side view (SV) of the points are denoted by their corresponding lower-case letters with double dashes as a", b", c" etc.
5. Projectors are always drawn as continuous thin lines and Points with Dot.

In Computer Aided Engineering Graphics for projection of points following commands are used other than evoking software, opening file, saving file and giving print command. Using these minimum nine commands any type of projection of point problem can be solved they are as follows:

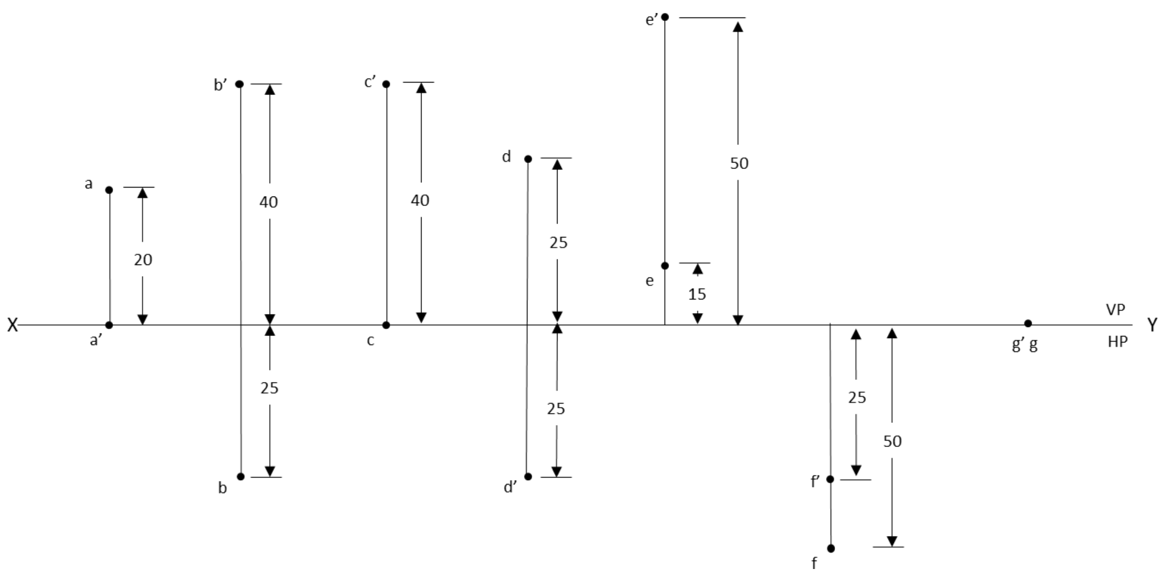
1. Select tool Command.
2. Point command.
3. Poly-line command.
4. Two point line command.
5. Parallel line command.
6. Bisector command.
7. Smart dimension command.
8. Line width command.

9. Insert text command.

Solved Problem:

1. Draw the projections of the following points on the same ground line, keeping the projectors 25 mm apart.

i. A is in the H.P. and 20 mm behind the V.P.
ii. B is 40 mm above the H.P. and 25 mm in front of the V.P.
iii. C is in the V.P. and 40 mm above the H.P.
iv. D is 25 mm below the H.P. and 25 mm behind the V.P.
v. E is 15 mm above the H.P. and 50 mm behind the V.P.
vi. F is 40 mm below the H.P. and 25 mm in front of the V.P.
vii. G is in both the H.P. and the V.P.



Solution

1. Open the Software. Click on the Application Menu and click on New and select "acad "in the open dialog box and click Open.
2. Enter the command "UNITS "in command bar and Select units as "Millimeters and click ok.
3. Enter the command "LIMITS "in command bar and enter 0,0 click enter and enter upper right corner as 120,90 and click enter
4. Enter the command "ZOOM "in command bar and enter A and click enter
5. As per the problem ,draw a XY line by using Xline command. Mark VP and HP above and below it by using "XTEXT" command in command bar
6. Divide the line into some equal parts depend upon how many points given.
7. Draw the lines representing the Projectors as per the dimensions mentioned in the problem and mark the front and top views of the points using P**oint** command.
8. Mention the dimensions for all points from the XY line using **dimlinear** command

Practice Problems

1. Draw the orthographic projections of the following points.
   i. Point P is30 mm. above H.Pand40mm.infrontof VP.
   ii. Point Q is25 mm. Above H.P and 35mm.behind VP.
   iii. Point R is 32 mm. below H.P and 45mm behind VP.
   iv. Point S is 35 mm. below H.P and 42mm in front to VP.
   v. Point T is in H.P and 30 mm behind VP.
   vi. Point U is in V.P and 40 mm. below HP.
   vii. Point V is in V.P and 35 mm. above H.P.
   viii. Point W is in H.P and 48 mm. in front of VP.

2. Draw the projections of the following points on the same XY line, keeping convenient distance between each projectors. Name the quadrants in which they lie.
   i. Point A is 30 mm above HP and 35 mm in front of VP.
   ii. Point B is 35 mm above HP and 40 mm behind VP.
   iii. Point C is 40 mm above HP and on VP.
   iv. Point D is 35 mm below HP and 30 mm in front of VP.

3. Draw the projections of the following points on the same XY line, keeping convenient distance between each projectors. Name the Quadrants in which they lie.
   i. Point E is 30 mm below HP and 25 mm behind VP.
   ii. Point F is 35 mm below HP and 30 mm in front of VP.
   iii. Point G is on HP and 30 mm in front of VP.
   iv. Point H is on HP and 35 mm behind VP.

Projection of Straight Lines

Introduction

A line may be defined as the locus of a point moving along a fixed path. A line consists of a number of points; its projections are drawn by joining the projection of its extreme (end) points. Hence, the projections of a straight line may be drawn by joining the respective projections of its ends, which are points. In a conventional drawing, a line has only length but no thickness . Whereas in computer aided engineering graphics the line has length and thickness.

The position of a straight line may have different orientations in space. As per first angle projection, it may be parallel, perpendicular or inclined to either or both the Reference planes (horizontal or vertical planes) as mentioned in the below classification.

Classification of Line Positions

A line may be placed in infinite number of positions with respect to the reference planes. These positions may be classified according to the inclination of the line to reference planes and the quadrants in which it is placed.

1. Line parallel to both the reference planes (HP & VP)
   (a) Line away from both HP and VP.
   (b) Line in HP and away from VP.
   (c) Line in VP and above HP.
   (d) Line on both HP and VP.

2. Line perpendicular to either of reference planes (HP or VP)
   (a) Line perpendicular to HP and away from VP.
   (b) Line perpendicular to HP and on VP.
   (c) Line perpendicular to VP and above HP.
   (d) Line perpendicular to VP and on HP.

3. Line inclined to HP and parallel to VP
   (a) Line inclined to HP, parallel to VP and away from VP.
   (b) Line inclined to HP, parallel to VP and in VP.

4. Line inclined to VP and parallel to HP
   (a) Line inclined to VP, parallel to HP and away from HP.
   (b) Line inclined to VP, parallel to HP and in HP.

5. Line inclined to both HP and VP
   (a) One end of line in HP and the other end away from VP.

(b) One end of line in VP and the other end away from HP.
(c) One end above HP and the other end away from VP.
(d) One end away from VP and the other end above HP.
(e) One end in HP and VP and other end away from HP and VP.
(f) Both ends on HP and VP.

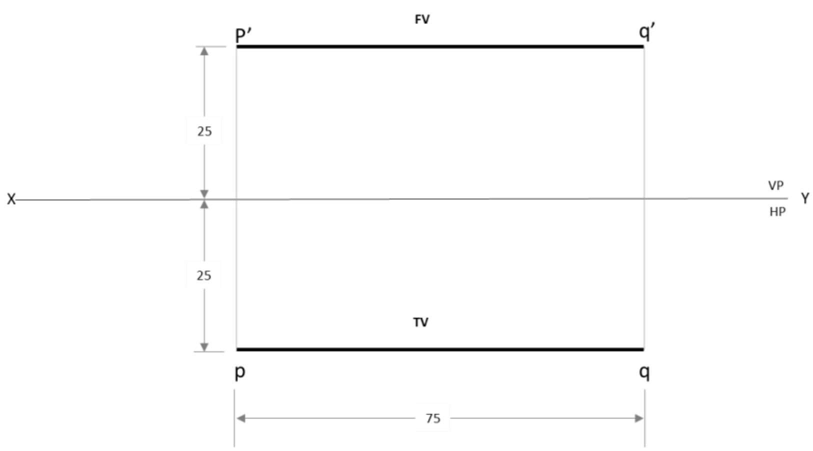
System of Notation

1. The actual line in space is denoted by capital letters A and B, or C and D etc.
2. The front view (FV) of a line is denoted by their corresponding lower letters with dashes as a' and b', c' and d' etc.
3. The top view (TV) of a line is denoted by their corresponding lower case letters without dashes as a and b, c and d etc.
4. The side view (SV) of a line are denoted by their corresponding lower case letters with double dashes as a'' and b'', c'' and d'' etc.
5. Projectors are always drawn as continuous thin lines.
6. Line with specific thickness for a particular type of line.

Solved Problems

1. Draw the projections of a 75 mm long straight line, in the following positions:
   i. Parallel to both the H.P. and the V.P. and 25 mm from each.
   ii. Perpendicular to the H.P., 20 mm in front of the V.P. and its one end 15 mm above the H.P.
   iii. Inclined at 30° to the H.P. and its one end 20 mm above it; parallel to and 30 mm in front of the V.P.

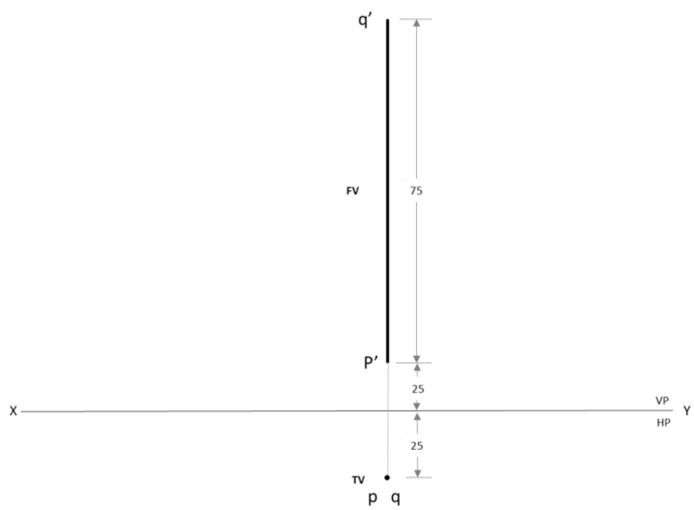
i. Parallel to both the H.P. and the V.P. and 25 mm from each.



Solution:

1. Draw XY line Using Xline Command.
2. Mark the annotations X, Y, VP, HP to the line drawn by using INSERT TEXT command from drafting tool bar. This must be done just by typing and inserting at the required positions using the left click of the mouse.
3. According to question 75 mm line Parallel and 25 mm from HP put the Point 25 mm from above XY line by Using Point Command Name the Point with p'
4. As per the problem, mark points p, q, p' and q' according to the dimensions given on boths side of XY line.
5. Draw a line of 75 mm that is parallel and above XY from point p' to q' by using Text command.
6. Draw another line of 75 mm parallel line and below XY from point p to q by using Text command
7. Mention the Dimensions by using **DIMLINEAR** Command.

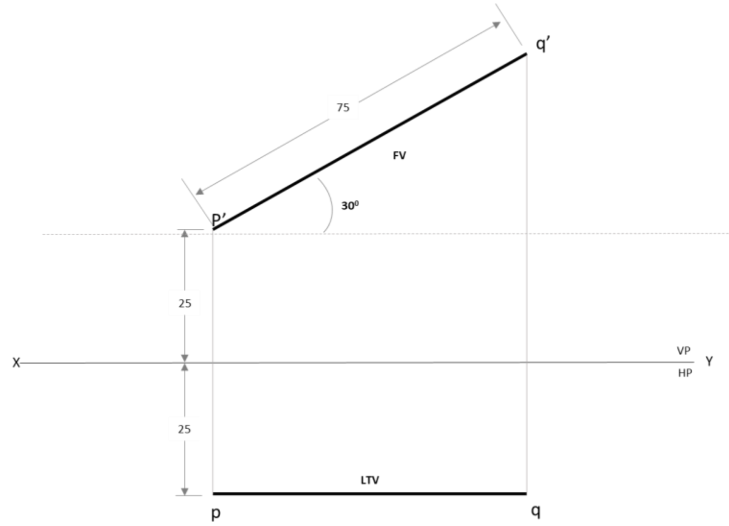
ii. Perpendicular to the H.P., 20 mm in front of the V.P. and its one end 15 mm above the H.P.



Solution:

1. Draw XY line By Using Line Command **L** and Name with X,Y at two ends By Using Text Command
2. According to question 75 mm line perpendicular to HP and 15 mm above HP. put the Point 15 mm from above XY line by Using Point Command Name the Point with p'
3. Line Parallel to and 25 mm in front of VP Put the point 25 mm below the XY line by using Point Command. Name the Point with p.
4. Draw 75 mm perpendicular line from p'. Name the end point q' by using Text command
5. When line Perpendicular to HP & Parallel to VP in top view Line Like Point its two end points on the same point then mention q on the same point 25 below XY line
6. Mention the Dimensions by using **DIMSTYLE** Command.

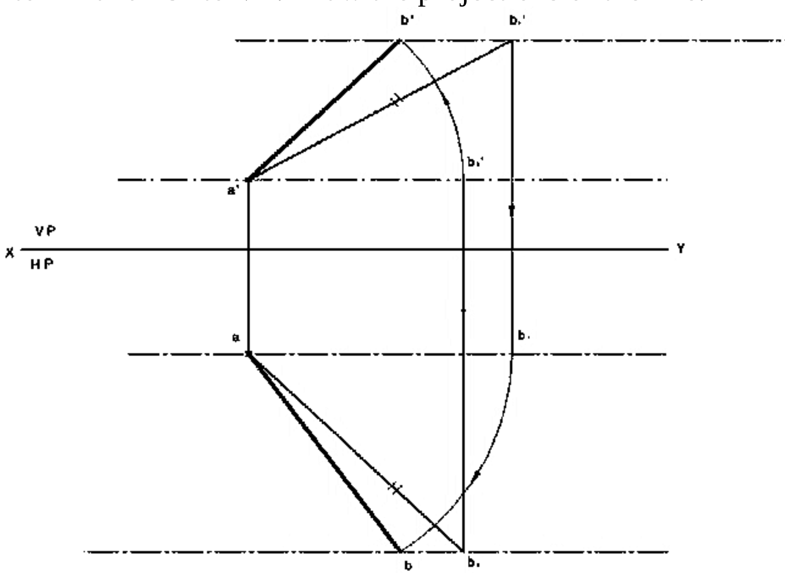
iii. Inclined at 30° to the H.P. and its one end 20 mm above it; parallel to and 30 mm in front of the V.P.



Solution:

1. Draw XY line By Using Line Command **L** and Name with X,Y at two ends By Using Text Command
2. According to question 75 mm line30 inclined and 20 mm above the H.P put the Point 20 mm from above XY line by Using Point Command Name the Point with p'
3. Line Parallel to and 30 mm in front of VP Put the point 30 mm below the XY line by using Point Command. Name the Point with p.
4. Draw 75 mm linen from p' with inclination of 30. Name the end point q' by using Text command Name it F.V
5. When line Inclined to HP & Parallel to VP in top view Line will be reduced Draw Perpendicular line from q' to locus of p name the intersection point as q & Name the reduced line as Length of Top View (LTV).
6. Mention the Dimensions by using **DIMLINEAR** Command.

2. A line AB 80 mm long has its end A 20 mm above the HP and 30 mm in front of VP. It is inclined at 30° to HP and 45° to VP. Draw the projections of the line.



Solution:

1. Draw XY line By Using Line Command **L** and Name with X,Y at two ends By Using Text Command
2. According to question 80 mm line 30^{θ} inclined and 20 mm above the H.P put the Point 20 mm from above XY line by Using Point Command Name the Point with p’
3. Draw 80 mm line from p’ with inclination of 30 $^{\theta}$. Name the end point q1’ by using Text command
4. According to question 80 mm line 45^{θ} inclined and 30 mm in front of V.P put the Point 30 mm from above XY line by Using Point Command Name the Point with p
5. Draw 80 mm line from p with inclination of 45^{θ}. Name the end point q2 by using Text command
6. Draw perpendicular line from q1’ to locus of p name it As q1. Draw another Perpendicular line from q2 to locus od p1 name the intersection point as q2’
7. Name p’q2’ Line as LFV and Name pq1 line as LTV.
8. For Final front View take P’ as center p’q2’line as radius draw arc which will intersect Locus of P’ at q’ Join p’q’ LINE it as FFV
9. For Final Top View take P as center p’q1’ line as radius draw arc which will intersect Locus of P at q Join p q line it as FTV
10. Mention the Dimensions by using **DIMLINEAR** Command.

Practice Problems:

1. The top view of a line AB, 80 mm long measures 65 mm and the length of the front view is 50 mm. The end A is on HP and 15 mm infront of VP. Draw the projections
2. Line AB has its end A 20 mm above the HP and 15 mm infront of the VP. The other end B is 60 mm above the HP and 45 mm in front of VP. The distance between end projectors is 70 mm. Draw its projections. Determine the apparent lengths and true inclinations.
3. A line has its end A 10 mm above HP and 15 mm in front of VP. The end B is 55 mm above HP and line is inclined at 30º to HP and 35º to VP. The distance between the end projectors is 50 mm. Draw the projections of the line. Determine the true length of the line and its inclination with VP.
4. A line CD 60mm long has its end 'C' in both H.P. and V.P. It is inclined at 30^0 to H.P. and 45^0 to V.P. Draw the projections.
5. A point C is 40mm below H.P. and 20mm behind V.P. another points D and E are 60mm above H.P. and in front V.P., 90mm below H.P. and 45mm in front of V.P. respectively. Draw the projections of all points on same reference line.
6. The end P of a straight line PQ is 20 mm above the H.P. and 30mm in from V.P. The end Q is 15mm below the H.P. and 45mm behind the V.P. If the end Projectors are 50mm apart, Draw the Projection of PQ and determine the true length, traces and inclination with the reference planes.
7. The front view of line inclined at 30^0 to V.P. is 65mm long. Draw the projections of a line, when it is parallel to and 40mm above H.P. and one end being 20mm in front of V.P.
8. Line PQ has72mm length in the front view and 66mm length in the top view. The end P is 48mm below HP and 40mm behind VP, while the end Q is 12mm below HP. Draw the projection of the line, locate the traces and determine the true length and inclinations of the line with the reference planes.

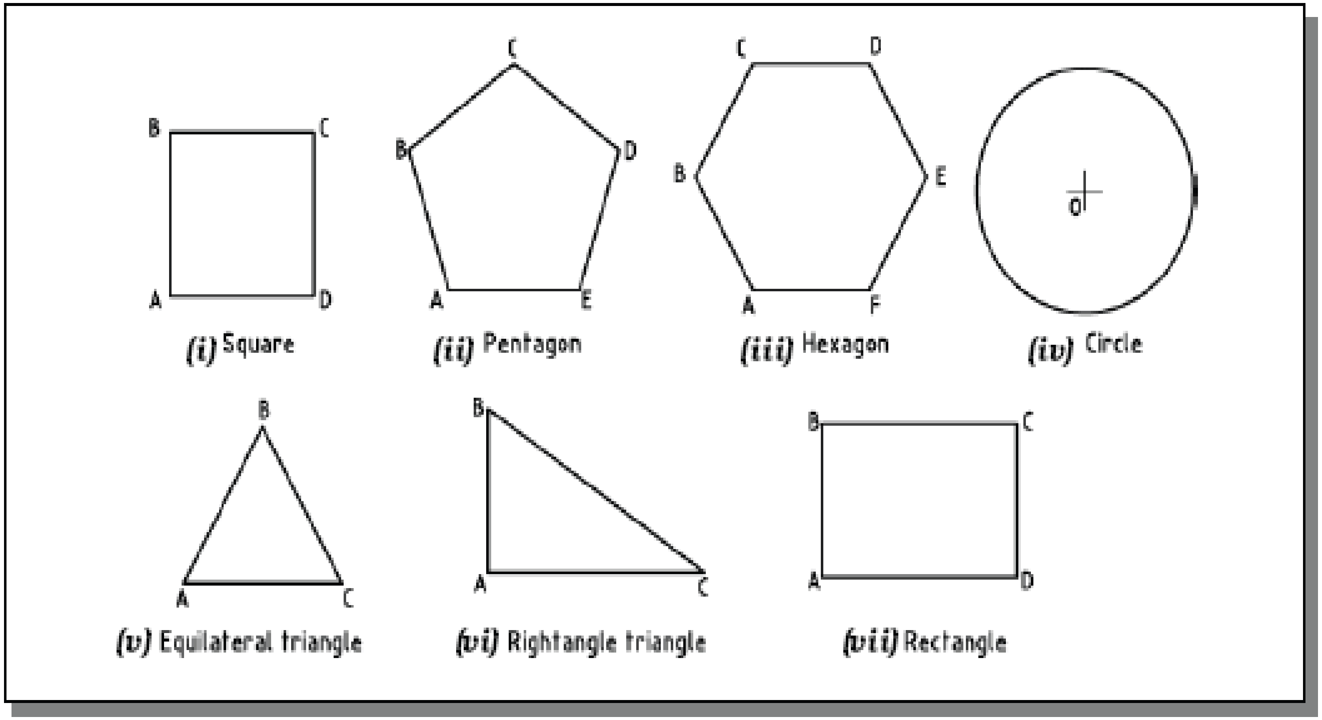
OPEN ENDED QUESTIONS

1. A line AB 80 mm long is inclined at 30° to the HP and 45° to the VP. The end A is 20 mm above HP and 30 mm in front of VP. Draw the projections of the line and find its traces.

2. The top view of a line measures 65 mm and makes an angle of 40° with the XY line. Its front view measures 50 mm and makes an angle of 35° with the XY line. The end A of the line is 25 mm above HP and 35 mm in front of VP. Draw the projections and determine the true length and true inclinations of the line.

PROJECTIONS OF PLANES

A plane is a two dimensional object having length and breadth only. Its thickness is always neglected. Various shapes of plane figures are considered such as square, rectangle, circle, pentagon, hexagon, etc.



PROJECTIONS OF PLANES

In this topic various plane figures are the objects.

What is usually asked in the problem?

To draw their projections means F.V, T.V. & S.V.

What will be given in the problem?

1. Description of the plane figure.
2. It's position with HP and VP.

In which manner it's position with HP & VP will be described?

1. **Inclination of it's SURFACE with one of the reference planes will be given.**
2. Inclination of one of it's EDGES with other reference plane will be given

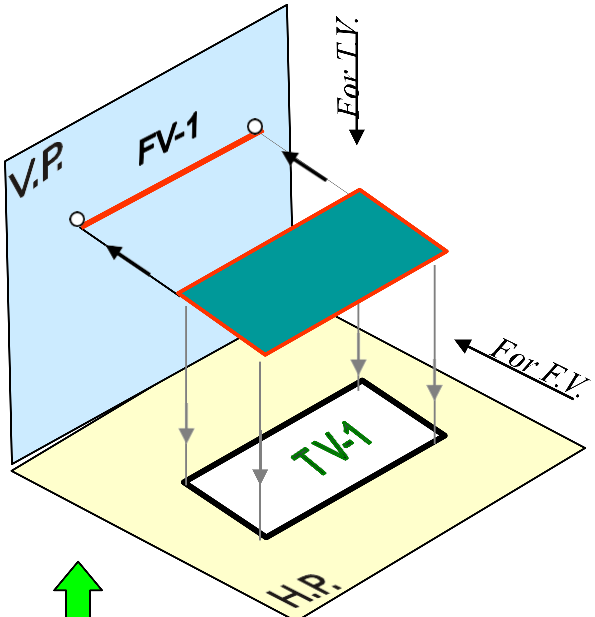
(Hence this will be a case of an object inclined to both reference Planes.)

Study the illustration showing surface & side inclination given on next page.

CASE OF A RECTANGLE – OBSERVE AND NOTE ALL STEPS.

SURFACE **PARALLEL** TO HP

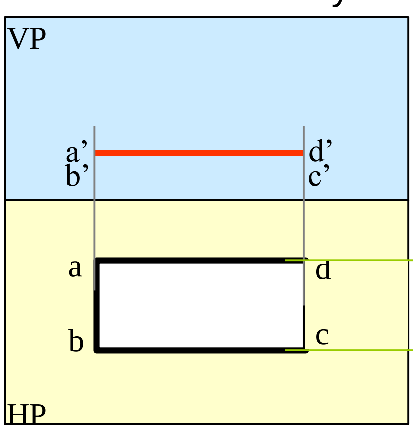
PICTORIAL PRESENTATION



ORTHOGRAPHIC

TV-True Shape

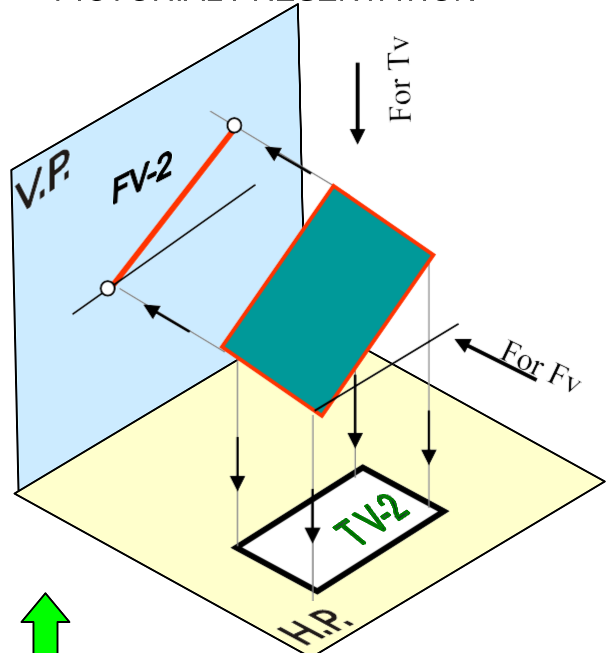
FV- Line // to xy



A

SURFACE **INCLINED** TO HP

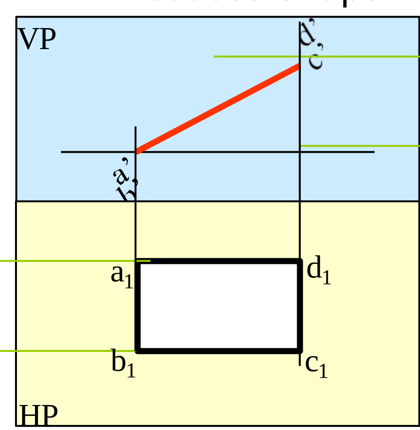
PICTORIAL PRESENTATION



ORTHOGRAPHIC

FV- Inclined to XY

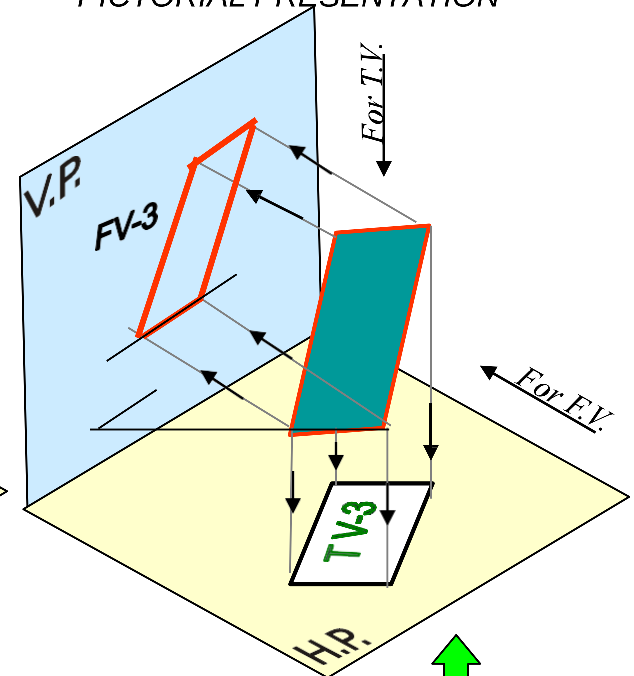
TV- Reduced Shape



B

ONE SMALL SIDE INCLINED TO VP

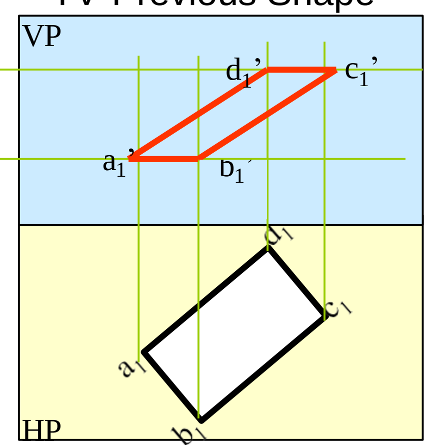
PICTORIAL PRESENTATION



ORTHOGRAPHIC

FV- Apparent Shape

TV-Previous Shape



C

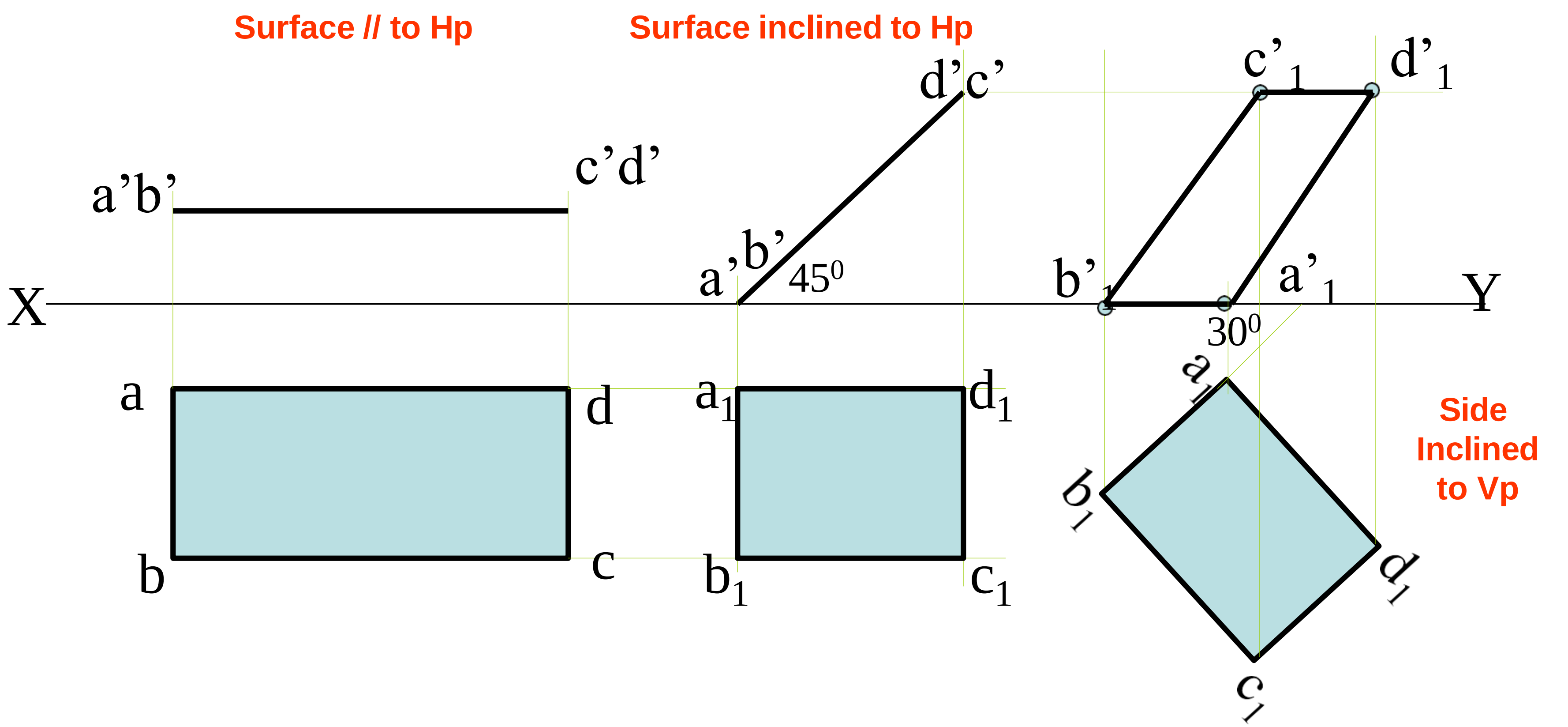
Problem 1:

Rectangle 30mm and 50mm sides is resting on HP on one small side which is 30^0 inclined to VP,while the surface of the plane makes 45^0 inclination with HP. Draw it's projections.

Read problem and answer following questions

1. Surface inclined to which plane? ------- HP
2. Assumption for initial position? ------// to HP
3. So which view will show True shape? --- TV
4. Which side will be vertical? ---One small side.

Hence begin with TV, draw rectangle below X-Y drawing one small side vertical.

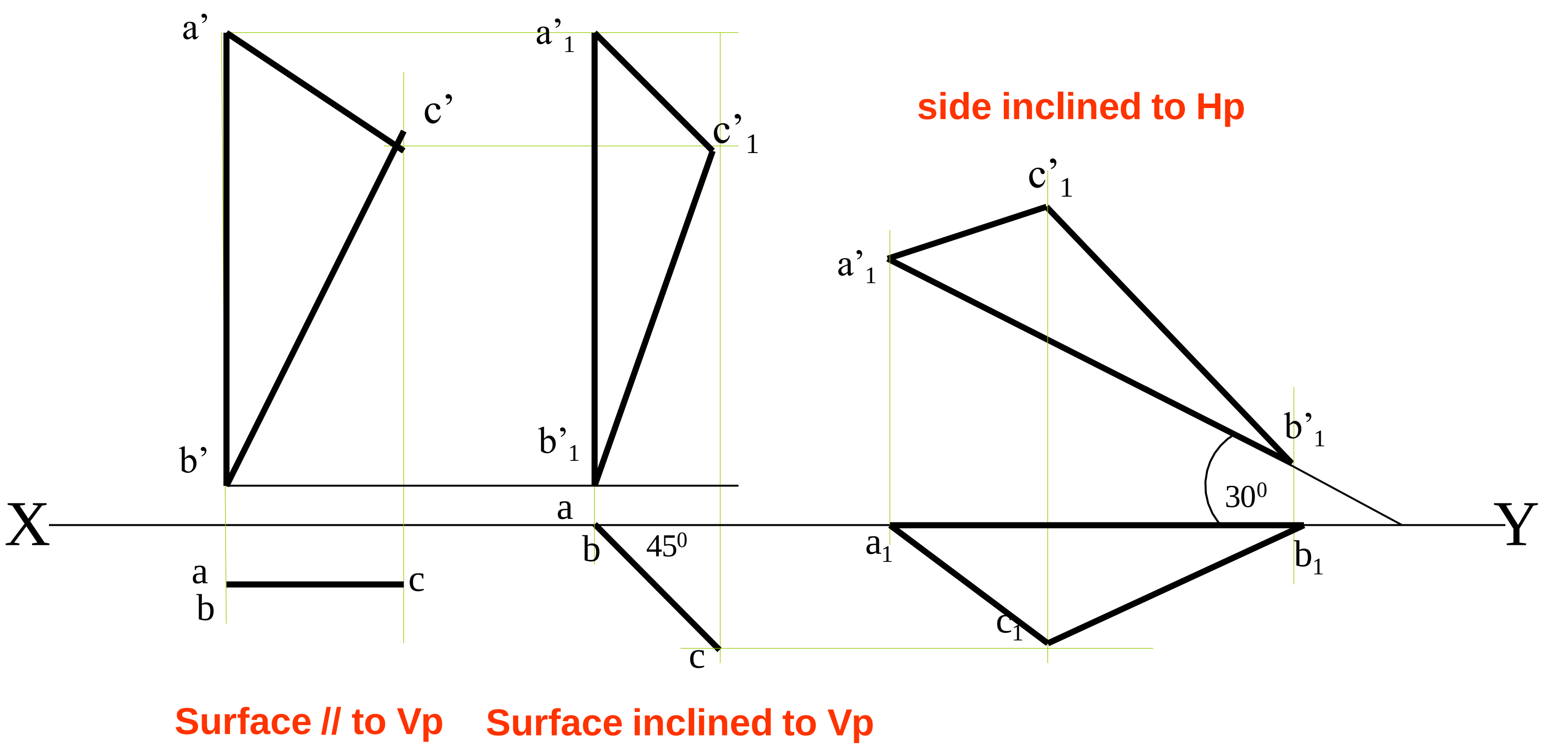


Problem 2:
A $30^0 - 60^0$ set square of longest side 100 mm long, is in VP and 30^0 inclined to HP while it's surface is 45^0 inclined to VP.Draw it's projections

(Surface & Side inclinations directly given)

Read problem and answer following questions
1 .Surface inclined to which plane? ------- VP
2. Assumption for initial position? ------// to VP
3. So which view will show True shape? --- FV
4. Which side will be vertical? ------longest side.

Hence begin with FV, draw triangle above X-Y keeping longest side vertical.



Problem 3:

A $30^0 - 60^0$ set square of longest side 100 mm long is in VP and it's surface 45^0 inclined to VP. One end of longest side is 10 mm and other end is 35 mm above HP. Draw it's projections

(Surface inclination directly given. Side inclination indirectly given)

Read problem and answer following questions

1 .Surface inclined to which plane? ------- VP

2. Assumption for initial position? ------// to VP

3. So which view will show True shape? --- FV

4. Which side will be vertical? ------longest side.

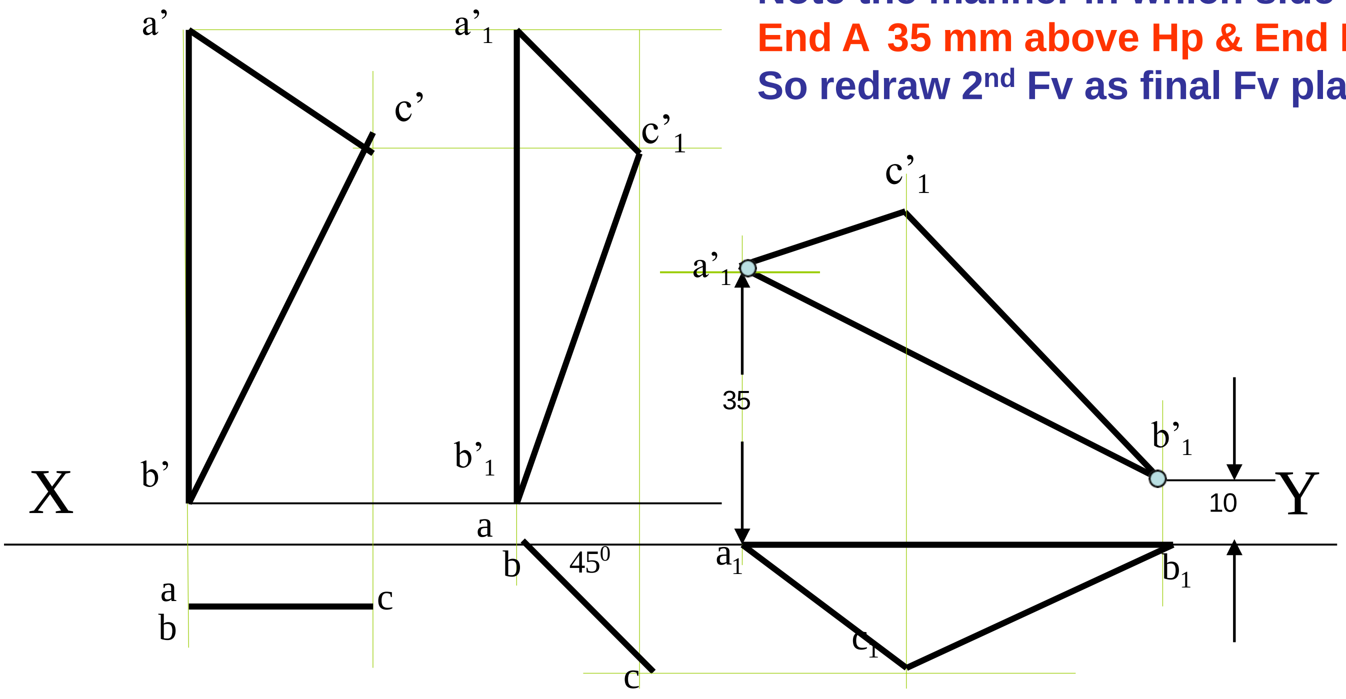
Hence begin with FV, draw triangle above X-Y keeping longest side vertical.

First TWO steps are similar to previous problem.

Note the manner in which side inclination is given.

End A 35 mm above Hp & End B is 10 mm above Hp.

So redraw 2nd Fv as final Fv placing these ends as said.



Problem 4:

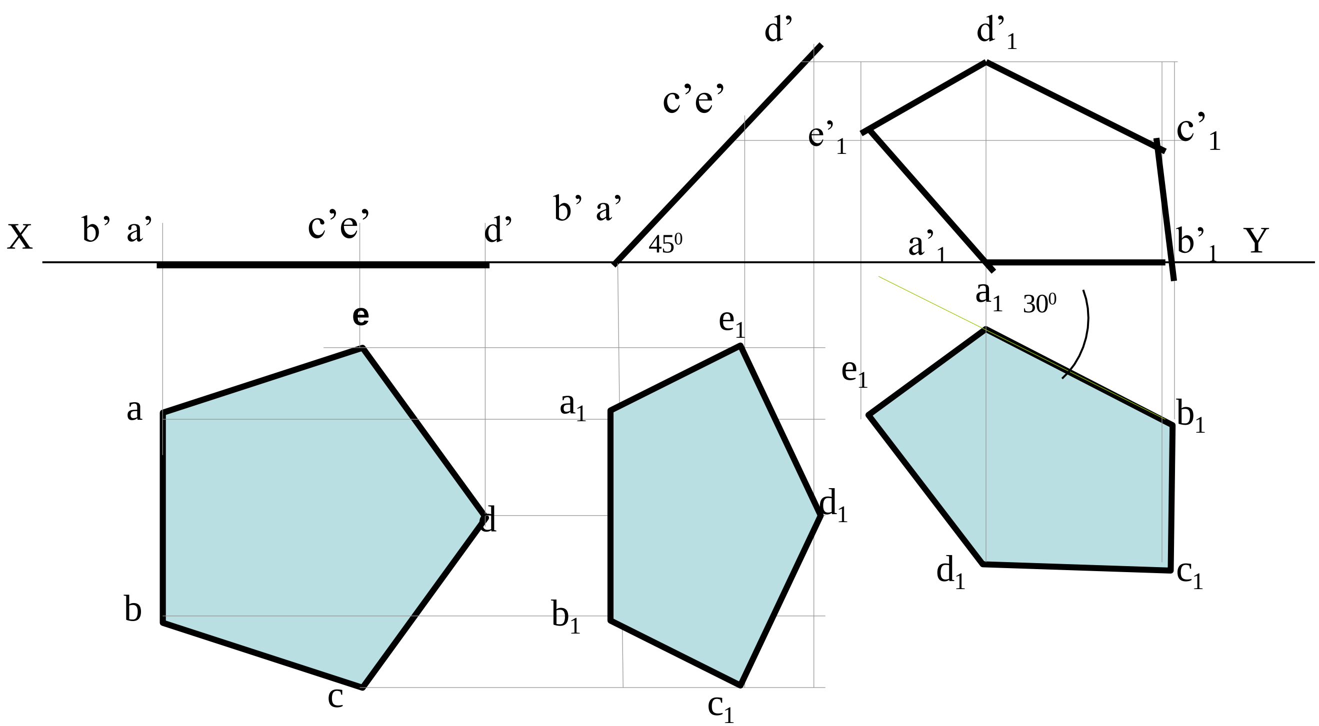
A regular pentagon of 30 mm sides is resting on HP on one of it's sides with it's surface 45^0 inclined to HP.
Draw it's projections when the side in HP makes 30^0 angle with VP

SURFACE AND SIDE INCLINATIONS ARE DIRECTLY GIVEN.

Read problem and answer following questions

1. Surface inclined to which plane? ------- ***HP***
2. Assumption for initial position? ------ ***// to HP***
3. So which view will show True shape? --- ***TV***
4. Which side will be vertical?----------- ***any side.***

Hence begin with TV,draw pentagon below X-Y line, taking one side vertical.

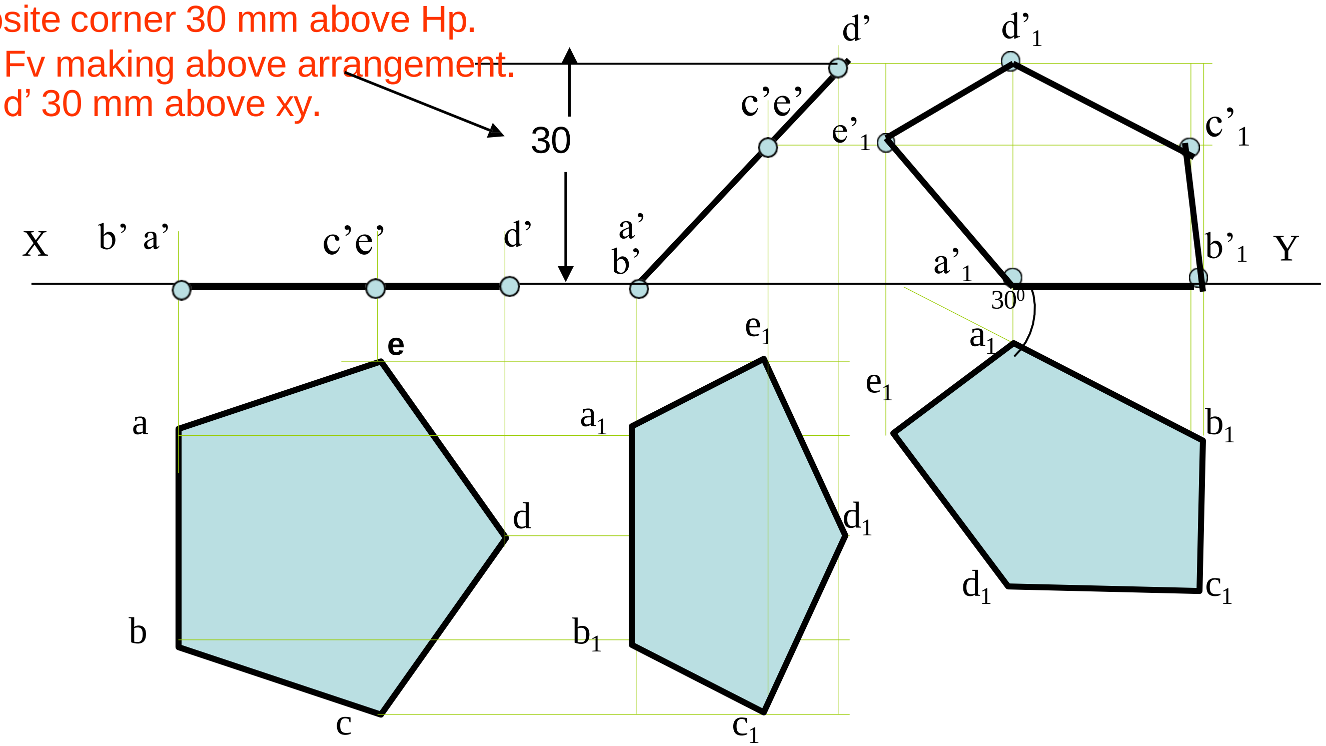


Problem 5:
A regular pentagon of 30 mm sides is resting on HP on one of it's sides while it's opposite vertex (corner) is 30 mm above HP.
Draw projections when side in HP is 30^0 inclined to VP.

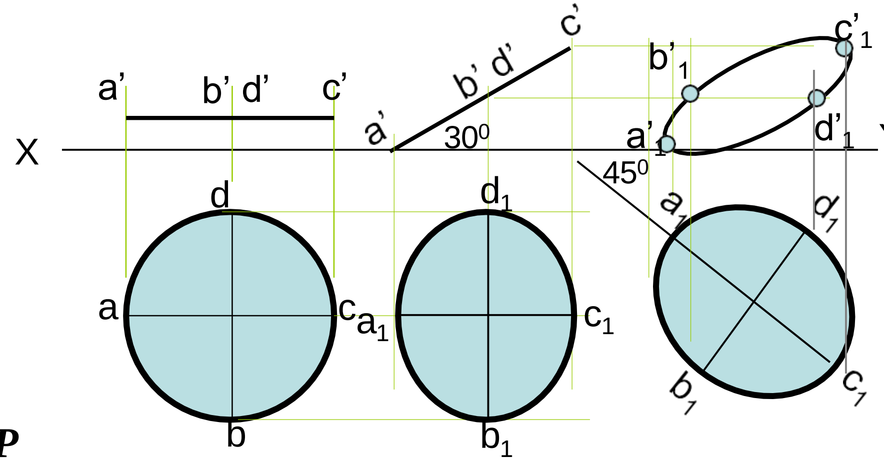
SURFACE INCLINATION INDIRECTLY GIVEN
SIDE INCLINATION DIRECTLY GIVEN:

Read problem and answer following questions
1. Surface inclined to which plane? ------- ***HP***
2. Assumption for initial position? ------ ***// to HP***
3. So which view will show True shape? --- ***TV***
4. Which side will be vertical? --------***any side.***
   Hence begin with TV,draw pentagon below X-Y line, taking one side vertical.

ONLY CHANGE is
the manner in which surface inclination is described:
One side on Hp & it's opposite corner 30 mm above Hp.
Hence redraw 1st Fv as a 2nd Fv making above arrangement.
Keep a'b' on xy & d' 30 mm above xy.



Problem 8: A circle of 50 mm diameter is resting on Hp on end A of it's diameter AC which is 30^0 inclined to Hp while it's Tv is 45^0 inclined to Vp.Draw it's projections.



Read problem and answer following questions

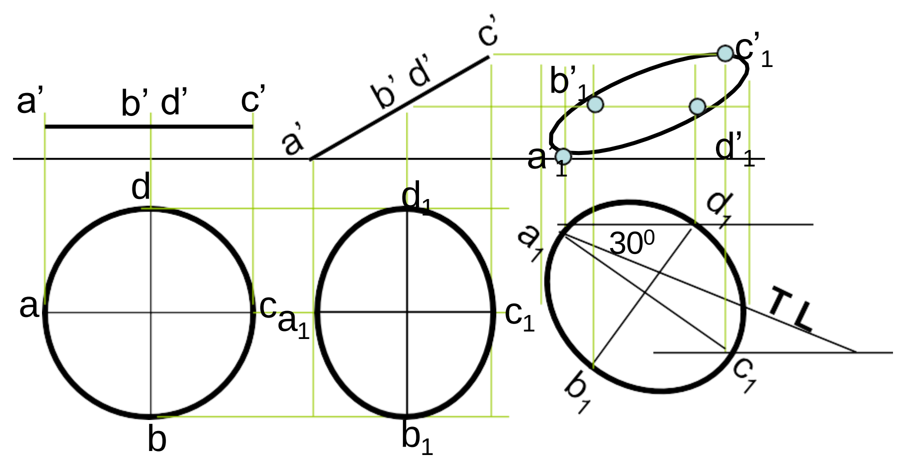
1. Surface inclined to which plane? ------- ***HP***
2. Assumption for initial position? ------ ***// to HP***
3. So which view will show True shape? --- ***TV***
4. Which diameter horizontal? ---------- ***AC***

   Hence begin with TV,draw rhombus below X-Y line, taking longer diagonal // to X-Y

The difference in these two problems is in step 3 only.
In problem no.8 inclination of Tv of that AC is given,It could be drawn directly as shown in 3rd step.
While in no.9 angle of AC itself i.e. it's TL, is given. Hence here angle of TL is taken,locus of c_1 Is drawn and then LTV I.e. a_1 c_1 is marked and final TV was completed.Study illustration carefully.

Problem 9: A circle of 50 mm diameter is resting on Hp on end A of it's diameter AC which is 30^0 inclined to Hp while it makes 45^0 inclined to Vp. Draw it's projections.

Note the difference in construction of 3rd step in both solutions.

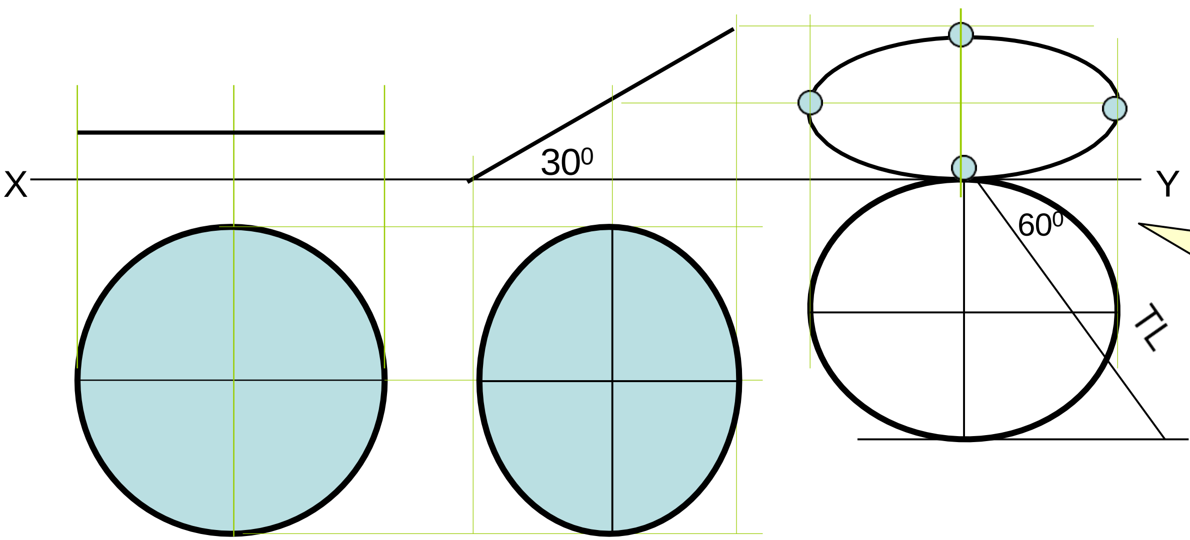


Problem 10: End A of diameter AB of a circle is in HP and end B is in VP.Diameter AB, 50 mm long is 30^0 & 60^0 inclined to HP & VP respectively. Draw projections of circle.

Read problem and answer following questions
1. Surface inclined to which plane? ------- ***HP***
2. Assumption for initial position? ------ ***// to HP***
3. So which view will show True shape? --- ***TV***
4. Which diameter horizontal? ---------- ***AB***

Hence begin with TV,draw CIRCLE below X-Y line, taking DIA. AB // to X-Y

The problem is similar to previous problem of circle – no.9.
But in the 3rd step there is one more change.
Like 9th problem True Length inclination of dia.AB is definitely expected but if you carefully note - the the SUM of it's inclinations with HP & VP is 90^0.
Means Line AB lies in a Profile Plane.
Hence it's both Tv & Fv must arrive on one single projector.
So do the construction accordingly AND ***note the case carefully***..



SOLVE SEPARATELY
ON DRAWING SHEET
GIVING NAMES TO VARIOUS
POINTS AS USUAL,
AS THE CASE IS IMPORTANT

Problem 11:

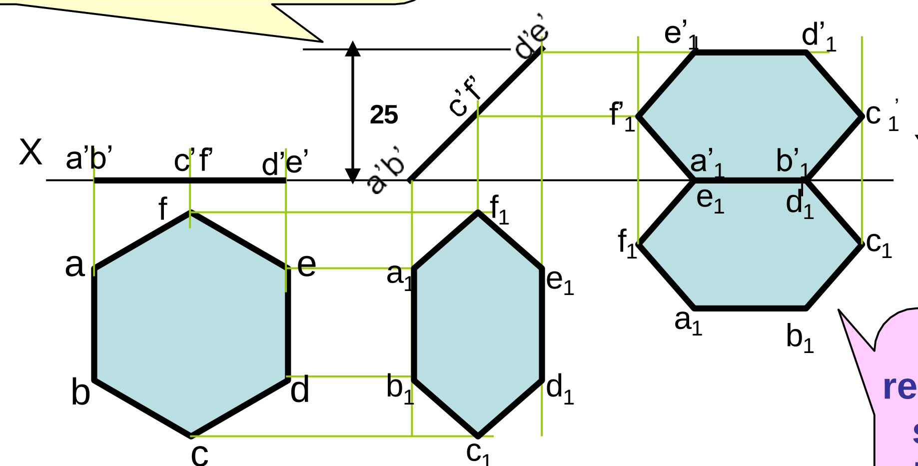
A hexagonal lamina has its one side in HP and Its apposite parallel side is 25mm above Hp and In Vp. Draw it's projections. Take side of hexagon 30 mm long.

Read problem and answer following questions

1. Surface inclined to which plane? ------- ***HP***
2. Assumption for initial position? ------ ***// to HP***
3. So which view will show True shape? --- ***TV***
4. Which diameter horizontal? ---------- ***AC***

Hence begin with TV, draw rhombus below X-Y line, taking longer diagonal // to X-Y

ONLY CHANGE is the manner in which surface inclination is described:
One side on Hp & it's opposite side 25 mm above Hp.
Hence redraw 1st Fv as a 2nd Fv making above arrangement.
Keep a'b' on xy & d'e' 25 mm above xy.



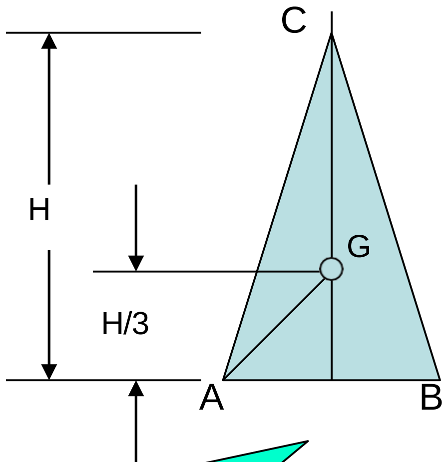
As 3rd step redraw 2nd Tv keeping side DE on xy line. Because it is in VP as said in problem.

FREELY SUSPENDED CASES.

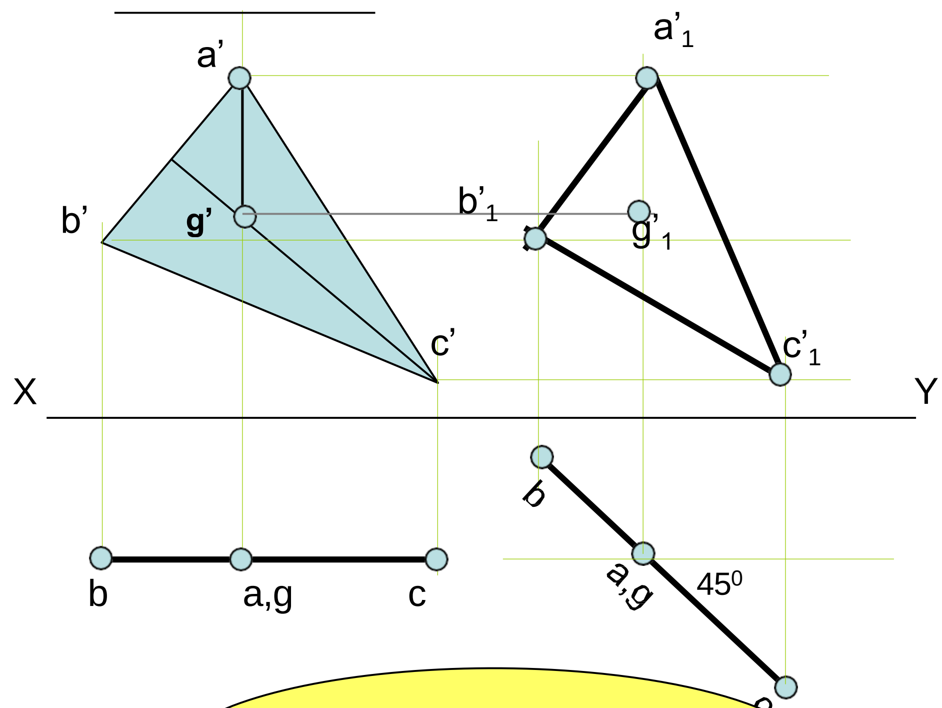
IMPORTANT POINTS

1. In this case the plane of the figure always remains ***perpendicular to Hp*.**
2. It may remain parallel or inclined to Vp.
3. Hence ***TV*** in this case will be always a ***LINE view.***
4. Assuming surface // to Vp, draw true shape in suspended position as FV.
   (Here keep line joining ***point of contact & centroid of fig. vertical***)
5. Always begin with FV as a True Shape but in a suspended position.
   AS shown in 1st FV.

Problem 12:
An isosceles triangle of 40 mm long base side, 60 mm long altitude Is freely suspended from one corner of Base side.It's plane is 45^0 inclined to Vp. Draw it's projections.



First draw a given triangle
With given dimensions,
Locate it's centroid position
And
join it with point of suspension.



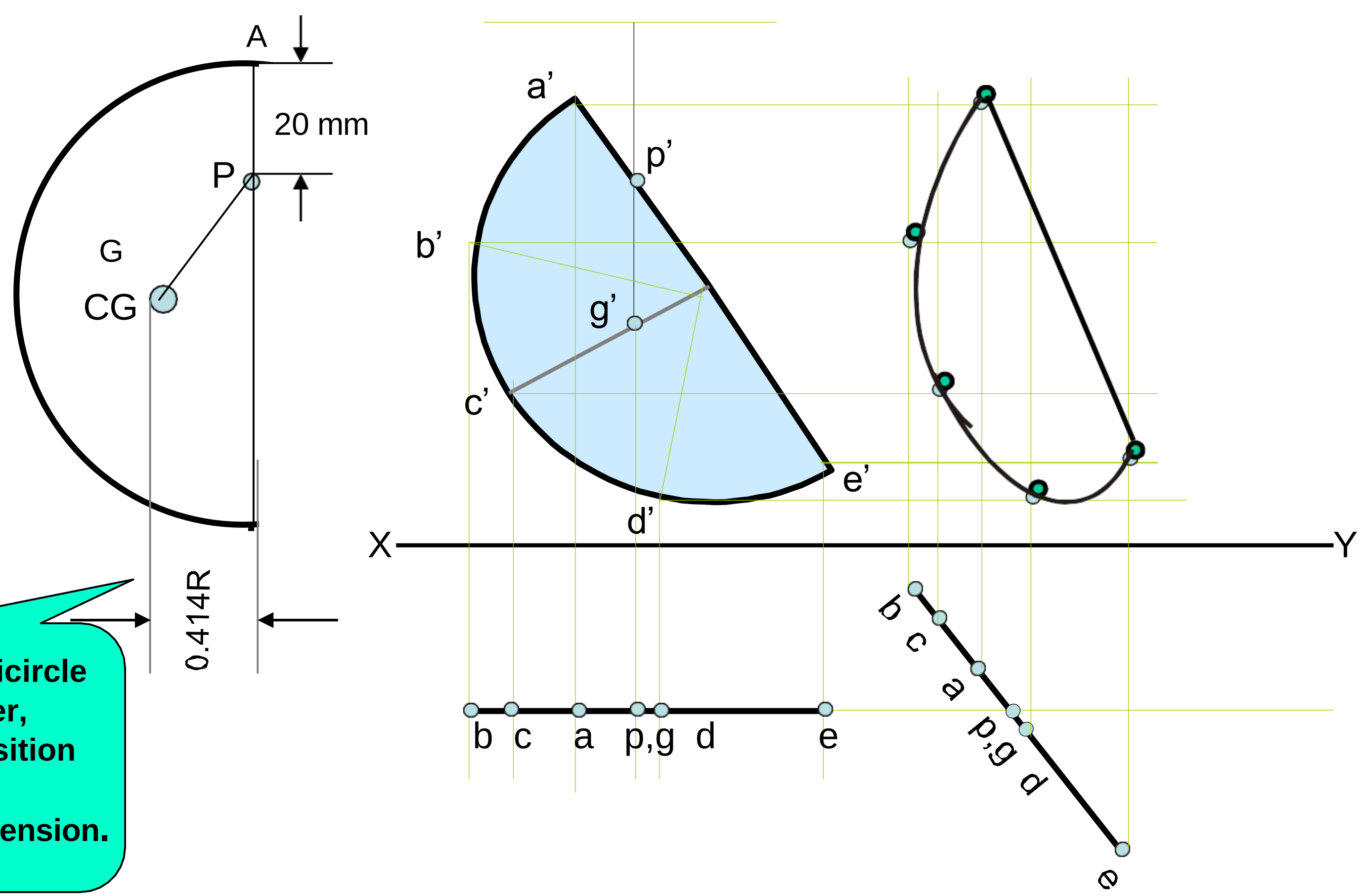
Similarly solve next problem of Semi-circle

Problem 13

:A semicircle of 100 mm diameter is suspended from a point on its straight edge 30 mm from the midpoint of that edge so that the surface makes an angle of 45^0 with VP. Draw its projections.

IMPORTANT POINTS

1. In this case the plane of the figure always remains ***perpendicular to Hp***.
2. It may remain parallel or inclined to Vp.
3. Hence ***TV*** in this case will be always a ***LINE view.***
4. Assuming surface // to Vp, draw true shape in suspended position as FV. (Here keep line joining ***point of contact & centroid of fig. vertical***)
5. Always begin with FV as a True Shape but in a suspended position. AS shown in 1^{st} FV.



First draw a given semicircle
With given diameter,
Locate it's centroid position
And
join it with point of suspension.

To determine true shape of plane figure when it's projections are given.
BY USING AUXILIARY PLANE METHOD

WHAT WILL BE THE PROBLEM?
Description of final Fv & Tv will be given.
You are supposed to determine true shape of that plane figure.

Follow the below given steps:

1. Draw the given Fv & Tv as per the given information in problem.
2. Then among all lines of Fv & Tv select a line showing True Length (T.L.) (It's other view must be // to xy)
3. Draw x_1-y_1 perpendicular to this line showing T.L.
4. Project view on x_1-y_1 (it must be a line view)
5. Draw x_2-y_2 // to this line view & project new view on it.

It will be the required answer i.e. True Shape.

The facts you must know:-
If you carefully study and observe the solutions of all previous problems,
You will find
IF ONE VIEW IS A LINE VIEW & THAT TOO PARALLEL TO XY LINE,
THEN AND THEN IT'S OTHER VIEW WILL SHOW TRUE SHAPE:

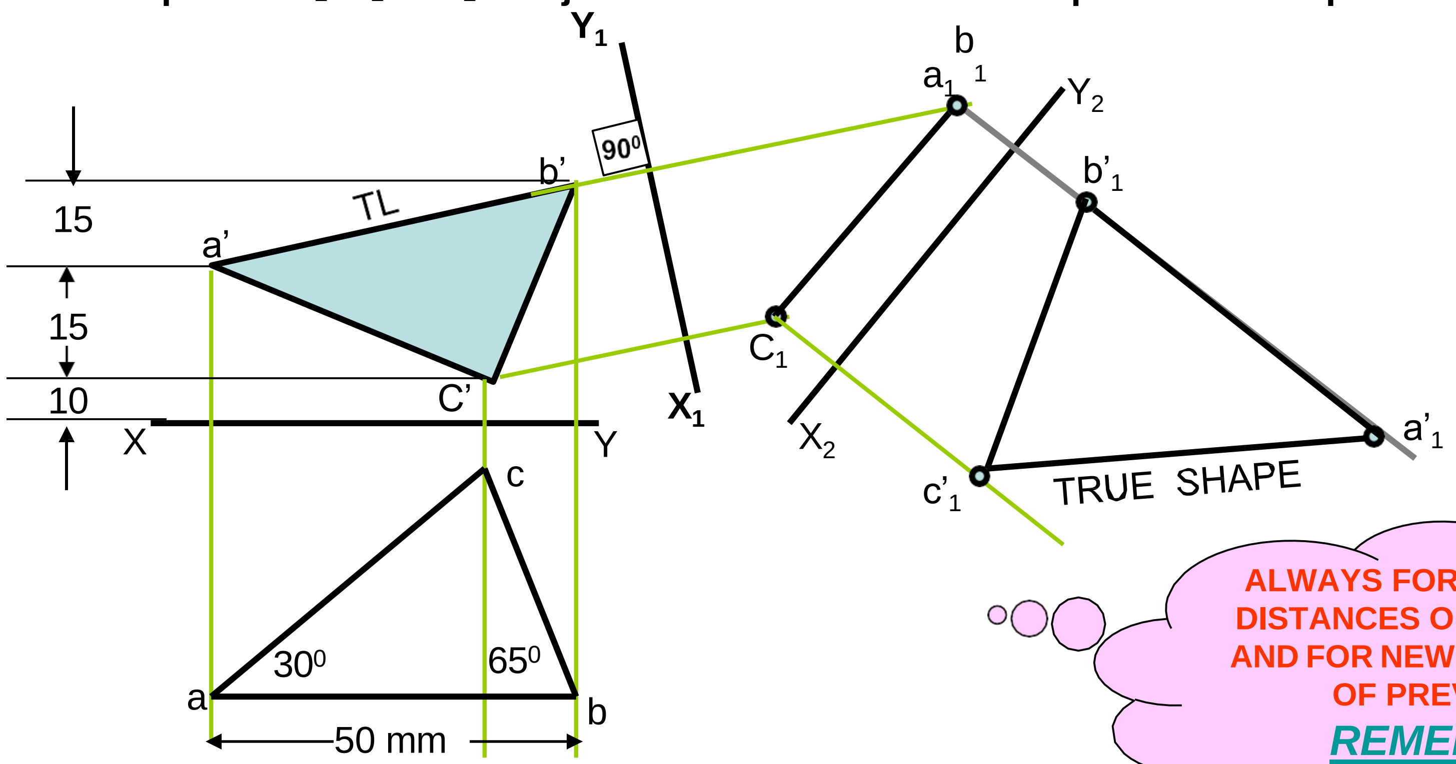
NOW FINAL VIEWS ARE ALWAYS SOME SHAPE, NOT LINE VIEWS:
SO APPLYING ABOVE METHOD:
WE FIRST CONVERT ONE VIEW IN INCLINED LINE VIEW .(By using x1y1 aux.plane)
THEN BY MAKING IT // TO X2-Y2 WE GET TRUE SHAPE.

Study Next Four Cases

Problem 14 Tv is a triangle abc. Ab is 50 mm long, angle cab is 300 and angle cba is 650. a’b’c’ is a Fv. a’ is 25 mm, b’ is 40 mm and c’ is 10 mm above Hp respectively. Draw projections of that figure and find it’s true shape.

As per the procedure-

1. First draw Fv & Tv as per the data.
2. In Tv line ab is // to xy hence it’s other view a’b’ is TL. So draw x_1y_1 perpendicular to it.
3. Project view on x1y1.
   a) First draw projectors from a’b’ & c’ on x_1y_1.
   b) from xy take distances of a,b & c(Tv) mark on these projectors from x_1y_1. Name points a1b1 & c1.
   c) This line view is an Aux.Tv. Draw x_2y_2 // to this line view and project Aux. Fv on it.
   for that from x_1y_1 take distances of a’b’ & c’ and mark from x_2y= on new projectors.
4. Name points a'_1 b'_1 & c'_1 and join them. This will be the required true shape.



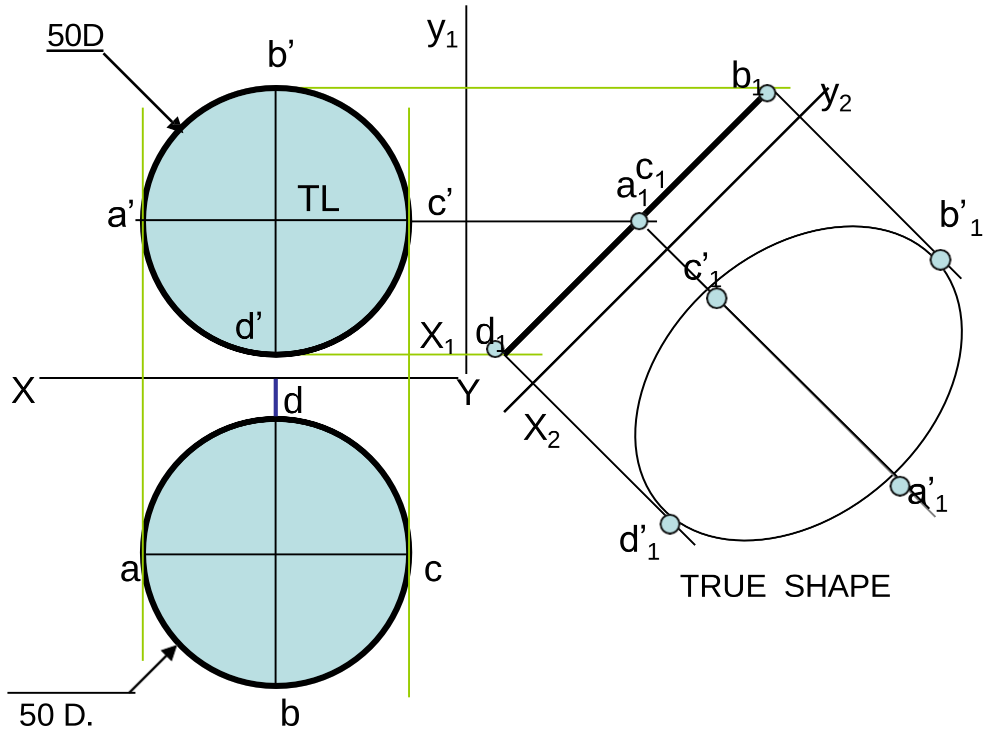
ALWAYS FOR NEW FV TAKE DISTANCES OF PREVIOUS FV AND FOR NEW TV, DISTANCES OF PREVIOUS TV

REMEMBER!!

PROBLEM 15: **Fv & Tv both are circles of 50 mm diameter. Determine true shape of an elliptical plate.**

ADOPT SAME PROCEDURE.
a c is considered as line // to xy.
Then a'c' becomes TL for the purpose.
Using steps properly true shape can be Easily determined.

Study the illustration.



ALWAYS, FOR NEW FV TAKE DISTANCES OF PREVIOUS FV AND FOR NEW TV, DISTANCES OF PREVIOUS TV

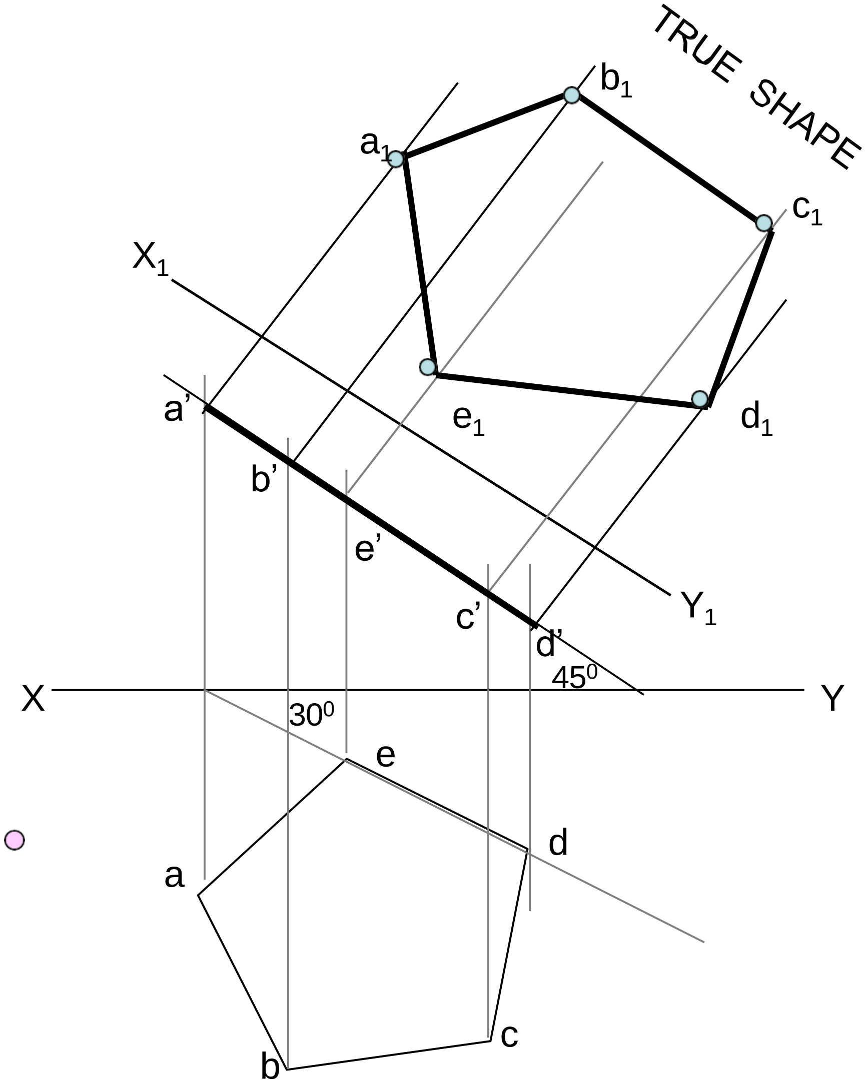
REMEMBER!!

Problem 16 : Draw a regular pentagon of 30 mm sides with one side 30^0 inclined to xy. This figure is Tv of some plane whose Fv is A line 45^0 inclined to xy. Determine it's true shape.

IN THIS CASE ALSO TRUE LENGTH IS NOT AVAILABLE IN ANY VIEW.

BUT ACTUALLY WE DONOT REQUIRE TL TO FIND IT'S TRUE SHAPE, AS ONE VIEW (FV) IS ALREADY A LINE VIEW. SO JUST BY DRAWING X1Y1 // TO THIS VIEW WE CAN PROJECT VIEW ON IT AND GET TRUE SHAPE:

STUDY THE ILLUSTRATION..



ALWAYS FOR NEW FV TAKE DISTANCES OF PREVIOUS FV AND FOR NEW TV, DISTANCES OF PREVIOUS TV

REMEMBER!!

4. ISOMETRIC PROJECTION OF PLANES AND SOLIDS

Isometric projection:

Isometric projection is a type of pictorial projection in which the three dimensions of a solid are not only shown in one view but their actual sizes can be measured directly from it. The three lines AL, AD and AH, meeting at point A and making 120^0 angles with each other are termed Isometric Axes. The lines parallel to these axes are called Isometric Lines. The planes representing the faces of the cube as well as other planes parallel to these planes are called Isometric Planes.

Isometric scale:

When one holds the object in such a way that all three dimensions are visible then in the process all dimensions become proportionally inclined to observer's eye sight and hence appear apparent in lengths. This reduction is 0.815 or 9/11 (approx.). It forms a reducing scale which is used to draw isometric drawings and is called Isometric scale. In practice, while drawing isometric projection, it is necessary to convert true lengths into isometric lengths for measuring and marking the sizes. This is conveniently done by constructing an isometric scale as described on next page.

Construction of isometric scale:

From point A, with line AB draw 30^0 and 45^0 inclined lines AC & AD respective on AD. Mark divisions of true length and from each division-point draw vertical lines up to AC line. The divisions thus obtained on AC give lengths on isometric scale.

Note:

Isometric Drawing/Isometric view ⟶ true length

Isometric Projection ⟶ ***Reduced length (isometric length)***

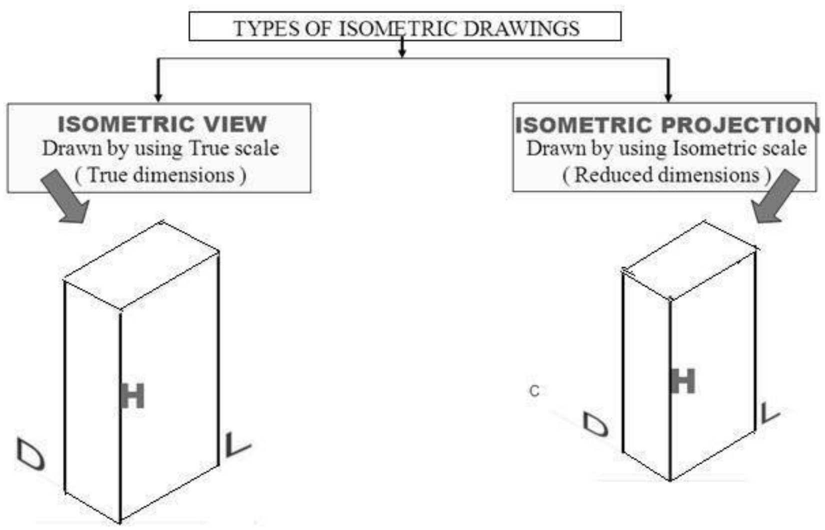


Figure 4.1

Isometric scale [Line AC] required for Isometric Projection:

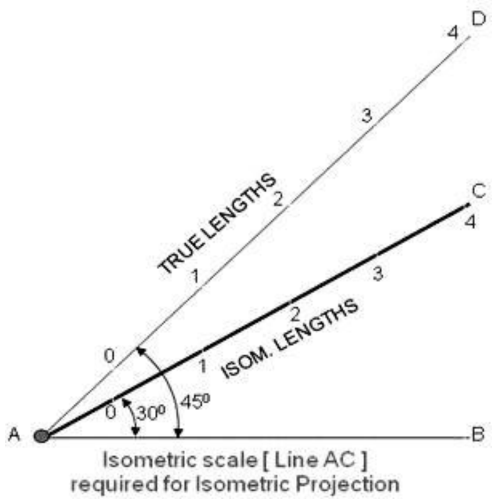


Figure 4.2

Terminology:

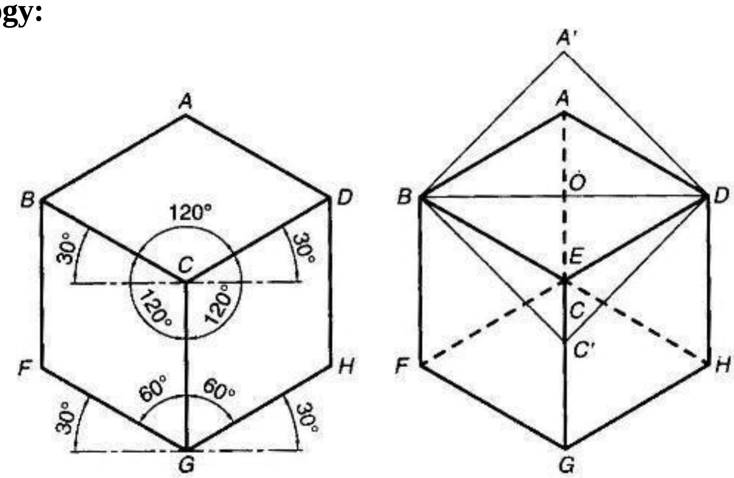


Figure 4.3

Isometric axes: The Three Lines CB, CD, CG meeting at a point C and making an angle of 120^0 with each other are called Isometric axes.

Isometric Lines: The Lines parallel to the Isometric Axis are termed as Isometric lines. Example from above fig. AB, AD, GF, GH, BF, DH are Isometric Lines.

Non-Isometric Lines*:* The lines which are not parallel to the isometric axes are known as Non- Isometric Lines Example from above fig. BD, AC, CF, BG are Non-Isometric Lines.

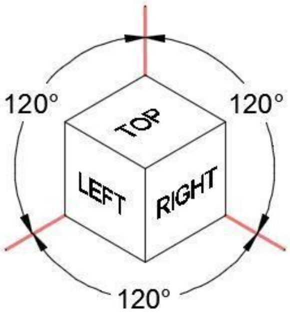
Isometric Planes: The planes representing the faces of the cube as well as other planes parallel to these planes are termed as Isometric Planes Example from above fig. ABCD, BCGF, CGHD are Isometric Planes

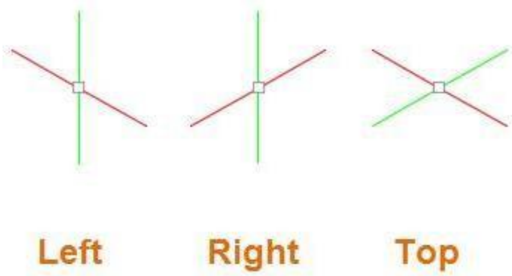
Isometric Scale: It is the scale which is used to convert the true length in to Isometric Length

Isometric Drawing using AutoCAD

In Computer Aided Engineering Graphics for isometric projections following commands are used other than evoking software, opening file, saving file and giving print command. A 2D isometric drawing is a flat representation of a 3D isometric projection. This method of drawing provides a fast way to create an isometric view of a simple design. Distances measured along an isometric axis are correct to scale, but the 3D distances and areas cannot be extracted since the drawings will be in 2D, display objects from different viewpoints, or remove hidden lines automatically.

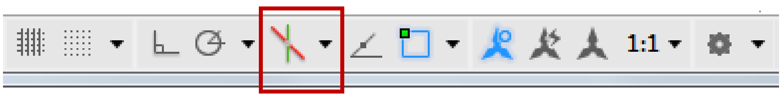
By using the ISODRAFT command, several system variables and settings are automatically changed to values that facilitate isometric angles. Isoplane specifies the current isometric plane. The standard isometric planes, called **isoplanes**, are as follows:

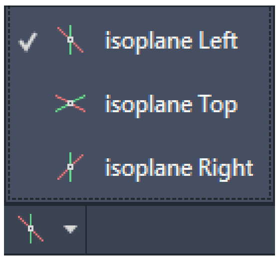




- Right.: Selects the right-hand plane, defined by the 30- and 90-degree axes pair
- Left: Selects the left-hand plane, defined by the 90- and 150-degree axes pair.
- Top: Selects the top face, called the top plane, defined by the 30- and 150-degree axis pair.

You can use the Isometric Drafting tool on the status bar to select the desired isoplane. Alternatively, you can press F5 or Ctrl+E to cycles through the isoplanes.





Using these following commands and features are the most commonly used ones to maintain precision in isometric drawings:

- Polar tracking and direct distance entry
- Object snaps and grid snaps
- Object snap tracking
- Move and Copy

Isometric views of planes:

Simple Problems:

Problem:

1. **Draw the isometric view of a square with 40mm side?**

Solution:

Draw the isometric view of a square with a 40mm side in AutoCAD, we can follow a structured approach. In the isometric view, a square will appear as a rhombus (diamond shape) due to the angle of the isometric projection.

Procedure to Draw an Isometric Square

- Set Isoplane:

Command: ISOPLANE

Set the isoplane to "Top" (or use F5 to cycle between isoplanes).

- Set View to Isometric:

Command: SE ISOP

Change to an isometric view (typically "Isoplane Top" is used).

- Activate the Line Command:

Command: LINE

You will use the LINE command to draw the edges of the square.

- Draw First Line (45° Angle):

At the origin, draw a line at a 30° angle from the horizontal (it appears at 30° in isometric views).

Command: Type @40<30 to create a 40mm line at 30° angle from the horizontal.

- Draw Second Line (90° to First):

To continue the square, use the @40<150 command to draw the next line (which will be at 150° in the isometric plane).

This will ensure the lines are parallel to each other.

- Draw Third Line (Back to Starting Point):

Command: @40<30

This line will be drawn parallel to the first line, closing the shape.

- Complete the Square:

Command: @40<90

Draw the final line, returning to the start point, closing the square.

- Check for Accuracy:

Use the DIST command to check the distance between opposite corners of the square.

Ensure that the diagonals form a 90-degree angle at the center, confirming the square's accuracy.

- Apply Hatching (Optional):

Command: HATCH

You can hatch the square to visually distinguish it as a filled shape if required.

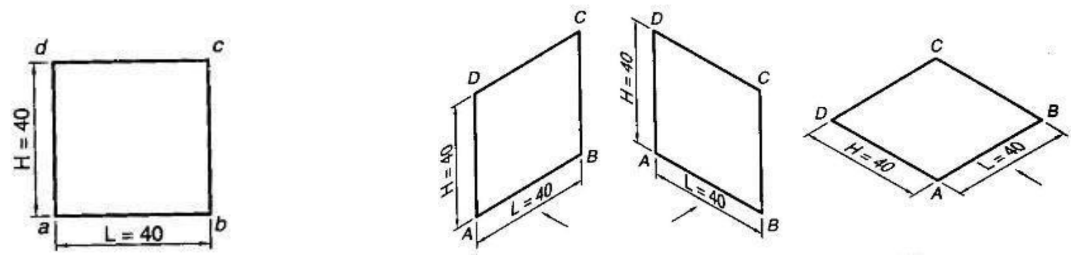
- Finish the Drawing:

Command: EXIT

Exit from the drawing environment to finish the process.

Commands Used:

i. **ISOPLANE**
ii. **SE ISOP**
iii. **LINE**
iv. **@40<30 (Line command with distance and angle)**
v. **@40<150 (Line command with distance and angle)**
vi. **@40<30 (Line command to complete the square)**
vii. **@40<90 (Line command to close the square)**
viii. **DIST (Check distance)**
ix. **HATCH (Optional for filling the square)**
x. **EXIT (Finish the drawing)**



(a) *(b)* *(c)*
Figure 4.4

2. Problem:
Draw the isometric view of a Hexagon with 40mm side such that its surface is Parallel to the HP and a side Parallel to the VP?

Solution:

Draw the isometric view of a hexagon with a 40mm side such that its surface is parallel to the **Horizontal Plane (HP)** and one side is parallel to the **Vertical Plane (VP)** in AutoCAD, we follow a procedure that ensures the hexagon is properly aligned in isometric projection.

Procedure to Draw an Isometric Hexagon

1. **Set Isoplane**:
   - Command: ISOPLANE

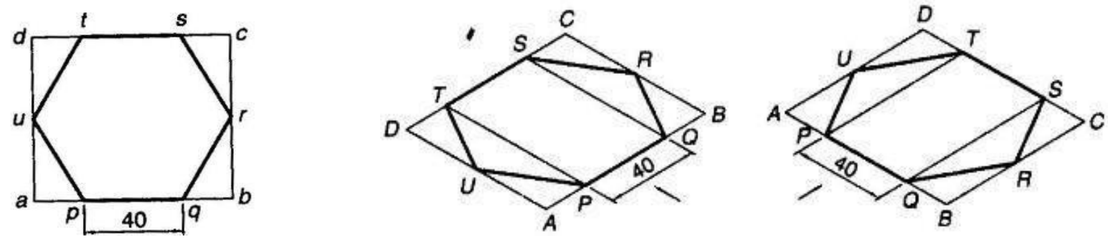
- Set the isoplane to "Top" (use F5 to toggle isoplane between isoplanes).

2. **Set View to Isometric**:
   - Command: SE ISOP
   - Change to an isometric view (using "Isoplane Top" for best alignment).
3. **Activate the Line Command**:
   - Command: LINE
   - Start drawing the hexagon's sides.
4. **Draw the First Line**:
   - To align the hexagon's side with the VP, you will start drawing a 40mm line.
   - Command: @40<0
   - This will draw a line at 0 degrees (horizontal).
5. **Draw the Second Line (120° to the First Line)**:
   - Command: @40<120
   - This creates the second side at 120° from the first, forming the angle of the hexagon.
6. **Draw the Third Line (120° to the Second Line)**:
   - Command: @40<240
   - Continue the third side, which is 120° to the second side.
7. **Draw the Fourth Line (120° to the Third Line)**:
   - Command: @40<360
   - The fourth side closes the hexagon, completing the shape.
8. **Close the Hexagon**:
   - Command: @40<120
   - This will close the hexagon by drawing the final side, completing the six sides.
9. **Verify Angles and Side Length**:
   - Use the DIST command to verify each side is 40mm.
   - Ensure that the internal angles form 120° to confirm the accuracy of the hexagon.
10. **Exit the Command**:
    - Command: EXIT
    - Close the command to finish the drawing process.

Commands Used:

i. **ISOPLANE (Set isoplane to top for isometric projection)**
ii. **SE ISOP (Set the isometric view to SE Isoplane)**
iii. **LINE (Activate line tool)**
iv. **@40<0 (Draw a 40mm line at 0 degrees)**
v. **@40<120 (Draw a 40mm line at 120 degrees)**
vi. **@40<240 (Draw a 40mm line at 240 degrees)**
vii. **@40<360 (Draw a 40mm line at 360 degrees to complete the hexagon)**
viii. **@40<120 (Close the hexagon by drawing the final side)**
ix. **DIST (Check distance to ensure the side length is correct)**
x. **EXIT (Exit the drawing command)**

Solution:



(a) *(b)*

Figure 4.5

3. Problem:

Draw the isometric view of a Circle with a 60mm Diameter on all three Principle Planes Using Co- ordinate methods?

Solution:

Draw the isometric view of a circle with a 60mm diameter on all three principal planes using the coordinate method in AutoCAD, you'll follow these steps for each plane (Top, Front, and Right). We'll create three isometric circles (ellipses) representing the circle as viewed on each of the principal planes.

Here's a step-by-step procedure:

1. Set Isoplane to Top (Isometric Plane):
- Command: ISOPLANE
- Set the isoplane to "Top" for the first isometric circle.

2. Set View to Isometric (SE Isoplane):
- Command: SE ISOP
- Switch to the isometric view (using "Isoplane Top").

3. Activate the Ellipse Command:
- Command: ELLIPSE
- Activate the ellipse tool to create the isometric circle.

4. Specify Axis and End for Ellipse:
- Command: Type A for Axis, End option.
- This allows you to draw an ellipse representing the circle.

5. Define the Axis at 30°:
- Command: Type 30 to specify the axis of the ellipse at 30° to simulate the isometric view.

6. Set the Radius of the Ellipse:
- Command: @30 (This is the radius based on the diameter of 60mm; half of the diameter is 30mm).
- Define the length of the major axis (30mm radius).

7. Draw the Circle on the Top Plane:
- Command: Place the first ellipse at the origin and specify the required radius (30mm).

8. Change Isoplane to Left or Right (For Front or Right Views):
- Command: ISOPLANE
- Toggle the isoplane to the appropriate angle (left or right) for drawing the next circle.

9. Draw the Circle on the Front or Right Plane:
- Repeat the same ellipse command for both the front and right views, using the

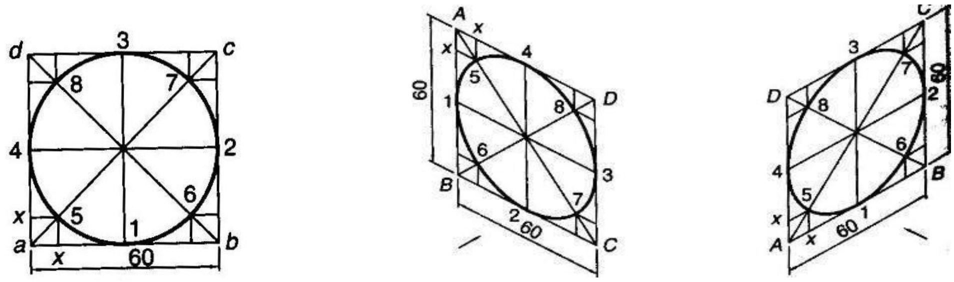
same axis and radius parameters. The circles will appear in the respective planes, appearing as ellipses with different angles for the respective planes.

10. Exit the Command:

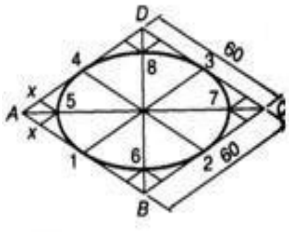
- Command: EXIT
- Close the drawing command.

Commands Used:

i. **ISOPLANE (To set isoplane to top, left, or right)**
ii. **SE ISOP (Set isometric view)**
iii. **ELLIPSE (Activate ellipse tool)**
iv. **A (Choose Axis, End option)**
v. **30 (Set 30° angle for the ellipse)**
vi. **@30 (Set the radius of 30mm for the circle's major axis)**
vii. **EXIT (Exit the drawing process)**



(a) *(b)* *(c)*



(d)

Figure

ISOMETRIC VIEW OF SOLIDS CONATINING - NON ISOMETRIC LINES

The inclined lines of an object are represented non isometric lines in isometric projections. These are drawn by one of the following methods

1. Box Method:
In this box method, the object is assumed to be enclosed in a rectangular box and both the isometric and non-isometric lines are drawn by locating the corresponding points of contact with the surfaces and edge of the box.

2. Off-Set Method:
In this Off-set Method the lines parallel to isometric axes are drawn from every corner or reference of an end to obtain the corner or the reference point at the other end.

The Box Method is generally convenient for solving most of the problems

Problem:
Draw isometric view of a hexagonal prism having a base with 30 mm side and a 70mm long axis resting on its base on the HP. With an edge of the base parallel to the VP when (a) using Box Methods (b) using Off-set Method?

Solution:

(a) Box Method Procedure:
Step-by-Step Procedure:

- Set Isoplane to Top (Isometric Plane):
Command: ISOPLANE
Set the isoplane to "Top" for the initial isometric view.

- Draw a Box for the Prism:
Command: RECTANGLE
Draw a rectangle with a width of 30mm (side of the hexagonal base) and a height of 70mm (height of the prism).

- Extrude the Box to Create the Prism:
Command: EXTRUDE
Extrude the rectangle to a height of 70mm, creating the hexagonal prism's shape.

- Draw a Hexagon (Base):
Command: POLYGON
Choose the 6-sided option for the hexagon and specify a 30mm side length.
Position the hexagon's first vertex at the bottom corner of the extruded box.

- Rotate the Hexagon to Align with the VP:
Command: ROTATE
Rotate the hexagon to align one edge parallel to the Vertical Plane (VP).

- Extrude the Hexagon to Form the Prism:

Command: EXTRUDE

Extrude the hexagon shape upward to form the hexagonal prism with a height of 70mm.

- Complete the Prism:

Command: UNION

Use the UNION command to combine the extruded hexagon and box shape into a single solid.

- Set View to Isometric:

Command: SE ISOP

Change to an isometric view (SE Isoplane).

- Check Dimensions:

Command: DIST

Verify the dimensions of the hexagonal prism (30mm base and 70mm height).

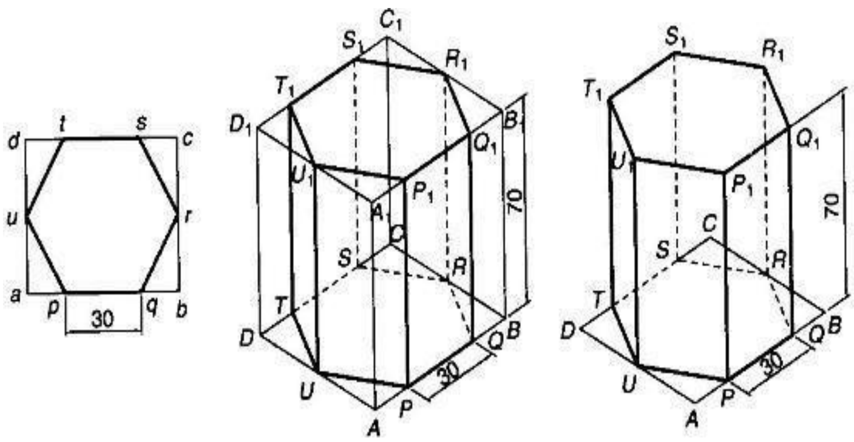
- Exit Command:

Command: EXIT

Finish the process and exit the command.

Commands Used in Box Method:

i. **ISOPLANE**
ii. **RECTANGLE**
iii. **EXTRUDE**
iv. **POLYGON**
v. **ROTATE**
vi. **EXTRUDE**
vii. **UNION**
viii. **SE ISOP**
ix. **DIST**
x. **EXIT**



(a) Box Method *(b) Off-set Method*

Figure 4.9

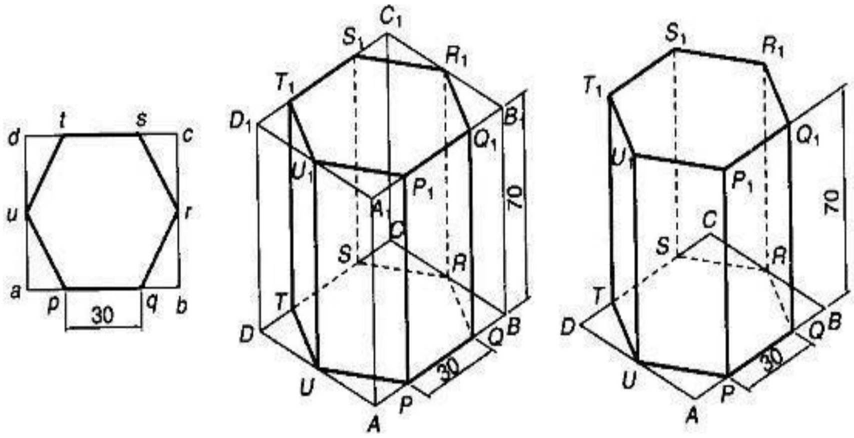
(b) Offset Method Procedure:

Step-by-Step Procedure:

1. **Set Isoplane to Top (Isometric Plane)**:
   - Command: ISOPLANE
   - Set the isoplane to "Top" for isometric drawing.
2. **Draw a Hexagonal Base Using Offsets**:
   - Command: POLYGON
   - Choose the **6-sided option** and define the side length as **30mm**.
   - Place the hexagon at the origin, aligning it horizontally.
3. **Offset the Hexagonal Sides**:
   - Command: OFFSET
   - Offset the hexagon's sides to create the base of the prism, ensuring that the hexagonal edge is parallel to the **Vertical Plane (VP)**.
4. **Extrude the Base**:
   - Command: EXTRUDE
   - Extrude the hexagonal base to a height of **70mm** to form the prism.
5. **Complete the Prism**:
   - Command: UNION
   - Use the UNION command to ensure all parts of the prism (hexagonal base and top) are fused into one solid.
6. **Set View to Isometric**:
   - Command: SE ISOP
   - Change to an isometric view to see the final result.
7. **Draw Top Face of the Prism**:
   - Command: OFFSET
   - Use the OFFSET command to define the distance from the base to the top of the prism, maintaining a uniform height of 70mm.
8. **Extrude the Top Face**:
   - Command: EXTRUDE
   - Extrude the top face of the prism to a height of **70mm**.
9. **Ensure Correct Alignment**:
   - Command: ROTATE
   - Rotate the shape as necessary to align the edges with the **Vertical Plane (VP)**.
10. **Exit Command**:
    - Command: EXIT
    - Exit the drawing mode once completed.

Commands Used in Offset Method:

1. **ISOPLANE**
2. **POLYGON**
3. **OFFSET**
4. **EXTRUDE**
5. **UNION**
6. **SE ISOP**
7. **OFFSET**
8. **EXTRUDE**
9. **ROTATE**
10. **EXIT**



(a) Box Method *(b) Off-set Method*
Figure 4.9

Problem:
Draw an isometric view of a cylinder, with a 50mm base diameter and a 70mm long axis when
(a) The base is on the HP (b) when one of the generators is on the HP?

Solution:

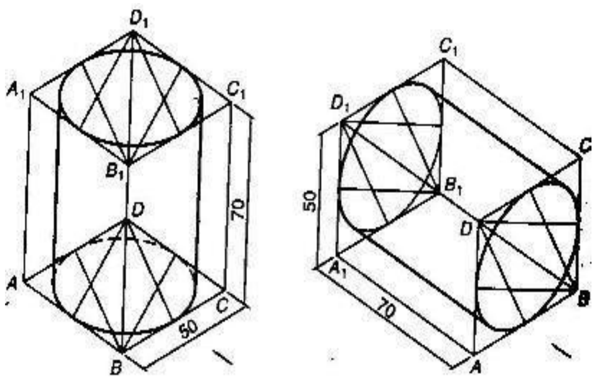
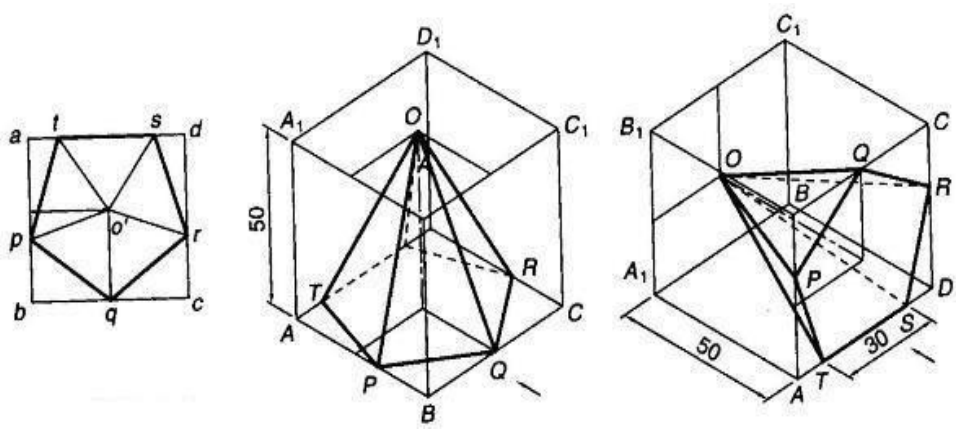


Figure 4.10

Problem:

Draw an isometric view of a pentagonal pyramid having a base , with a 30 mm side and 50mm long axis (a) when the its axis is vertical (b) when the its axis is horizontal?

Solution:



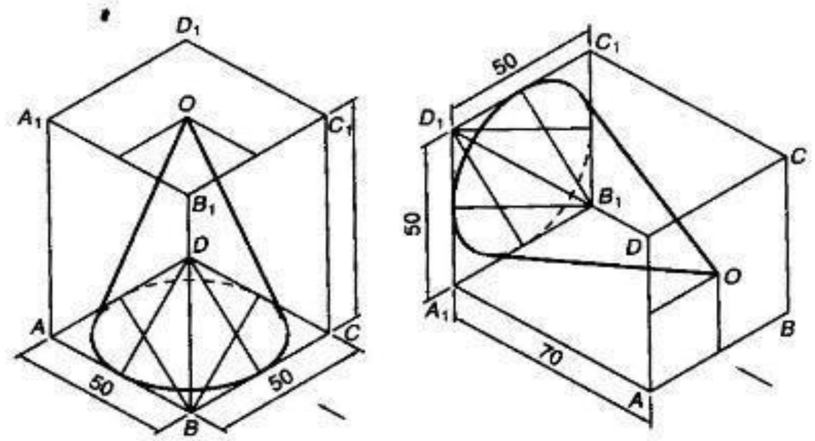
(a)Axis is Vertical *(b)Axis is horizontal*

Figure 4.11

Problem:

Draw an isometric view of Cone with a base diameter is 50 mm side and 70mm long axis (a) when the base is on the HP (b) when the base is on the VP?

Solution:



(a)Base is on the HP *(b) Base is on the VP*

Figure 4.12

ISOMETRIC VIEW OF COMPOSITE SOLIDS

Problem:

A Sphere with a 60 mm diameter is resting centrally on the Top of the Square Block with a 70 mm side 20 mm thickness. Draw an isometric view of the arrangement?

Solution:

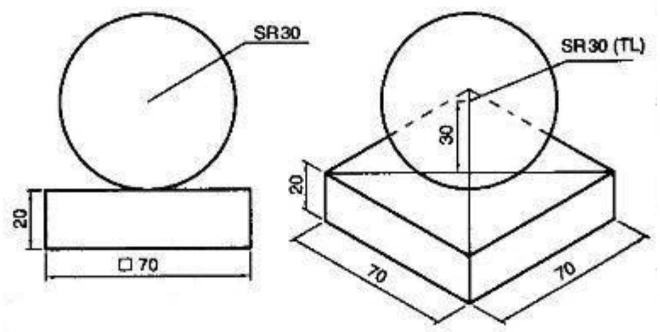


Figure 4.15

Problem:

A square pyramid resting centrally over a cylindrical block which is resting centrally on top of the Square block. Draw an isometric projection of the arrangement .consider the pyramid has a base of 25mm side and a 40 mm long axis, the cylinder block has a 50mm base diameter and 20mm thickness and the square block has a70mm base side and 15mm thickness.?

ORTHOGRAPHIC PROJECTION

Theory:

Representation of 3-Dimensional Object on Plane surfaces:

Fig. 2 gives easily understood pictorial view of U-shaped block. For the complete description of three dimensional object, at least two or three views are required.

Orthographic projection:

The more important standard method is Orthographic projection. In orthographic projection, an object is represented by two or three views on the mutually perpendicular projection planes (a plane has length and breadth, but no thickness). Each projection view represents two dimensions of an object.

The problem which confronts us is how best to show a solid object, i.e. a three-dimensional object on a plane surface.

Front view and Plan:

See Fig. 3 (a) to (c). Imagine two flat drawing boards hinged at right angles to each other as at (a). Surface of the upright board we call the vertical plane (V.P), and that of the other the horizontal plane (H.P). Jointly these planes are called principle planes of projection. Now imagine that the shaped block shown as Fig. 2 is situated in space above the H.P and in front of V.P as shown at (a). One typical view would be that from directly in front. We should call it the front view or front elevation. At (a), this front view is clearly shown projected on to the V.P by the simple process of drawing perpendiculars from the object to V.P.

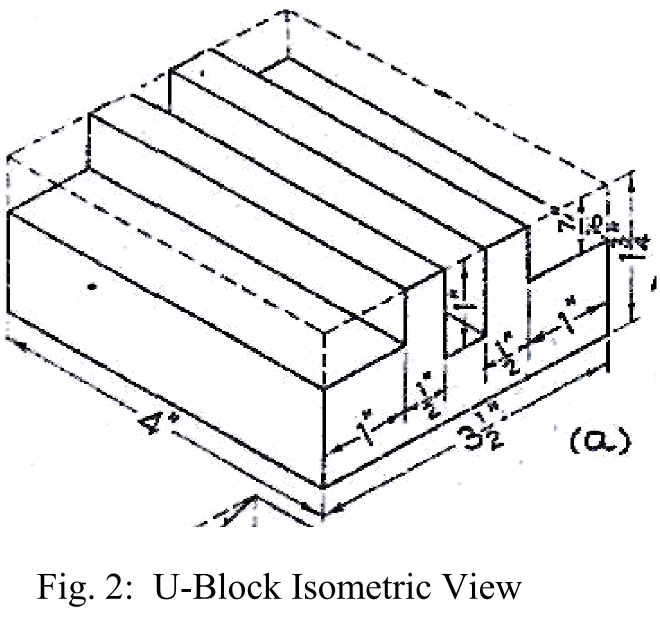


Fig. 2: U-Block Isometric View

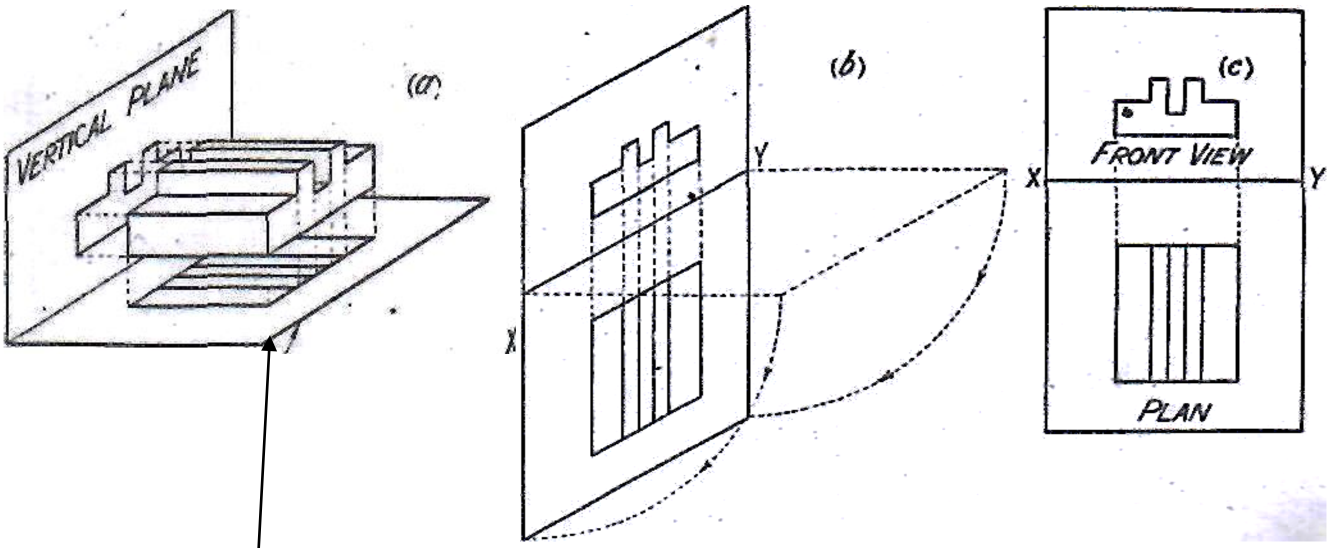
Another aspect or viewpoint would be from directly above the object. This view is projected on to the H.P by means of perpendiculars. It is called the plan.

Suppose we removed the shaped block and drew the front view and the plan upon the appropriate planes. Then, as shown at (b), we could fold the H.P down through 90° so that both H.P and V.P lie in the same plane, and so have what is shown at (c) viz. two views of the object in orthographic projection. Note that the two planes intersect in a line. We call it the XY line.

Additional Views—Side Views:

Now, also we may show any other face by the simple process of projecting it on to a plane and then revolving the plane away from the object into the plane of the drawing paper.

See Fig. 4 (a) and (b). Here we have the U-shaped block suspended in space above the H.P and in front of the two vertical planes A and B. It will not be difficult to see that by means of the projectors (broken lines) shown, view 3 (the plan) is seen on looking in



HORIZONTAL PLANE

Fig. 2 (a, b, c): The Reference Planes or Planes of Projection: First angle method

The direction of arrow No. 3. Again, view 1 is obtained on looking in the direction of arrow No. 1. If only remains to say that the side view (No. 2) is projected on to V.P B by looking in the direction of arrow No. 2. If we now "spread the planes out flat" on a smooth surface, we shall have the three views in orthographic projection, as shown at (b). The intersection of V.Ps A and B is called the auxiliary XY line and written X'Y’.

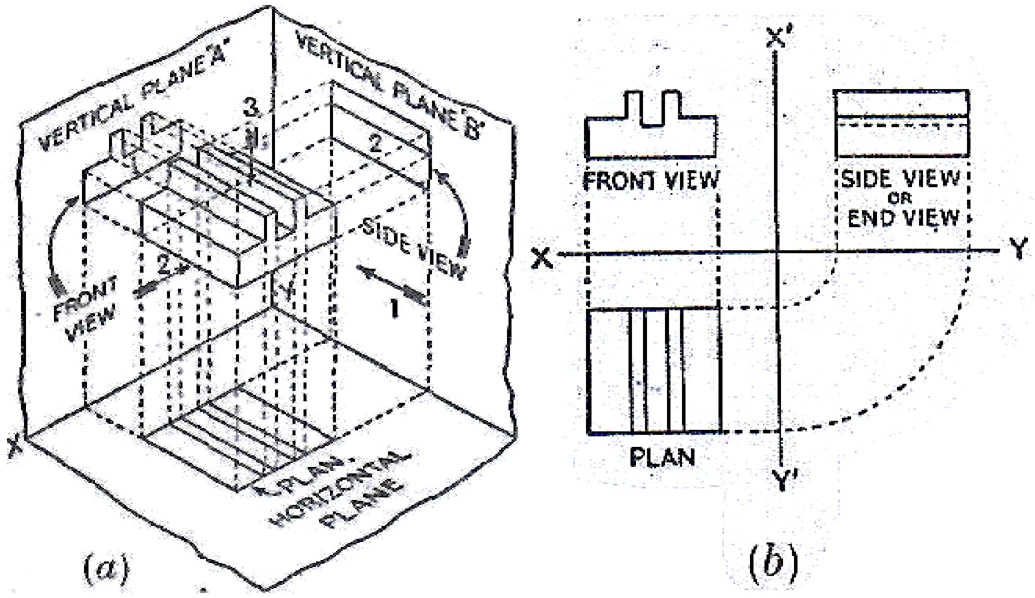


Fig. 3 (a, b): Three views in First angle projection

First angle projection:

In 1st angle projection, the object comes between the eye of observer and the plane of projection. Thus the object is present in the space of 1st-quadrant of the principal planes.

Third angle projection:

In 3rd angle projection, the plane of projection comes between the eye of observer and the object. Thus the object is present in the space of 3rd-quadrant of the principal planes.

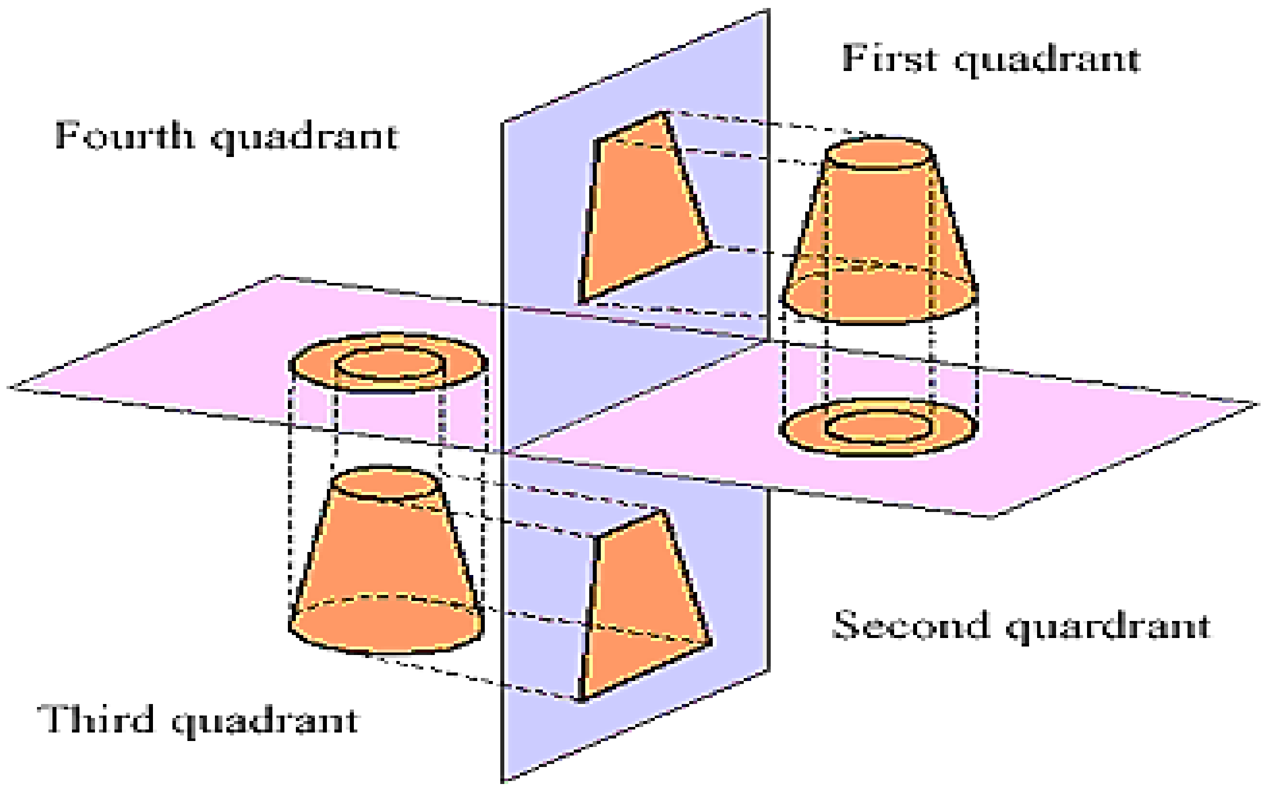


Fig. 4 (a): First angle projection VS third angle projection Method of drawing

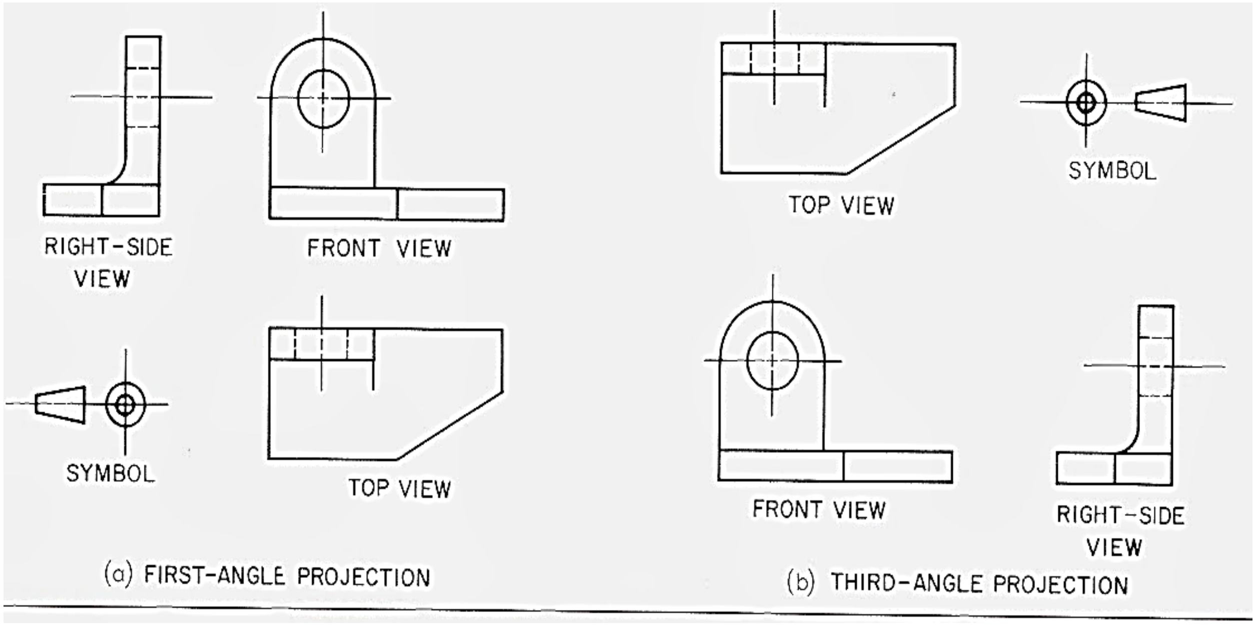


Fig. 4 (b): First angle projection VS third angle projection Method of drawing

Sheet 2: **“U-Block”**

Aim:

To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:

Draw the orthographic Projection (Front, Top & side Views) of U – Block from its isometric (3d) view.

Apparatus:

Drawing Instruments

Instructions:

1) Fig.5 (a) shows an isometric view of an object.
2) Fig.5 (b) shows an orthographic view of an object.
3) Do apply suitable scaling if required.
4) Apply 1st or 3rd angle projection method, unless you are asked specifically to use any one of these.

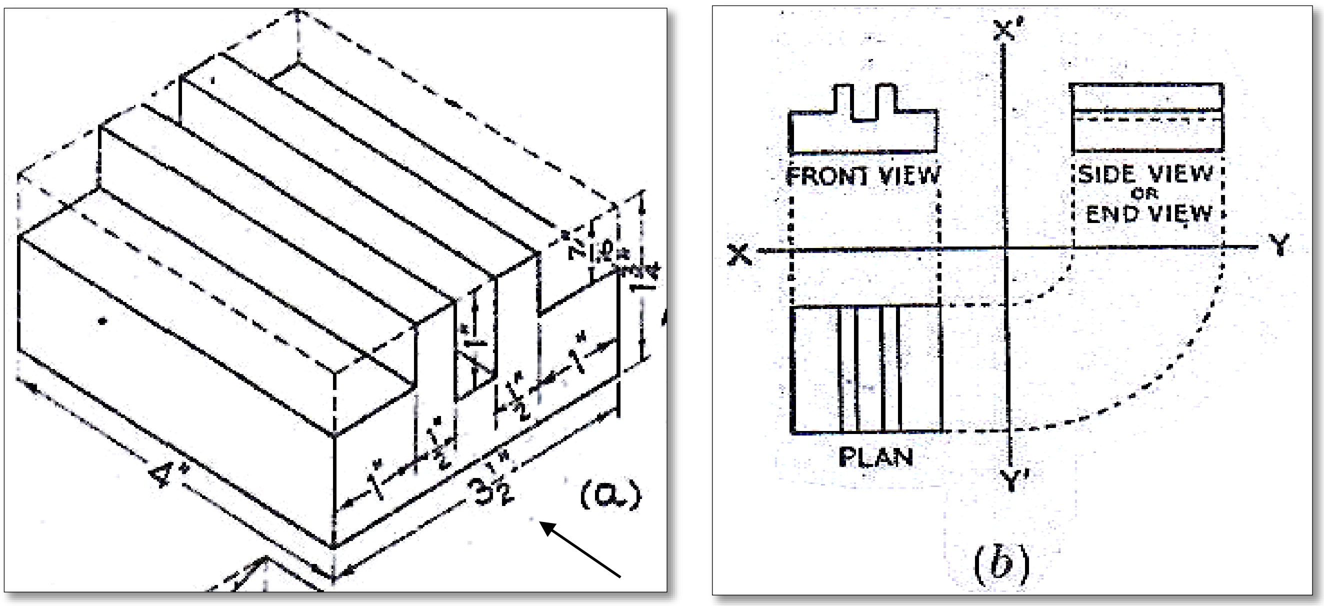


Fig. 5: U-Block (a) Isometric View, (b) Orthographic View

Hint:

Draw neat and clean orthographic views of:

- Front view from ‘X’/ Arrow Head ;
- Side view from left;
- Top view.

Sheet 3: **"Part of Rolled Steel Joist"**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of Part of rolled steel joist (I-Section) from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:
1) Fig.6 shows an isometric and orthographic view of an object.
2) Do apply suitable scaling if required.
3) Apply 1st or 3rd angle projection method, unless you are asked specifically to use any.

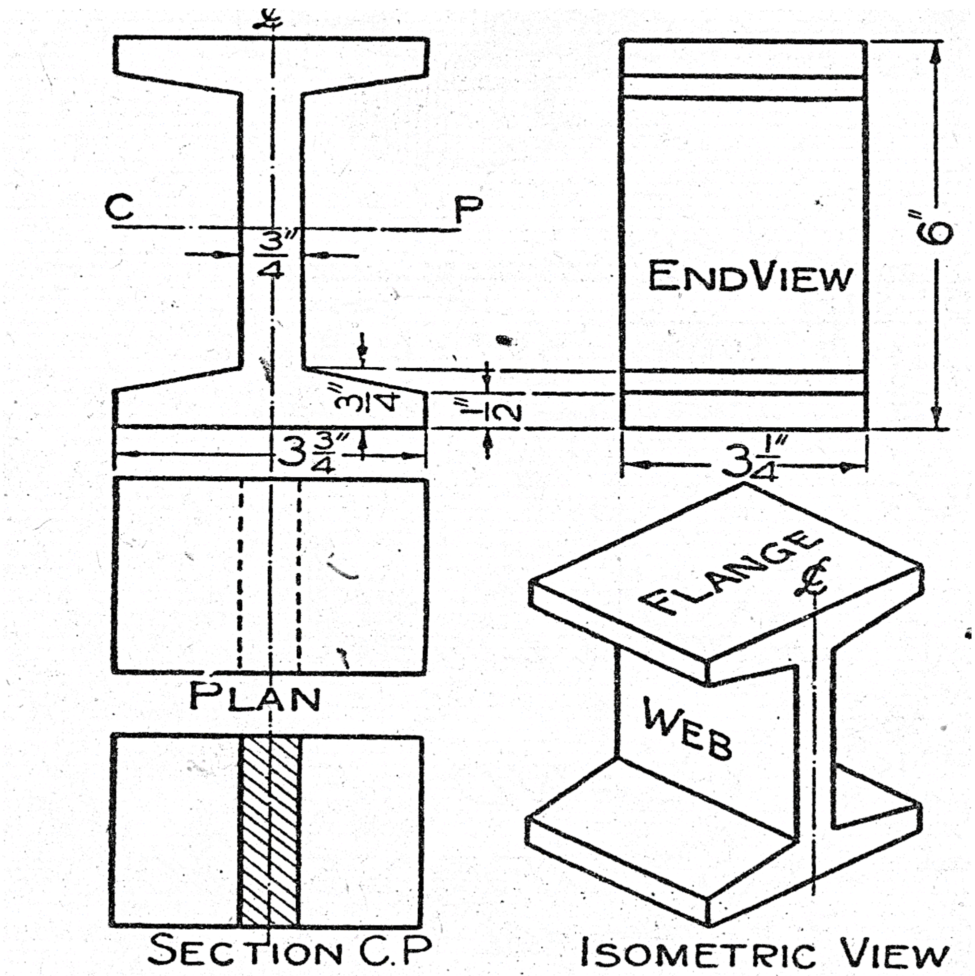


Fig. 6: Orthographic views and a pictorial view of the Part of rolled steel joist **(I-section)**

Hint:
Draw neat and clean orthographic views of:
- Front view from 'X'/ Arrow Head ;
- Side view from left;
- Top view.

Sheet 4: **“Gland for Stuffing Box”**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of gland for stuffing box from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:
1) Fig.7 (a) and 7 (b) shows an isometric and orthographic view of an object.
2) Do apply suitable scaling if required.
3) Apply 1st or 3rd angle projection method, unless you are asked specifically to use any one of these.

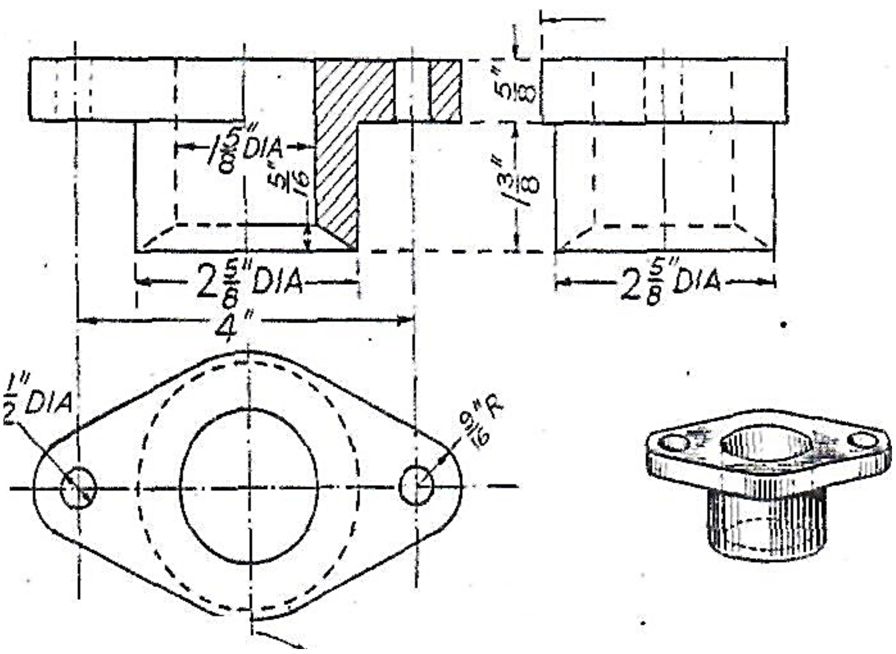


Fig. 7: (a) Orthographic views and a pictorial view of the gland for stuffing box

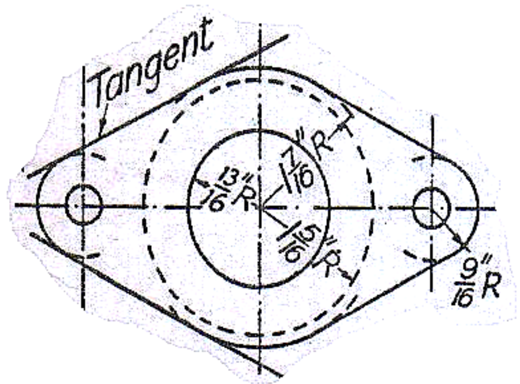


Fig. 7: (b) Orthographic views and a pictorial view of the gland for stuffing box

Hint:

Draw neat and clean orthographic views of:

- Front view from ‘X’/ Arrow Head ;
- Side view from left;
- Top view.

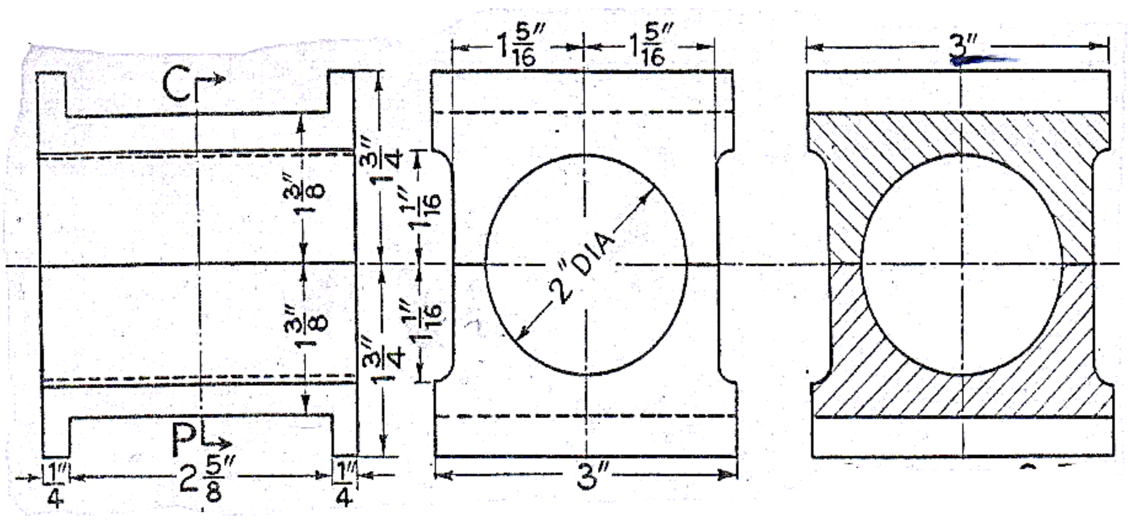
Sheet 5: **“Pair of Brasses”**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

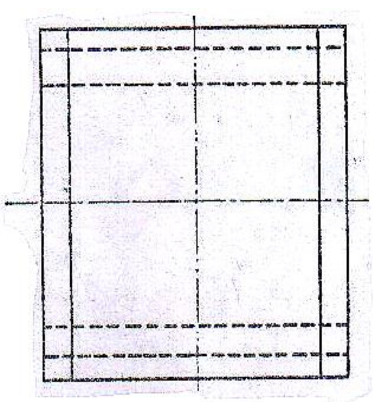
Objective:
Draw the orthographic Projection (Front, Top & side Views) of Pair of Brasses from its isometric (3d) view.

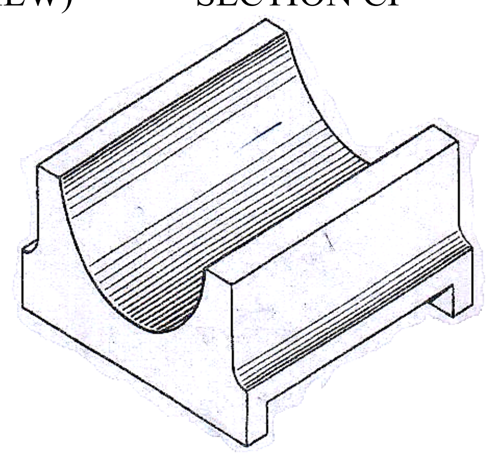
Apparatus:
Drawing Instruments

Instructions:
1) Fig.8 shows an isometric and orthographic views of an object.
2) Do apply suitable scaling if required.
3) Apply 1st or 3rd angle projection method, unless you are asked specifically to use any one of these.



END VIEW (SIDE VIEW) SECTION CP





PLAN ISOMETRIC VIEW

Fig. 8: Orthographic views of a pair of brasses and isometric view of the lower brass

Sheet 6: **"Monkey for Scribing Block"**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of Monkey for scribing block from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:
1. Fig. 9 shows an isometric and orthographic view of an object.
2. Do apply suitable scaling if required.
3. Apply 1st or 3rd angle projection method, unless you are asked specifically to use any one of these.

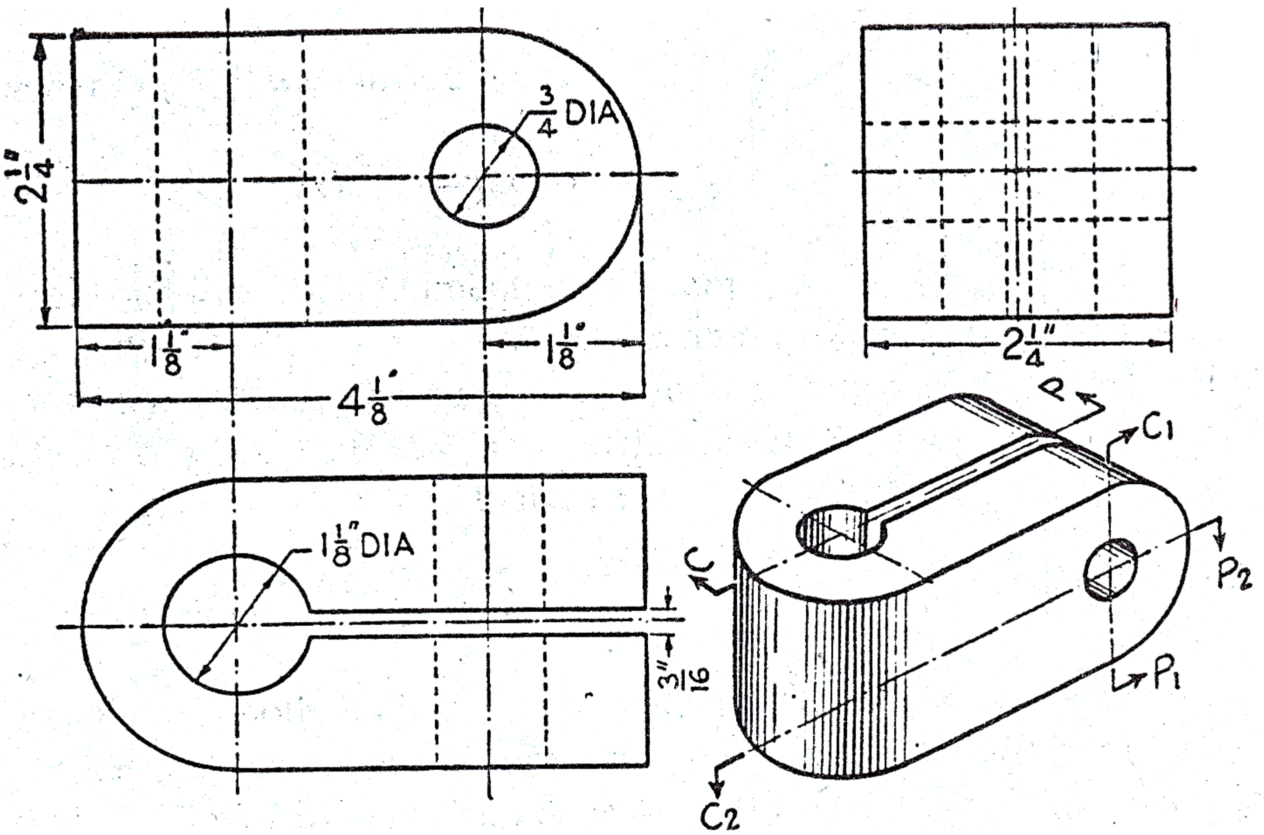


Fig. 9: Orthographic and isometric view of the Monkey for scribing block

Hint:
Draw neat and clean orthographic views of:
- Front view from 'X'/ Arrow Head ;
- Side view from left;
- Top view.

Sheet 7: **"Cutting Planes"**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of Cutting Planes from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:
1. Fig.10 shows an isometric and orthographic views of an object.
2. Do apply suitable scaling if required.
3. Apply 1^{st} or 3^{rd} angle projection method, unless you are asked specifically to use any one of these.

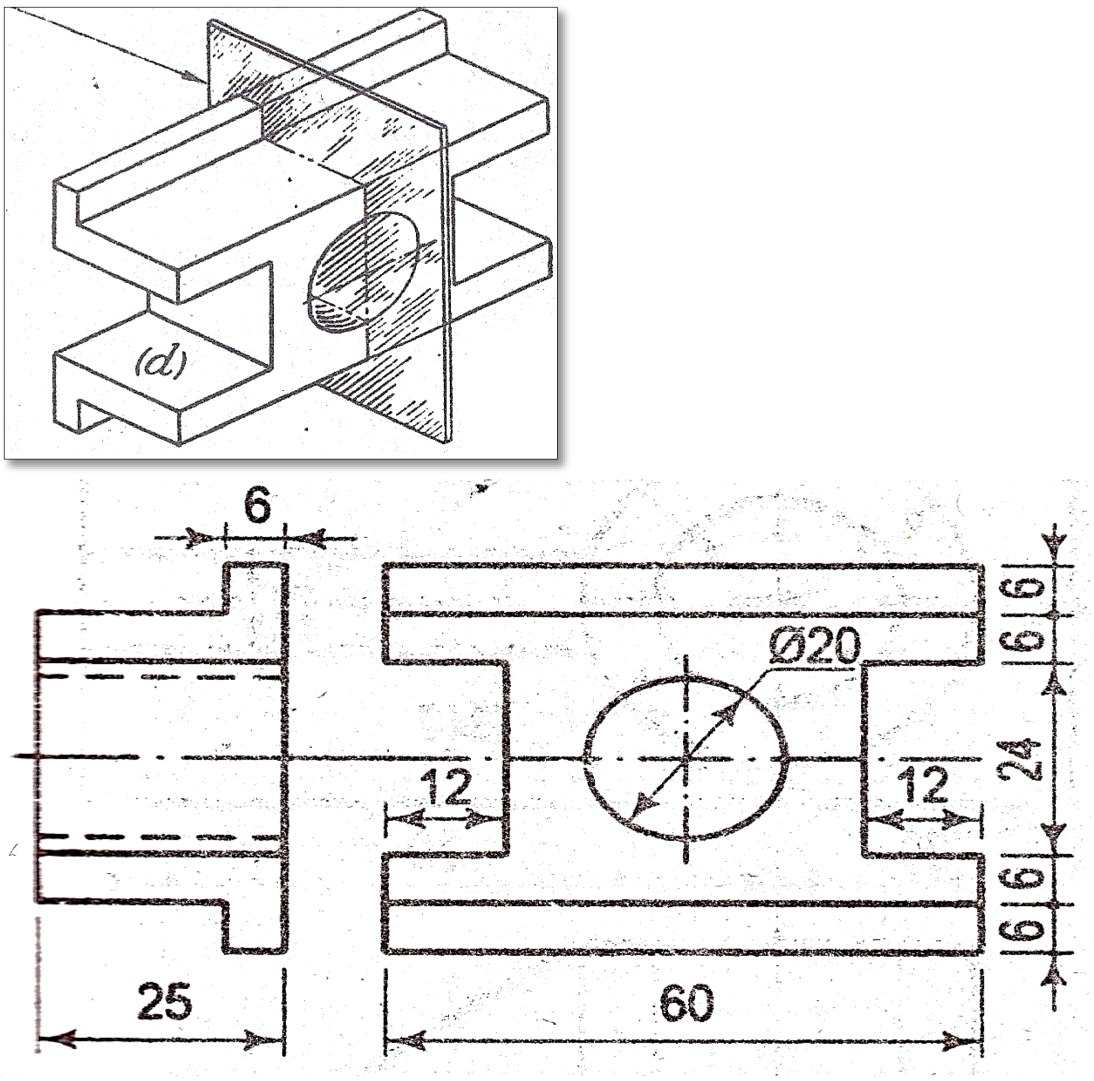


Fig. 10: Orthographic and isometric view of the Cutting Planes

Hint:

Draw neat and clean orthographic views of:

- Front view from ‘X’/ Arrow Head ;
- Side view from left;
- Top view.

Sheet 8: **"Bearing"**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of Bearing from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:
1. Fig.11 (a) shows an isometric view of an object.
2. Fig.11 (b) shows an orthographic view of an object.
3. Do apply suitable scaling if required.
4. Apply 1^{st} or 3^{rd} angle projection method, unless you are asked specifically to use any one of these.

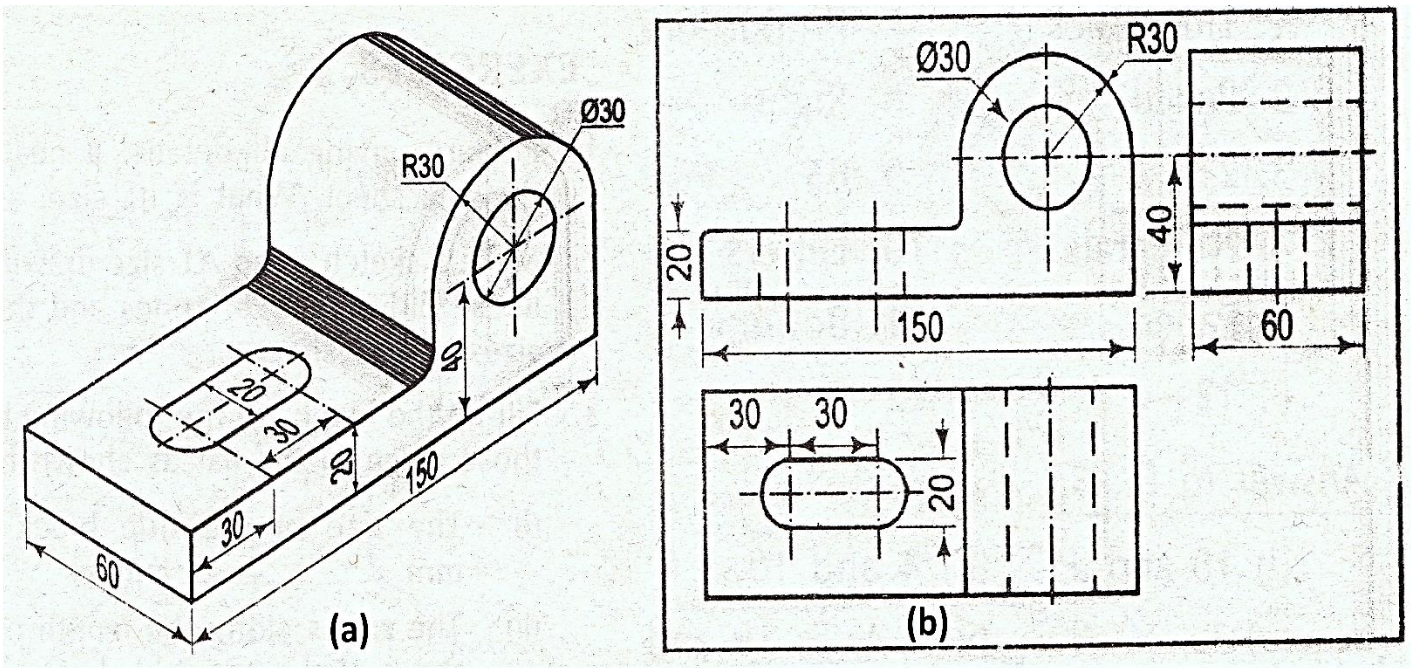


Fig. 11: (a) Isometric and (b) Orthographic view of a Bearing

Hint:
Draw neat and clean orthographic views of:
- Front view from 'X'/ Arrow Head ;
- Side view from left;
- Top view.

Sheet 9: **“Journal Bearing”**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of Journal Bearing from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:
1. Fig.12 (a) shows an isometric view of an object.
2. Fig.12 (b) shows an orthographic view of an object.
3. Do apply suitable scaling if required.
4. Apply 1st or 3rd angle projection method, unless you are asked specifically to use any one of these.

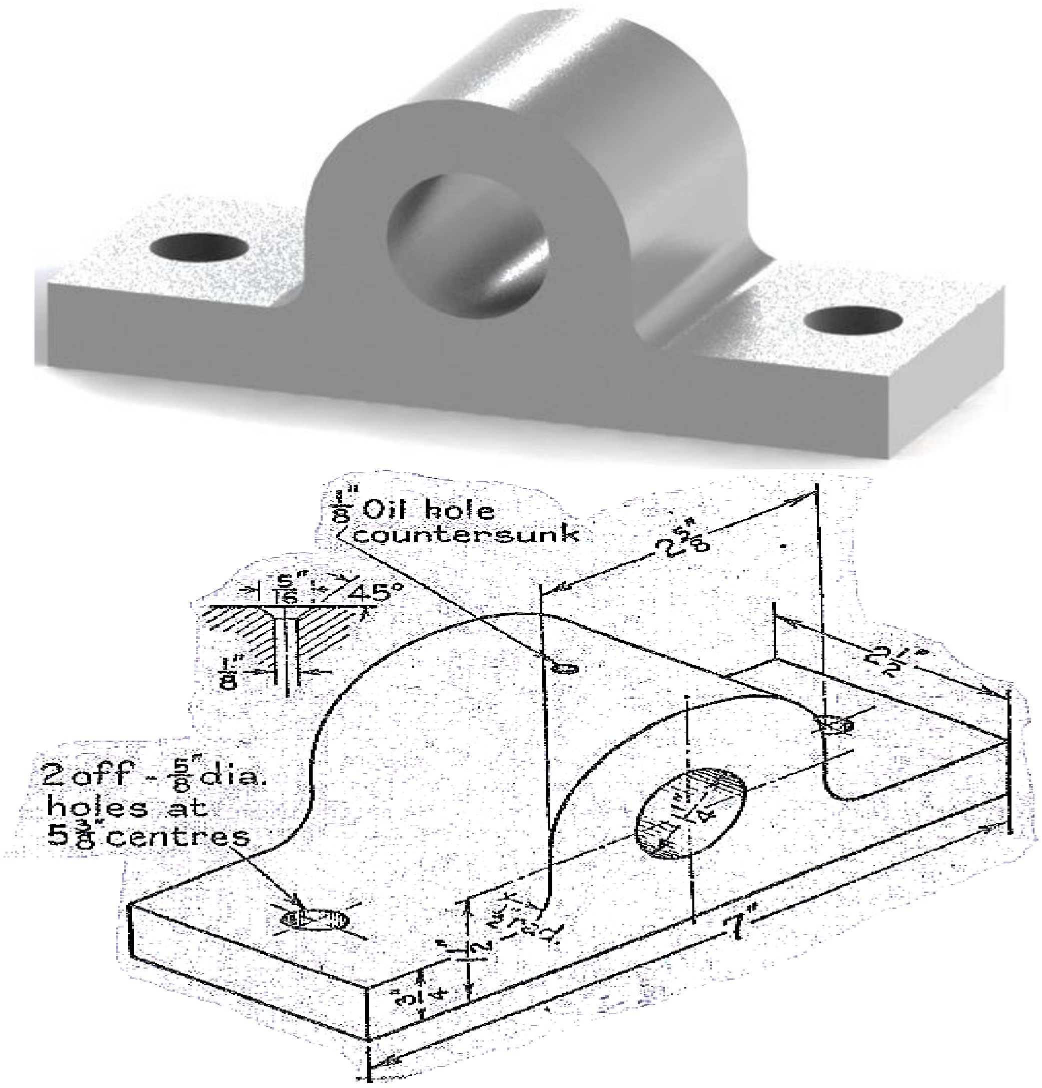


Fig. 12: (a) Isometric view of a Journal Bearing

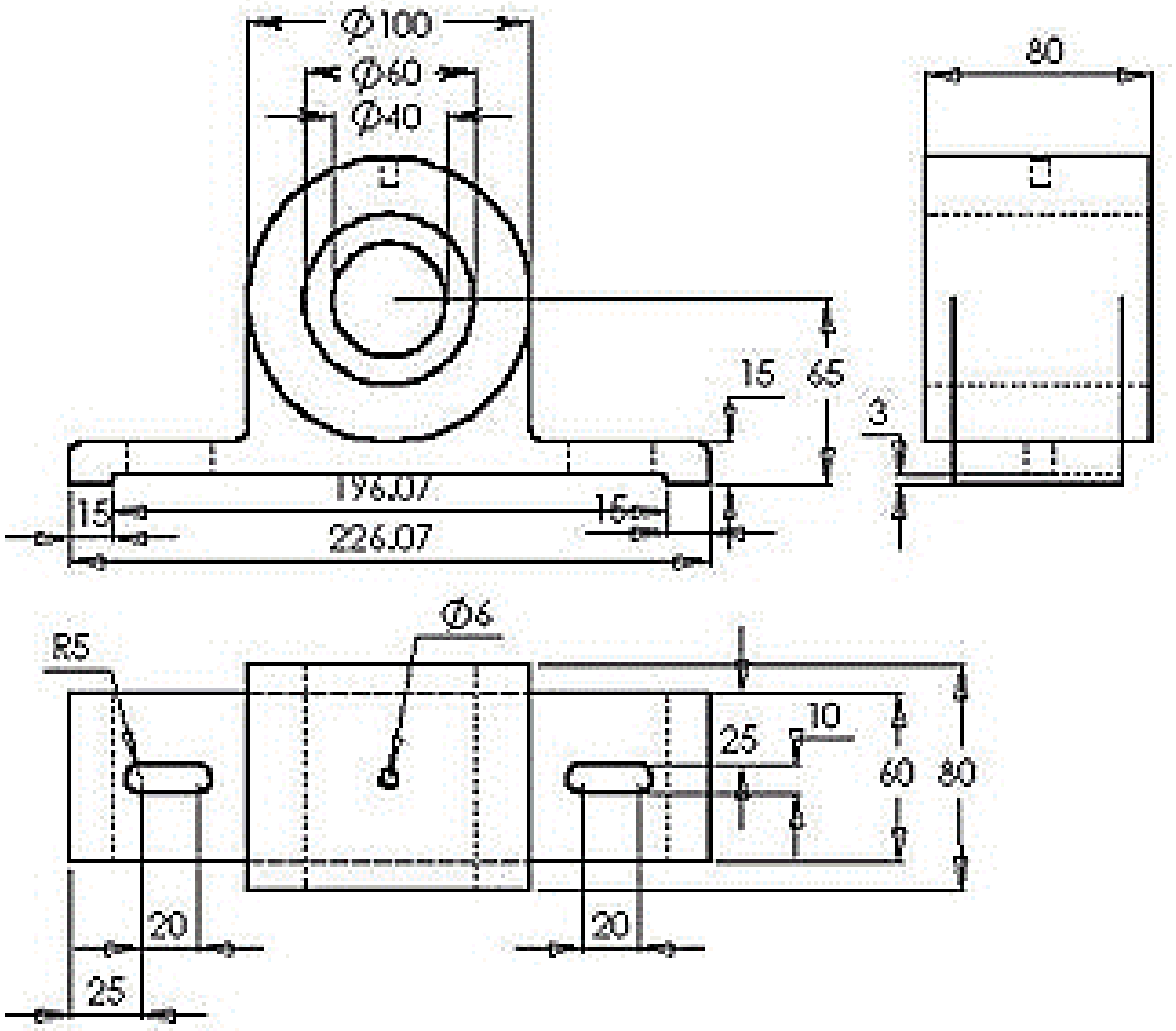


Fig. 12: (b) Orthographic view of a Journal Bearing

Hint:

Draw neat and clean orthographic views of:

- Front view from ‘X’/ Arrow Head ;
- Side view from left;
- Top view.

Sheet 10: **"Open Bearing"**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of Journal Bearing from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:

5. Fig.13 (a) shows an isometric view of an object.
6. Fig.13 (b) shows an orthographic view of an object.
7. Do apply suitable scaling if required.
8. Apply 1st or 3rd angle projection method, unless you are asked specifically to use any one of these.

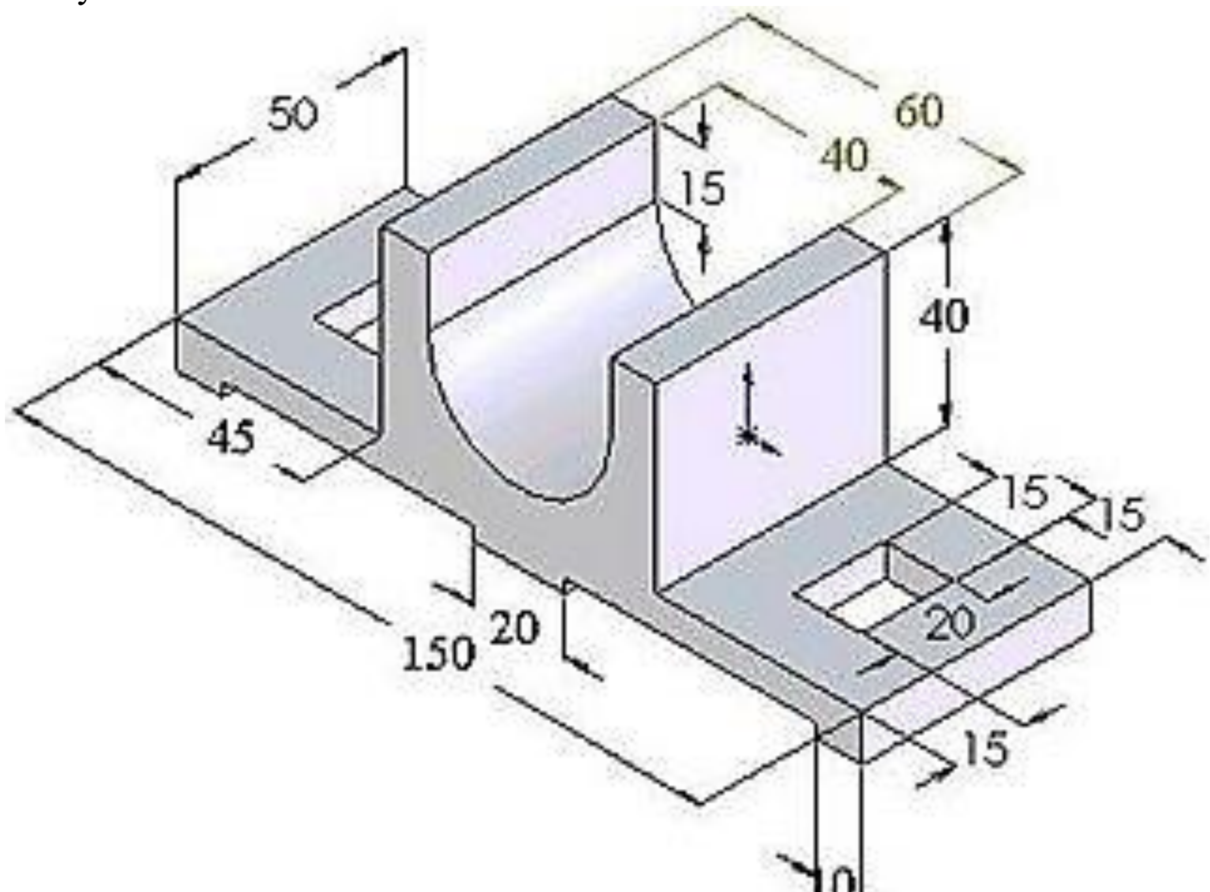


Fig. 13 (a): Isometric view of an Open Bearing

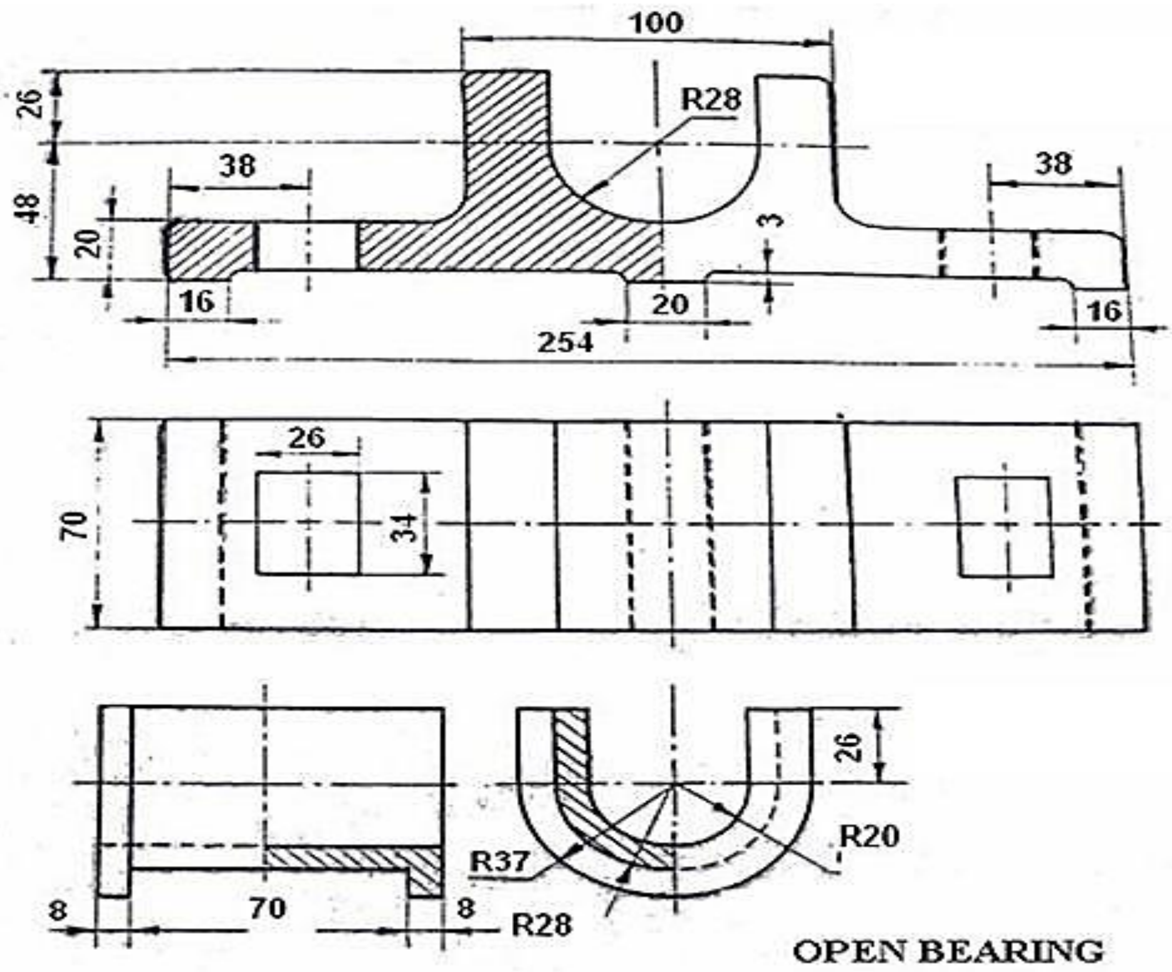


Fig. 13 (b): Orthographic view of an Open Bearing

Hint:

Draw neat and clean orthographic views of:

- Front view from ‘X’/ Arrow Head ;
- Side view from left;
- Top view.

Sheet 11: **“Isometric View of a 3d Object”**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of an object from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:

1. Fig.14 (a) shows an isometric view of an object.
2. Fig.14 (b) shows an orthographic view of an object.
3. Do apply suitable scaling if required.
4. Apply 1st or 3rd angle projection method, unless you are asked specifically to use any one of these.

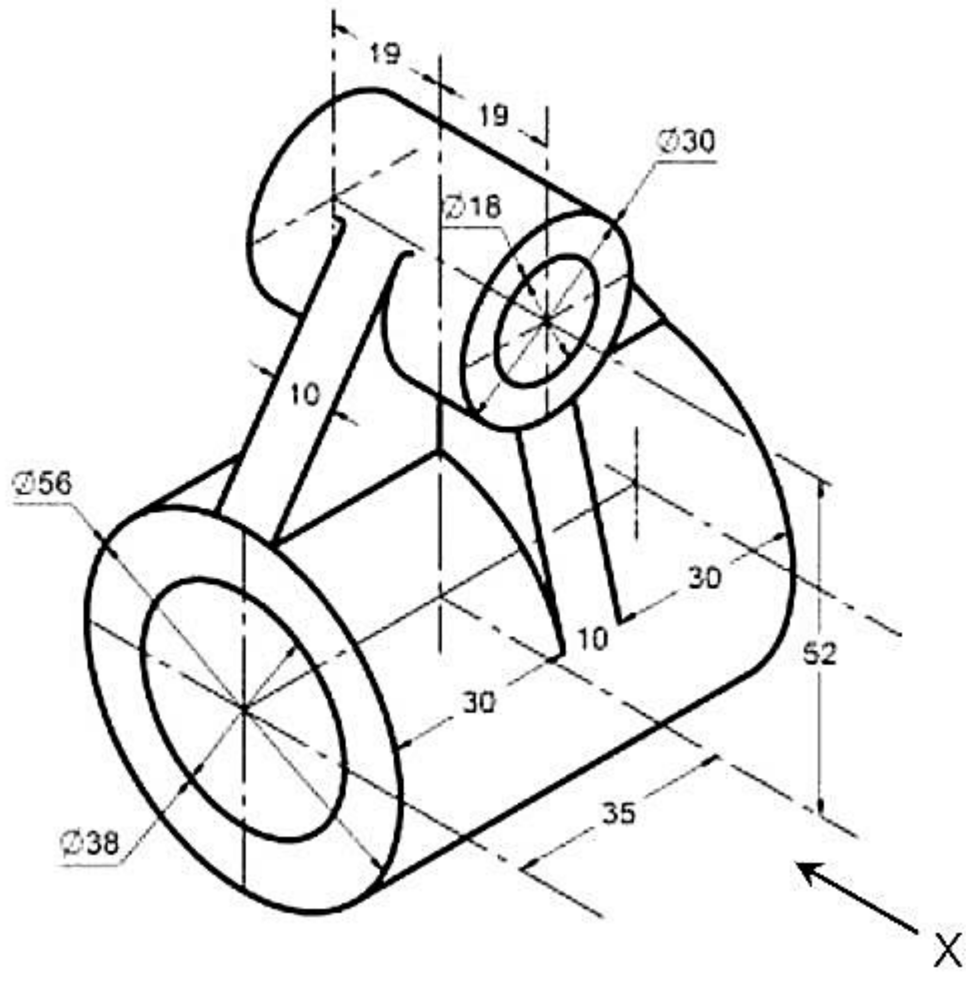


Fig. 14 (a): Isometric view

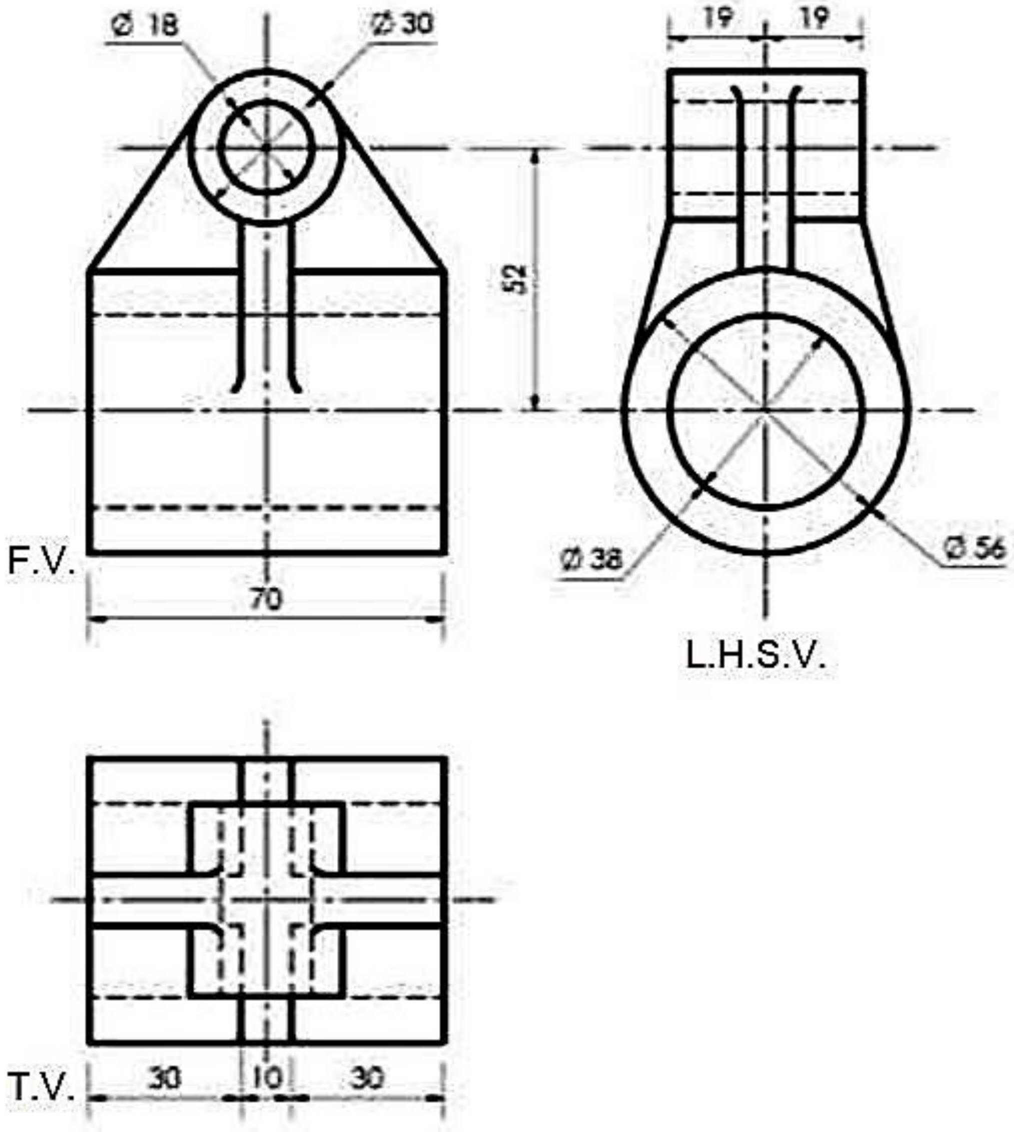


Fig. 14 (b): Orthographic view

Hint:
Draw neat and clean orthographic views of:

- Front view from 'X'/ Arrow Head ;
- Side view from left;
- Top view.

Sheet 12: **"Isometric View of a 3d Object"**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of an object from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:
1. Fig.15 (a) shows an isometric view of an object.
2. Fig.15 (b) shows an orthographic view of an object.
3. Do apply suitable scaling if required.
4. Apply 1st or 3rd angle projection method, unless you are asked specifically to use any one of these.

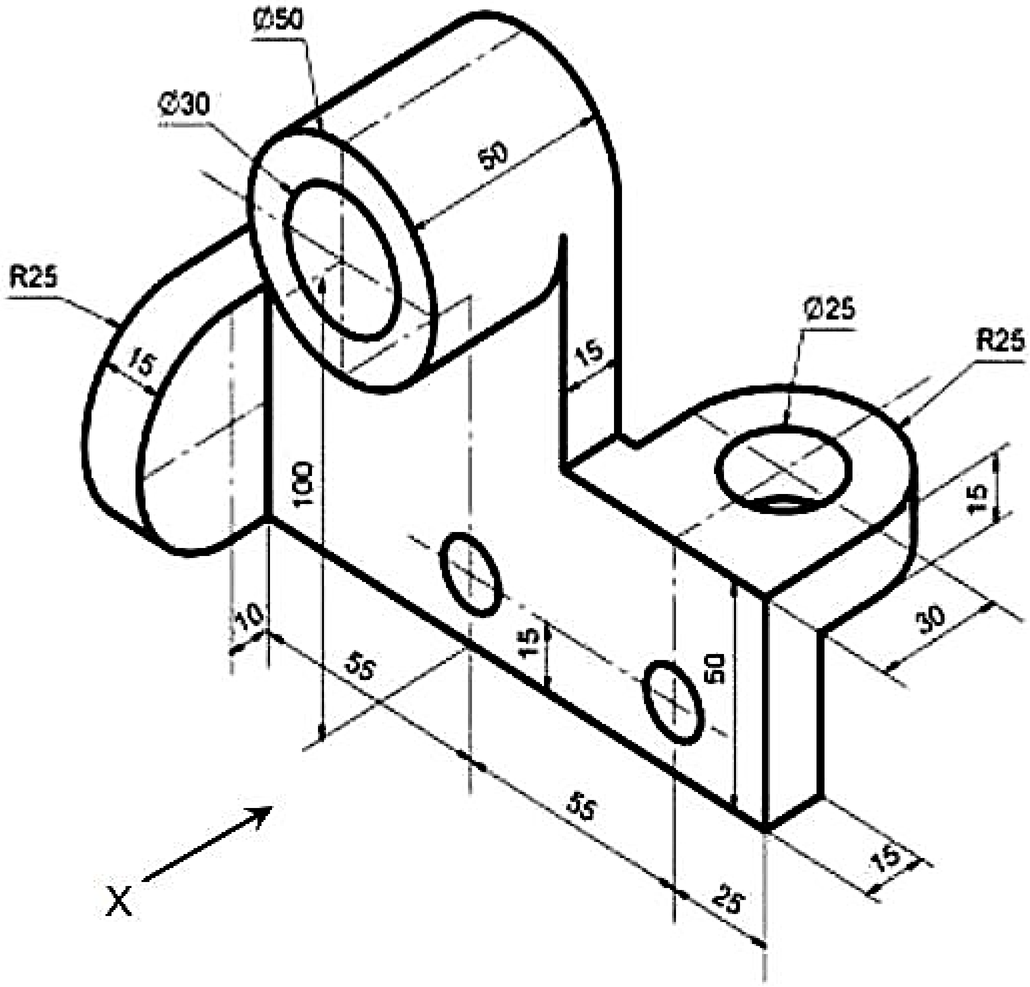


Fig. 15 (a): Isometric view

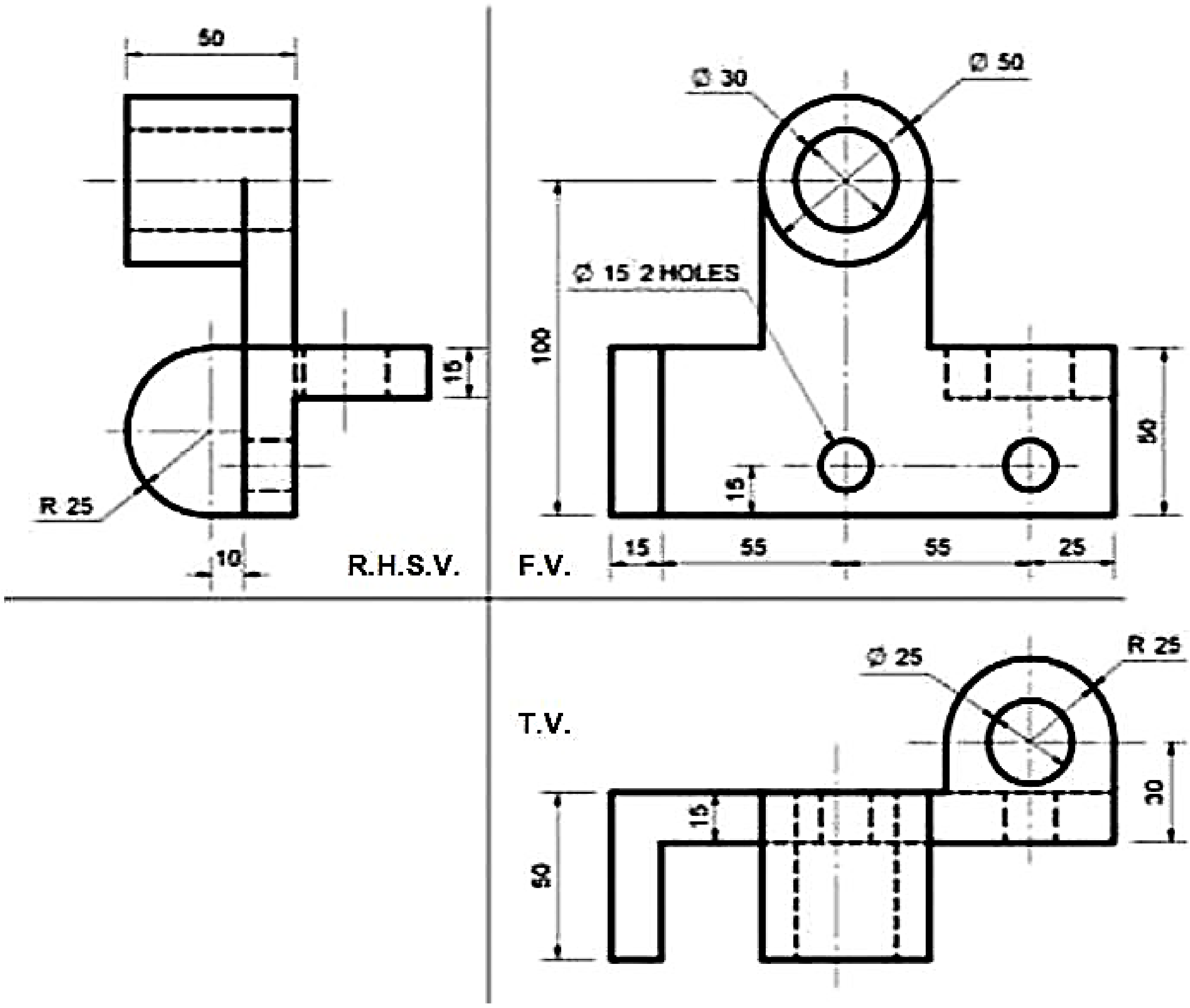


Fig. 15 (b): Orthographic view

Hint:

Draw neat and clean orthographic views of:

- Front view from ‘X’/ Arrow Head ;
- Side view from left;
- Top view.

Sheet 13: **"Isometric View of a 3d Object"**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of an object from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:
1. Fig.16 (a) shows an isometric view of an object.
2. Fig.16 (b) shows an orthographic view of an object.
3. Do apply suitable scaling if required.
4. Apply 1st or 3rd angle projection method, unless you are asked specifically to use any one of these.

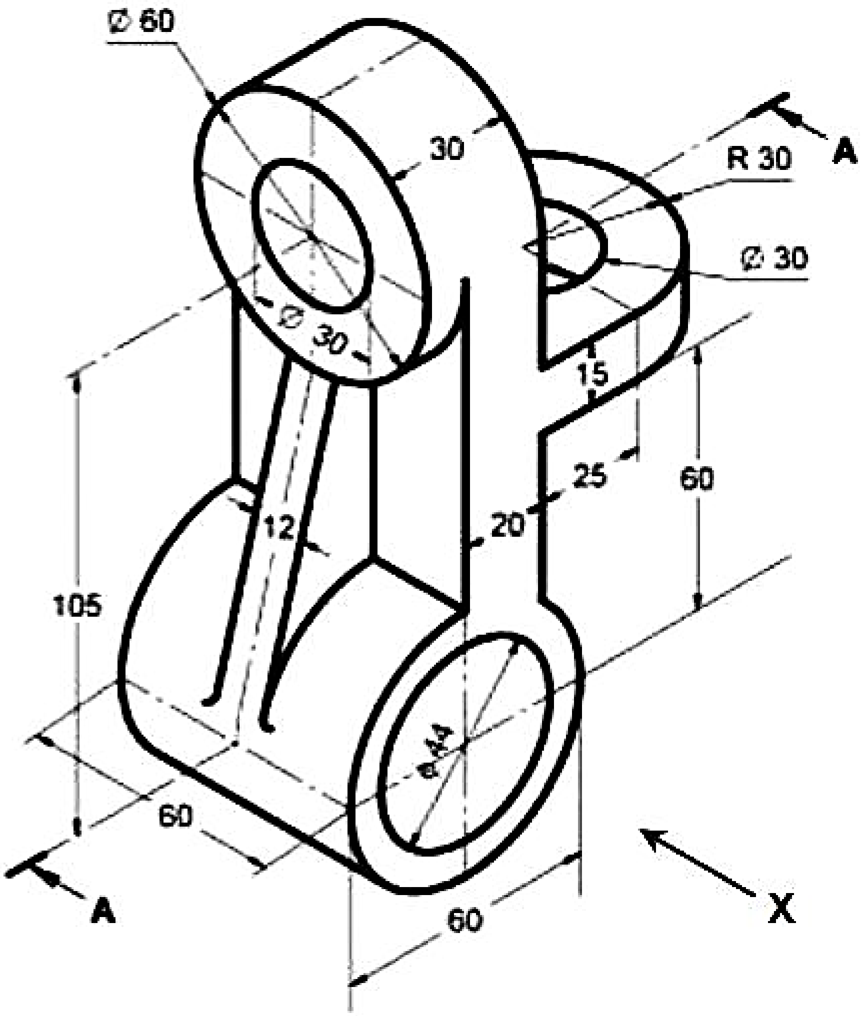


Fig. 16 (a): Isometric view

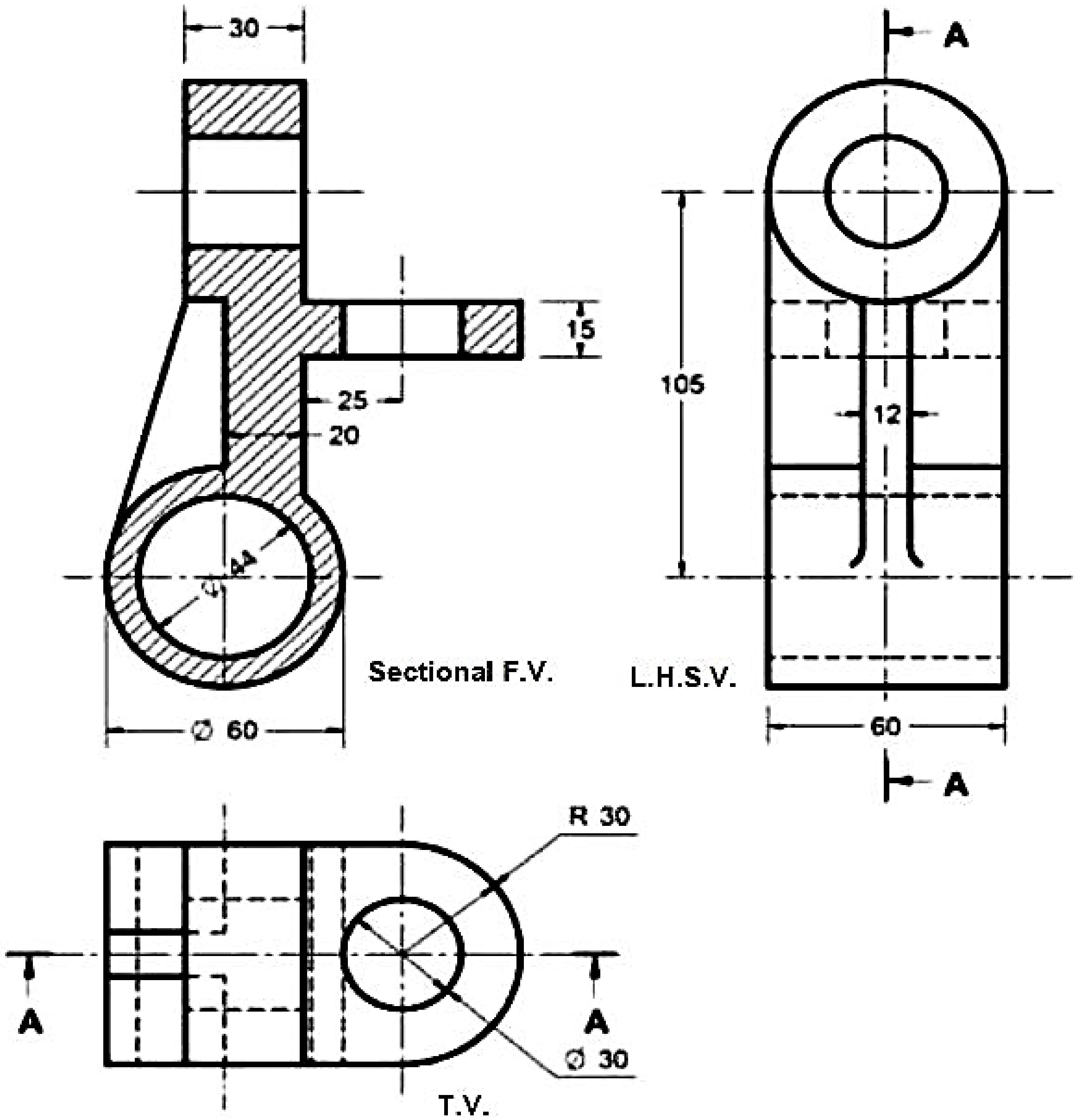


Fig. 16 (b): Orthographic view

Hint:
Draw neat and clean orthographic views of:

- Front view from 'X'/ Arrow Head ;
- Side view from left;
- Top view.

Sheet 14: **"Isometric View of a 3d Object"**

Aim:
To understand the conversion of 3 dimensional views into 2 dimensional views.

Objective:
Draw the orthographic Projection (Front, Top & side Views) of an object from its isometric (3d) view.

Apparatus:
Drawing Instruments

Instructions:

1. Fig.17 (a) shows an isometric view of an object.
2. Fig.17 (b) shows an orthographic view of an object.
3. Do apply suitable scaling if required.
4. Apply 1st or 3rd angle projection method, unless you are asked specifically to use any one of these.

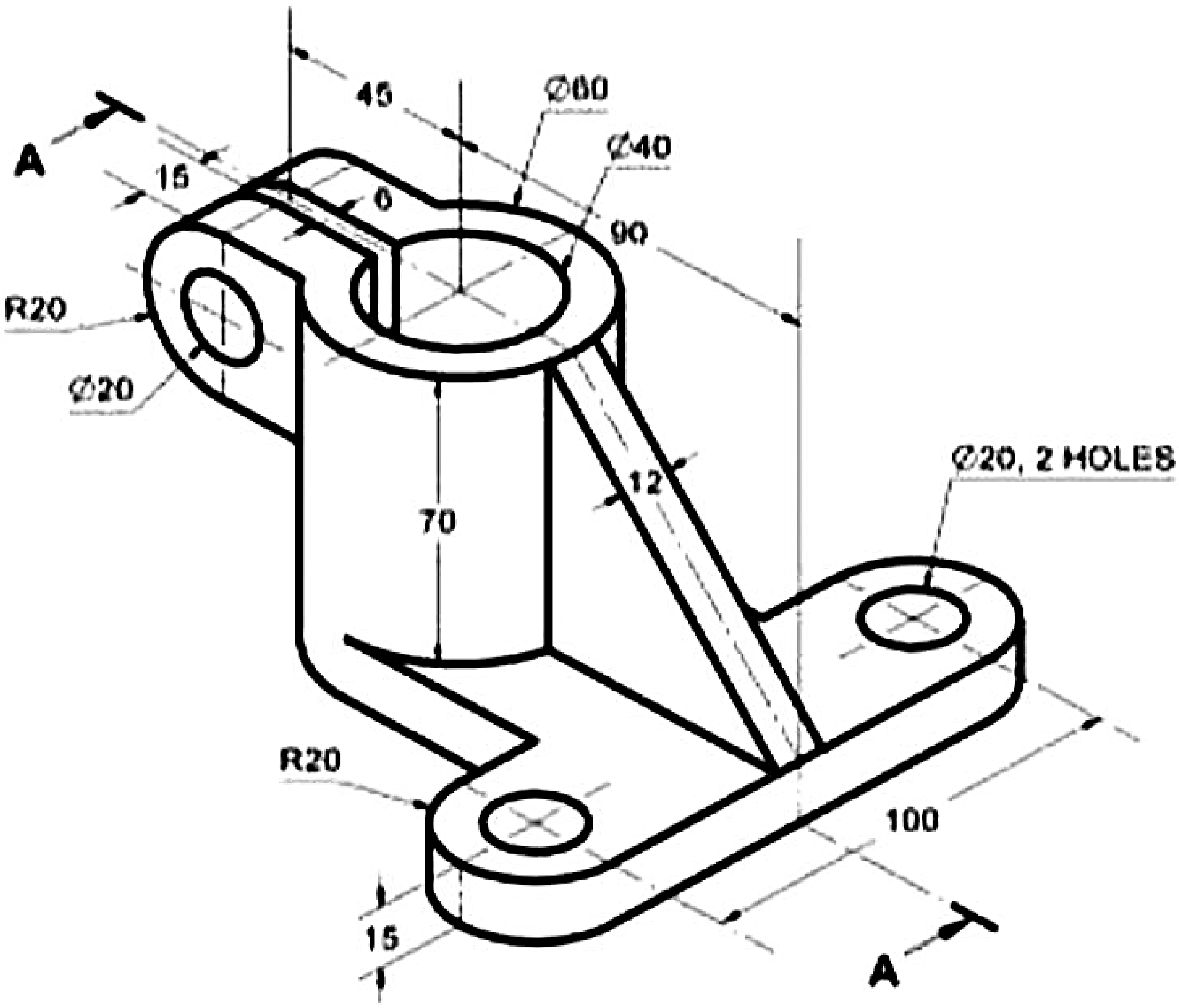


Fig. 17 (a): Isometric view

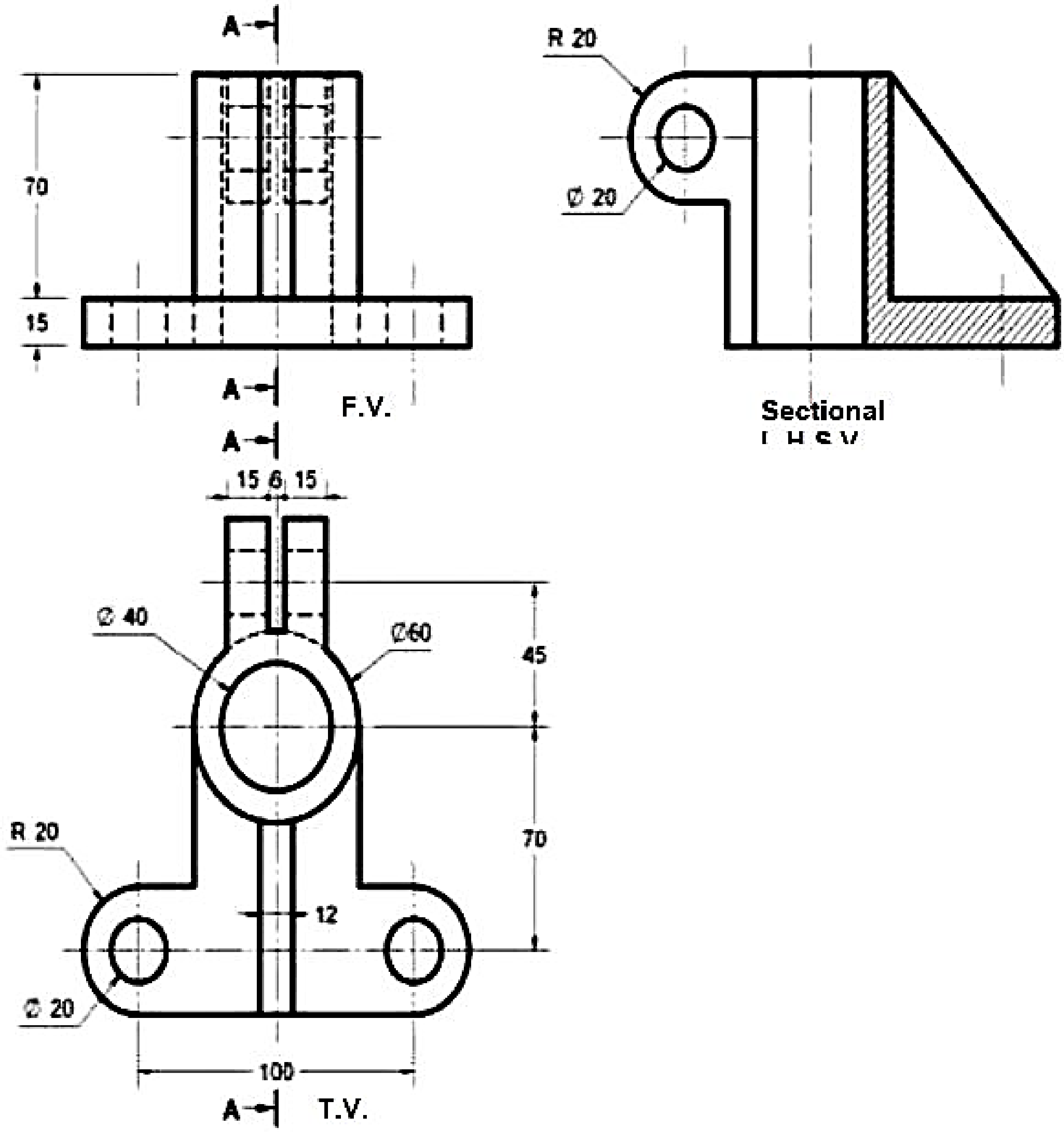


Fig. 17 (b): Orthographic view

Hint:

Draw neat and clean orthographic views of:

- Front view from 'X'/ Arrow Head ;
- Side view from left;
- Top view.