Department of Mechanical Engineering

Course File

COMPUTER AIDED ENGINEERING GRAPHICS
(Course Code: EG203ES)

IB.Tech II Semester

2023-24

Mr.Y.RAJESH KHANNA
Assistant Professor

Ananthagiri, Kodad, Telangana 508 206, India.

Department of Mechanical Engineering

COMPUTER AIDED ENGINEERING GRAPHICS

Check List

Department of Mechanical Engineering

Int. Marks:40Ext. Marks:60 Total Marks:100

B.Tech ME I Year II-Semester **L T P C**
1 4 0 3

(EG203ES)COMPUTER AIDED ENGINEERING GRAPHICS

UNIT – I: Introduction to Engineering Graphics: Principles of Engineering Graphics and their Significance, Scales – Plain & Diagonal, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid, Introduction to Computer aided drafting – views, commands and conics

UNIT- II: Orthographic Projections: Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures. Computer aided orthographic projections – points, lines and planes

UNIT – III: Projections of Regular Solids Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone, and Computer aided projections of solids – sectional views

UNIT – IV: Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone, Development of surfaces using computer aided drafting

UNIT – V: Isometric Projections: Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice-versa –Conventions. Conversion of orthographic projection into isometric view using computer aided drafting.

Text Book:

1. Engineering Drawing N.D. Bhatt / Charotar
2. Engineering Drawing and graphics Using AutoCAD Third Edition, T. Jeyapoovan, Vikas: S. Chand and company Ltd.2009.

References:

1. Engineering Drawing, Basant Agrawal and C M Agrawal, Third Edition McGraw Hill
2. Engineering Graphics and Design, WILEY, Edition 2020.
3. Engineering Drawing, M. B. Shah, B.C. Rane / Pearson.
4. Engineering Drawing, N. S. Parthasarathy and Vela Murali, Oxford
5. Computer Aided Engineering Drawing – K Balaveera Reddy et al – CBS Publishers.

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Timetable

I B.Tech. II Semester – CAEG

Day/Hour	9.30-10.20	10.2-11.10	11.20-12.10	12.10-1.00	1.35-2.25	2.25-3.10	3.15-4.00
Monday	CAEG						
Tuesday	CAEG						
Wednesday							
Thursday							
Friday							
Saturday							

Department of Mechanical Engineering

Vision of the Institute

To be a premier Institute in the country and region for the study of Engineering, Technology and Management by maintaining high academic standards which promotes the analytical thinking and independent judgment among the prime stakeholders, enabling them to function responsibly in the globalized society.

Mission of the Institute

To be a world-class Institute, achieving excellence in teaching, research and consultancy in cutting-edge Technologies and be in the service of society in promoting continued education in Engineering, Technology and Management.

Quality Policy

To ensure high standards in imparting professional education by providing world-class infrastructure, top-quality-faculty and decent work culture to sculpt the students into Socially Responsible Professionals through creative team-work, innovation and research

Vision of the Department

To equip the Mechanical Engineering students with the best analytical skills in the state of the latest technologies and the best communication skills to meet the Mechanical Engineering manpower requirement both nationally and internationally to responds to the demands of the market which are dynamic in nature.

Mission of the Department

To equip the Mechanical Engineering students with the best analytical skills in the state of the latest technologies and the best communication skills to meet the Mechanical Engineering manpower requirement both nationally and internationally to responds to the demands of the market which are dynamic in nature.

Program Educational Objectives (B.Tech. – ME)
Graduates will be able to

PEO 1: To transcend in a professional career by acquiring knowledge in basic sciences, mathematics and mechanical engineering.

PEO 2: To exhibit problem solving skills on par with global requirements in industry and R&D.

PEO 3: To adopt the latest technologies, evolve as entrepreneurs, solving mechanical engineering problems, dealing with environmental society and ethical issues.

Program Outcomes (B.Tech. – ME)

At the end of the Program, a graduate will have the ability to

PO 1:An ability to apply the knowledge of mathematics, science and engineering fundamentals.

PO 2: An ability to conduct Investigations using design of experiments, analysis and interpretation of data to arrive at valid conclusions.

PO 3: An ability to design mechanical engineering components and processes within economic, environmental, ethical and manufacturing constraints.

PO 4: An ability to function effectively in multidisciplinary teams.

PO 5: An ability to identify, formulates, analyze and solve Mechanical Engineering problems.

PO 6: An ability to understand professional, ethical and social responsibility.

PO 7: An ability to communicate effectively through written reports or oral presentations.

PO 8: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

PO 9: An ability to recognize the need and to engage in independent and life-long learning.

PO 10: A knowledge of contemporary issues.

PO 11: An ability to use the appropriate techniques and modern engineering tools necessary for engineering practice.

PO 12: An ability to demonstrate knowledge and understanding of engineering.

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COURSE OBJECTIVES

On completion of this Subject/Course the student shall be able to:

S.No	Objectives
1	To develop the ability of visualization of different objects through technical drawings.
2	To impart knowledge about standard principles of orthographic projection of objects
3	To draw the regular solids and sectional views of the objects.
4	To development the right regular solids surfaces of solids.
5	To draw Isometric views and modern engineering tools like Auto Cad software necessary for engineering practice

COURSE OUTCOMES

The expected outcomes of the Course/Subject are:

S.No	Outcomes
1	Apply computer aided drafting tools to create 2D and 3D objects.
2	Visualize the different aspects of Points, Lines and Planes.
3	Acquire knowledge on projections of solids.
4	Draw the Sectional views of solids and plan the drawing for development of surfaces.
5	Understand the isometric views and projections. Exposure to computer-aided geometric design and creating working drawings

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Note: Please refer to Bloom's Taxonomy, to know the illustrative verbs that can be used to state the outcomes.

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GUIDELINES TO STUDY THE COURSE / SUBJECT

Course Design and Delivery System (CDD):

- The Course syllabus is written into number of learning objectives and outcomes.
- Every student will be given an assessment plan, criteria for assessment, scheme of evaluation and grading method.
- The Learning Process will be carried out through assessments of Knowledge, Skills and Attitude by various methods and the students will be given guidance to refer to the text books, reference books, journals, etc.

The faculty be able to –

- Understand the principles of Learning
- Understand the psychology of students
- Develop instructional objectives for a given topic
- Prepare course, unit and lesson plans
- Understand different methods of teaching and learning
- Use appropriate teaching and learning aids
- Plan and deliver lectures effectively
- Provide feedback to students using various methods of Assessments and tools of Evaluation
- Act as a guide, advisor, counselor, facilitator, motivator and not just as a teacher alone

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Date: | Date:

Department of Mechanical Engineering

COURSE SCHEDULE

The Schedule for the whole Course / Subject is:

S. No.	Description	Duration (Date)		Total No. of Periods
		From	To	
1.	**UNIT – I: Introduction to Engineering Graphics:** Principles of Engineering Graphics and their Significance, Scales – Plain & Diagonal, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid, Introduction to Computer aided drafting – views, commands and conics	05.02.2024	20.02.2024	18
2.	**UNIT- II: Orthographic Projections:** Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures. Computer aided orthographic projections – points, lines and planes	26.02.2024	05.03.2024	12
3.	**UNIT – III:** Projections of Regular Solids Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone, and Computer aided projections of solids – sectional views	11.03.2024	15.04.2024	21
4.	**UNIT – IV: Development of Surfaces** of Right Regular Solids – Prism, Cylinder, Pyramid and Cone, Development of surfaces using computer aided drafting	16.04.2024	29.04.2024	12
5.	**UNIT – V: Isometric Projections:** Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice-versa –Conventions. Conversion of orthographic projection into isometric view using computer aided drafting.	30.04.2024	11.06.2024	27

Total No. of Instructional periods available for the course: 90 Hours

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SCHEDULE OF INSTRUCTIONS - COURSE PLAN

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Textbook, Journal)
1.	1	05.02.2024	3	UNIT-1 Introduction to Engineering Drawing- Principles of Engineering Graphics	1 1	Engineering Drawing N.D. Bhatt / Charotar
	2	06.02.2024	3	Geometrical Constructions	1 1	Engineering Drawing N.D. Bhatt / Charotar
	3	12.02.2024	3	Conic sections Ellipse, Parabola , Hyperbola	1 1	Engineering Drawing N.D. Bhatt / Charotar
	4	13.02.2024	3	Rectangular hyperbola ,Cycloid and Epicycloid	1 1	Engineering Drawing N.D. Bhatt / Charotar
	5	19.02.2024	3	Hypocycloid and Scales	1 1	Engineering Drawing N.D. Bhatt / Charotar
	6	20.02.2021	3	Practice	1	Engineering Drawing N.D. Bhatt / Charotar
2.	1	26.02.2024	3	UNIT-2 Orthographic Projections and projection of points	2 2	Engineering Drawing N.D. Bhatt / Charotar
	2	27.02.2024	3	Projections of lines	2 2	Engineering Drawing N.D. Bhatt / Charotar
	3	04.03.2024	3	Projections of Planes-I&II	2 2	Engineering Drawing N.D. Bhatt / Charotar
	4	05.03.2024	3	Projections of Planes-III	2 2	Engineering Drawing N.D. Bhatt / Charotar
3.	1	11.03.2024	3	UNIT-3 Projections of Regular Solids	3 3	Engineering Drawing N.D. Bhatt / Charotar
	2	12.03.2024	3	Projections of Regular Solids	3 3	Engineering Drawing N.D. Bhatt / Charotar
	3	18.03.2024	3	Projections of Regular Solids	3 3	Engineering Drawing N.D. Bhatt / Charotar
	4	19.03.2024	3	Practice	3	Engineering Drawing N.D. Bhatt / Charotar
	4	26.03.2024	3	Practice	3	Engineering Drawing N.D. Bhatt / Charotar
	6	08.04.2024	3	Sections of Solids	3 3	Engineering Drawing N.D. Bhatt / Charotar
	7	15.04.2024	3	Sections of Solids	3 3	Engineering Drawing N.D. Bhatt / Charotar
4	1	16.04.2024	3	UNIT-4 Development of surfaces of Right Regular Solids	4 4	Engineering Drawing N.D. Bhatt / Charotar
	2	22.04.2024	3	Traingulation Line Method	4	Engineering Drawing

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					4	N.D. Bhatt / Charotar
	3	23.04.2024	3	Parallel Line Method-Problems	4 4	Engineering Drawing N.D. Bhatt / Charotar
	4	29.04.2024	3	Radial Line Method-Problems	4 4	Engineering Drawing N.D. Bhatt / Charotar
	1	30.04.2024	3	UNIT-5 Isometric Projections-Principles of Isometric Projection	5 5	Engineering Drawing N.D. Bhatt / Charotar
	2	06.05.2024	3	Isometric Projections-Pyramid and cone	5 5	Engineering Drawing N.D. Bhatt / Charotar
	3	07.05.2024	3	Conversion of Isometric Views to Orthographic Views and Vice-versa	5 5	Engineering Drawing N.D. Bhatt / Charotar
	4	13.05.2024	3	Practice	5	Engineering Drawing N.D. Bhatt / Charotar
5	5	14.05.2024	3	Practice	5	Engineering Drawing N.D. Bhatt / Charotar
	6	20.05.2024	3	Conversion of Isometric Views to Orthographic Views and Vice-versa	5 5	Engineering Drawing N.D. Bhatt / Charotar
	7	21.05.2024	3	Conversion of Isometric Views to Orthographic Views and Vice-versa	5 5	Engineering Drawing N.D. Bhatt / Charotar
	8	10.06.2024	3	Conversion of Isometric Views to Orthographic Views and Vice-versa	5 5	Engineering Drawing N.D. Bhatt / Charotar
	9	11.06.2024	3	Conversion of Isometric Views to Orthographic Views and Vice-versa	5 5	Engineering Drawing N.D. Bhatt / Charotar

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Date:

Signature of faculty

Date:

ANURAG Engineering College

(An Autonomous Institution)
(Approved by AICTE, New Delhi, Affiliated to JNTUH, Hyderabad)
Ananthagiri (V&M), Kodad, Suryapet (Dt). Pin: 508 206.

DEPARTMENT OF HUMANITIES AND SCIENCES

A.Y. 2023-24 (Even Semester)					
I B.Tech II Semester Teaching Plan					
Branch/Section:		ECE		Commence of Classwork: 05-02-2024	
Name of the Faculty:			Y.RAJESH KHANNA		
SUBJECT:			CAEG		
Date	Day	Week No	Classes per week	Topics to be covered	Topic covered Date
5-Feb-24	MON	1	6	UNIT-1 Introduction to Engineering Drawing-Principles of Engineering Graphics	
6-Feb-24	TUE			GEOMENTRICAL CONSTRUCTIONS	
7-Feb-24	WED				
8-Feb-24	THU				
9-Feb-24	FRI				
10-Feb-24	SAT			Second Saturday	
11-Feb-24	SUN	SUNDAY			
12-Feb-24	MON	2	6	Conic sections Ellipse,Parabola, Hyperbola	
13-Feb-24	TUE			Rectangular hyperbola,Cycloid and Epicycloid	
14-Feb-24	WED				

15-Feb-24	THU				
16-Feb-24	FRI				
17-Feb-24	SAT				
18-Feb-24	SUN	SUNDAY			
19-Feb-24	MON	3	6	Hypocycloid and Scales	
20-Feb-24	TUE			practice	
21-Feb-24	WED				
22-Feb-24	THU				
23-Feb-24	FRI				
24-Feb-24	SAT				
25-Feb-24	SUN	SUNDAY			
26-Feb-24	MON	4	6	UNIT-2 Orthographic Projections and projection of points	
27-Feb-24	TUE			Projections of lines	
28-Feb-24	WED				
29-Feb-24	THU				
1-Mar-24	FRI				
2-Mar-24	SAT				
3-Mar-24	SUN	SUNDAY			
4-Mar-24	MON	5	6	Projections of Planes	
5-Mar-24	TUE			Projections of Planes	
6-Mar-24	WED				
7-Mar-24	THU				
8-Mar-24	FRI			MahaShivaratri	
9-Mar-24	SAT			Second Saturday	
10-Mar-24	SUN	SUNDAY			
11-Mar-24	MON	6	6	UNIT-3 Projections of Regular Solids	
12-Mar-24	TUE			Projections of Regular Solids	
13-Mar-24	WED				
14-Mar-24	THU				
15-Mar-24	FRI				
16-Mar-24	SAT				
17-Mar-24	SUN	SUNDAY			
18-Mar-24	MON	7	6	Projections of Regular Solids	
19-Mar-24	TUE			Practice	
20-Mar-24	WED				

21-Mar-24	THU				
22-Mar-24	FRI				
23-Mar-24	SAT				
24-Mar-24	SUN	SUNDAY			
25-Mar-24	MON	8	3	Holi	
26-Mar-24	TUE			Practice	
27-Mar-24	WED				
28-Mar-24	THU				
29-Mar-24	FRI			Good Friday	
30-Mar-24	SAT				
31-Mar-24	SUN	SUNDAY			
1-Apr-24	MON	9	0	I Mid Examinations	
2-Apr-24	TUE			I Mid Examinations	
3-Apr-24	WED			I Mid Examinations	
4-Apr-24	THU				
5-Apr-24	FRI			BabuJagjivan Ram Jayanthi	
6-Apr-24	SAT			Sectional views of Right Regular solids	
7-Apr-24	SUN	SUNDAY			
8-Apr-24	MON	10	3	Sections of Solids	
9-Apr-24	TUE			Ugadi	
10-Apr-24	WED				
11-Apr-24	THU			Ramzan	
12-Apr-24	FRI			Ramzan	
13-Apr-24	SAT			Second Saturday	
14-Apr-24	SUN	SUNDAY			
15-Apr-24	MON	11	6	Sections of Solids	
16-Apr-24	TUE			UNIT-4 Development of surfaces of Right Regular Solids	
17-Apr-24	WED			Ram Navami	
18-Apr-24	THU				
19-Apr-24	FRI				
20-Apr-24	SAT				
21-Apr-24	SUN	SUNDAY			
22-Apr-24	MON	12	6	Triangulation Line Method	
23-Apr-24	TUE			Parallel Line Method-Problems	
24-Apr-24	WED				

25-Apr-24	THU				
26-Apr-24	FRI				
27-Apr-24	SAT				
28-Apr-24	SUN	SUNDAY			
29-Apr-24	MON	13	6	Radial Line Method-Problems	
30-Apr-24	TUE			UNIT-5 Isometric Projections-Principles of Isometric Projection	
1-May-24	WED				
2-May-24	THU				
3-May-24	FRI				
4-May-24	SAT				
5-May-24	SUN	SUNDAY			
6-May-24	MON	14	6	Isometric Projections-Pyramid and cone	
7-May-24	TUE			Isometric Projections-Pyramid and cone	
8-May-24	WED				
9-May-24	THU				
10-May-24	FRI				
11-May-24	SAT			Second Saturday	
12-May-24	SUN	SUNDAY			
13-May-24	MON	15	6	practice	
14-May-24	TUE			practice	
15-May-24	WED				
16-May-24	THU				
17-May-24	FRI				
18-May-24	SAT				
19-May-24	SUN	SUNDAY			
20-May-24	MON	16	6	Conversion of Isometric Views to Orthographic Views and Vice-versa	
21-May-24	TUE			Conversion of Isometric Views to Orthographic Views and Vice-versa	
22-May-24	WED				
23-May-24	to 05-06-2024			Summer vacation	
6-Jun-24	THU	17	0		
7-Jun-24	FRI				
8-Jun-24	SAT			Second Saturday	

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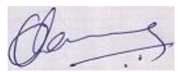
9-Jun-24	SUN	**SUNDAY**			
10-Jun-24	MON	**18**	**6**	Conversion of Isometric Views to Orthographic Views and Vice-versa	
11-Jun-24	TUE			Conversion of Isometric Views to Orthographic Views and Vice-versa	
12-Jun-24	WED				
13-06-2024 to 15-06-2024				**II Mid Examinations**	
18-06-2024 to 24-06-2024				**PREPARATION & PRACTICAL EXAMINATIONS**	
25-06-2024 to 20.07.2024				**END SEMESTER EXAMINATIONS**	

Signature of HOD

Date:



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ASSIGNMENT – 1

This Assignment corresponds to Unit No. 1

Question No.	Question	Objective No.	Outcome No.
1	Construct an ellipse, with distance of the focus from the directrix as 50 mm and eccentricity as 2/3. also draw normal and tangent to the curve at a point 40 mm from the directrix.	1	1
2	A circle of 50 mm diameter rolls along a line for one revolution clockwise. Draw a locus of a point on the circle, which is in contact with the line.	1	1
3	Construct a parabola, with distance of the focus from the directrixas 60 mm. also draw normal and tangent to the curve at a point 70 mm from the focus.	1	1

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ASSIGNMENT – 2

This Assignment corresponds to Unit No. 2

Question No.	Question	Objective No.	Outcome No.
1	A line AB measures 100mm is inclined at an angle of 30 0 to HP and 40 0 to VP. The point A is 20mm above HP and 30mm in front of VP. Draw the projections of the line.	2	2
2	A semi-circular lamina of 60mm diameter has its straight edge in VP and inclined at an angle of 45^0 to HP. The surface of the lamina makes an angle of 30^0 with VP. Draw the projections.	2	2
3	A Hexagonal plane of side 30mm its straight edge in HP and inclined at an angle of 45^0 to HP. The surface of the lamina makes an angle of 30^0 with VP. Draw the projections.	2	2

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ASSIGNMENT – 3

This Assignment corresponds to Unit No. 3

Question No.	Question	Objective No.	Outcome No.
1	A square prism side of base 30 mm and axis 50 mm long has its axis inclined at 45 0 to the H.P. It has an edge of its base in the H.P. Draw its projections.	3	3
2	A hexagonal prism side of base 35 mm and axis 60 mm long hasits axis inclined at 45^0 to the H.P. It has an edge of its base in theH.P. Draw its projections.	3	3
3	A pentagonal pyramid side of base 35 mm and axis 60 mm long hasits axis inclined at 45^0 to the H.P. It has an edge of its base in theH.P. Draw its projections.	3	3

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ASSIGNMENT – 4

This Assignment corresponds to Unit No. 4

Question No.	Question	Objective No.	Outcome No.
1	A hexagonal prism edge of base 30mm and axis 70mm long, rest with its corner on the HP such that one of its rectangular face is parallel to VP. It is cut by a plane perpendicular to the VP, inclined at 45 0 HP and passing through the 30mm from the bade of axis. Draw the development of lateral surface of the truncated prism.	4	4
2	A cone of base diameter is 50mm and axis 60mm long is resting with its base on HP. It is cut by a section plane perpendicular to the VP and inclined at 45 0 to the HP and bisecting axis.Draw the development.	4	4
3	A pentagonal pyramid edge of base 30mm and axis 70mm long, rest with its corner on the HP such that one of its rectangular face is parallel to VP. It is cut by a plane perpendicular to the VP, inclined at 45 0 HP and passing through the 30mm from the bade of axis. Draw the development of lateral surface of the truncated prism.	4	4

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ASSIGNMENT – 5

This Assignment corresponds to Unit No. 5

Question No.	Question	Objective No.	Outcome No.
1	Draw an isometric view of a Cylinder of base diameter 40mm and axis 60mm long, in the following position. (i) Vertical. (ii) Horizontal.	4	4
2	Draw an isometric projection of a hexagonal prism of side of base 25mm and axis 65mm long, in the following position. (i) Vertical. (ii) Horizontal.	4	4
3	Draw an isometric projection of a pentagonal pyramd of side of base 25mm and axis 65mm long, in the following position. (i) Vertical. (ii) Horizontal.	4	4

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TUTORIAL – 1

This tutorial corresponds to Unit No. 2 (Objective Nos.: 1, Outcome Nos.: 1)

1. The angle between the asymptotes of a rectangular hyperbola is

   a) 30^0 b) 45^0 c) 60^0 d) 90^0

2. Eccentricity for an Ellipse?

   a) Less than 1 b) Equal to 1
   c) Greater than 1 d) None of the above

3. Application of cycloids is to produce

   a) Gear Teeth b) sprocket c) Caliper d) Compass

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TUTORIAL – 2

This tutorial corresponds to Unit No. 1 (Objective Nos.: 2, Outcome Nos.: 2)

1.The line joining the front and top views of a point is called?

a) reference line

b) projector

c) connector

d) locus

2.If a line is parallel to both H.P and V.P., its true length will be seen in

a) front view

b) top view

c) Side view

d) Both front and top views

3.A hexagon is placed parallel to vertical plane which of the following projection is true?

a)Frontview-line,topview-hexagon

b)Frontview-hexagon,topview-line

c)Frontview–line,topview-line

d)Top view- hexagon, side view- line

4.A line AB is on the vertical plane of projection planes, which view from the following gives the actual length of the line AB?

a) Front view

b) Top view

c) Side view

d) Isometric view

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Date:

TUTORIAL SHEET – 3

This tutorial corresponds to Unit No. 3 (Objective Nos.: 3, Outcome Nos.: 3)

1.When a solid is placed such that axis is inclined with both the H.P and V.P. Its projections are drawn in __________ stages.

a) 1

b) 4

c) 2

d) 3

2. When the axis of a solid is parallel to a plane, the projection of the solid shows the true shape and size of its base.
a) False
b) True

3.When the axis of a solid perpendicular to H.P__________ should be drawn first.
a) Top view
b) Front view
c) Side view
d) Rare view

4.When the axis of a solid perpendicular to V.P, __________ should be drawn first.
a) Top view
b) Front view
c) Side view
d) Rare view

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TUTORIAL – 4

This tutorial corresponds to Unit No. 4 (Objective Nos.: 3, Outcome Nos.: 3)

1.What is the method of development of a cube?
a) Parallel line method
b) Radial line method
c) Triangulation method
d)Approximate method
2.When the development of the curved surface of a cone is a______
a) Sector of a circle
b) Segment of a circle
c) Segment of an ellipse
d) None of the above
3.Approximate development is the method of developing of non-developable surfaces, by divided the surface of the object into ____________
a) Parallel parts
b) Triangular parts
c) Circular parts
d) Zone and lune
4.In _____________ development method, the surface is divided into parts of parallel lines to determine the surface.
a) Approximate development
b) Parallel line development
c) Triangulation method
d) Radial line development

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TUTORIAL SHEET – 5

This tutorial corresponds to Unit No. 5 (Objective Nos.: 5, Outcome Nos.: 5)

1.If isometric projection of an object is drawn with true lengths the shape would be same and size is how much larger than actual isometric projection?
a) 25%
b) 29.5%
c) 22.5%
d) 33.3%

2.If an isometric projection is drawn with true measurements but not with isometric scale then the drawings are called ______________
a) Isometric projection
b) Isometric view
c) Isometric perception
d) Orthographic view

3.If an isometric drawing is made use of isometric scale then the drawings are called ____________
a) Isometric projection
b) Isometric view
c) Isometric perception
d) Orthographic view

4.Isometric projection comes under which category of projections-----------

a) Axonometric projection

b) Perspective projection

c) Oblique projection

d)None of the above

Signature of HOD | Signature of faculty

Date: | Date:

Department of Mechanical Engineering

EVALUATION STRATEGY

Target (s)

a. Percentage of Pass : 95%

Assessment Method (s) (Maximum Marks for evaluation are defined in the Academic Regulations)

a. Daily Attendance
b. Assignments
c. Online Quiz (or) Seminars
d. Continuous Internal Assessment
e. Semester / End Examination

List out any new topic(s) or any innovation you would like to introduce in teaching the subjects in this semester

Case Study of any one existing application

Signature of HOD

Date:

Signature of faculty

Date:

Department of Mechanical Engineering

COURSE COMPLETION STATUS

Actual Date of Completion & Remarks if any

Units	Remarks	Objective No. Achieved	Outcome No. Achieved
Unit 1	completed on 20.02.2024	1	1
Unit 2	completed on 05.03.2024	2	2
Unit 3	completed on 15.04.2024	3	3
Unit 4	completed on 29.04.2024	4	4
Unit 5	completed on 11.06.24	5	5

Signature of HOD

Date:

Signature of faculty

Date:

Department of Mechanical Engineering

Mappings

1. Course Objectives-Course Outcomes Relationship Matrix

(Indicate the relationships by mark "X")

Course-Objectives \ Course-Outcomes	1	2	3	4	5
1	H			M	
2		L			
3			H		
4		M			
5					M

2. Course Outcomes-Program Outcomes (POs) & PSOs Relationship Matrix

(Indicate the relationships by mark "X")

C-Outcomes \ P-Outcomes	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
1	L		M		M									
2	L		M		H						H	M	M	
3	M		M		H						H	M		L
4	H		M		H								M	
5	H						M				H	L		

Department of Mechanical Engineering

Rubric for Evaluation

Performance Criteria	Unsatisfactory	Developing	Satisfactory	Exemplary
	1	**2**	**3**	**4**
Research & Gather Information	Does not collect any information that relates to the topic	Collects very little information some relates to the topic	Collects some basic Information most relates to the topic	Collects a great deal of Information all relates to the topic
Fulfill team role's duty	Does not perform any duties of assigned team role.	Performs very little duties.	Performs nearly all duties.	Performs all duties of assigned team role.
Share Equally	Always relies on others to do the work.	Rarely does the assigned work - often needs reminding.	Usually does the assigned work - rarely needs reminding.	Always does the assigned work without having to be reminded
Listen to other team mates	Is always talking—never allows anyone else to speak.	Usually doing most of the talking-- rarely allows others to speak.	Listens, but sometimes talks too much.	Listens and speaks a fair amount.

Department of Mechanical Engineering

Anurag Engineering College
An Autonomous Institution
(Approved by AICTE, New Delhi & Affiliated to JNTUH)
Accredited with NAAC A+ Grade
Ananthagiri (V&M), Kodad, Suryapet (Dt.), Telangana – 508 206
www.anurag.ac.in +91 9553122270

I B.TECH II SEMESTER I MID EXAMINATIONS - APRIL 2024

Branch : B.Tech. (ECE & IT) **Max. Marks: 30**
Date : 03 - Apr - 2024 FN **Time: 120 Minutes**
Subject : Computer Aided Engineering Graphics,EG203ES

PART - A

ANSWER ALL QUESTIONS **10 X 1 M = 10 M**

Q.No	Question		CO	BTL
1.	The angle between the asymptotes of a rectangular hyperbola is (A). 30 0 (B). 45 0 (C). 60 0 (D). 90 0	( )	CO1	1
2.	Eccentricity for an Ellipse? (A). Less than 1 (B). Equal to 1 (C). Greater than 1 (D). None of the above	( )	CO1	1
3.	If the plane cuts at an angle to the axis but does not cut all the generators then what is the name of the conics formed? (A). Ellipse (B). Hyperbola (C). Circle (D). Parabola	( )	CO1	1
4.	In general method of drawing an ellipse, a vertical line called as ____ is drawn first. (A). Tangent (B). Normal (C). Major axis (D). Directrix	( )	CO1	2
5.	The line joining the+D9 front and top views of a point is called? (A). reference line (B). projector (C). connector (D). locus	( )	CO2	1
6.	If a line is parallel to both H.P and V.P., its true length will be seen in (A). front view (B). top view (C). Side view (D). Both front and top views	( )	CO2	1
7.	If a line is in profile plane making an angle of 30 degrees with vertical plane. In which angle the line makes with the horizontal plane? (A). 30 0 (B). 90 0 (C). 0 0 (D). 60 0	( )	CO2	1
8.	A square of side is resting on the H.P.What is the top view of object? (A). Circle (B). Ellipse (C). square (D). Line	( )	CO2	2
9.	A solid is an object having__________ (A). one dimension (B). two dimension (C). three dimension (D). four dimension	( )	CO3	1
10.	When a solid is placed such that axis is inclined with both the H.P and V.P.Its projections are drawn in __________ stages. (A). 1 (B). 2 (C). 3 (D). 4	( )	CO3	2

PART - B

ANSWER ANY FOUR **4 X 5 M = 20 M**

Q.No	Question	CO	BTL
11.	Construct a parabola, with the distance between the focus and the directrix as 60 mm. Also, draw normal and tangent to the curve at a point 30 mm from the directrix.	CO1	3
12.	Construct a hyperbola, with the distance between the focus and the directrix as 50 mm and eccentricity as 3/2. Also, draw normal and tangent to the curve at a point 30 mm from the directrix.	CO1	2
13.	A line AB measures 100mm is inclined at an angle of 30 0 to HP and 40 0 to VP. The point A is 20mm above HP and 30mm in front of VP. Draw the projections of the line.	CO2	3
14.	A line CD measures 80mm is inclined at an angle of 30 0 to HP and 45 0 to VP. The point C is 20mm above HP and 30mm in front of VP. Draw the projections of the line.	CO2	3
15.	A Pentagonal pyramid, side of base 25 mm and axis 60 mm long, rests with one of the edge of its base on HP and its axis is inclined at 45 0 HP and parallel to VP. Draw its projections.	CO3	4
16.	A cone of base diametre 50 mm and axis 60 mm long, rests with its base on HP and its axis is inclined at 45 0 HP and parallel to VP. Draw its projections.	CO3	3

Department of Mechanical Engineering

I B.TECH II SEMESTER II MID EXAMINATIONS - JUNE 2024

Branch : B.Tech. ECE & IT **Max. Marks : 30M**
Date : 20-Jun-2024 **Session : Morning** **Time : 120 Min**
Subject : Computer Aided Engineering Graphics,EG203ES

PART - A

ANSWER ALL THE QUESTIONS **10 X 1M= 10M**

Q.No	Question		CO	BTL
1.	When the axis of a solid perpendicular to H.P __________ should be drawn first. (A). Top view (B). Front view (C). Side view (D). Rare view	( )	CO3	1
2.	When a solid is placed such that axis is inclined with both the H.P and V.P. Its projections are drawn in __________ stages. (A). 1 (B). 4 (C). 2 (D). 3	( )	CO3	1
3.	The development of the lateral surface of a cylinder is a rectangle having one side equal to the____________ of its base-circle and the other equal to its length. (A). circumference (B). area (C). diameter (D). radius	( )	CO4	2
4.	What will be the value of the radius of the arc in the development of the pyramids? (A). Height of the pyramid (B). The slant height of the pyramid (C). 4*Side of the pyramid (D). 0.5*Height of the pyramid	( )	CO4	1
5.	Approximate development is the method of developing of non-developable surfaces, by divided the surface of the object into __________ (A). Parallel parts (B). Triangular parts (C). Circular parts (D). Zone and lune	( )	CO4	2
6.	In ____________ development method, the surface is divided into parts of parallel lines to determine the surface. (A). Approximate development (B). b) Parallel line development (C). Triangulation method (D). Radial line development	( )	CO4	1
7.	Which of the projection is mainly used in engineering practice ------ (A). Perspective projection (B). Isometric projection (C). Orthographic projection (D). Oblique projection	( )	CO5	1
8.	The isometric projection of a sphere is -------- (A). Ellipse (B). circle (C). Sphere (D). None of the above	( )	CO5	1
9.	If an isometric projection is drawn with true measurements but not with isometric scale then the drawings are called __________ (A). Isometric projection (B). Isometric view (C). Isometric perception (D). Orthographic view	( )	CO5	1
10.	Isometric projection comes under which category of projections------------ (A). Axonometric projection (B). Perspective projection (C). Oblique projection (D). None of the above	( )	CO5	1

Department of Mechanical Engineering

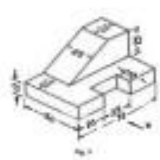
PART - B

ANSWER ANY FOUR — 4 X 5M = 20M

Q.No	Question	CO	BTL

Page : 1

11.	A square pyramid, side of base 40 mm and axis height 60 mm is resting on its base edge on the HP. With a side of base parallel to VP. Draw its sectional view and true shape of the section, if it cut by a section plane perpendicular to the VP, bisecting the axis and inclined at angle 45 0 to the H.P.	CO3	3
12.	A pentagonal pyramid, side of base 30 mm and axis height 60 mm is resting on its base edge on the HP. With a side of base parallel to VP. Draw its sectional view and true shape of the section, if it cut by a section plane perpendicular to the VP, bisecting the axis and inclined at angle 45 0 to the H.P.	CO3	3
13.	A cone of base diameter is 50mm and axis 60mm long is resting with its base on HP. It is cut by a section plane perpendicular to the VP and inclined at 45 0 to the HP and bisecting axis. Draw the development.	CO4	3
14.	A Pentagonal prism edge of base 20mm and axis 50mm long, rest with its corner on the HP such that one of its rectangular face is parallel to VP. It is cut by a plane perpendicular to the VP, inclined at 45 0 HP and passing through the right corner of top face of the prism. Draw the development of lateral surface of the truncated prism.	CO4	4
15.	Draw front view, top view and side view of given figure.	CO5	4



Department of Mechanical Engineering

Continuous Internal Assessment (R-22)

Programme: **B.Tech** Year: **I** Course: **Theory** **A.Y: 2023-24**

Course: CAEG Section: ECE Faculty Name: Y.RAJESH KHANNA

S. No	Roll No	MID-I (35M)	MID-II (35M)	Avg. of MID I & II	Viva-Voce/Poster Presentation (5M)	Total Marks (40)
1	22C11A0406	13	20	17	5	22
2	22C11A0412	18	20	17	5	24
3	23C11A0401	28	32	24	5	35
4	23C11A0402	30	35	26	5	38
5	23C11A0403	14	25	21	5	25
6	23C11A0404	33	35	27	5	39
7	23C11A0405	15	24	20	5	25
8	23C11A0406	18	29	24	5	29
9	23C11A0407	18	25	22	5	27
10	23C11A0408	24	29	27	5	32
11	23C11A0409	16	19	18	5	23
12	23C11A0410	26	25	26	5	31
13	23C11A0411	19	24	22	5	27
14	23C11A0412	22	27	25	5	30
15	23C11A0413	32	32	32	5	37
16	23C11A0414	12	26	19	5	25
17	23C11A0415	19	25	22	5	28
18	23C11A0416	9	22	16	5	21

Department of Mechanical Engineering

19	23C11A0417	34	35	35	5	40
20	23C11A0418	9	14	12	5	17
21	23C11A0419	17	30	24	5	29
22	23C11A0420	27	31	29	5	34
23	23C11A0421	16	22	19	5	24
24	23C11A0422	11	16	14	5	19
25	23C11A0423	10	15	13	5	18
26	23C11A0424	24	29	27	5	32
27	23C11A0425	15	24	20	5	25
28	23C11A0426	23	26	25	5	30
29	23C11A0427	18	21	20	5	25
30	23C11A0428	25	26	26	5	31
31	23C11A0429	22	25	24	5	29
32	23C11A0430	33	28	31	5	36
33	23C11A0431	25	28	27	5	32
34	23C11A0432	22	28	25	5	30
35	23C11A0433	18	29	24	5	29
36	23C11A0434	17	25	21	5	26
37	23C11A0435	9	10	10	5	15
38	23C11A0436	29	34	32	5	37
39	23C11A0437	22	28	25	5	30
40	23C11A0438	16	34	25	5	30
41	23C11A0439	31	34	33	5	38
42	23C11A0440	16	26	21	5	26

Department of Mechanical Engineering

43	23C11A0441	29	31	30	5	35
44	23C11A0442	22	34	28	5	33
45	23C11A0443	8	27	18	5	23
46	23C11A0444	18	24	21	5	26
47	23C11A0445	7	18	13	5	18
48	23C11A0446	28	33	31	5	36
49	23C11A0447	15	29	22	5	27
50	23C11A0448	31	32	32	5	37
51	23C11A0449	11	5	8	5	14
52	23C11A0450	34	34	34	5	39
53	23C11A0451	34	33	34	5	39
54	23C11A0452	24	34	29	5	34
55	23C11A0453	18	25	22	5	27
56	23C11A0454	23	33	28	5	33
57	23C11A0455	35	35	35	5	40
58	23C11A0456	23	19	21	5	26
59	23C11A0457	34	35	35	5	40

No. of Absentees: 00

Total Strength: 59

Signature of Faculty

Signature of HoD

Department of Mechanical Engineering

COURSEMATERIAL

I Year B. Tech II-SemesterMECHANICALENGINEERING

COMPUTR AIDEDENGINEERING GRAPHICS

Engineering Graphics is the principal method of communication in the field of engineering and science. The graphics of engineering design and construction is one among the most important courses of all studies for engineering. It is the language used by the designer, technician and engineer to communicate, design and construct details to others.

The Graphic Language

Engineering drawing is the graphic language used by engineers and technologists globally. The graphic language may be defined as the graphic representation of physical objects and their relationships. This language is written in the form of drawings using straight and curved lines which represent the shape, size and specifications of physical objects. The language is read by interpreting the drawings so that the physical objects can be constructed exactly as conceived by the designer. An engineer, should have proper understanding of the theory of projection, dimensioning and conventions related to working drawings, in order to become professionally efficient.

Traditional Drafting

Engineering drawings are made up of straight and curved lines to represent the surfaces, edges and centres of objects. Symbols, dimensional values and word-notes are added to these lines so that they collectively make the complete description. The traditional drafting is the presentation of these drawings manually, by freehand sketching or with the help of drawing instruments.

Computer Aided Drafting

Computer Aided Drafting is a process of preparing a drawing of an object on the screen of a computer. There are various types of drawings in different fields of engineering and sciences. In the fields of mechanical or aeronautical engineering, the drawings of machine components and the layouts of them are prepared. In the field of civil engineering, plans and layouts of the buildings are prepared. In the field of electrical engineering, the layouts of power distribution system are prepared. In all fields of engineering use of computer is made for drawing and drafting.

The use of CAD process provides enhanced graphics capabilities which allows any designer to

- Conceptualize his ideas
- Modify the design very easily
- Perform animation
- Make design calculations
- Use colors, fonts and other aesthetic features

Benefits of CAD

The implementation of the CAD system provides variety of benefits to the industries in design and production as given below:

1. Improved productivity in drafting
2. Shorter preparation time for drawing
3. Reduced man power requirement
4. Customer modifications in drawing are easier
5. More efficient operation in drafting
6. Low wastage in drafting
7. Minimized transcription errors in drawing
8. Improved accuracy of drawing
9. Assistance in preparation of documentation
10. Better designs can be evolved
11. Revisions are possible
12. Colours can be used to customize the product
13. Production of orthographic projections with dimensions and tolerances
14. Hatching of all sections with different filling patterns
15. Preparation of assembly or sub assembly drawings
16. Preparation of part list
17. Machining and tolerance symbols at the required surfaces
18. Hydraulic and pneumatic circuit diagrams with symbols
19. Printing can be done to any scale

CAD SOFTWARES

The software is an interpreter or translator which allows the user to perform specific type of application or job related to CAD. The following software's are available for drafting

1. AUTOCAD
2. CREO
3. CATIA
4. SOLID WORKS
5. NX Unigraphics
6. FUSION 360
7. INVENTOR
8. SOLID EDGE

Drawing Instruments and aids:

Drawing Instruments are used to prepare drawings easily and accurately. A neat and clean drawing is prepared by the help of good quality drawing instruments and other aids. The following are the drawing aids commonly used in industries:

- Drawing board
- Setsquares
- French curves
- Templates
- Mini drafter
- Instrument box
- Protractor
- Set of scales
- Drawing sheets

• Pencils

UNIT1

INTRODUCTIONTOCOMPUTERAIDEDE NGINEERING GRAPHICS

Department of Mechanical Engineering

EngineeringGraphics

EngineeringGraphicsistheprincipalmethodofcommunicationinthefieldofengineeringandscience . the graphics of engineering design and construction is one among the most importantcoursesofallstudiesforengineering.Itisthelanguageusedbythedesigner,technicianand engineertocommunicate,designandconstructdetailstoothers.

TheGraphicLanguage

Engineering drawing is the graphic language used by engineers and technologists globally. Thegraphic language may be defined as the graphic representation of physical objects and theirrelationships. This language is written in the form of drawings using straight and curved lineswhich represent the shape, size and specifications of physical objects. The language is read byinterpreting the drawings so that the physical objects can be constructed exactly as conceived bythedesigner.Anengineer,shouldhaveproperunderstandingofthetheoryofprojection,dimensioning and conventions related to working drawings, in order to become professionallyefficient.

TraditionalDrafting

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ComputerAidedDrafting

Computer Aided Drafting is a process of preparing a drawing of an object on the screen of acomputer. There are various types of drawings in different fields of engineering and sciences. Inthefieldsofmechanicaloraeronauticalengineering,thedrawingsofmachinecomponentsandthelayouts of them are prepared. In the field of civil engineering, plans and layouts of the buildingsare prepared. In the field of electrical engineering, the layouts of power distribution system areprepared.In allfields ofengineering useof computerismadefordrawingand drafting.

TheuseofCADprocessprovidesenhancedgraphics capabilitieswhichallows anydesignerto

- Conceptualizehisideas
- Modifythedesign very easily
- Performanimation
- Makedesigncalculations
- Usecolors,fontsandotheraestheticfeatures.

BenefitsofCAD

TheimplementationoftheCADsystemprovidesvarietyofbenefitstotheindustriesindesignandproductionas given below:

1. Improvedproductivityindrafting
2. Shorterpreparationtime fordrawing
3. Reducedmanpowerrequirement
4. Customermodificationsindrawingareeasier
5. Moreefficientoperationindrafting
6. Lowwastageindrafting
7. Minimizedtranscriptionerrorsindrawing
8. Improvedaccuracyofdrawing
9. Assistanceinpreparationofdocumentation
10. Betterdesignscan beevolved
11. Revisionsarepossible
12. Colourscanbeusedtocustomizetheproduct
13. Productionoforthographicprojectionswithdimensionsandtolerances
14. Hatchingofallsectionswithdifferentfillingpatterns
15. Preparationof assemblyorsubassemblydrawings
16. Preparationofpartlist
17. Machiningandtolerance symbolsattherequiredsurfaces
18. Hydraulicandpneumatic circuitdiagramswithsymbols
19. Printingcan bedonetoany scale

CADSOFTWARES

Thesoftwareisaninterpreterortranslatorwhichallowstheusertoperformspecifictypeofapplication orjob relatedto CAD. Thefollowing softwaresare availablefordrafting

1. AUTOCAD
2. CREO
3. CATIA
4. SOLIDWORKS
5. NXUnigraphics
6. FUSION360
7. INVENTOR
8. SOLIDEDGE

Theabovesoftware’sareuseddependinguupontheirapplication

Department of Mechanical Engineering

DrawingInstrumentsand aids:

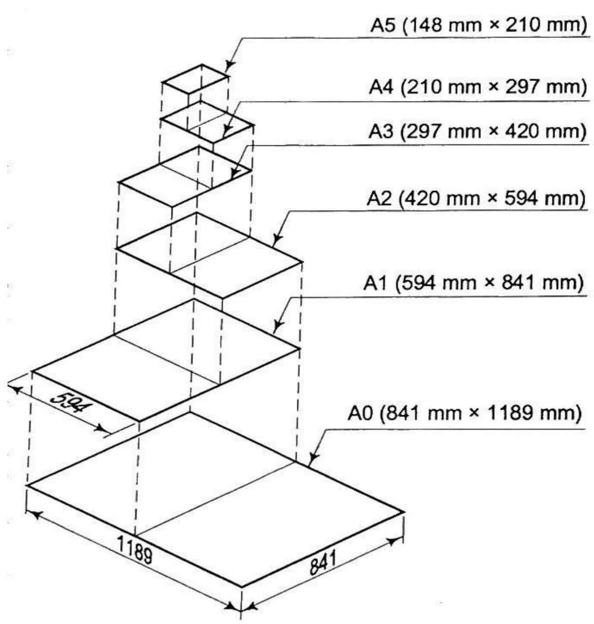
DrawingInstrumentsareusedtopreparedrawingseasilyandaccurately.Aneatandcleandrawingis prepared by the help of good quality drawing instruments and other aids. The following are thedrawingaids commonlyused in industries:

- Drawingboard
- Setsquares
- Frenchcurves
- Templates
- Minidrafter
- Instrumentbox
- Protractor
- Setofscales
- Drawingsheets
- Pencils

DrawingSheet:

Engineering drawings are prepared on standard size drawing sheet. The correct shape and size oftheobjectcanbevisualizedfromtheunderstandingofnotonlyitsviewsbutalsofromthevarioustypes of lines used, dimensions, notes, scales etc., The standard drawing sheet sizes are arrived aton the basic Principal of X:Y =1: √2 and XY=1 where x and y are the sides of the sheet. Forexample, AO, having a surface area of 1Sq.m; X=841mm and Y=1189mm.The successive sizesare obtained by either by halving along the length or doubling the width, the area being in theratio1:2. Designation of sizes is given in the fig. For class work use of A2 size drawing sheet ispreferred.

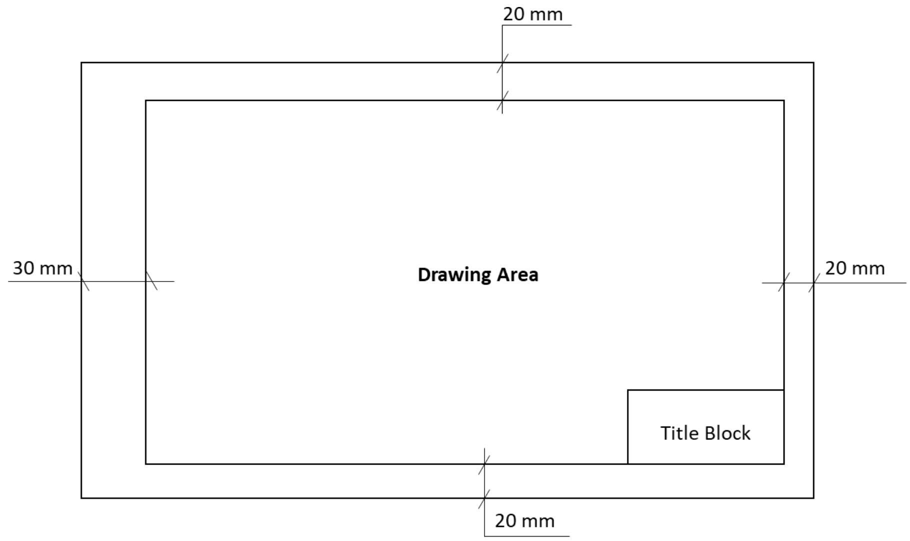
Designation	Trimmed Sizes in mm (width x length)
A0	841 x 1189
A1	594 x 841
A2	420 x 594
A3	297 x 420
A4	210 x 297



Department of Mechanical Engineering

DrawingSheetLayout

It is an important function of engineering drawing. Also, it is very important to understand thestandardfortheselectionofsuitablescale,marginspace,titleblockandpartlistetc.,onthesheet.Thebe low mentioned detailsin thedrawingsheetis according toIS 46:2003



TitleBlock

Titleblockistobeplacedwithinthedrawingspaceatthebottomrighthandcornerofthedrawingsheet and it should be visible when prints are folded. It should consist of one or more adjoiningrectangles. These rectangles may be divided further into boxes for inserting specific information.The size of the title block as recommended by the B.I.S. is 185 mm x 65 mm fro all designationsofthedrawingsheets. Allthetitleblocks shouldcontain atleast theparticulars mentionedbelow.

SN	Particulars
1	Nameofthe firm
2	TitleoftheDrawing
3	Scale
4	Symboldenotingthemethodofprojection
5	Drawingnumber
6	Initialswithdatesofpersonswhohavedesigned,drawn,checked,standards, andapproved
7	No.ofsheet and total numberofsheets of thedrawing ofthe object

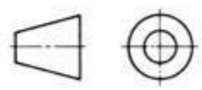
TheTitle blocks usedin industries andforclass work purposeareshown below.

Department of Mechanical Engineering

	NAME	DATE	MATERIAL	TOLERANCE	FINISH
DRN					
CHD					
APPD					
PROJECTION		LEGAL OWNER	TITLE		
SCALE			IDENTIFICATION NUMBER		

TitleBlockforIndustry

Name:	Title:	
Class	Sheet No.:	Date:
Roll No.	Projection:	
College:		



TitleBlockforClass Work

TypesofLines:

1. Outlines(A):Continuousthickorwidelinesdrawntorepresentthevisible edgesandsurfaceboundariesof theobjectsarecalled Outlines or PrincipalLines.
2. MarginLines(A):Theyarecontinuousthickorwidelinesalongwhichtheprintsaretrimmed
3. Dimension lines (B): these lines are continuous thin lines that are terminated at the outer endsbypointed arrowheads touching theoutlines, extension lines or centrelines.
4. Extension or Projection Lines (B): These are also continuous thin lines that extend by about 3mm beyondthe dimension lines.
5. ConstructionLines(B):Thesecontinuousthinlightlinesusedforconstructingfigures.
6. HatchingorSectionLines(B):Thesearethecontinuousthinlinesgenerallydrawnatanangleof 45^0 to the main outline of the section and are uniformly spaced about 1mm to 2 mm apart.Theseareused to makethe section evident.
7. Leaderorpointerlines(B):Itisacontinuousthinlinedrawntoconnectanotewiththefeatureto which it applies.
8. Border Lines (B): Perfectly rectangular working space is determined by drawing the borderlines.

9. Short-breaklines(C):Thesearecontinuous,thinandwavylinesdrawnfreehandandareusedtoshow ashort break or irregularboundaries.

10. Long-breaklines(D):Thesearethinruledlineswithshortzigzagswithinthemandaredrawntoshow thelong breaks.
11. Hiddenordottedlines(E/F):Interiororhiddenedgesandsurfacesareshownbyhiddenlines.Theyar ealso calledas dotted lines.
12. Centre lines (G): These are thin, long, chain lines composed of alternately long and dot linesdrawn to indicate the axes of cylindrical, conical or spherical objects or details and also toshowthecentres of circles and arcs.
13. Cutting-plane lines (H): The location of cutting plane is shown by this line. It is a long, thin,chainline, thick at ends only.

LineType		**Description**	**GeneralApplications**
A		ContinuousthickorContinuouswide	Visible outlines, Visible edges,Mainrepresentationsindiagr ams, flowchartsetc.,
B		Continuousthin(narrow)	Imaginary lines of intersection, Dimensions,Extension,Projection,Leaderlines ,Referencelines,Hatching,Constructionlines, Outlinesofrevolvedsections
C		Continuousthin(narrow)freehand	Limitsofpartialorinterruptedviews andsections,ifthelimitisnotachainthinline
D		Continuousthin(narrow)withzigzags	Long-breakline
E		Dashedthick(wide)	Lineshowingpermissibleofsurfacetreatment
F		Dashedthin(narrow)	Hiddenoutlines,hiddenedges
G		ChainthinLong–dasheddotted	Centrelines,linesofsymmetry,trajectories,Pitchci rcleofholes,Axes
H		Chainthin(narrow)withthick(wide) attheendsandatchangingoftheposition	Cuttingplanes

Department of Mechanical Engineering

LETTERING

Lettering is defined as writing of titles, sub-titles, dimensions, and other important particulars onadrawing.

Toundertakeproductionworkofanengineeringcomponentasperthedrawing,thesizeandotherdetails are indicated on the drawing. This is done in the form of notes and dimensions. Mainfeatures of lettering consume more time. Lettering should be done freehand with speed. Practiceaccompaniedby continuous efforts would improvethe letteringskill and style.

SizeofLetters:

- SizeofLettersismeasuredbytheheight*h*oftheCapitalLettersaswellasnumerals.
- Standard heights for Capital letters and numerals recommended by BIS are given below:1.8, 2.5, 3.5, 5, 6, 10, 14, 20 mm

Note:Sizeof thelettersmay beselected based upon the sizeof thedrawing.

Guidelines:

Inordertoobtaincorrectanduniformheightoflettersandnumerals,guidelinesaredrawnusing2Hpencil with light pressure.HB gradeconical end pencilis used forlettering.

Thefollowing aresomeof theguidelines for lettering

- Drawingnumbers,titleblockandlettersdenotingcuttingplanes,sectionsarewrittenin10mmsize.
- Drawingtitleiswritten in7mmsize.
- Hatching,subtitles,materials,dimensions,notes,etc.,arewrittenin3.5mm size.
- Spacebetween lines=3/4h
- Spacebetween words may be

$$d= \frac{h}{10}$$

Characteristic		Ratio	Dimensions(mm)						
Letteringheight Heightof Capitals	h	h	2.5	3.5	5	7	10	14	20
HeightofLower-caseletters	c	$(\frac{5}{7})h$	-	2.5	3.5	5	7	10	14
Spacingbetweencharacters	a	$(\frac{2}{14})h$	0.35	0.5	0.7	1	1.4	2	2.8
Minimumspacingofbaselines	b	$(\frac{10}{7})h$	3.5	5	7	10	14	20	2.8
Minimumspacingbetweenwords	e	$(\frac{3}{7})h$	1.05	1.5	2.1	3	4.2	6	8.4
Thicknessof lines	d	$(\frac{1}{14})h$	0.18	0.25	0.35	0.5	0.7	1	1.4

Characteristicsoflettering asper BIS

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DIMENSIONING

A drawing describes the shape of an object. For complete details of an object, its size descriptionisalsorequired.Theinformationlikedistancebetweensurfacesandedgeswithtolerance,location of holes, machining symbols, surface finish, type of material, quantity, etc., is indicated on thedrawing by means of lines symbols, and holes. The process of furnishing this information on atechnicaldrawing as peracodeof practiceis called dimensioning.

Principlesofdimensioning

1. Dimensioningshouldbedonesocompletelythatfurthercalculationorassumptionofanydimensionor direct measurement fromthe drawing isnot necessary
2. Everydimension mustbegiven, butnoneshould begiven morethan once.
3. Adimension should beplacedon the view whereitsuseis shown moreclearly.
4. Dimensionsshouldbeplacedoutsidetheviews,unlesstheyareclearerandmoreeasilyreadinside.
5. Mutualcrossingofdimensionlinesanddimensioningbetweenhiddenlinesshouldbeavoided. Dimension lines should not cross any otherlineof thedrawing.
6. Anoutlineoracentrelineshouldneverbeusedasadimensionline.Acentrelinemayextendto serve as an extension line
7. Alignedsystemofdimensioningisrecommended.

Elementsofdimensioning

1. **Projectionorextension Line**

   Itisathincontinuouslinedrawninextensionofanoutline.Itextendsby3mmbeyondthedimensionline.

2. **DimensionLine**

   Itisathincontinuouslineterminatedbyarrowheadstouchingtheoutlines,extensionlinesorcentrelines.

3. **Leaderline**

   Aleaderlineisathincontinuouslineconnectinganoteor adimensionfigurewiththe featureto which it applies. One end of the leader line terminated either in an arrowhead or a dot. Theotherendoftheleaderlineisterminatedinahorizontallineatabottomlevelofthefirstorthelast letter of the note. It is always drawn at a convenient angle of not less than 30^0 to the linewhichit touches.

4. **ArrowheadorTerminationofdimension line**

An arrow head is placed at each end of a dimensional line. Its pointed end touches an outline,anextensionlineoracentreline.Thesizeofanarrowheadshouldbeproportionaltothe thickness of the outlines. The length of the arrowhead should be three times its maximumwidth.Differenttypesofarrowheadscanbeobserved,butclosedandfilledtypeofarrowheadiswidely used in engineering drawing.

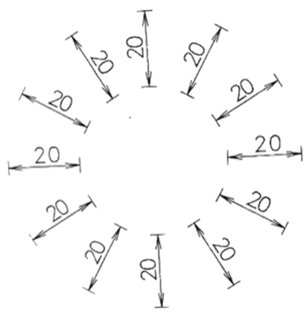
MethodsofindicatingDimensions

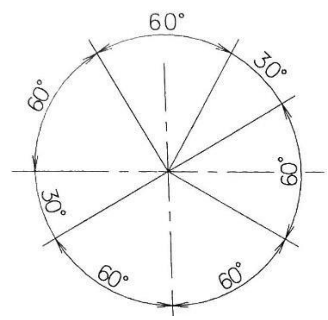
Thetwomethodsofindicatingdimensions are:

1. Aligned
2. Unidirectional

1. Alignedmethod

In this method, the dimension is placed perpendicular to the dimension line such a way that itmaybereadfromthebottomedgeoftheright-handedgeofthedrawingsheet.Thedimensionsmustbeplaced in themiddle and

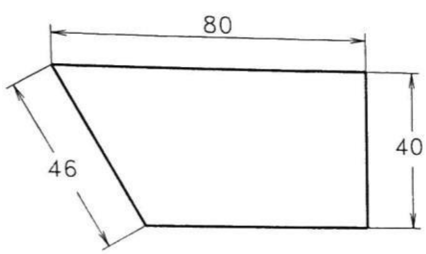


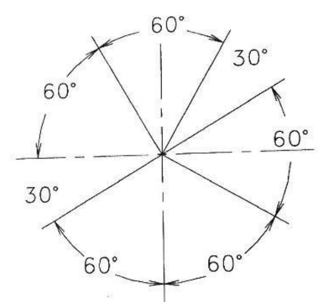


abovethedimension line.

2. Unidirectionalmethod

In unidirectional method, all the dimensions are placed in such a Way that they can be readfrom the bottom edge of the drawing sheet. The dimension lines are broken near the middleforinserting thedimensions. This ismethod is generally used onlargedrawings.





ArrangementofDimension lines

Thedimensionsofanobjectcanbeplacedaccordingtoeither AlignedorUnidirectionalmethods,but they are arranged in the followings ways and the selection depends on the design and theconstructionrequirements.

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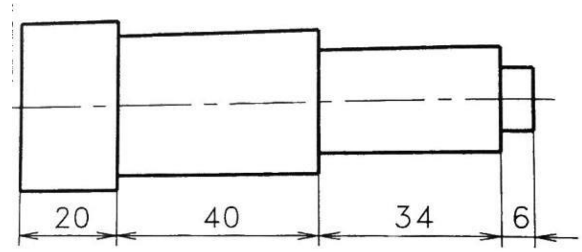
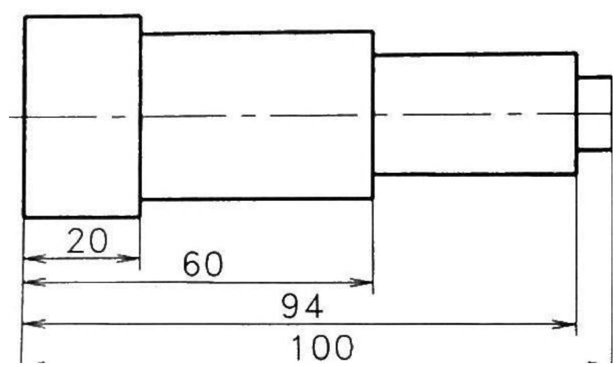
1. Chaindimensioning

Thistypeofdimensioningisusedonlywherethepossibleaccumulationoftolerancesdoesnotendangerthefunctionalrequirements of thepart.(fig.)



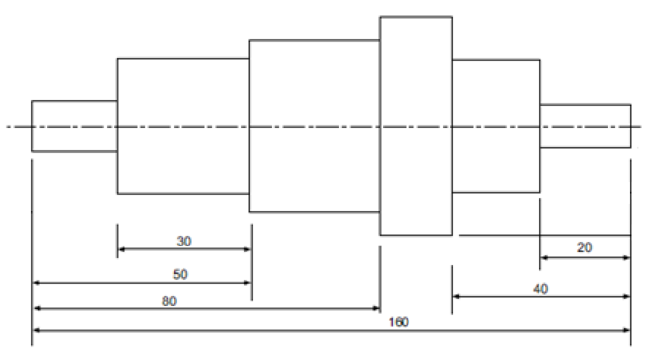
2. Paralleldimensioning

Thistypeofdimensioningisusedonlywhereanumberofdimensionsof aparthavecommondatumfeature.



3. Combineddimensioning

Inthisacombinationofbothchainandparalleldimensioningareapplied.But,thedistanceofdimension line from the object boundary or nearby dimensions line should be at least 5mm to6mm.



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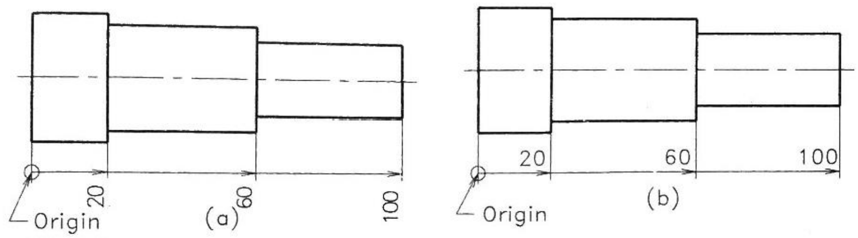
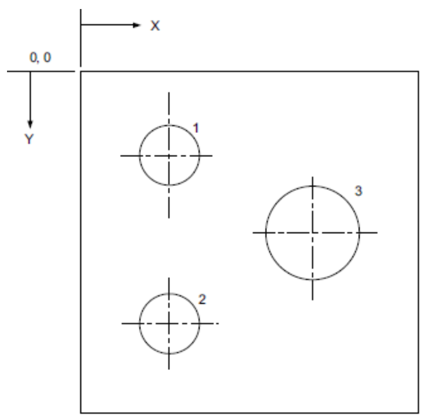
4. Superimposedrunningdimensioning

This type of dimensioning is a simple parallel dimensioning and may be used where there arespace limitations and where no legibility problems will arise. In this, origin is to be indicatedappropriately and the opposite end of each dimension line should be terminated only witharrowhead.



5. Dimensioningbycoordinates

Thistypeofdimensioningfollowstheprincipleofcoordinatesystemofidentifyingthepoints.



	1	2	3
X	20	20	40
Y	20	45	30
ϕ	15	15	20

Thistypeofdimensioningfollowstheprincipleofcoordinatesystemofidentifyingthepoints.Therea rethreeways of indicating this type ofdimensioning.

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AutoCADInstallationProcess

1. Gotothefollowingwebsite:https://www.autodesk.com/education/free-software/all
2. Click**AutoCAD**
3. CreateyourloginaccountusingtheMRCETmailid.xyz@mrcet.ac.in(youcanaccessthesoftwarefor3 Years).
4. Afteryou createyouraccount, sign inand choose
   a. Version:AutoCAD2020
   b. OperatingSystem:32 or64bit
      (Tofindtheinformation,Right clickon **MyComputerorMyPC**andselectproperties.)
   c. Language:English(so youcan havemoreeffectivetechnicalsupport)
5. SerialnumberandProductkeywillbedisplayed.Thisinformationisrequiredatthetimeofactivationafter installingthe software.
6. Downloadcanbecarried intwoways:
   a. DownloadNow(Recommended)
   b. BrowserDownload
7. Afterdownloadingthefile,doubleclickontheinstallationfile,andthenclick**Yes**tocompletetheinstallation.
8. Nowclick on**Install**
9. Checkthebox**Iaccept**theclick **next**
10. ForthestandaloneLicensetypedefaultoption,entertheserialkey&productkeydetailsfoundonthe softwaredatabaseforthis softwareversion.
11. Click**Install**and theClick **Finish**tocompletetheinstallation.

SystemRequirements

- OperatingSystem :32 or64-bitMicrosoftWindows/XP-professional/vistaormore
- Processor :Pentium 4 or later
- RAM :4GB or more
- GraphicsCard :1GBormore/integratedgraphics
- HardDisk : 20GBfreehard diskspace available includinginstallation
- Pointingdevices :Mouse,digitizerwithwintabdrive,Keyboard
- DVDROM : AnySpeed(not mandatory)

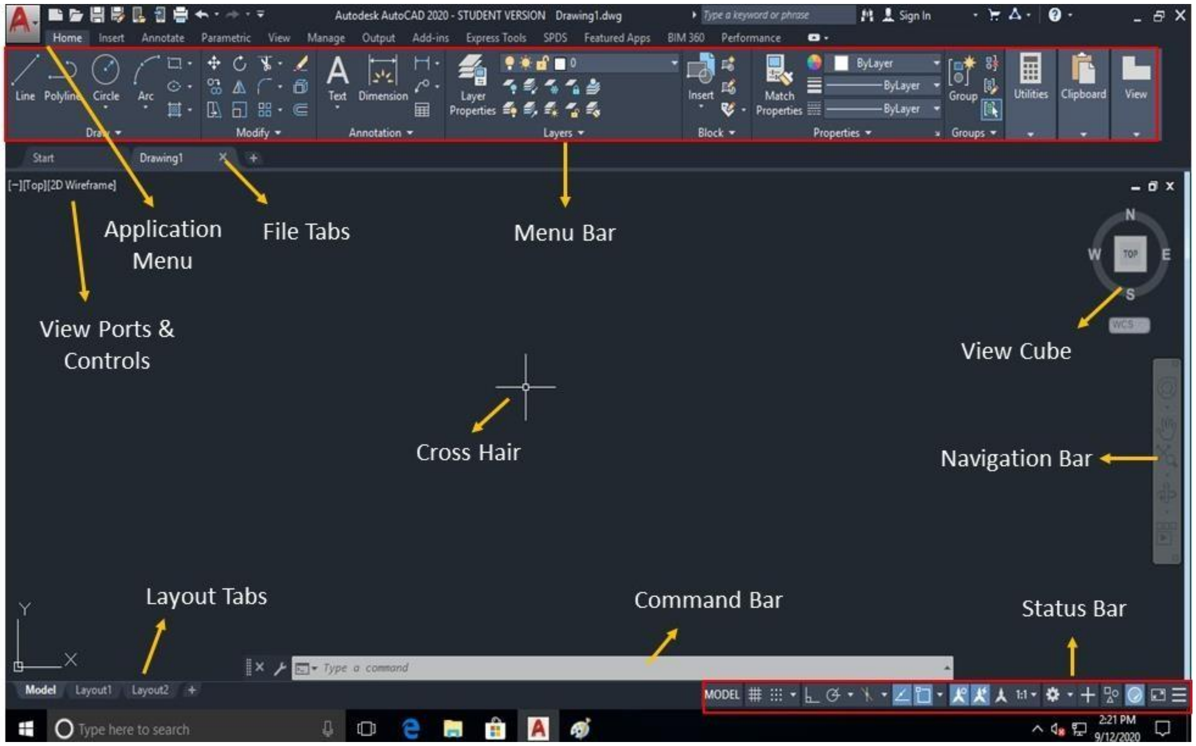
FunctionKeys

ThekeyboardfunctionkeysF1-F12controlsettingsthatarecommonlyturnedonandoffasweworkin theproduct.

Key	Feature	Description
F1	Help	Displays Help for the active tooltip, command, Palette ordialog box.
F2	ExpandedHistory	DisplaysanexpandedcommandhistoryintheCommandwin dow
F3	ObjectSnap	TurnsobjectsnapON andOFF
F4	3DObjectSnap	Turnsadditionalobject snapsfor3DON andOFF
F5	Isoplane	Cyclesthrough2Disoplanesettings (Top,Right andLeft)
F6	DynamicUCS	TurnsautomaticUCSalignmentwithplanarsurfacesONand OFF
F7	Griddisplay	Turnsthegriddisplay ONand OFF
F8	Ortho	Lockscursormovement tohorizontal orvertical
F9	GridSnap	Restrictscursormovementto specifiedgridintervals
F10	PolarTracking	Guidescursormovementtospecifiedangles
F11	ObjectSnapTracking	Tracksthecursorhorizontallyandverticallyfromobjectsna plocations
F12	Dynamicinput	Displaysdistancesandanglesnearthecursorandacceptsinpu tas weuseTab between fields

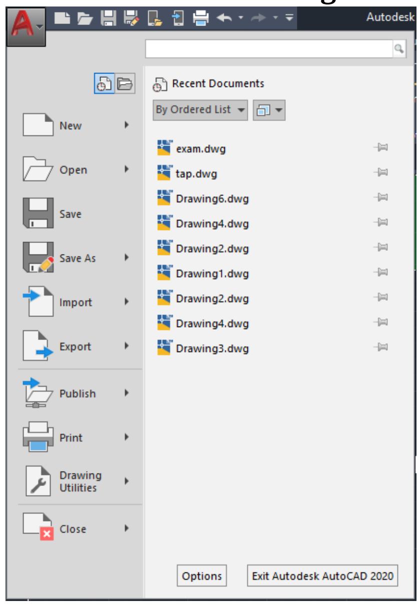
Note:F8andF10aremutually exclusive-turningoneOnwill turntheotherOFF.

UserInterface



ApplicationMenu 

Menusareavailablethroughtheapplicationbuttonintheupperleftcornerofthedrawingwindow.Thismenu contains thecommands used tocreate,save, print, andmanageyour drawing.


Autodesk
Recent Documents
By Ordered List
New
Open
Save
Save As
Import
Export
Publish
Print
Drawing Utilities
Close
exam.dwg
tap.dwg
Drawing6.dwg
Drawing4.dwg
Drawing2.dwg
Drawing1.dwg
Drawing2.dwg
Drawing4.dwg
Drawing3.dwg
Options
Exit Autodesk AutoCAD 2020

Commandprompt

The rectangular horizontal window at lower side of the screen is called the command area. Theinstructionsgiventothecomputerthroughkeyboardisshowninthisarea.Itimportanttoreadthecommandprompt whenworking withan unfamiliar command.

Toenteracommandusingthekeyboard,typethecommand nameonthecommandlineandpressEnter orthe Spacebar.

Navigation Bar

The navigation bar is a user interface element where you can access both unified and product-specific navigation tools. Unified navigation tools are those that can be found acrossmanyAutodeskproducts. Product-specificnavigation tools areunique to aproduct.

Quickaccesstoolbar

The Quick Access toolbar, displayed in the Drafting & Annotation workspace, is located at theverytopofthedrawing windownexttotheApplicationbutton.TheQuickAccesstoolbarmaybecustomized by adding or removing commands. This is done by right clicking on the toolbar andselectingCustomizeQuickAccess toolbaror selectingthe arrow at theendofthetoolbar.

TheQuick Accesstoolbar contains thefollowing commands:

- QNew:Opensanewdrawing.
- Open:Opensanexistingdrawing.(Ctrl+O)
- Save:Savesthecurrentdrawing.(Ctrl+S)
- Saveas: Allowsyou to savethe current drawingunder adifferent name. (Ctrl+Shift+S)
- Plot:Plotsorprintsthe currentdrawing.(Ctrl+P)
- Undo:Used toundo previous commandoractions.
- Redo:Used to redocommands that havebeen undone.

Drawingarea& CrossHair

The rectangular large space between the pull-down menu bar and the command window is thedrawing area. The cursor moves moves in this area in the form of a cross hair as mouse is movedby the user. The cross hair position is indicated by coordinate values shown at the left end of thestatusbar.

ViewCube

The View Cube is a navigation tool that allows you to switch between viewing directions. Whilethis is very useful in 3D space, it is not very useful in 2D space. It is located in the upper rightcornerof thedrawing area.

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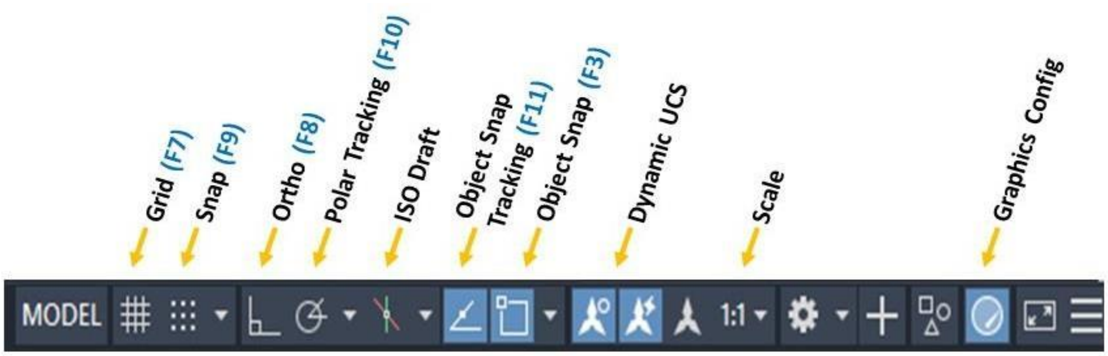
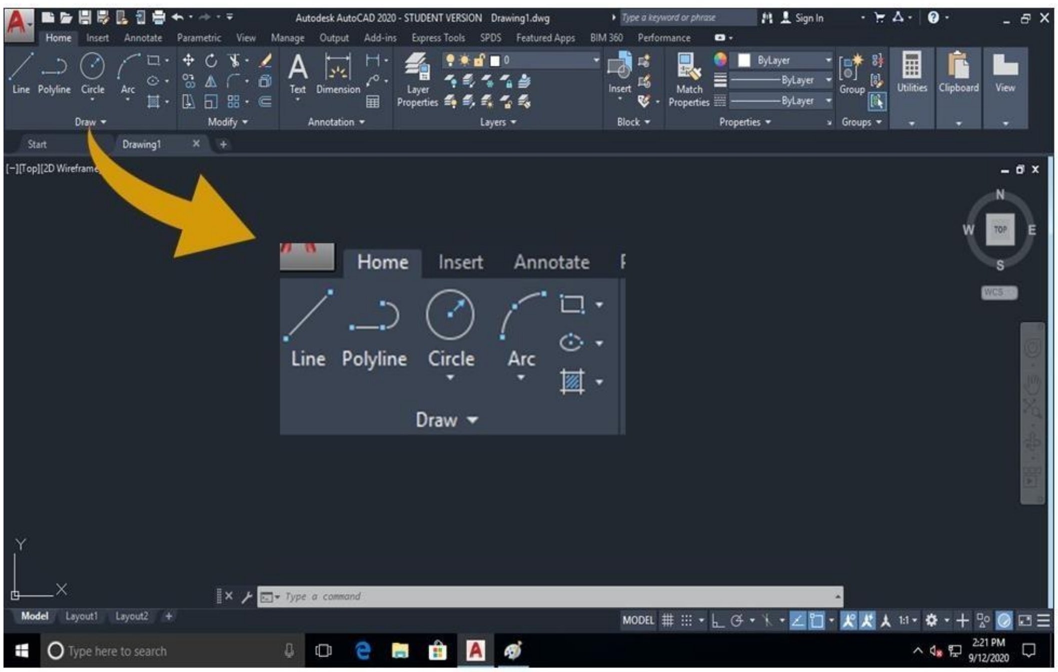
Statusbar

The status bar displays the cursor location, drawing tools, and the tools that affect the drawingenvironment. It also provides quick access to some of the most commonly used drawing tools,Coordinates of the cross hair (Cursor) and we can toggle the settings such ads grid, snap, polartrackingand object snap.



DrawCommands



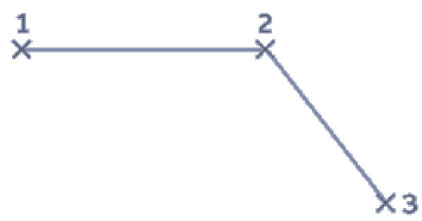
1. Point:

ThePointcommandwillinsertapointmarkerinyourdrawingatapositionwhichyoupickorat any coordinate location which you enter in the Command window. Other ways of definingapointcanbeaccessedthroughthefly-outmenu.Thedefaultpointstyleisasimpledot,which isoftendifficulttoseebutyoucanchangethepointstyle tosomethingmoreeasilyvisibleorelaborateusing thepointstyledialoguebox.

ToolBar:Menu→Draw→Point	**Command**:Point (PO)

2. **Line:**

Createsastraightlinesegment.Itisusedtodrawlinescontinuously.Eachsegmentisalineobjectthat can beeditedseparately.



Continue:Continuesalinefrom theendpointofthemostrecentlydrawnline.
Close:Endthelinesegmentatthebeginningofthefirstlinesegment,whichformsaclosedloop oflinesegment.
Undo:Erasesthemost recentsegmentofalinesequence.

ToolBar:Menu→Draw→ Line	**Command**:Line(L)

3. **ConstructionLine(XL):**

Theconstructionline(XLINE)commandcreatesalineofinfinitelengthwhichpassesthroughtwo picked points. Construction lines are very useful for creating construction frameworks orgrids.Constructionlinesarenotnormallyusedasobjectsinfinisheddrawings.Therefore,itisusualt odrawallyourconstructionlinesonaseparatelayerwhichwillbeturnedofforfrozenpriorto printing.
Constructionlineoptions

- **Hor:**Creates ahorizontalconstructionline.
- **Ver:**Creates averticalconstructionline.
- **Ang:**Createsaconstructionlineataspecifiedangle.
- **Bisect:**Createaconstructionlinethatbisectsanangledefinedby3 points.
- **Offset:**Createsaconstruction linethat is offsetfrom anexisting line byaspecified
- distance.

ToolBar:Menu→Draw→ Xline	**Command**:Xline(xl)

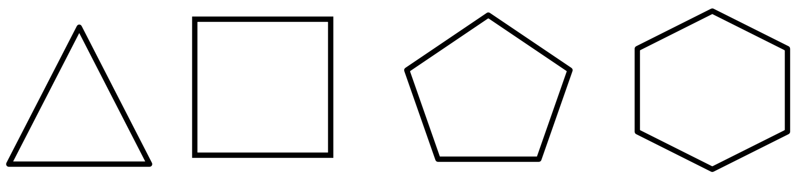
4. Polyline(Pline):

The PLINE command differs from the LINE command in that the segments of the PLINE areconnected. When using the LINE command, each segment is its own object. When usingPLINE,all linesegments areoneobject.

ToolBar:**Menu→Draw→Polyline**	Command:**Pline(PL)**

5. Polygon

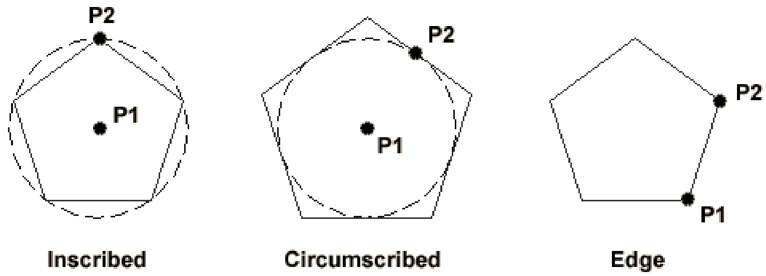
A polygon of sides ranging from 3 to any number can be drawn using Polygon command. Itcreatesan equilateral closed polyline.



Centreof Polygon: Defines thecenter ofthe polygon.

Inscribed in Circle: Specifies the radius of a circle on which all vertices of the polygon line.**Circumscribe about circle:** Specifies the distance from the centre of the polygon to themidpointsof theedges ofthe polygons.

Edge: Definesapolygonbyspecifying theendpointsofthefirstedge.



Specifying the radius with your pointing device determines the rotation and size of the polygon.Specifyingtheradiuswithavaluedrawsthebottomedgeofthepolygonatthecurrentsnaprotatio nangle.

ToolBar:**Menu→Draw→Polygon**	Command:**Polygon**

6. Arc

This command is used to draw an arc accurately. To create an arc, a combination of centre,endpoint, start point, radius, angle, chord length, and direction values can be specified. Arcsaredrawn in acounterclockwise direction by default.

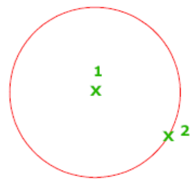
StartPoint: Drawsanarc

ToolBar:**Menu→Draw→Arc**	Command:**Arc**

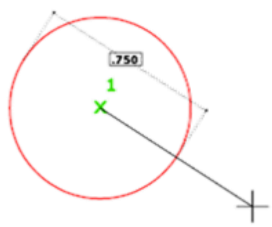
7. Circle

Therearemanywaystodrawacircle,thedefaultbeingthecentrepointofcircleandradius.Belowareth e possibleways of drawing the circle.

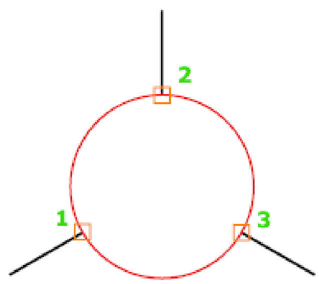
i. **CentrepointandRadius:**Definesthe radiusofthecircle.



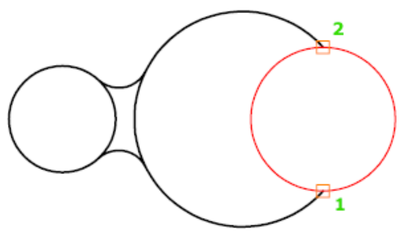
ii. **CentrepointandDiameter:** Definesthediameterofthe circle.



iii. **3P(ThreePoints):**Draws acirclebased onthreepoints oncircumference.



iv. **2P(TwoPoints):**Draws acirclebasedontwoendpointsofthediameter.



v. **Tan,Tan,Tan**:Creates acircletangentto threeobjects.

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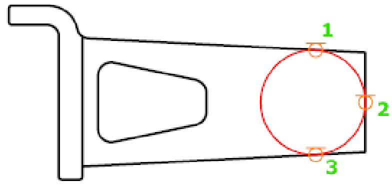
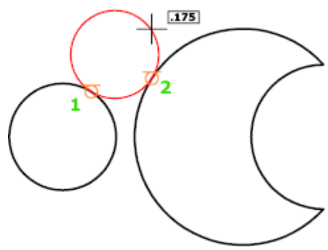


vi. **Tan, Tan, Radius:** Creates a circle with a specified radius and tangent to two objects.Sometimesmorethanonecirclematchesthespecifiedcriteria.Theprogramdraw



sthecircleofthespecifiedradiuswhose tangentpointsareclosesttothe selected points.

ToolBar:**Menu→Draw→Circle**	Command:**Circle(C)**

Ellipse

The Ellipse command gives you a number of different creation options. The default option isto pick the two end points of an axis and then a third point to define the eccentricity of theellipse.

ToolBar:**Menu→Draw→Ellipse**	Command:**Ellipse(E)**

8. Donut

The DONUT is a special type of polyline which is made up of arc segments. A DONUT has twoproperties: it has width, and it is closed. The width of DONUT is set by specifying inside andoutsidediameters. Theinside diameter maybezero thereby making it afilled circle.

9. Hatchpatterns

The HATCH command is used to fill up the area using a suitable pattern. The type of pattern andpattern variables can be chosen from a library of patterns available. The hatching will be carriedoutinside aclosed definedarea.

ToolBar:**Menu→Draw→Hatch**	Command:**Hatch(H)**

10. Text

Words, messages and numbers can be inserted as required on an engineering drawing. Thealphanumeric keyboard is used extensively for non-graphical input such as text. The text style,height, text angle, aspect ratio, colour, etc. are some of the attributes associated with text. Theseattributescan bechangedas per requirements.

11. Rectangle

Creates a rectangular polyline. With this command, the parameters (length, width, rotation)canbespecifiedcontrol thetype ofcorners(fillet, chamfer,square).

ToolBar:**Menu→Draw→Rectangle**	Command:**Rectang(R)**

DraftingAids

1. Limits

Drawing limits are used to set the boundaries of the drawing. The drawing boundaries areusuallysettomatchthesizeofasheetofdrawingpaper.Thismeansthatwhenthedrawingisplotted and ahardcopy is made, itwill fit on thedrawing paper.

Fig: Page67 :Engineering Graphics with AutoCAD2020

Command:Limits

Specifylowerleftcorner

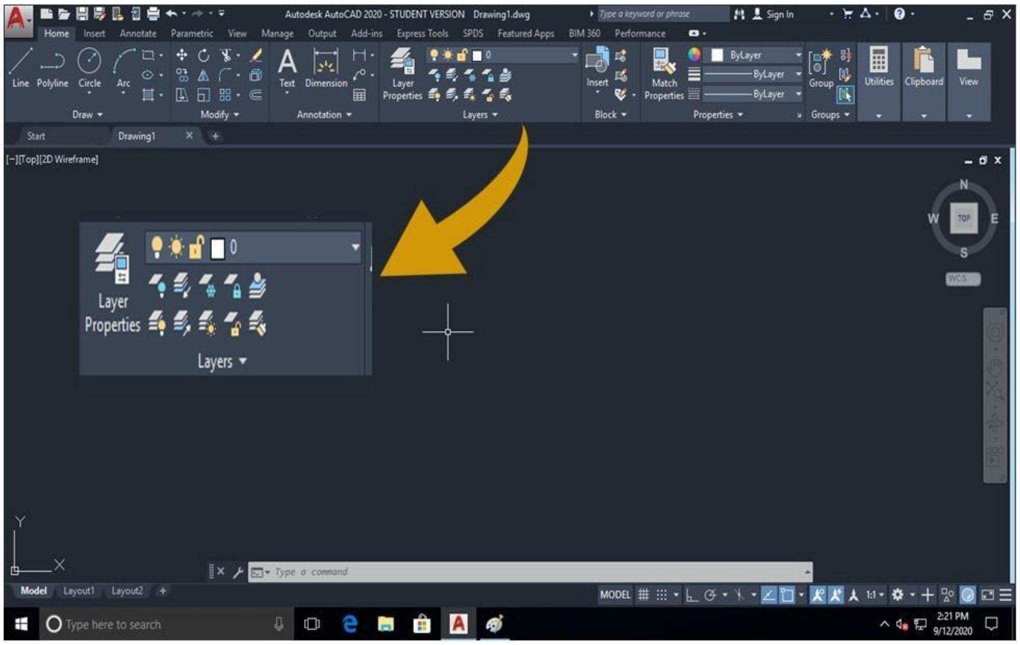
or[ON/OFF]<0,0>:SpecifyapointSpecifyupperright corner

or<12,9>:Specify apoint

Note:Limitshas nolimit,itcan beinfinity withrespect topaper size

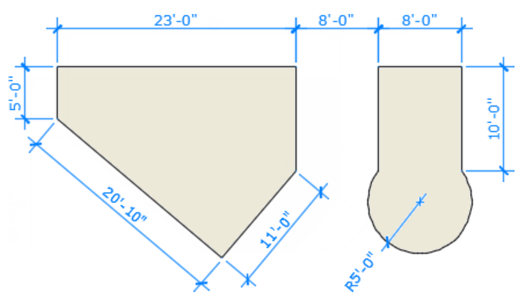
2. Layers

A layer is like a clear piece of paper that can be laid directly over the drawing. We can drawon the layer and see through it to the original drawing. Layers can be made invisible, andinformation can be transferred between layers. Layers are used to control the visibility ofobjectsandtoassignpropertiessuchascolorandlinetype.Objectsonalayernormallyassumethepr operties of that layer.



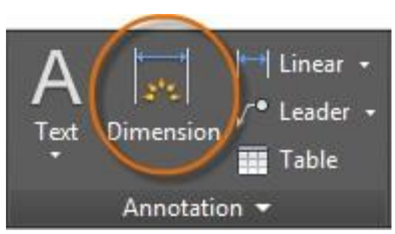
3. Dimensioning

Createseveraltypesofdimensionsand savedimensionsettingsbyname.



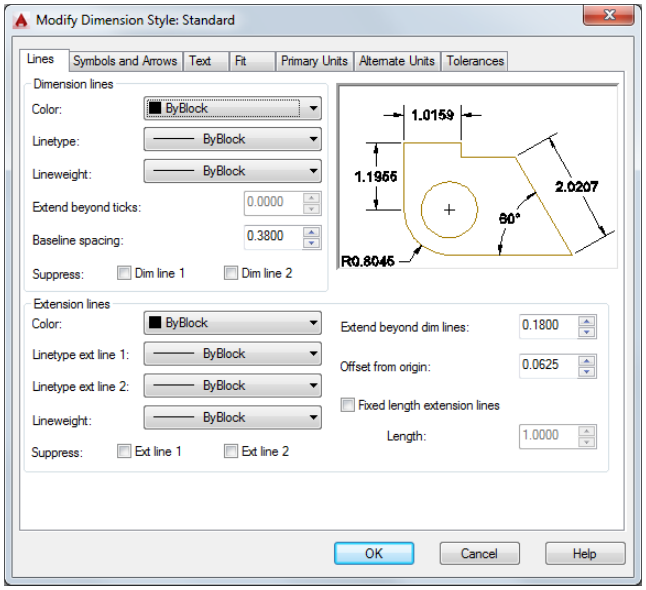
LinearDimensions

horizontal, vertical, aligned, and radial dimensions can be created with the DIM command. Thetypeofdimensiondepends on theobject thatis selected andthe direction ofdimension line.



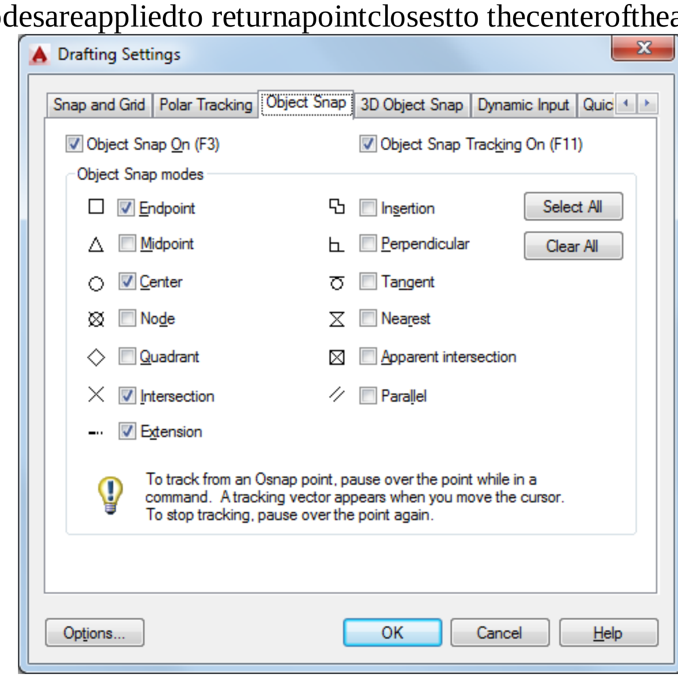
DimensionStyles

Dimensionstyleshelpestablishandenforcedraftingstandards.Therearemanydimensionvariables that can be set with the DIMSTYLE command to control virtually every nuance of theappearanceandbehaviorofdimensions.Allthesesettingsarestoredineachdimensionstyle.The defaultdimensionstyleisnamedeitherStandard(imperial)orISO-25(metric).Itisassignedtoalldimensions until youset another styleas thecurrent dimension style. Thecurrentdimensionstylename,Hitchhikerinthiscase,isdisplayedinthedrop-downlistoftheAnnotationpanel.



4. Objectsnap

Objectsnapprovideawaytospecifypreciselocationsonobjectswheneveryouarepromptedfor a point within acommand. With running object snap(Osnap) settings, a snap point at anexact location on an object can be specified. When more than one option is selected, theselectedsnap modesareappliedto returnapointclosestto thecenteroftheaperturebox.



ObjectSnapON(F3)

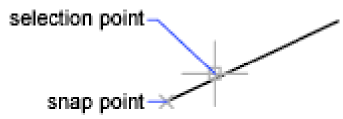
TurnsrunningobjectsnapsONandOFF.TheobjectsnapsselectedunderObjectSnapModesareactiv ewhile theOsnap modein ON.

ObjectSnapTrackingOn(F11)
TurnsobjectsnaptrackingONandOFF.Withobjectsnaptracking,thecursorcantrackalongalignme ntpathsbased onotherobjectsnap pointswhen specifyingpoints inacommand.

ObjectSnapModes:

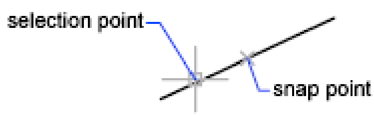
EndPoint

Snaps to the closest endpoint of an arc, elliptical arc, line, multiline, polyline segment, spline,regionor to theclosest corner ofa trace. Solid or 3D face.



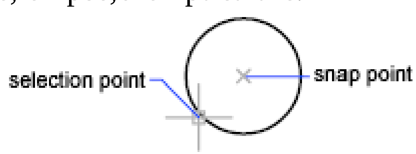
Midpoint

Snapstothemidpointofanarc,ellipse,ellipticalarc,line,multiline,polylinesegment,region,solid, splineorxline.



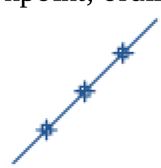
Center

Snapstothecenterof anarc,circle, ellipse,orellipticalarc.

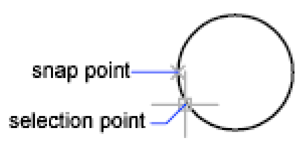


Node

Snapstoapoint object,dimensiondefinitionpoint, ordimensiontextorigin.



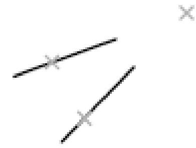
Quadrant



Snapsto aquadrantpointofan arc, circle,ellipse, orellipticalarc.

Intersection

Snapstothe intersectionof anarc, circle, ellipse, line,multiline, polyline,spline,orxline andothergeometricalobjects.Extendedintersections arenotavailableas a runningobject snap.

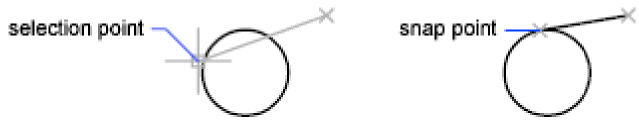


Extension
Itcausesatemporaryextensionlineorarctobedisplayedwhenthecursorispassedovertheendpointof objects, so that pointscanbespecifiedon the extension.

Insertion
Snapsto theinsertion pointof anattribute, ablock, ashape, ortext.

Perpendicular
Snapstoapoint perpendiculartotheselectedgeometricobject. DeferredPerpendicularsnapmodeisautomaticallyturnedonwhentheobjectyouaredrawingrequiresthatmorethanoneperpendicularsnapcanbecompleted.Anobjectsuchasaline,arc,circle, polyline, ray, xline, multiline, or 3D solid edge as an object from which to draw aperpendicularlinecanbeused.

Tangent
Snaps to the tangent of an arc, circle, ellipse, elliptical arc, polyline arc, or spline. DeferredTangent snap mode is automatically turned on when the object that is being drawn requiresandcompletemorethan onetangentsnap.Itcanbeusedtodrawalineorxlinethatis tangenttoarcs,polylinearcs,orcircles.WhenthecursorpassesoveraDeferredTangentsnappoint,amarker and anAutoSnap tooltip aredisplayed.



ApparentIntersection
Snapstothevisualintersectionoftwoobjectsthatdonotintersectin3Dspacebutmayappeartointersect in the currentview.
Nearest
Snapstothenearestpointonanarc,circle,ellipse,ellipticalarc,line,multiline,point,polyline,ray,spline orxline.
Parallel
Constraintsalinesegment,polylinesegment,rayorxlinetobeparalleltoanotherlinearobject.The parallel object snap is to be specified, after specifying the first point of a linear object.Unlikeotherobjectsnapmodes,thecursormustbemovedand*hover* overanotherlinearobjectuntil the angle is acquired. Then, move the cursor back toward the object that is to be created.When the path of the object is parallel to the previous linear object, an alignment path isdisplayed,which you canuseto create theparallelobject.

SelectAll
Turnsonall runningobject snapmodes.

ClearAll
Turnsoffallrunning objectsnap modes.

5. **Zoom**

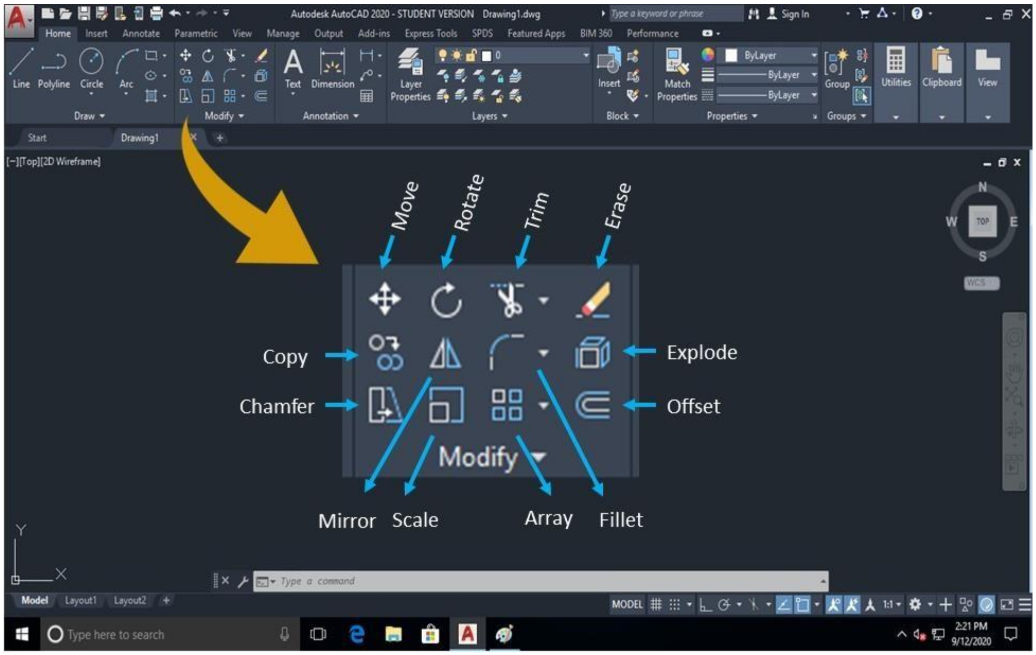
Theobjectsviewedinthedrawingareacanbezoomedinorout,andmovedtoseedifferentportionsof thesheet in detail by using the following commands:

Thezoom flyout of standard tool bars hasnineicons toopt.

a) Zoomwindow:Thiscommandenlargesarectangularareaofadrawingbasedonadefinedwindowusing thecross hair
b) Zoomall:Thiscommanddisplaystheareofthedrawinglimitsorextentwhicheveraregreater.
c) Zoomdynamic:Pansand zoomsusingarectangularviewbox.
d) Zoomscale: Zooms tochangethe magnificationofaviewusingascale factor.
e) Zoomcenter:Zoomstodisplayaviewdefinedbyacenterpointandamagnificationvalueor aheight.
f) ZoomObject:Zoomstodisplayoneormoreselectedobjectsaslargeaspossibleandinthecenter of theview.
g) RealTime:Zoomsinteractivelytochangethemagnificationoftheview.
h) Zoomextends:Zoomsto displaythemaximumextents ofallobjects.
i) ZoomPrevious:Zoomstodisplaythepreviousview.Youcanrestoreupto10previousviews.

Outofthese“Zoomwindow”and“Zoomall”commandaremoreuseful.Similarly,“Zoomrealtime”,“Panrealtime”and“Zoomprevious”commandsarealsofrequentlyappliedfordrafting.

EditingCommands(ModifyCommands)



1. Move

TheMovecommandworksinasimilarwaytotheCOPYcommandexceptthatnocopyismade;theselected object(s)issimply moved from onelocation to another

ToolBar:**Menu →Modify→**	Command**:explode**

2. Rotate

The Rotate command allows an object or objects to be rotated about a base point selected andtheangle can betyped inthe commandprompt by the user.

ToolBar:**Menu →Modify→**	Command**:explode**

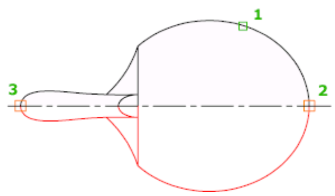
3. Copy

The Copy command can be used to create one or more duplicates of any object(s) which havebeenpreviously created.

ToolBar:**Menu →Modify→**	Command**:explode**

4. Mirror

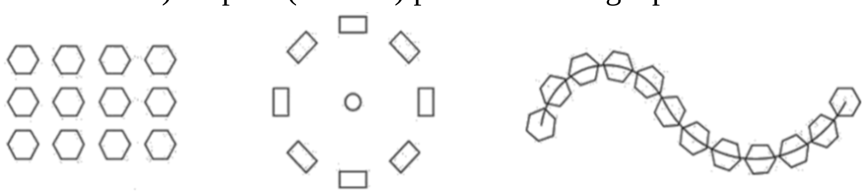
The Mirror command allows you to mirror selected objects in your drawing by picking themandthendefiningthepositionofanimaginarymirrorlineusingtwopoints.Tocreateperfectlyhorizontalorvertical mirror lines turn theORTHO command on.



ToolBar:**Menu →Modify→**	Command:**explode**

5. Array

The Array command makes multiple copies of a selected objects in a rectangular pattern(columnsand rows)or apolar(circular) pattern oraalong a paththat is defined.

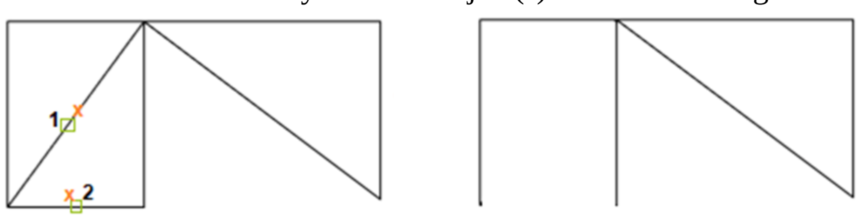


Rectangular Polar Path

ToolBar:**Menu →Modify→**	Command:**explode**

6. Erase

The Erase command is one of the simplest AutoCAD commands and is one of the most used.Thecommand erases ordeletesany selected object(s) fromthe drawing.



Selected lines before erasing Removed lines after erasing

ToolBar:**Menu →Modify→**	Command:**explode**

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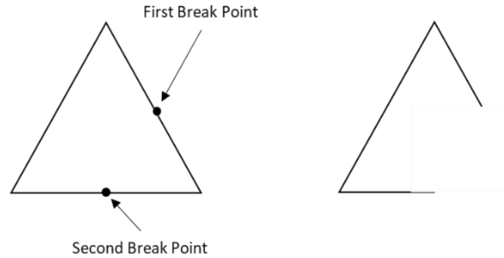
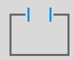
7. Break

TheBreakcommandhelpstobreak (removeapartof)an objectbydefiningtwobreakpoints.

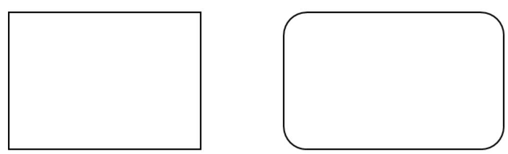


Before Break After Break

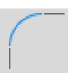
ToolBar:**Menu →Modify→** 	Command**:explode**

8. Fillet

The Fillet command is a very useful tool which allows to draw a tangent arc between twoobjects. The objects are usually intersecting. The objects do not have to intersect, but theirseparationcannot be morethan thefillet radius.

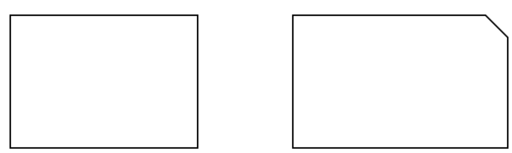


Without Fillet Filleted Object

ToolBar:**Menu →Modify→** 	Command**:explode**

9. Chamfer

TheChamfercommandcreatesanangledcorner(Chamfer)betweenanytwonon-parallellinesoranytwoadjacentpolylinesegments.Achamfer isusually appliedtointersectinglines.

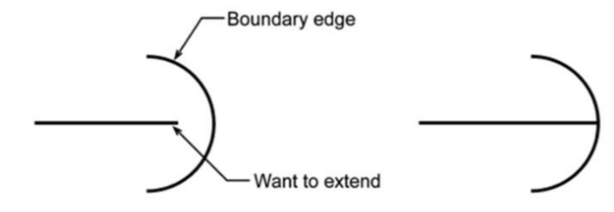


Chamfered Object

ToolBar:**Menu →Modify→Fillet →** 	Command**:explode**

10. Extend

TheExtendcommand isusedto extendaline, polylineorarctomeetan alreadyexistingobject.

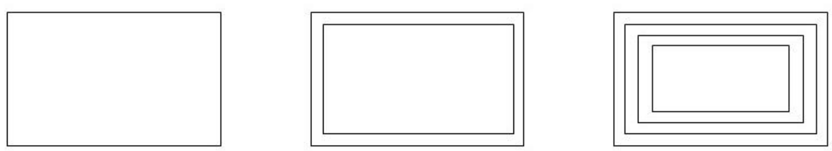


Before Extending After Extending

ToolBar:**Menu →Modify→**	Command**:explode**

11. Offset

The OFFSET command creates a new object parallel to or concentric with a selected object.The new object is drawn at a user defined distance (the offset) from the original and in adirectionchosen.TheOFFSETcommand mayonly beused ononeobjector entityat atime.

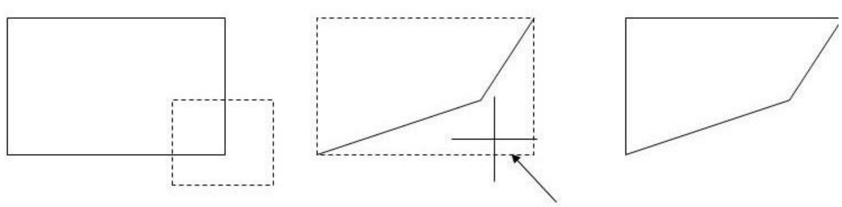


Original Object Single Offset Multiple offset

ToolBar:**Menu →Modify→**	Command**:explode**

12. Stretch

TheSTRETCHcommandcanbeusedtomoveoneormoreverticesofanobjectwhileleavingtherest of the object unchanged

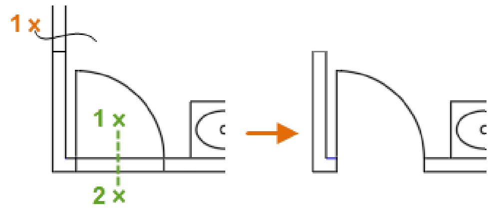


Select Vertex Move the Vertex Final Shape

ToolBar:**Menu →Modify→**	Command**:explode**

13. Trim

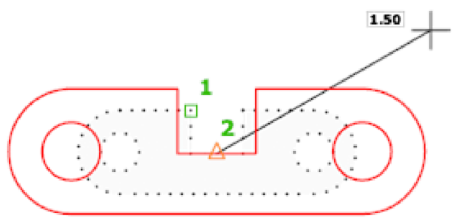
The Trim command is used to trim off the part of an object that is not necessary. In order totrimanobject,asecondobjectwhichformsthecuttingedgemustbedrawn.Cuttingedgescanbelines, xlines, rays, polylines, circles, arcs orellipses.



ToolBar:**Menu →Modify→**	Command:**explode**

14. Scale

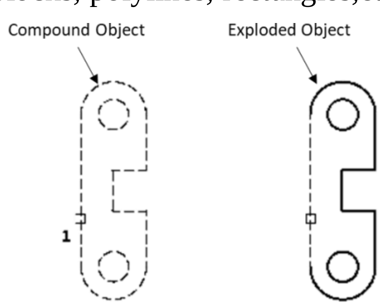
The Scale command can be used to change the size of an object or group of objects. It allowsto shrink or enlarge the already existing drawing objects about a base point on specifying thescalefactor.



ToolBar:**Menu →Modify→**	Command:**explode**

15. Explode

This command is used to break a single compound object into their constituent parts. In otherwords, s compound object explodes when the components to be modified separately. thecommandis used to return blocks, polylines, rectangles,etc.,



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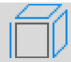
ToolBar:**Menu →Modify→** 	Command:**explode**

Quickaccesstoolbar

The Quick Access toolbar, displayed in the Drafting & Annotation workspace, is located at theverytopofthedrawingwindownexttotheApplicationbutton.TheQuickAccesstoolbarmaybecustomized by adding or removing commands. This is done by right clicking on the toolbar andselectingCustomizeQuickAccess toolbaror selectingthe arrow at theendofthetoolbar.

TheQuickAccess toolbarcontainsthefollowingcommands(reading lefttoright):

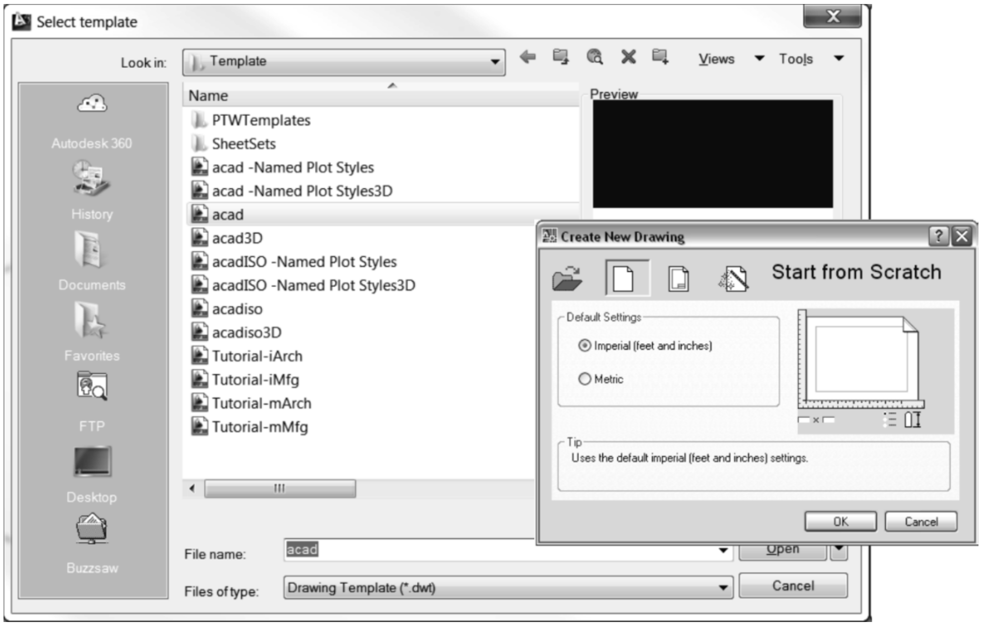
- QNew:Opensanewdrawing.
- Open…:Opensan existingdrawing.(Ctrl+O)
- Save:Savesthecurrentdrawing.(Ctrl+S)
- Saveas: Allowsyou to savethe current drawingunder adifferent name. (Ctrl+Shift+S)
- Plot…:Plotsorprintsthecurrentdrawing.(Ctrl+P)
- Undo:Used toundo previous commandoractions.
- Redo:Used to redo commandsthat havebeen undone

Starting a newDrawing

When starting a new drawing (QNEW), you have a choice of either starting from the *Create NewDrawing* window or the *Select Template* window. The *Create New Drawing* window allows youto set up a drawing to your preferences. You may set parameters such as the units (Imperial orMetric), the size of the drawing, and the degree of precision. The *Select Template* window allowsyoutochoosefrompredefinedtemplates.Figure2.5-1showsbothstartupwindows.The**STARTUP** variable is used to choose what is displayed when the application is started, or whichwindowwillappearwhenyoustartanewdrawing.Ithas4valuesthatmaybeset(i.e.,0,1,2,and3).

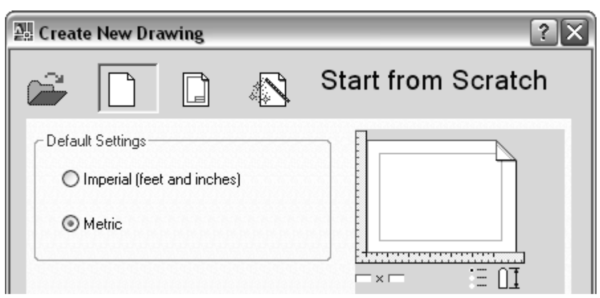
However, for starting a new drawing, only 0 and 1 are of interest. If STARTUP = 0, then the*Select Template* window will appear. If STARTUP = 1, then the *Create New Drawing* windowwillappear.

Template drawings store all the settings for a drawing and may also include predefined layers,dimensionstyles,andviews.Templatedrawingsaredistinguishedfromotherdrawingfilesbythe .dwtfile extension.Severaltemplate drawingsare includedinAutoCAD®.You canmakeadditionaltemplatedrawings by changingtheextensions of drawing filenames to.dwt.



StartinganewdrawingusingtheCreateNew Drawingwindow
Command:**startup**

EnternewvalueforSTARTUP<0>:**1**
QuickAccesstoolbarorApplicationbutton:**File–New…**(**Ctrl+N**).TheCreateNewDrawingwindowwill appear.
4) CreateNewDrawingwindow:Activatethe**StartfromScratch**button,activateeitherImperialorMet



rictoggle, and then select OK
5) QuickAccesstoolbar:

6) CreateNewDrawingwindow:
   a. Activatethe **Usea Wizard**button.
   b. SelectaWizardfield:Select **Advanced Setup** andthen**OK**.

7) Thewizard willtakeyou throughasetupwhichwill allowyoutochooseyourdrawingsnits,angle,angle measure,angle direction anddrawing area.

Savingandopeningadrawing

When saving (or open) a drawing (***Application*** button - ***Save*** or ***Saveas***or ***Open***),you havethe option ofsaving (oropening) the following filetypes.

- **DWG** (DraWinG) is a binary file format used for storing two- and three-dimensional designdataand metadata. Mostofwhat you draw will be saved in this format.
- **DWT** is a template file. These files are used as a starting point when starting a new drawing.Theymaycontaindrawingpreferences,settings,andtitleblocksthatyoudonotwanttocr eateoverand over again forevery new drawing.
- **DXF** (Drawing Interchange Format, or Drawing Exchange Format) is a CAD data file formatdeveloped by Autodesk® for enabling data interoperability between AutoCAD® and otherprograms.
- **DWS** is a standards file. To set standards, you create a file that defines properties for layers,dimension styles, linetypes, and text styles, and you save it as a standards file with the .dwsfilename extension.

PlottingofDrawings

Toprinta drawing,clickontheicon ‘Plot’. Thisopensa dialogue boxhavingtwopages,namely‘Plotdeviceand Plot Settings’. Theplotterconfigurationoritsequivalenthastobeselectedinthe PlotDevicepage.Andthefollowingoptions to beset in the Plot setting page

PageSize	:	A4(210x297mm) orA3oretc.,
Units	:	Mm
DrawingOrientation	:	Portrait/Landscape
PlotArea	:	Limits
PlotScale	:	1:1

ByclickingontheFullpreviewbutton,theareaofthefiguretoprintedwillbeprojected.ClickOKif it has asuitableorientation to start printing.

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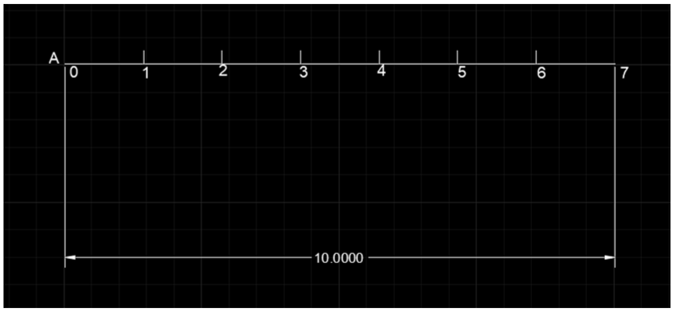
GeometricalConstructions

Introduction:

Engineeringdrawingconsistsofanumberofgeometricalconstructions. Afewmethodsareillustratedhe rewithoutmathematical proofs**.**

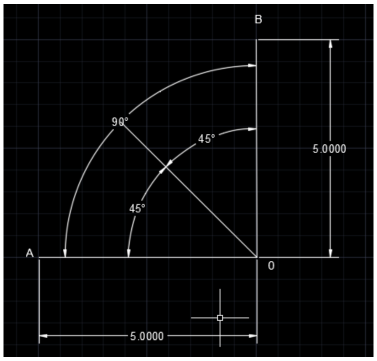
1. Todivideastraightline65 mminto agivennumber ofequalparts say 5.



Solution

1. Draw alineof 65mm withCommand**L**
2. NametheLine With TextCommandA,B
3. ToDivide lineTypeCommand **DIV**Enter
4. SelectObjectToDivideSelectLine
5. EntertheNumberOfSegment of5 Enter
6. SelectPointStylefromutilities toshowdivisions.

2. Tobisect agiven angle90^0



Solution

1. Draw alineof50mm withCommand LNametheLaneWithText CommandA,B
2. DrawanotherLine50mmFromtheEndofPreviousLinewith**90^0**AnglewithCommandLname theLineWith Text Command B,C
3. ToBisectLineTypeCommand**XL** pressenter
4. SelectBisectOptionorEnter**B**and specify angle vertexpointatEndPoint.

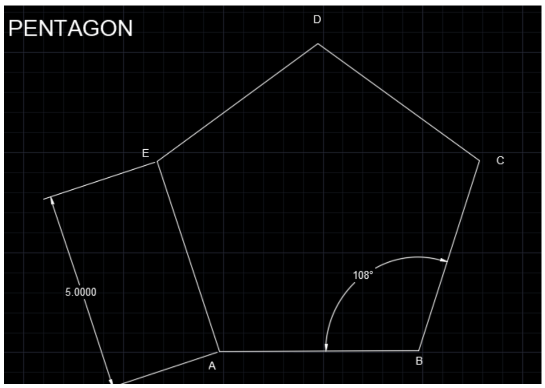
5. SpecifyAngleStartingPoint
6. Specifyangleendpoint enter
7. MentionAngleAfterBisection

Polygons

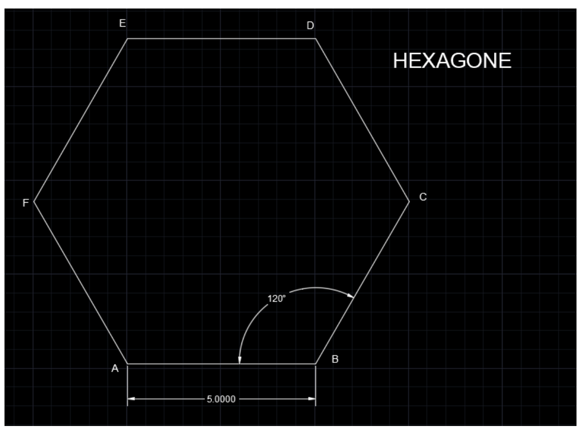
1. Toconstructaregular polygon(sayapentagon)giventhelengthoftheside5(EDGEMETHOD)

Solution

1. Toconstruct any polygonEnterCommand **POL**
2. EnterNoofSides**5**
3. SpecifyCenter pfPolygonorEdgeenter Command**E**
4. Specify FirstEnd Pointof Edge&SpecifysecondEnd PointofEdgebyenteringspecificDistance**5**
5. NametheEdgesWith textCommand**TEXT**



2. Inscribeahexagon inagiven circleof50 mmDiameter(InscribeCircleMethod)



Solution

1. Toconstruct anypolygon EnterCommand**POL**
2. EnterNoofSides**6**
3. SpecifyCenter pfPolygonorEdgeenterselect Center
4. EnteranoptionwithInscribed inCirclewithcommand**I**
5. SpecifyradiusOf Circle with50
6. NametheEdgesWith textCommand**TEXT**

PracticeExercises

1. Dividean80 mmlongstraight lineintofiveequalparts.
2. Dividea90 mmlong straight lineinto parts thatarein proportionto 2:3:5.
3. Draw a perpendicular to a 100 mm long line AB, at a point P lying on the line at a distance of40mm from theend A.
4. Draw a 120 mm long line AB inclined at 60° to the horizontal. Erect a perpendicular to ABfrompoint P, lying at a distance30 mm from endA.
5. Drawperpendicularto a 100mmlonglineAB,fromapointPlyingatadistance60mmfromendA and 70 mm from end B.
6. Draw alineABinclinedat30ºtothehorizontal.Draw anotherlineCDparalleltoand50 mmawayfrom AB.
7. Draw tangent to a circle of 40 mm diameter from any point P which is at a distance of 65 mmfromthecentreof the circle.
8. Two circles of radii 20 mm and 30 mm have their centres 65 mm apart. How many commontangents to both the circles are possible? Draw an internal and an external common tangent tothesecircles.
9. Two circles of radii 20 mm and 30 mm have their centres 50 mm apart. Draw all the possiblecommontangents to both thecircles.
10. Twocirclesofradii20mmand30mmhavetheircentres40mmapart.Drawapairofcommontangentsto both thecircles.
11. Draw a tangent to connect two circles of radii 25 mm and 40 mm. The centres of the circlesare15mm apart.
12. Draw anarcof30mmradiusconnecting twostraightlinesinclinedat135ºtoeachother.
13. Draw arc of 20 mm radius to connect a straight line AB and a circle of 30 mm radius,tangentially. The centre of the circle is at a distance 25 mm from AB. Consider the centres ofthearclies (a) within thecircle (b) outside thecircle.
14. Twocircleshavetheircentres70mmapartandradii20mmand30mm,respectively.Drawacircleof radius 25 lyinginternal to and connectboth thecircles tangentially.
15. Twocircleshavetheircentres70mmapartandradii20mmand30mm,respectively.Drawacircleof radius65 lying externalto andconnect both thecircles tangentially.

16. Twocircleshavetheircentres70mmapartandradii20mmand30mm,respectively.Drawacircleofradius55whichconnectstangentiallybothethecirclesand(a)include20mmcircle (b)include30mm circle.
17. ApointPis40mmfromalineAB.AnotherpointQisintheABandis50mmfromthepoint P.DrawacirclepassingthroughpointPand tangentialtotheline ABatpointQ.
18. Drawtwopossiblecirclestoconnectagivencircleof50mmdiameterABandapointP,lyingata distance70 mm and25 mm from theends of thediameterAB.
19. Inscribeacircleina triangle of75mm, 65mm and 55mm long sides.
20. Draw asquareof60mm longdiagonals.Circumscribe anothersquareon thesquare.
21. Drawregularpentagon, hexagonandaheptagonon acommonedgeof side 30 mm.
22. Drawapentagonof30mmsidewithasidevertical.Attachanon-overlappinghexagonofsamesidelength with common vertical edge.
23. Construct aheptagon ofedgelength30 mm. Construct a pentagon of sameedgelength insidetheheptagon with oneedgeof thepolygons beingcommon.
24. Draw an octagonof25mm sidekeeping oneof thesides vertical.
25. Drawfivecirclesinagivencircleof80mmdiameter,eachtouchingthegivencircleandtheothertwo circles.
26. Draw five circles inside the pentagon of 30 mm side, such that each circle touches one side ofthepentagon and two other circles.
27. Drawfivecirclesinsidethepentagonof30mmside,suchthateachcircletouchestwosideofthepentagon and two other circles.
28. Drawthreecirclesinsideahexagonof30mmside,suchthateachcircletouchesonesideofthehexagon and two other circles.
29. Drawfivecirclesoutsidethepentagonof20mmside,suchthateachcircletouchesonesideofthepentagon and twoothercircles.
30. Drawsixcirclesoutsideagivencircleof30mmdiameter,suchthateachcircletouchesthegivenand two othercircl

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UNIT 2

ORTHOGRAPHICPROJECTIONS

Projections

Projection

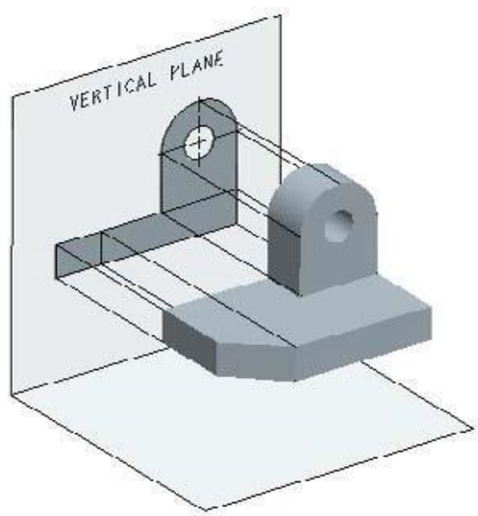
As per the optical physics, projection is a process of causing an image by rays of light taken in aparticulardirectionfromanobjecttoapictureplane.Theimaginaryrayoflightbetweentheobjectandthe projection planeis called lineof sight or projector.

OrthographicProjection

Inorthographicprojection,theprojectorsareparallelandperpendiculartotheplaneofprojection.Orthographicprojectionsonmutuallyperpendicularprojectionplaneswillfullydescribetheobjectin its shape and size. Hence, all design and manufacturing drawings are made with orthographicprojections.
Projectors⊥to theProjectionplane

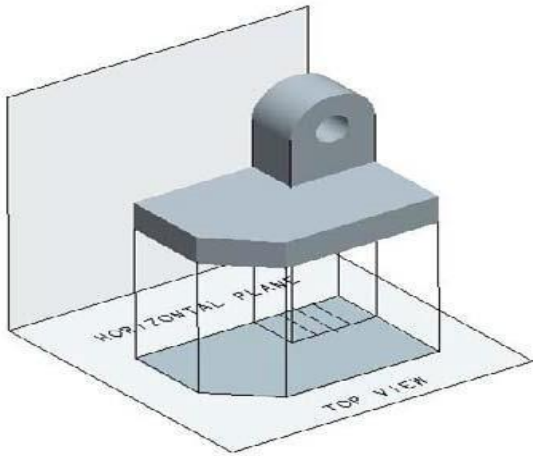
VerticalPlaneandFrontElevation

A view looking from the front is projected onto the vertical plane. This view is called front vieworfrontelevationandshowsthewidthandheightdimensions.Averticalplaneofprojection,whichis behind theobject in relation to theobserver, is shown
infigurebelow.



HorizontalPlaneandTopView

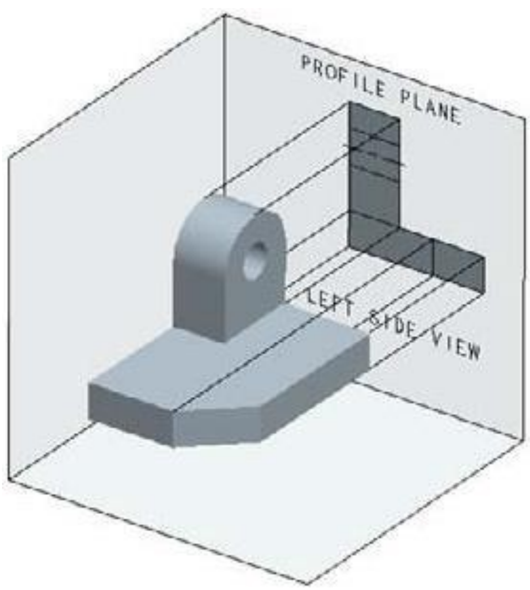
A view looking from the top is projected onto the horizontal plane placed below the object. Thisview is called top view or plan. Top view shows the width and depth dimensions of an object. Ahorizontalplanewith a top viewis shown in figure below.



ProfilePlaneand EndView

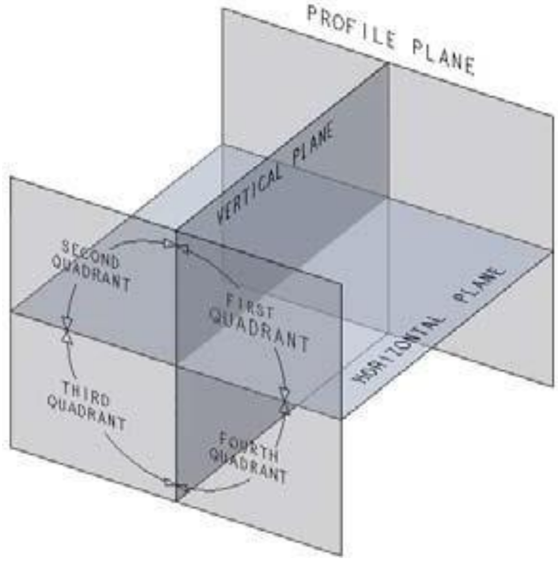
A view looking from the side of an object is projected onto the profile plane. The observer andthe projection plane are on different sides of the object (i.e.) the object is between the observerand the projection plane. The viewing can be from the right or the left side of the object.

Theviewdrawnlookingtheobjectfromtherightiscalledrightsidevieworrightendelevation.Theview looking the object from the left is called left side view or left end elevation. Side view ofan object shows the depth and height dimensions. A profile plane with a left side view is shownin figurebelow.



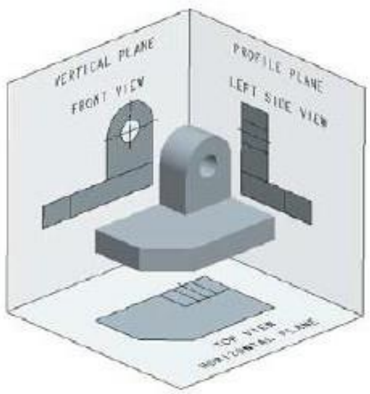
FirstAngleProjection

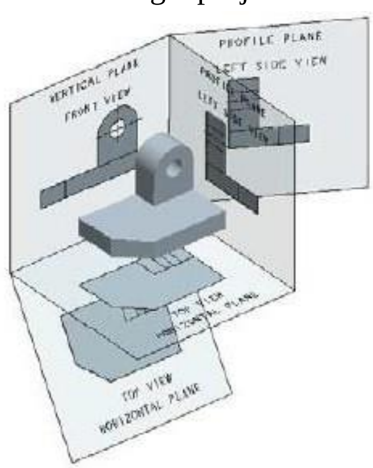
Anarrangementofvertical,horizontal,andprofileplanesandquadrantsusedtodrawfirstangleprojections is shown below. Front view is projected onto the vertical plane, top view onto thehorizontalplane, and sideviewonto theprofileplane.



Projectionin FirstAngle

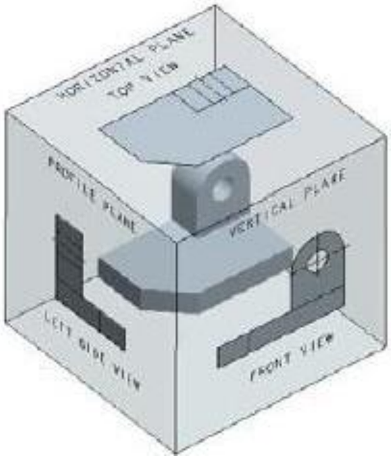
An object placed in the first quadrant. The vertical plane is behind the object, horizontal planebelowtheobject,andprofileplanetorightoftheobject.Theviewswiththecorrespondingplanesar e shown in figure. The top view is seen below the elevation and left side view is seen on therightof front view. This is thearrangement ofviews in thefirstangle projection.

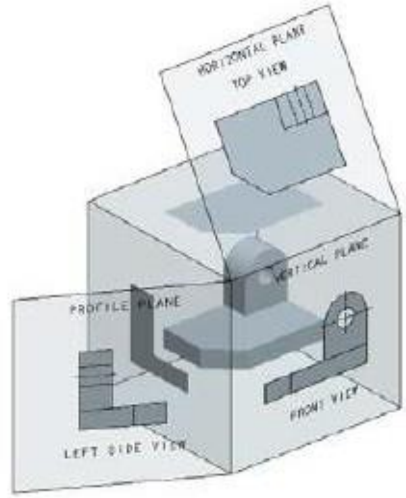




Projectionin ThirdAngle:

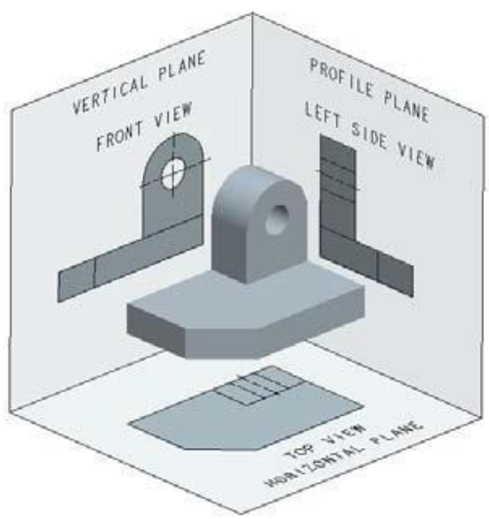
Anobjectplacedinthethirdquadrant.Theverticalplaneisinfrontoftheobject,horizontalplaneabove the object and profile plane to the left of the object. The views with corresponding planesareshowninfigure.Topviewisabovethe frontviewandleftsideviewistotheleft ofthefrontview.This is the arrangement ofthe views in third angle projection.





MultiviewProjection

Itconsistsofasetoftwoormoreorthographicviewsofanobjecttakenfromdifferentdirections,whichar emutuallyperpendicular.Theseviewsarearrangedrelativetoeachotherinaparticularway. Each of these views shows the shape of the object for a particular view direction. Multipleviews collectively describe the object completely and exactly. Hence, multiview projections areusedin engineering to describethe trueshapeofany object.



ProjectionsofPoints

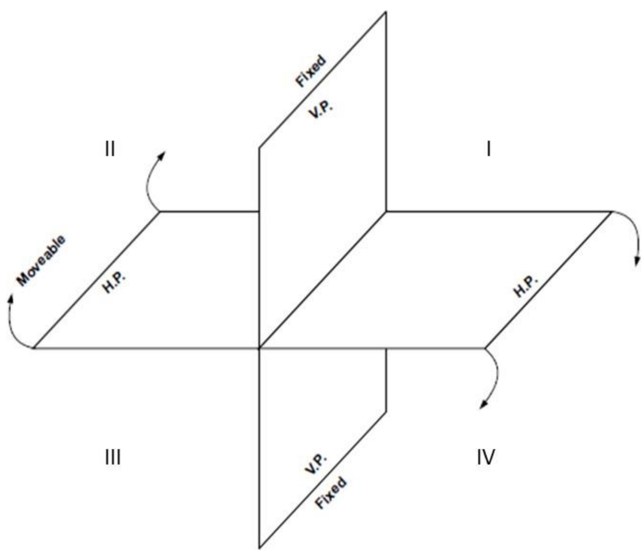
Point

A point usually represented by a dot is a dimensionless geometrical entity that has a position butno magnitude.Whereas in computer aided engineering drawing the point has dimension but it isnot considered or neglected.A point is obtained wherever two straight or curved lines intersecteachother.

ProjectionofPoints

Projection of points in various quadrants is the basis for projection of lines, projection of planesand projection of solids. In a conventional coordinate system, the position of a point in space isdenotedby its threecoordinates i.e., x, y and z.

Inprojections,twoprincipalplanesareusedtogettheprojectionofanobjectthatisverticalplaneand 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 asaxis of the plane. The vertical plane of projection is always infront of the observer and theprojectiononthisplaneisknownasfrontvieworelevation.Theotherplaneisthehorizontalplaneofprojection and the projection onthis planeis called thetopview orplan.

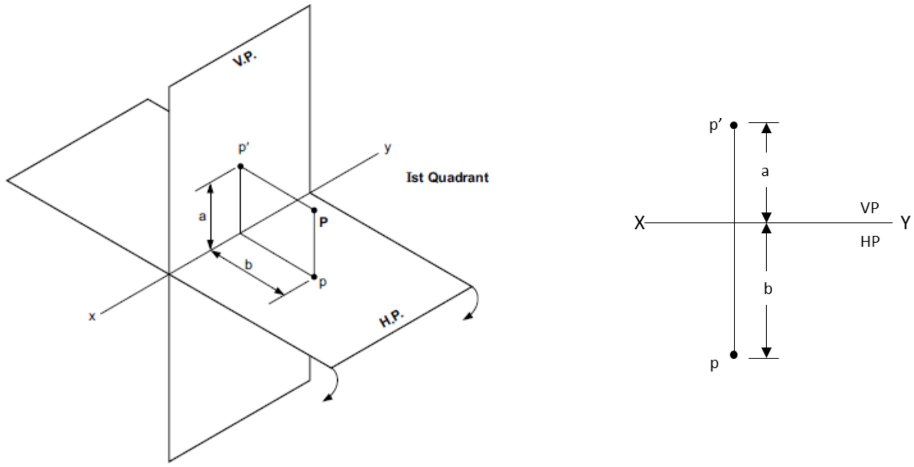


PictorialviewofPrincipalPlanes

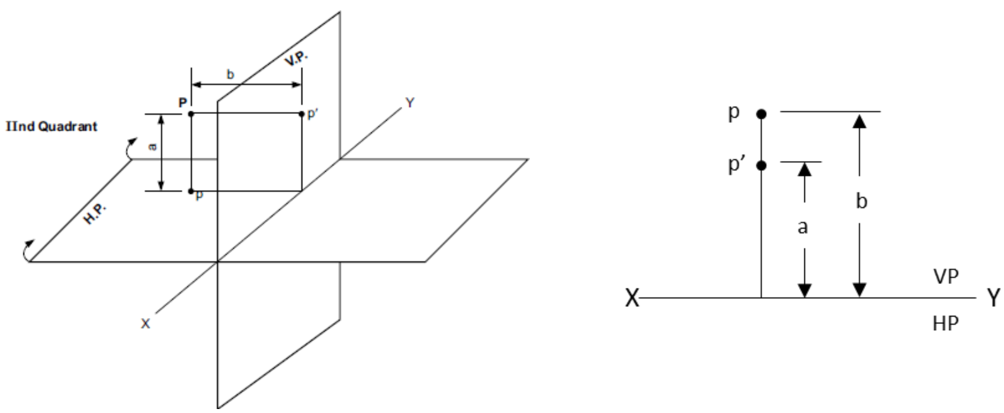
Theviewobtainedbyviewingobjectformrightsideiscalledrightsidevieworright endview.Aplane perpendicular to both H.P. and V.P. is called profile plane (P.P). The right side view isalways on the right to the front view. If the object is viewed from left on profile plane then theviewis known as left sideviewor left end view.

PositionofPoints inVarious Quadrants

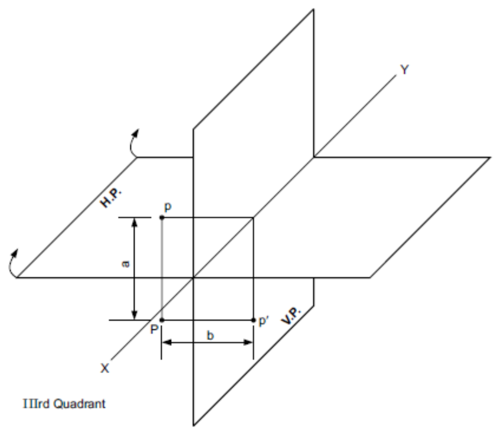
1. WhenpointisinFirstQuadrant
   WhenaPointPissituatedinIquadranti.e.,aboveH.P.andinfrontofV.P.,Itsfrontview(p')will be aboveXYlineanditstop view(p)will be belowthe XYline.

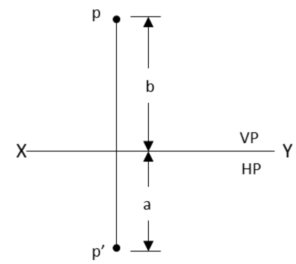


2. WhenpointisinSecondQuadrant
   WhenaPointPissituatedinIIquadranti.e.,aboveH.P.andbehindV.P.,Itsfrontview(p')willbeaboveX Ylineand its top view(p)will alsobe abovetheXYline.

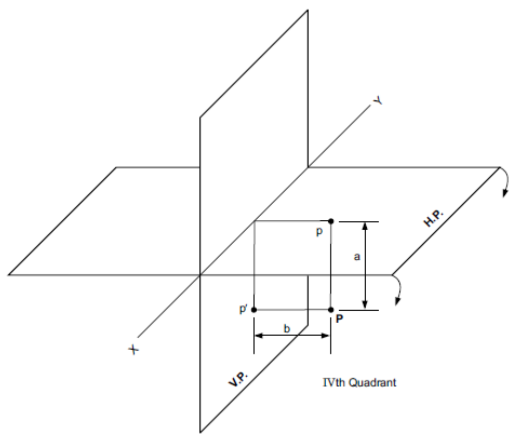


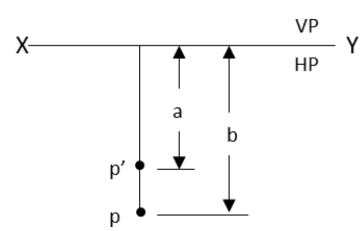
3. WhenpointisinThirdQuadrant
   WhenaPointPissituatedinIIIquadranti.e.,belowH.P.andbehindofV.P.,Itsfrontview(p')will be belowXYlineand itstop view(p)will be abovethe XYline.





4. WhenpointisinFourth Quadrant
   WhenaPointPissituatedinIVquadranti.e.,belowH.P.andinforntV.P.,Itsfrontview(p')willbebelow XYlineand also its top view(p).





Positionsofgeometricalentitiesinvariousquadrantsoftheprojections

When	Position		Quadrant	FrontView	TopView
	VP	HP			
Pointis	Infront	Above	I	AboveXY	BelowXY
Pointis	Behind	Above	II	AboveXY	AboveXY
Pointis	Behind	Below	III	BelowXY	AboveXY
Pointis	Infront	Below	IV	BelowXY	BelowXY
Pointis	Infront	Inoron	Ior IV	OnXY	BelowXY
Pointis	Inoron	Above	IorII	AboveXY	OnXY
Pointis	Behind	Inoron	IIor III	OnXY	AboveXY
Pointis	Inoron	Below	IIIorIV	BelowXY	OnXY
Pointis	Inoron	Inoron	I, II, III,orIV	OnXY	OnXY

SystemofNotation

1. Theactualpoints inspacearedenoted bycapitalletters A,B, Cetc.
2. Thefrontview(FV)ofthepointsaredenotedbytheircorrespondinglower-caseletterswithdashesas a', b',c', etc.
3. Thetopview(TV)ofthepointsaredenotedbytheircorrespondinglower-caseletterswithoutdashesas a, b,cetc.
4. The sideview(SV)ofthepointsaredenotedbytheircorrespondinglower-caseletterswithdoubledashes asa", b", c" etc.
5. Projectorsarealwaysdrawn ascontinuousthin linesandPoints withDot.

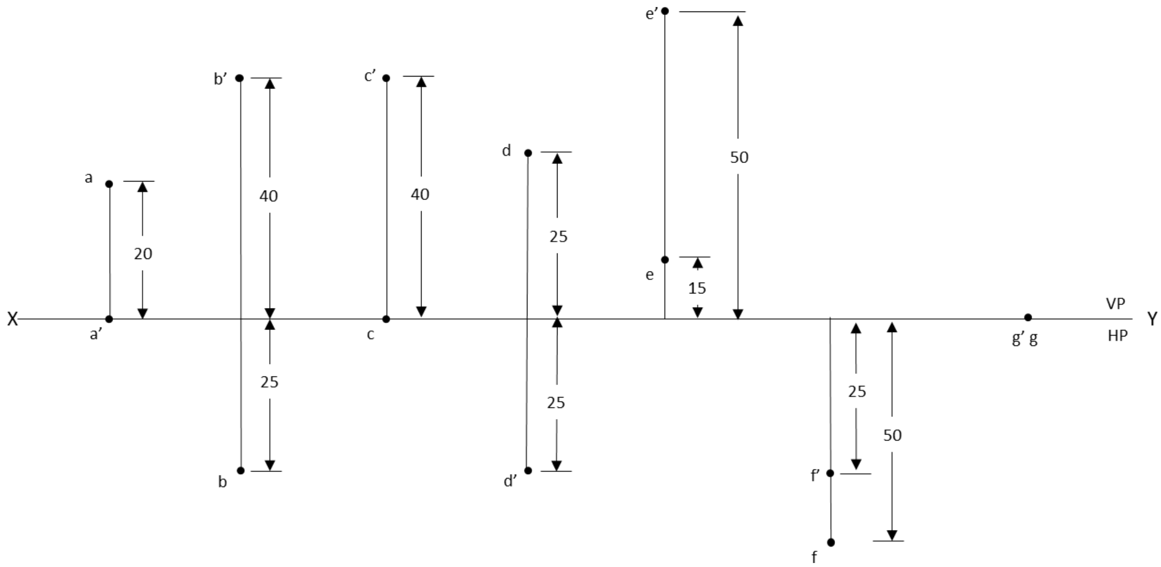
In Computer Aided Engineering Graphics for projection of points following commands are usedother than evoking software, opening file, saving file and giving print command. Using theseminimum nine commands any type of projection of point problem can be solved they are asfollows:

1. SelecttoolCommand.
2. Pointcommand.
3. Poly-linecommand.
4. Twopointlinecommand.
5. Parallellinecommand.
6. Bisectorcommand.
7. Smartdimensioncommand.
8. Linewidth command.
9. Inserttextcommand.

SolvedProblem:

1. Drawtheprojectionsofthefollowingpointsonthesamegroundline,keepingtheprojectors25mm apart.

i. Ais in theH.P.and 20 mmbehind theV.P.
ii. Bis 40 mmabovethe H.P. and25 mm infront of theV.P.
iii. Cis inthe V.P.and 40mm abovethe H.P.
iv. Dis 25 mm below theH.P. and 25 mm behindthe V.P.
v. Eis 15 mm abovethe H.P. and 50 mm behind theV.P.
vi. Fis 40 mm below the H.P. and 25 mm in front oftheV.P.
vii. Gis in both theH.P. and theV.P.



Solution

1. Open the Software. Click on the Application Menu and click on New and select "acad "intheopen dialog box andclick Open.
2. Enterthecommand"UNITS"incommandbarandSelectunitsas"Millimetersandclickok.
3. Enterthecommand"LIMITS"incommandbarandenter0,0clickenterandenterupperrightcorneras 120,90 and click enter
4. Enterthecommand"ZOOM"incommandbar andenterAandclickenter
5. Aspertheproblem,drawaXYlinebyusingXlinecommand.MarkVPandHPaboveandbelowit by using "XTEXT"command in command bar
6. Dividethelineinto someequal partsdepend uponhow manypoints given.
7. DrawthelinesrepresentingtheProjectorsasperthedimensionsmentionedintheproblemand mark the front and top views of thepoints using P**oint**command.
8. Mentionthe dimensionsforall pointsfrom theXYline using**dimlinear**command

PracticeProblems

1. Drawtheorthographicprojections of thefollowing points.
   i. PointPis30mm.aboveH.Pand40mm.infrontofVP.
   ii. PointQ is25 mm. AboveH.P and 35mm.behind VP.
   iii. PointR is 32mm. below H.P and 45mm behindVP.
   iv. PointS is 35mm.below H.P and 42mmin front to VP.
   v. PointT is in H.P and 30mm behindVP.
   vi. PointU is in V.P and 40mm.below HP.
   vii. PointV is in V.P and 35mm. aboveH.P.
   viii. PointWis in H.P and 48mm. in front ofVP.

2. Drawtheprojectionsofthefollowingpointsonthesame XYline,keepingconvenientdistancebetweeneach projectors.Name thequadrants in which theylie.
   i. PointA is 30 mm aboveHPand 35 mm in front ofVP.
   ii. PointB is 35mm aboveHP and 40 mm behindVP.
   iii. PointC is 40mmaboveHP and on VP.
   iv. PointD is 35 mm belowHPand 30 mm in front ofVP.

3. Drawtheprojectionsofthefollowingpointsonthesame XYline,keepingconvenientdistancebetweeneach projectors.Name theQuadrants in which they lie.
   i. PointE is 30 mm belowHP and 25 mm behind VP.
   ii. PointFis 35 mmbelow HP and 30mm in front of VP.
   iii. PointG is on HP and 30mm in frontof VP.
   iv. PointH is on HP and 35mm behind VP.

ProjectionofStraightLines

Introduction

Alinemaybedefinedasthelocusofapointmovingalongafixedpath.Alineconsistsofanumberof 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 incomputeraidedengineering graphics thelinehas length and thickness.

The position ofa straight line may have different orientations in space. As perfirst angleprojection, it may be parallel, perpendicular or inclined to either or both the Reference planes(horizontalor vertical planes) asmentioned in thebelowclassification.

Classificationof LinePositions

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

1. Lineparallel toboth thereferenceplanes (HP& VP)
   (a) Line awayfrombothHPandVP.
   (b) LineinHP andawayfromVP.
   (c) Linein VPandaboveHP.
   (d) Lineon both HP andVP.

2. Lineperpendicularto eitherofreferenceplanes(HP or VP)
   (a) LineperpendiculartoHPandawayfromVP.
   (b) Lineperpendicular to HPand on VP.
   (c) LineperpendiculartoVPand aboveHP.
   (d) Lineperpendicular to VPand on HP.

3. Lineinclinedto HPandparallel toVP
   (a) Lineinclinedto HP,parallelto VPandaway fromVP.
   (b) Lineinclined to HP,parallel to VPand in VP.

4. Lineinclinedto VPandparallel toHP
   (a) Lineinclinedto VP,parallelto HPandaway fromHP.
   (b) Lineinclined toVP,parallelto HP andin HP.

5. Lineinclined to both HP and VP
   (a) OneendoflineinHPand theotherendawayfromVP.
   (b) OneendoflineinVPand theotherendawayfromHP.

(c) Oneend aboveHP and the other end awayfrom VP.
(d) Oneend awayfromVPand theotherendaboveHP.
(e) Oneend in HP andVP and otherendaway from HP andVP.
(f) Bothends onHP andVP.

SystemofNotation

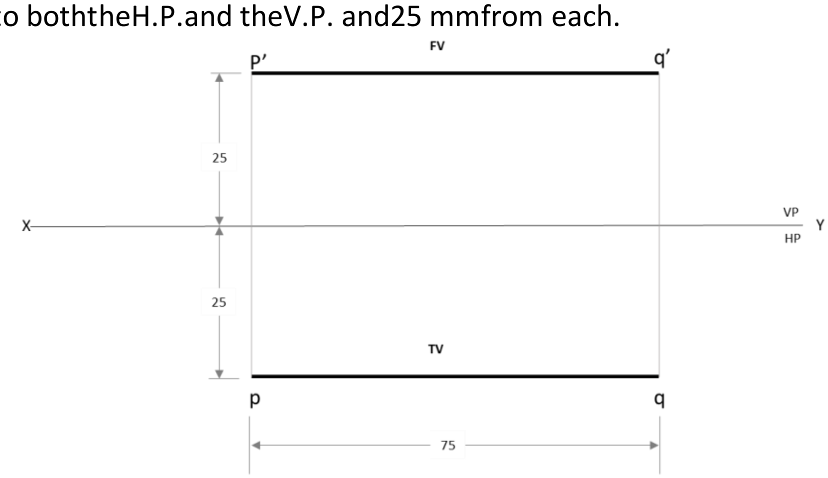
1. Theactual linein spaceis denotedby capital lettersAandB, orC andDetc.
2. Thefront view (FV)ofalineis denotedbytheircorresponding lower letterswith dashesasa'andb', c' and d'etc.
3. Thetopview(TV)ofalineisdenotedbytheircorrespondinglowercaseletterswithoutdashesasaan d b, cand d etc.
4. Thesideview(SV)ofalinearedenotedbytheircorrespondinglowercaseletterswithdoubledashes as a"and b", c" and d" etc.
5. Projectorsarealways drawnascontinuous thinlines.
6. Linewith specificthickness foraparticulartypeof line.

SolvedProblems

1. Drawtheprojectionsofa75mmlongstraightline,inthefollowing positions:

i. Parallelto boththeH.P.and theV.P. and25 mmfrom each.
ii. PerpendiculartotheH.P.,20mminfrontoftheV.P.anditsoneend15mmabovetheH.P.
iii. Inclinedat30°totheH.P.anditsoneend20mmaboveit;paralleltoand30mminfrontof theV.P.

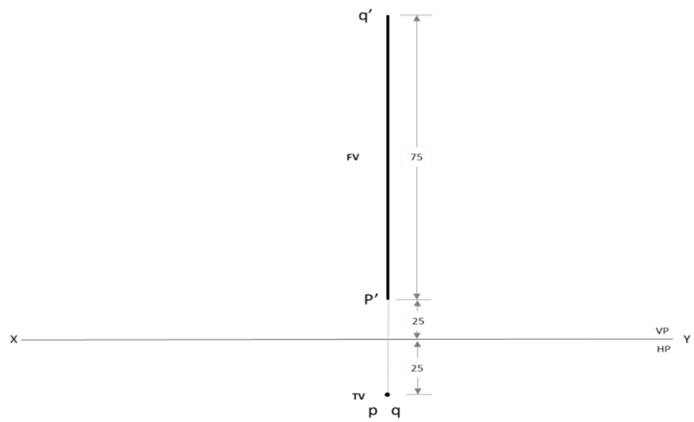
i. Parallelto boththeH.P.and theV.P. and25 mmfrom each.



Solution:

1. DrawXYline UsingXline Command.
2. Mark the annotations X, Y, VP, HP to the line drawn by using INSERT TEXTcommand from drafting tool bar. This must be done just by typing and inserting at therequiredpositions using the left click of the mouse.
3. According to question 75 mm line Parallel and 25 mm from HP put the Point25 mmfromaboveXY line by Using Point Command Name thePoint withp'
4. As per the problem, mark points p, q, p' and q' according to the dimensions given onbothsside ofXYline.
5. Draw a line of 75 mm that is parallel and above XY from point p' to q' by using Textcommand.
6. Draw another line of 75 mmparallel line and below XY from point p to q by usingTextcommand
7. MentiontheDimensionsbyusing **DIMLINEAR**Command.

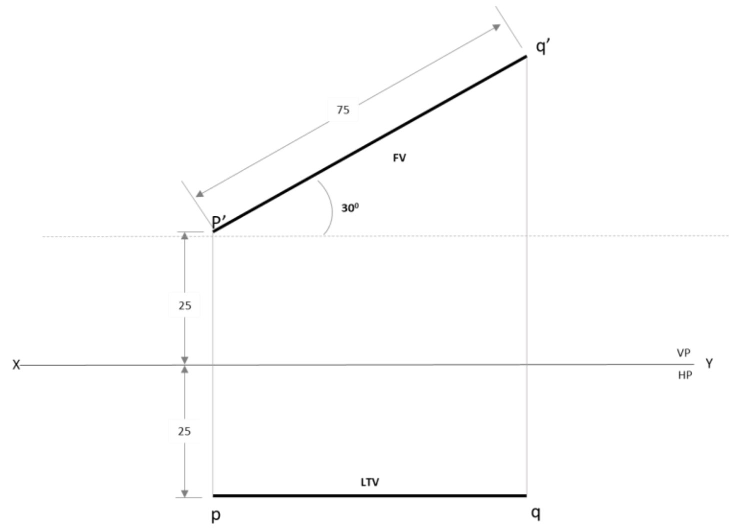
ii. PerpendiculartotheH.P.,20mminfrontoftheV.P.anditsoneend15mmabovetheH.P.



Solution:

1. DrawXYline ByUsingLine Command**L**andNamewithX,YattwoendsByUsingTextCommand
2. Accordingtoquestion75mmlineperpendiculartoHPand15mmaboveHP.putthePoint15 mmfrom aboveXYlinebyUsingPointCommand NamethePointwithp'
3. Line Paralleltoand25mminfrontofVPPutthepoint25mmbelowtheXYline byusingPoint Command. Name thePoint with p.
4. Draw75mmperpendicularlinefromp'.Nametheendpointq'byusingTextcommand
5. WhenlinePerpendiculartoHP&ParalleltoVPintopviewLineLikePointitstwoendpoints on thesame pointthen mention q on thesamepoint 25 below XY line
6. MentiontheDimensionsbyusing **DIMSTYLE** Command.

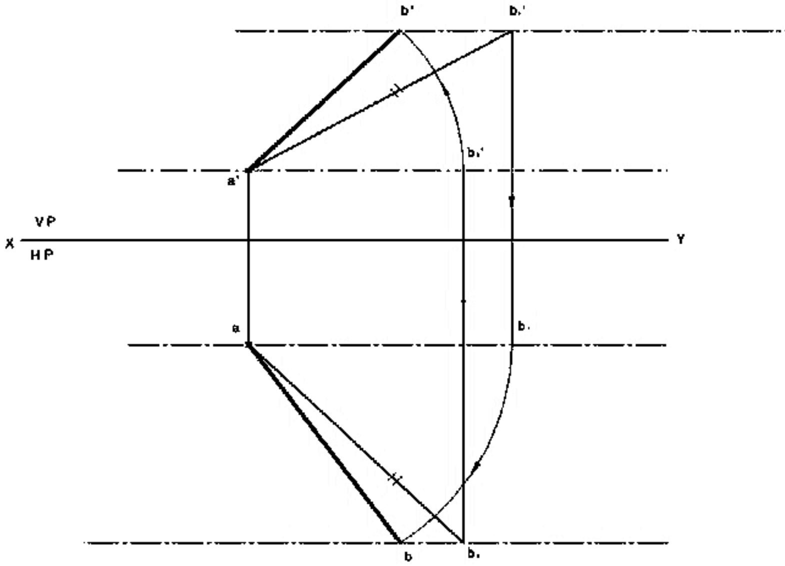
iii. Inclinedat 30°to theH.P.and itsoneend 20mm aboveit; parallel toand 30mm infrontoftheV.P.



Solution:

1. Draw XY line By Using Line Command **L** and Name with X,Y at two ends By UsingTextCommand
2. According to question 75 mm line30inclined and 20 mm above the H.P put the Point20mm from aboveXYlineby Using Point Command Name thePoint withp'
3. Line Parallel to and 30 mm in front of VP Put the point 30 mm below the XY line byusingPoint Command. Name thePoint with p.
4. Draw75mmlinenfromp'withinclinationof30.Nametheendpointq'byusingTextcommandName it F.V
5. When line Inclined to HP & Parallel to VP in top view Line will be reduced DrawPerpendicular line from q' to locus of p name the intersection point as q & Name thereducedlineas Length ofTop View(LTV).
6. MentiontheDimensionsbyusing **DIMLINEAR**Command.

2. AlineAB80mmlonghasitsendA20mmabovetheHPand30mminfrontofVP.Itisinclinedat 30°to HP and45°to VP.Draw theprojections of theline.



Solution:

1. DrawXYlineByUsingLineCommand**L**andNamewithX,YattwoendsByUsingTextCommand
2. Accordingtoquestion80mmline30$^{\theta}$inclinedand20mmabovetheH.PputthePoint20mmfrom aboveXYlinebyUsingPoint CommandName thePointwithp'
3. Draw80mmlinefromp'withinclinationof30$^{\theta}$.Nametheendpointq1'byusingTextcommand
4. Accordingtoquestion80mmline45$^{\theta}$inclinedand30mminfrontofV.PputthePoint30mmfrom aboveXYlineby UsingPoint Command Name thePoint with p
5. Draw80mmlinefrompwithinclinationof45$^{\theta}$.Nametheendpointq2byusingTextcommand
6. Drawperpendicularlinefromq1'tolocusofpnameitAsq1.DrawanotherPerpendicularlinefromq 2 to locus od p1 name theintersection point asq2'
7. Namep'q2'LineasLFV andNamepq1 line asLTV.
8. ForFinalfrontViewtakeP'ascenterp'q2'lineasradiusdrawarcwhichwillintersectLocusofP'at q' Joinp'q'LINE it asFFV
9. ForFinalTopViewtakePascenterp'q1'lineas radiusdrawarcwhichwillintersectLocusofP at qJoin p q lineitas FTV
10. MentiontheDimensionsby using **DIMLINEAR**Command.

PracticeProblems:

1. ThetopviewofalineAB,80mmlongmeasures65mmandthelengthofthefrontviewis50mm.Theend A is on HP and15 mm infront of VP. Draw theprojections
2. Line AB has its end A 20 mm above the HP and 15 mm infront of the VP. The other end B is60 mm above the HP and 45 mm in front of VP. The distance between end projectors is 70mm.Draw itsprojections. Determinethe apparentlengths andtrueinclinations.
3. A line has its end A 10 mm above HP and 15 mm in front of VP. The end B is 55 mm aboveHPand lineis inclined at30º toHP and 35ºto VP.Thedistancebetweentheend projectorsis50mm.Drawtheprojectionsoftheline.Determinethetruelengthofthelineanditsinclinationwith VP.
4. AlineCD60mmlonghasitsend‘C’inbothH.P.andV.P.Itisinclinedat30^{0}toH.P.and45^{0}toV.P. Draw theprojections.
5. ApointCis40mmbelowH.P.and20mmbehindV.P.anotherpointsDandEare60mmabove H.P. and in front V.P., 90mm below H.P. and 45mm in front of V.P. respectively. Draw theprojectionsof all points on samereferenceline.
6. TheendP ofastraight linePQ is20mmabovetheH.P.and30mminfromV.P.Theend Qis15mmbelowtheH.P.and45mmbehindtheV.P.IftheendProjectors are50mmapart,Drawthe Projection of PQ and determine the true length, traces and inclination with the referenceplanes.
7. The front view of line inclined at 30^0 to V.P. is 65mm long. Draw the projections of a line,whenit is parallelto and40mmaboveH.P. and oneend being 20mmin front ofV.P.
8. Line PQ has72mm length in the front view and 66mm length in the top view. The end P is48mm below HP and 40mm behind VP, while the end Q is 12mm below HP. Draw theprojection of the line, locate the traces and determine the true length and inclinations of thelinewith thereferenceplanes.

UNIT 3

PROJECTIONSOFPLANES&SOLI DS

ProjectionofPlanes

Introduction

A plane is a two-dimensional geometrical entity. It has length and width but no thickness. Forpractical purposes, a flat face of an object may be treated as a plane. A plane which has limitedextentis termed as alamina.

A planecan belocated by:

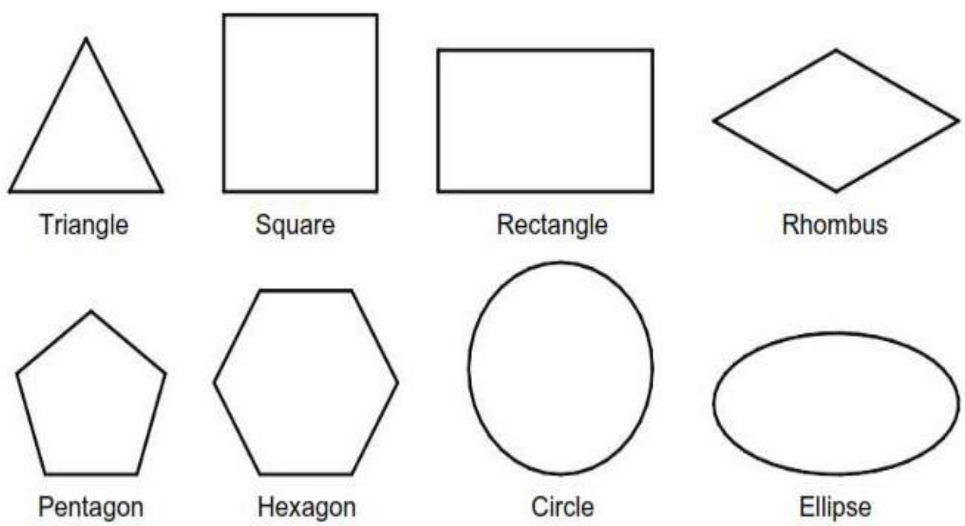
(i) Threenon-collinearpoints,

(ii) Astraight lineand apoint outside it,

(iii) Twoparallelorintersectingstraightlines,or

(iv) Tracesofthelines.

This chapter deals with the projections of laminas of pre-defined shapes, e.g., triangular plane,square plane, rectangular plane, pentagonal plane, hexagonal plane, circular plane, semicircularplane, etc. Sometimes, a given plane is composed of two or more planes mentioned above. Suchplanes are called composite planes, e.g., plane composed of a half hexagon and a semicircle,circularplanewith hexagonal hole, etc.



Planes

Positionsof Planes

1. Planeparallel andperpendicularto referenceplanes (HP& VP)
   - A. PlaneparalleltoHPand perpendiculartoVP.
   - B. PlaneparalleltoVPand perpendiculartoHP.
2. Planeperpendicularandinclinedto referenceplanes(HP&VP)
   - A. Planeperpendicular to HPand inclined toVP.
   - B. Planeperpendicular to VPand inclined toHP.
3. Planeperpendicular to both HP & VP.
4. Planeinclined to both HP & VP
   - A. InclinationtoHPand VPisnot equalto90°.
   - B. InclinationtoHPandVPisequalto90°.

TermsUsedin ProjectionsofPlanes

Thefollowingtermsmustbeunderstoodbeforeweproceedforthestep-by-stepprocedureofobtainingtheprojections of aplane.

TrueShape:Theactualshapeof aplaneiscalleditstrueshape.

InclinationwiththeRPs:TheinclinationofaplanewithanRPistheacuteangletheplanemakeswiththat RP.It is alwaysmeasured in aplaneperpendicularto thegivenplaneand theRP.

*Inclinationwith the HP(ϑ_p)*It isthe acute angletheplanemakeswith theHP.

*Inclinationwiththe VP(ϕ_p)*Itis theacuteangletheplanemakes withtheVP.

Traces of the Plane: Just like a line, a plane also has traces. The traces of a plane are the lines ofintersections of the plane with the RPs. A plane may have a horizontal trace or vertical trace orboth.

Horizontal Trace (HT) The real or imaginary line of intersection of a plane with the HP iscalledhorizontal traceoftheplane. HTis always locatedin the TV.

Vertical Trace (VT) The real or imaginary line of intersection of a plane with the VP iscalledvertical traceof theplane. VTis always located in the FV.

ItshouldbenotedthattheplanehasnotraceontheRPtowhichitisparallel.Forexample,aplaneparallel to the HP will have no HT. Similarly, a plane parallel to the VP will have no VT. HT andVTof aplane(producedif necessary)meet at apoint on the XY.

Perpendicular Planes: The planes perpendicular to one or both the RPs are called perpendicularplanes.Thefirstthreepositionsoftheplanesmentionedintheprevioussectionrepresentperpendicularplanes.

ObliquePlanes:TheplanesinclinedtoboththeRPsarecalledobliqueplanes.Thefourthpositionoftheplanes mentioned in theprevious section represents obliqueplanes.

LineVieworEdgeView:Theviewofaplaneseenasalineiscalledlinevieworedgeviewoftheplane.Oneviewofaperpendicularplaneisalwaysanedgeview.Theedgeviewalwaysrepresentsthe trace of the plane. For example, if a plane is perpendicular to the VP, then its FV will be anedgeviewrepresenting VToftheplane.Similarly,TVofaplaneperpendiculartotheHPWillbeanedgeview representing HT.

SystemofNotation

1. Theactual planein space is denotedby capitallettersA, B,C andD etc.
2. Thefrontview(FV)ofaplaneisdenotedbytheircorrespondinglower-caseletterswithdashesas a', b',c' and d'etc.
3. Thetop view (TV)ofaplaneis denotedbytheircorresponding lower-caseletters withoutdashesas a, b,cand detc.
4. Thesideview(SV)ofaplanearedenotedbytheircorrespondinglower-caseletterswithdoubledashesasa”, b", c"and d" etc.
5. Projectorsarealwaysdrawnascontinuousthinlines.
6. Linewith specificthickness foraparticulartypeof line.

In Computer Aided Engineering Graphics for projection of plane following commands are usedother than evoking software, opening file, saving file and giving print command. Using theseminimum12commands anytype ofprojection ofline problem canbesolvedthey areas follows:

1. SelecttoolCommand.
2. Pointcommand.
3. Poly-Linecommand.
4. TwoPointLinecommand.
5. Parallellinecommand.
6. CenterCirclecommand
7. Bisectorcommand.

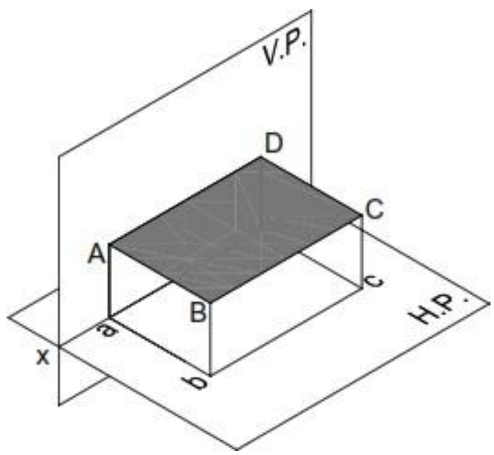
8. SmartDimensioncommand.
9. LineWidthcommand.
10. InsertTextcommand.
11. MoveCopycommand.
12. Rectanglecommand.

Planeparallelandperpendiculartoreferenceplanes(HP&VP)

IfthegivenplaneisparalleltoanRP,itremainsperpendiculartotheother RP.Insuch acase,theviewoftheplaneontheRPtowhichitis parallelgives thetrueshape. Anotherview isalwaysanedgeviewparallel to XY.

PlaneparalleltoHPandperpendiculartoVP.

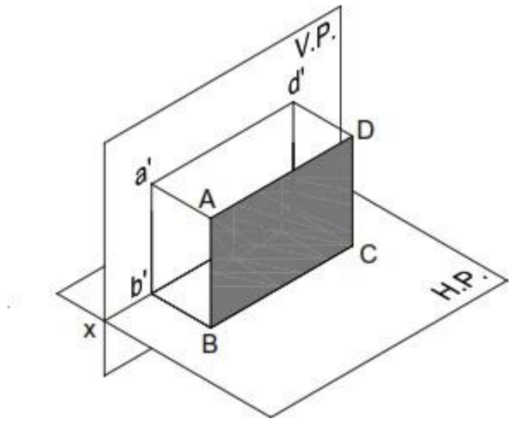
If a plane is parallel to the HP, its TV gives the true shape. Therefore, TV should be drawn first.FVwillbeanedge viewparallel to XY. SV will be perpendicularto XY.



Planeparallelto HPand perpendicular to VP.

PlaneparalleltoVPand perpendiculartoHP.

If a plane is parallel to the VP, its FV gives the true shape. Therefore, FV should be drawn first.TV willbe anedge viewparallel to XY. SV will be perpendicularto XY.



Planeparallelto VPand perpendicular to HP.

PlaneInclinedtooneRPandPerpendiculartotheotherRP

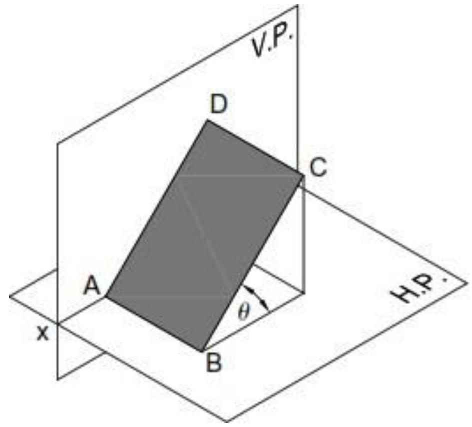
If a plane is inclined to one RP and perpendicular to the other RP, none of its views will give thetrue shape. The view on the RP to which the plane is inclined will be smaller than the actual sizeof the plane. The view on the RP to which the plane is perpendicular will be a line view. Suchproblems can be solved in two stages. In the first stage, the given plane is assumed to be parallelto the RP to which it is finally inclined. The true shape can thus be obtained in one view. In thesecond stage, another view (which is an edge view parallel to XY) is tilted so as to make desiredinclinationwith the first RP.

PlaneInclinedtotheHPandPerpendiculartotheVP

When the surface of the plane is inclined at θ to the H.P. and perpendicular to the V.P., theprojections are obtained in two stages. In the first stage, the plane is assumed to lie on the H.P.The true shape of the plane is viewed in the top view and a straight line lying on xy in the frontview. In the second stage, the plane is tilted at θ to the H.P. The front view is redrawn inclined atθ to the xy. The final top view is obtained by joining the points of intersection of the verticalprojectorsofthecornersfromthefrontviewwiththehorizontalprojectorsofthecornersfromthet opview ofthe precedingstage.

Note 1If the plane has a side on the H.P. (or parallel to the H.P. or on the ground), then keep anedgeof theplaneperpendicular to xy in thetop view ofthe first stage.

Note 2 If the plane has a corner in the H.P. (or on the ground), then keep the line joining a cornerandthe centreof theplaneparallel to xy.



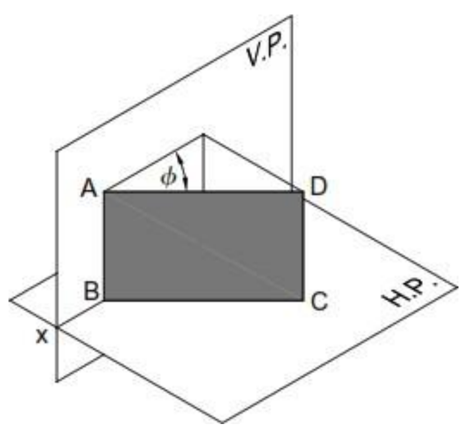
PlaneInclined totheHPand Perpendicularto theVP

PlaneInclinedtotheVPandPerpendiculartotheHP

When the surface of the plane is inclined at ϕ to the V.P. and perpendicular to the H.P., theprojections are obtained in two stages. In the first stage, the plane is assumed to lie on the V.P.The true shape of the plane is viewed in the front view and a straight line lying on xy in the topview. In the second stage, the plane is tilted at ϕ to the V.P. The top view is redrawn inclined at ϕto the xy. The final front view is obtained by joining the points of intersection of the verticalprojectors of the corners from the top view with the horizontal projectors of the corners from thefrontview ofthe preceding stage.

Note 1If the plane has a side on the V.P. (or parallel to the V.P. or on the ground), then keep anedgeof theplaneperpendicular to xy in thefrontviewof thefirststage.

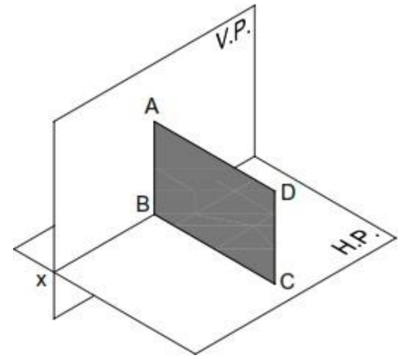
Note 2 If the plane has a corner in the V.P. (or on the ground), then keep the line joining a cornerandthe centreof theplaneparallel toxy in thefront view ofthefirst stage.



PlaneInclinedtotheVPandPerpendiculartotheHP

Planeperpendicularto bothHP &VP.

If a plane is perpendicular to both the RPs, then its FV and TV both will be seen as edge viewsperpendicular to XY. Such a plane is parallel to the PP and hence its true shape is seen in SV.Therefore,for such problems, it is advisableto draw SVfirst.

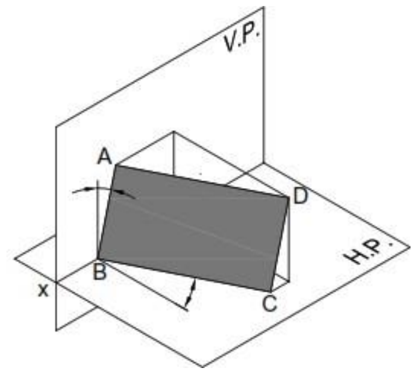


PlanePerpendiculartobothHP&VP

PlaneinclinedtobothHP&VP.

AplaneinclinedtoboththeRPsiscalledan*obliqueplane.*Noneoftheviewsoftheobliqueplanegives the true shape. It should be noted that the angles made by the oblique plane with the RPs(i.e., θ and ϕ) might not be directly given in the problem. Often, either of the inclinations, θ or ϕ,is given along with some other condition(s) that automatically pose the restriction on the otherinclination.

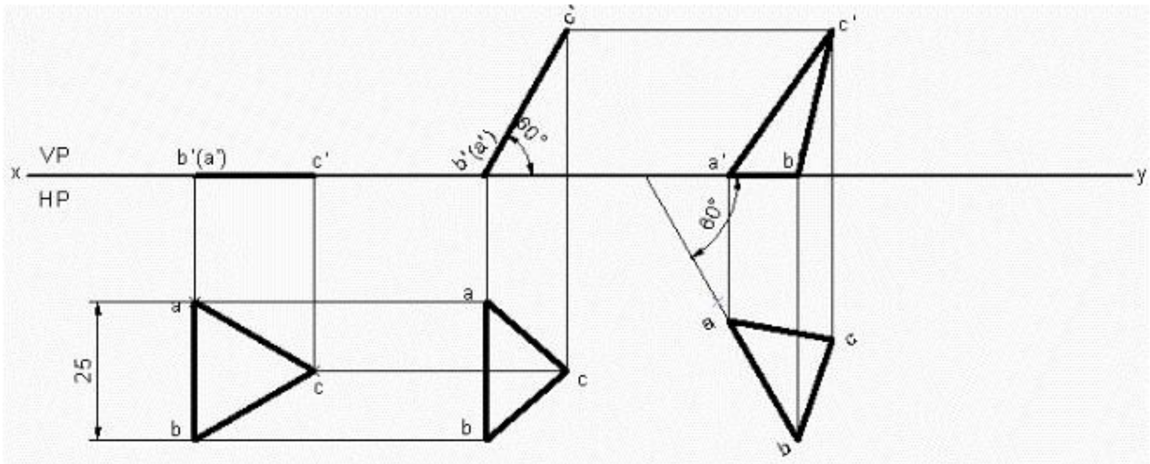
The problems on oblique planes are solved in three stages. In the first stage, the plane is oftenassumed to be parallel to one of the RPs so that the true shape can be obtained in one view. In thesecondstage,thegivenanglebetweentheplaneandtheRP(i.e.,eithertheHPortheVP)orsomeother condition mentioned in the problem is established. In the third stage, all other remainingconditionsaresatisfied.



PlaneInclined tobothHP&VP

SolvedProblems

1.An equilateral triangular lamina of 25 mm side lies with one of its edges on HP such that thesurface of the lamina is inclined to HP at 60º. The edge on which it rests is inclined to VP at60º.Draw theprojections.

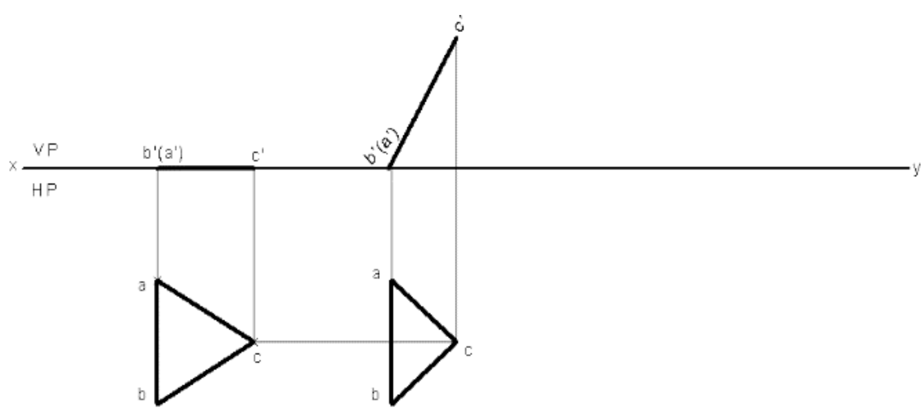


Solution

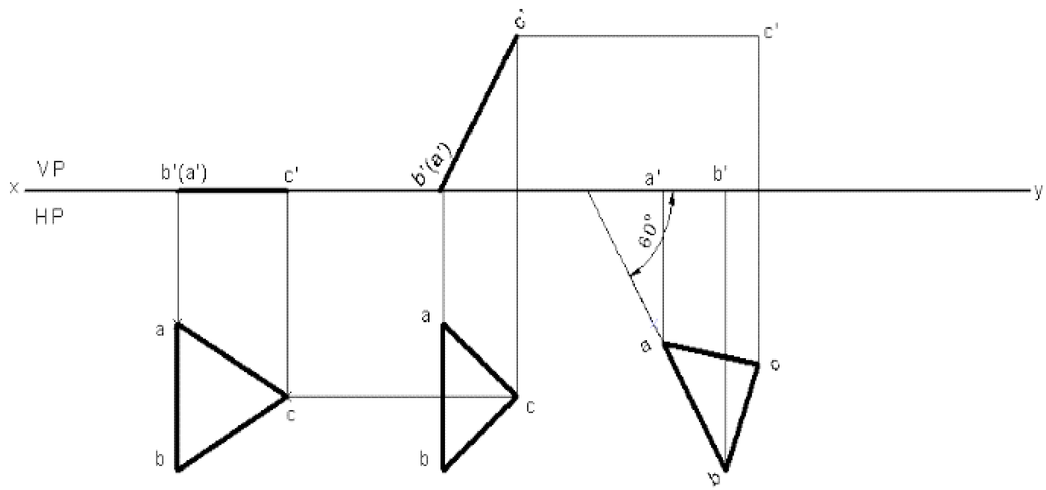
1. OpentheSoftware.ClickontheApplicationMenuandclickonNewandselect“acad“intheopendia log box and click Open.
2. Enterthecommand“UNITS“in commandbarandSelectunitsas“Millimetersand clickok.
3. Enterthecommand“LIMITS“incommandbarandenter0,0clickenterandenterupperrightcorner as 120,90 andclick enter
4. Enterthecommand“ZOOM“incommandbar andenterAandclickenter
5. Draw a XY line by using line command. Mark VP and HP above and below it by using“XTEXT” command in command bar
6. Aspertheproblem equilateraltriangularlaminaof25mmhastobedrawninHP,hencedrawaverticallineof25mmusin gPOLYLINEcommandandinformatselectVLandenterlengthas25andangleas–90inminidialogbox.MarkannotationsaandbusingXTEXTCommandasshown below.

7. Draw an arc of radius of 25 from a and b to cut each other at c using CENTER CIRCLEcommand in drafting tool bar and in format select PL. In mode option select arc. Join abc togettriangularlamina of25 mm usingPOLYLINEcommand
8. Draw front view of the triangular lamina using POLYLINE command and in format selectVL,mark annotations as(a')b' andc'as shown below.

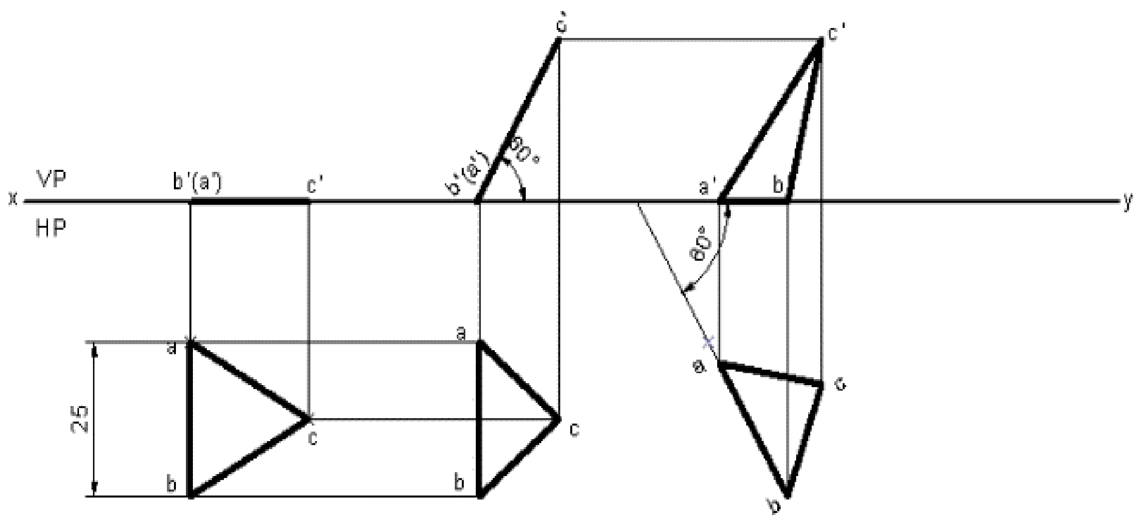
9. Sincethelaminaisinclinedat60°toHP.ByusingPOLYLINEcommandandinformatselectVL enter length equal to length of first stage front view and angle as 60 in mini dialog box,markannotations as (a')b' and c' using XTEXT Command
10. Drawverticalprojectorsdownwardsfromthesecondfrontviewusing POLYLINEcommandand in format select PL. Draw horizontal projectors from top view to intersect verticalprojectorsat a, b and cwhich formsthe second stagetop view as shownbelow.



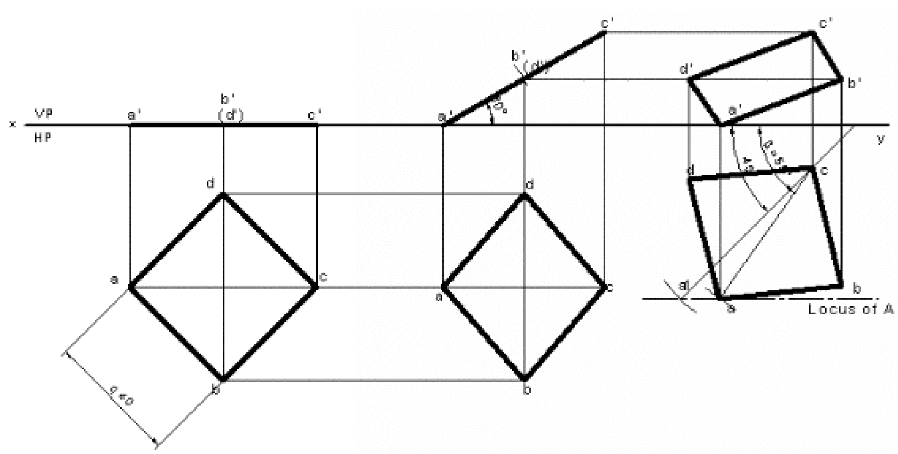
11. Since the edge on which it rests is inclined to VP to 60° Draw a line of 60° in HP usingPOLYLINEcommandandinformatselectPL.FromeditmenuselectMOVECOPYcommandan dthenselectsecondstagetopview.Inselectiontreerightclickonthestartpointand click reset to select the start point anywhere on the edge of lamina to shift on to 60° linedrawn. Click and drag the lamina on 60° line. Click or drag to rotate and enter angle as 30 inminidialog box and click on OK
12. Drawtheverticalprojectionupwardsfromallthecornersoftriangularlaminafromthirdstagetop view using POLYLINE command and in format select PL. Again, draw horizontalprojectorsfrom secondstagefrontview tointersect verticalprojectors ata'b'and c'.



13. Joina'b'andc' usingPOLYLINECommand
14. Using DIMENSION Command in Annotation tool bar or Enter DIM command in commandbardimension the drawing



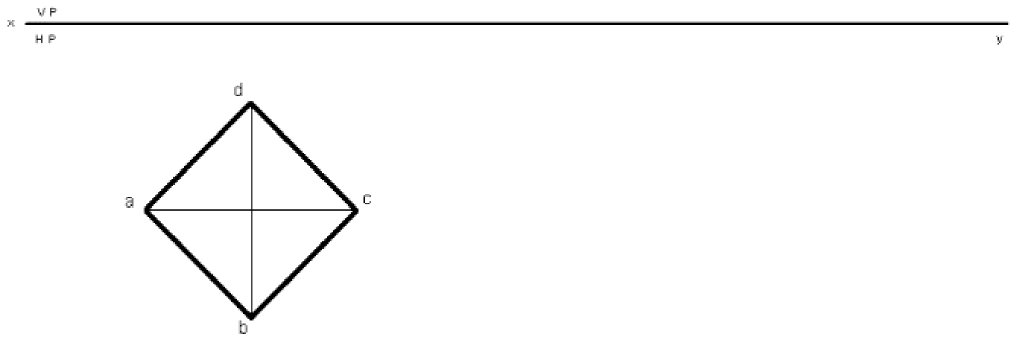
2.Asquareplateof40mmsiderestsonHPsuchthatoneofthediagonalsisinclinedat30ºtoHPand 45º to VP. Drawits projections.



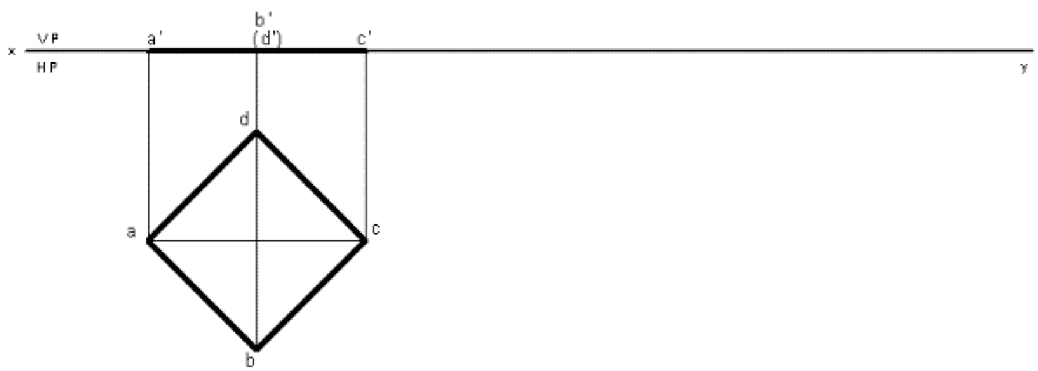
Solution

1. Open the Software. Click on the Application Menu and click on New and select “acad “in theopendialog box and click Open.
2. Enterthecommand“UNITS“in commandbarandSelectunitsas“Millimetersand clickok.
3. Enterthecommand“LIMITS“incommandbarand enter0,0clickenterandenterupperrightcorner as 100,100 andclick enter
4. Enterthecommand“ZOOM“incommandbar andenterAandclickenter

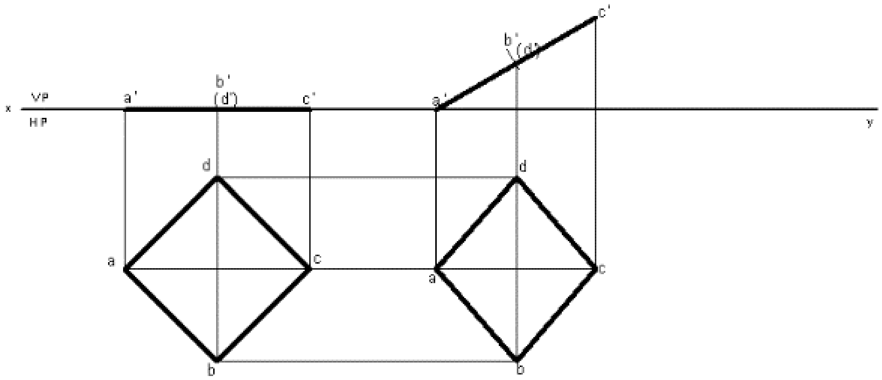
5. Draw a XY line by using line command. Mark VP and HP above and below it by using"XTEXT" command in commandbar.
6. As per the problem a square lamina of 40 mm has to be drawn in HP, hence draw a square of40 mm using RECTANGLE command Now enter X size = 40, Y size = 40 and angle as 45 inminidialog box. Mark annotations abcand d using XTEXT Command asshown below.



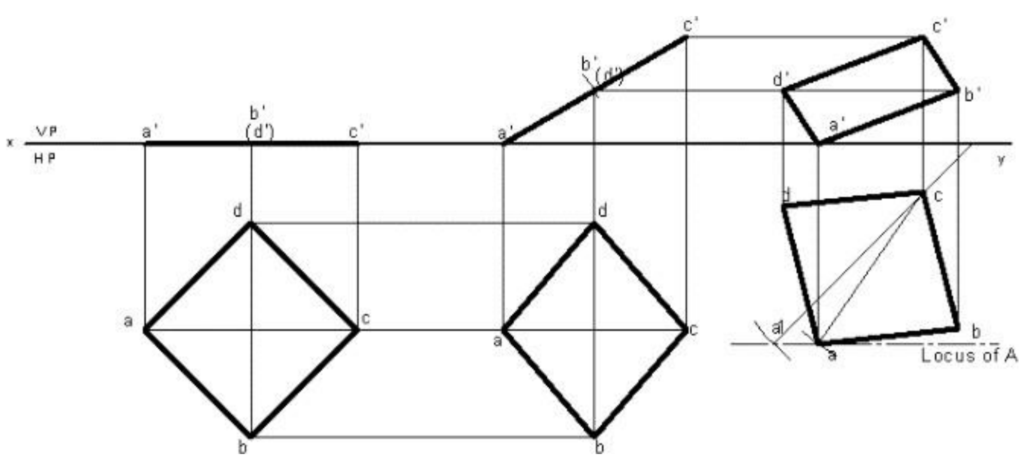
7. Drawtheverticalprojectionupwardsfromallthecorners ofsquarelamina intopviewuntilittouchesXYline, usingPOLYLINEcommand andinformat select PL.
8. DrawfrontviewofthetriangularlaminausingPOLYLINEcommandandinformatselectVL,markannotations as a' b'c' and (d')as shownbelow.



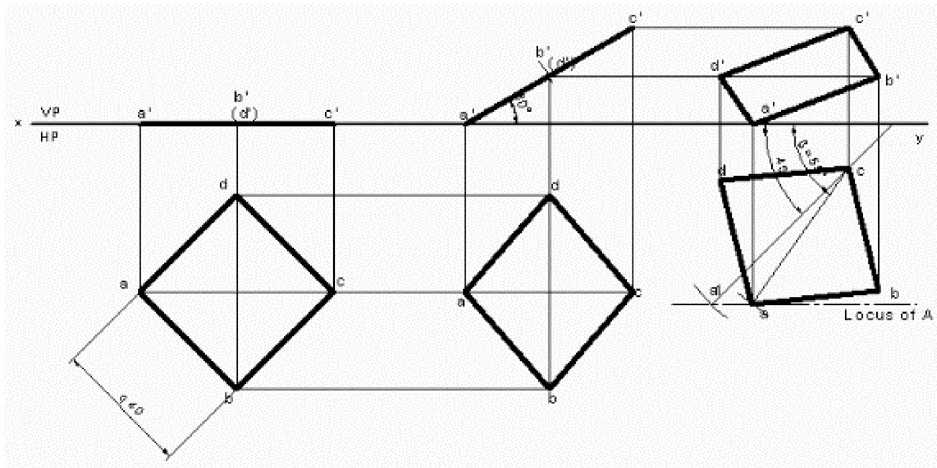
9. Since the diagonal of lamina is inclined at 30° to HP. By using POLYLINE command and informat select VL enter length equal to length of first stage front view and angle as 30 in minidialogbox, mark annotations as a'b' (d')andc' using XTEXTcommand
10. Draw vertical projectors downwards from the second front view using POLYLINE commandand in format select PL. Draw horizontal projectors from top view to intersect verticalprojectorsat a, bcand dwhich formsthesecond stagetop viewas shown below.



11. Since the diagonal of lamina is inclined to VP at 45°. Draw a line of 45° in HP usingPOLYLINEcommandandinformatselectPL.Drawanarcofradiusequaltodiagonallengthof lamina from first stage top view to cut on 45° line drawn. Draw a locus from point a1, nowwith radius equal to diagonal length of lamina from second stage top view to cut on the locus.Join ac to get the diagonal of third stage top view. From edit menu select MOVE commandand then select second stage top view. In selection tree right click on the start point and clickreset to select the start point anywhere on the diagonal of lamina to shift on to new diagonalline drawn. Click and drag the lamina on new diagonal line. Click or drag to rotate and enterangleso asto matchbothdiagonalsand clickon OK.Mark annotationsasa b cand d.
12. Draw the vertical projection upwards from all the corners of square lamina from third stagetopviewusing POLYLINEcommandandinformatselectPL.Again,drawhorizontalprojectorsfromsecond stagefront viewto intersectvertical projectorsat a' b' c'andd'.
13. Joina'b' c'andd' usingLINECommand andinformat selectVL.



14. UsingDIMENSIONCommandinAnnotationtoolbarorEnterDIMcommandincommandbardimension the drawing



PracticeProblems

1. ASquareplanewitha40mmsidehasitssurfaceparalleltoand20mmabovetheHP.DrawitsProjections, when
   A. Asideisparallel toVP
   B. Aside is inclined at $30^0$to VP and
   C. All sides areequally inclined to VP.
2. AHexagonalplanewitha30mmsidehasitssurfaceparalleltoand20mminfrontoftheVP.Drawits Projections, when
   A. Asideis perpendicular to HP
   B. Asideis parallelto the HP
   C. Sideis inclinedat 450to theHP
3. A Pentagonal plane with a 30 mm side has an edge on the HP, the surface of the Plane isinclinedat 450 to the HP. Drawit's Projections?
4. AHexagonalplatewitha 30mmsideandnegligiblethicknesshasitssurfacePerpendiculartotheHPandinclinedat450tothe VP.DrawitsProjections?WhenoneofitssidesofthePlaneisParallel to and 15 mm Infront of theVP

5. A Circular plane with a 60 mm Diameter is resting on a point it's circumference on the VP.Thecenteris40mmabovetheHP,andthesurfaceisinclinedat450totheVP.andperpendicularto theHPDrawIts Projections?
6. Rectangle30mmand50mmsidesisrestingonHPononeofitssmallsidewhichis300inclinedtoVP,while thesurfaceoftheplanemakes 45^0 inclination withHP.Draw it'sprojections?
7. A regular pentagon of 30 mm sides is resting on HP, on one of its sides with its surface 45^0inclinedtoHP.Drawit'sprojectionswhenthe sidein HPmakes30^0anglewithVP?
8. Acircleof50mmdiameterisrestingonHPonendAofitsdiameterACwhichis30^0inclinedtoHP whileit's TVis 45^0inclinedto VP. Draw its Projections?
9. A semicircle of 100mm diameter is suspended from a point on its straight edge 30mm fromthe midpoint of that edge so that the surface makes an angle of 450 with VP. Draw itsprojections.
10. A pentagon of sides 30mm rests on the ground on one of its corners with the sides containingthe corners being equally inclined to the ground. The side opposite to the corner on which itrests is inclined at30degrees to the VP and is parallel to the HP. The surface of the pentagonmakes10degrees with theground. Drawthetop and front viewsofthe pentagon.
11. A regular pentagon of 30mm side is resting on one of its edges on HP which is inclined at 45degreesto VP.Its surfaceis inclined at30degreestoHP. Draw itsprojections.
12. Draw the projections of a regular hexagon of 25mm side, having one of its sides in the H.P.andinclined at60degreestotheV.Pand itssurfacemakingan angleof 45degreeswithH.P.
13. A thin circular plate of 40mm diameter having its plane vertical and inclined at 40 to V.P. Itscenteris30mm above H.P. and 35mm infront of V.P. Drawtheprojections.

ProjectionsofSolids

Introduction

Anyobjecthavingdefinitelength,widthandheightiscalledasolid.Inengineeringdrawing,solidsare often represented by two or more orthographic views, i.e., FV, TV or SV. The study of theprojectionsofasolidisveryimportantinmechanical-designproblems.Theknowledgeofprojections of solids is essential in 3D modeling and animation. Projections of solids find wideapplicationsin the construction industry.

Basic Solids

Basic solids are those which have predefined shapes. The basic solids are the constituent parts ofany complex solid. Objects in the real world are made up of combinations of basic solids. In 3Dmodeling, the basic solids are called solid primitives. Solid primitives are combined in logicalwaysto obtain the desired 3D shape.

SystemofNotation

7. Theactual planein spaceis denotedbycapital lettersA, B,C andD etc.
8. Thefrontview(FV)ofaplaneisdenotedbytheircorrespondinglower-caseletterswithdashesasa', b', c'and d' etc.
9. Thetopview(TV)ofaplaneisdenotedbytheircorrespondinglower-caseletterswithoutdashesas a, b,cand detc.
10. Thesideview(SV)ofaplanearedenotedbytheircorrespondinglower-caseletterswithdoubledashesasa”, b", c"and d" etc.
11. Projectorsarealwaysdrawn ascontinuousthinlines.
12. Linewith specificthicknessforaparticulartypeof line.

In Computer Aided Engineering Graphics for projection of solids following commands are usedother than evoking software, opening file, saving file and giving print command. Using theseminimum 13 commandsany typeofprojectionoflineproblemcan besolved theyareas follows:

1. SelecttoolCommand.
2. Pointcommand.
3. Poly-Linecommand.
4. TwoPointLinecommand.
5. Parallellinecommand.
6. CenterCirclecommand
7. Bisectorcommand.
8. SmartDimensioncommand.
9. LineWidthcommand.
10. InsertTextcommand.
11. MoveCopycommand.
12. Rectanglecommand.
13. SmartDeleteCommand

Classificationof solids

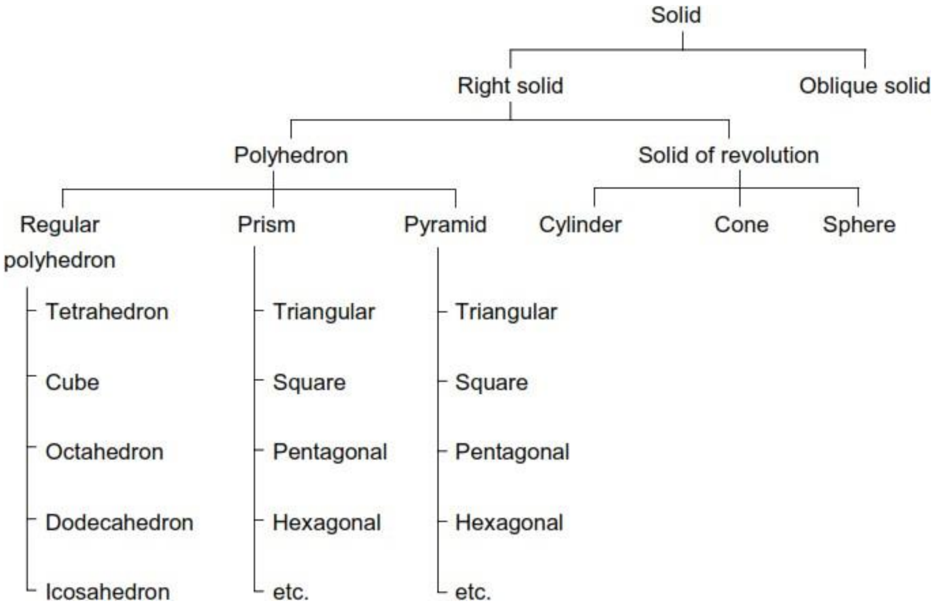
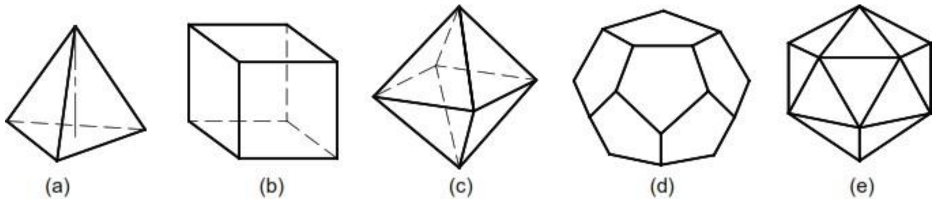


Figure3.1 ClassificationofRegularSolids

Polyhedron

Apolyhedronisasolidboundedbyplanescalledfaces,whichmeetinstraightlinescallededges.A regularpolyhedron hasall the facesequal andregular asshown inFig.3.2.

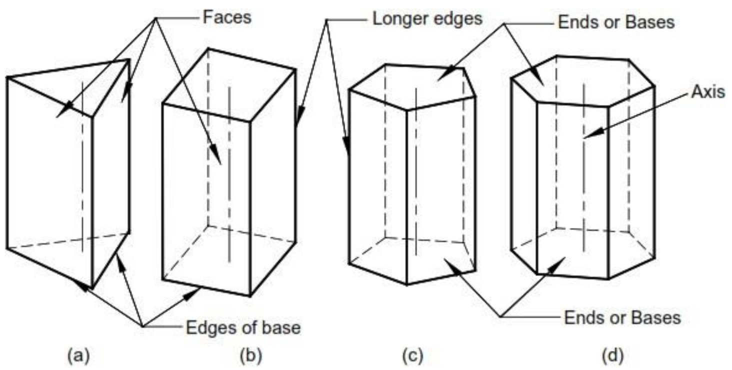


(a) *Tetrahedron* **(b)** *Cube* **(c)** *Octahedron* **(d)** *Dodecahedron* **(e)** *Icosahedron*

Figure3.2 RegularPolyhedron

Prism

A prism is a polyhedron with two n-sided polygonal bases which are parallel and congruent,and lateral faces are rectangles. All cross-sections parallel to the bases are congruent with thebases.Animaginarylinethatjoinsthecentreofthebasesiscalledanaxis.Arightandregularprism has regular polygonal bases, axis perpendicular to the bases and all the faces are equalrectangles, as shown in Fig.3.3. Prisms are named according to the shape of their base, so aprism with a triangular base is called a triangular prism; a square base is called a square prismand soon.



: **(a)** *Triangular* **(b)** *Square* **(c)** *Pentagonal* **(d)** *Hexagonal*

Figure3.3 Prisms

Pyramid

A pyramid is a polyhedron with n-sided polygonal base and lateral faces are triangles meetingatapointcalledthevertexorapex.

Animaginarylinethatjoinstheapexwiththecentreofthebase is known as the axis. A right and regular pyramid has a regular polygon base, axisperpendicular to the base and all the faces are equal isosceles triangles, as shown in Fig. 3.4.Pyramids are named according to the shape of their base, so a pyramid with a triangular baseis called a triangular pyramid; a square base is called a square pyramid and so on. The centreofgravity of pyramids lieson theaxis atone-fourth ofits height fromthebase.

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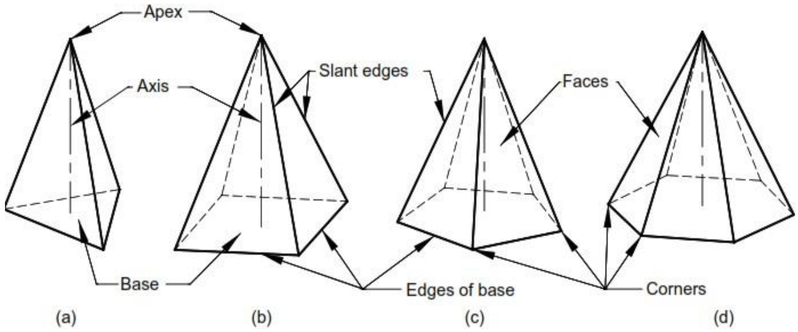


: **(a)** *Triangular* **(b)** *Square* **(c)** *Pentagonal* **(d)** *Hexagonal*

Figure3.4 Pyramids

SolidofRevolution

These solids are obtained by revolving a plane figure like rectangle, triangle or a semi-circleabouta fixed line.

Cylinder: A cylinder is a solid of revolution obtained by revolving a rectangle about one of itsfixed side called an axis. It can be imagined as a prism of infinite number of lateral faces. Anyline on the surface of a cylinder is called its generator. Thus, a cylinder has an infinite numberof generators. A right cylinder has all the generators and the axis perpendicular to the base, asshownin Fig. 3.5(a).

Cone:Aconeisobtainedbyrevolvingatriangleaboutitsfixedsidecalledanaxis.Aconecanbeimagined asapyramidwithinfinitenumberoflateralfaces.Anylineonthesurfaceofaconeiscalleditsgenerator.Thus,aconehasaninfinitenumberofgenerators.Arightconehasall generators of equal length and the axis perpendicular to the base, as shown in Fig. 3.5(b).***Sphere:***A sphereis obtainedby revolvingasemi-circlearounditsdiameter, asshown inFig

ObliqueSolid

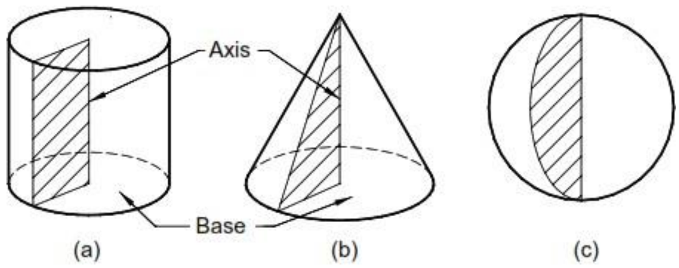
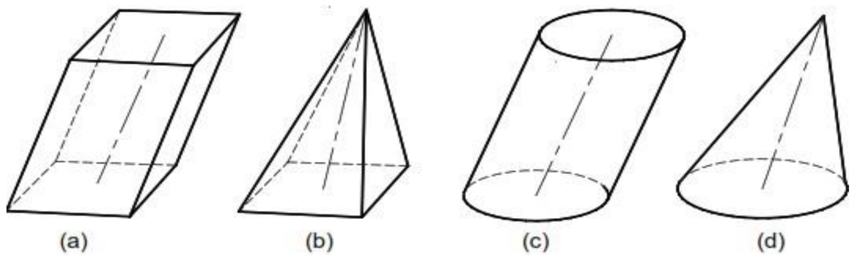


Figure3.5 SolidsofRevolution

An oblique solid such as oblique prism, pyramid, cylinder or cone has its axis inclined to itsbase as shown in Fig.3.6. The faces of an oblique prism are parallelograms of different sizes.The faces of an oblique pyramid are triangles of different sizes. The generators in an obliquecylinderhaveequal lengthswhereas thosein anobliqueconehaveunequallengths.

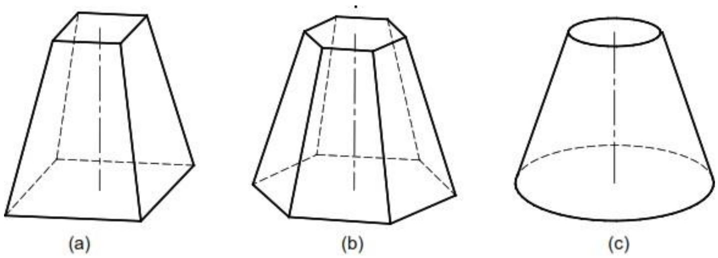


(a) *Square prism* **(b)** *Square pyramid* **(c)** *Cylinder* **(d)** *Cone*

Figure3.6 ObliqueSolids

FrustumofPyramidandCone

When a regular pyramid or a cone is cut by a plane parallel to its base and the portion of thesolid containing apex is removed, the remaining portion of the solid is called the frustum ofthatpyramid or cone,asshown in Fig.3.7.



(a) *Square pyramid* **(b)** *Hexagonal pyramid* **(c)** *Cone*

Figure3.7 Frustums

RecommendedMethodofLabelling

Itisrecommended tolabel thecorners ofthesolids ina manneras shownin Fig.3.8.

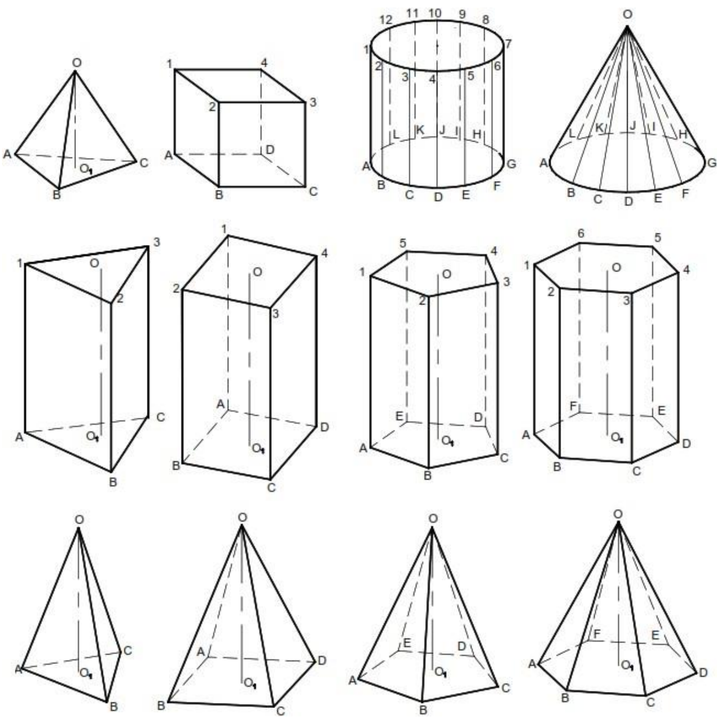


Figure3.8 MethodofLabelling

Positionsof Solids

The position of a solid in space is specified by the inclinations of its axis with the RPs.Therefore, a solid will have positions with respect to RPs same as that of a line. Depending ontheorientation ofits axisin space, asolid mayhavethe following positions:

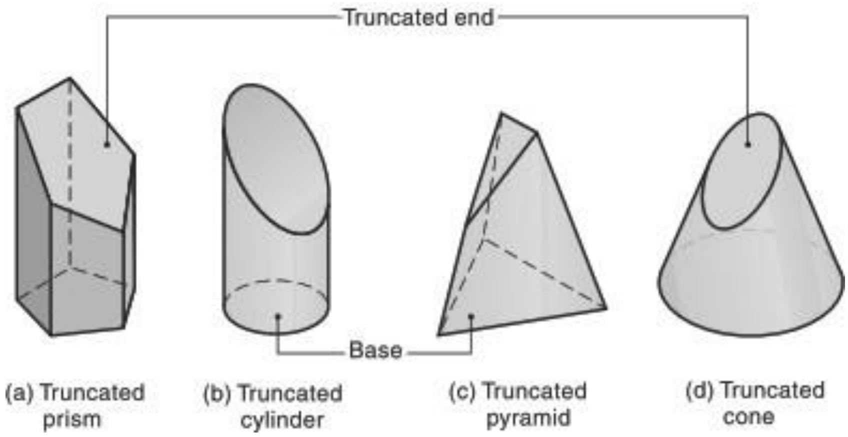


Figure3.9 TruncatedSolids

Thesolid may bein oneof thefollowing positions:

1. Axisperpendicularto the H.P.
2. Axisperpendicularto the V.P.
3. Axisparallelto boththe H.P. andtheV.P.(i.e.,perpendicular totheprofile plane)
4. AxisinclinedtotheH.P.andparalleltotheV.P.
5. AxisinclinedtotheV.P.andparalleltotheH.P.
6. Axisinclined toboth theH.P. andthe V.P.

AxisPerpendiculartoH.P.

This is one of the basic positions of the solid. It is evident that if the axis of a right solid isperpendicular to the H.P., its base will be parallel to the H.P. The true shape and size of thebase can be viewed in the top view. Therefore, first obtain the top view of the solid and thenprojectit to obtain the front view.

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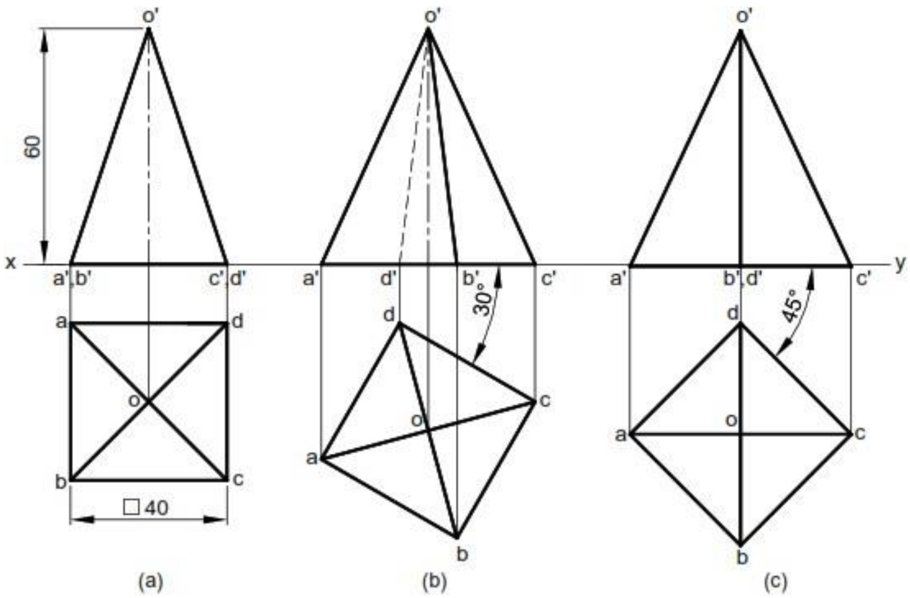


Figure3.10 AxisPerpendiculartoH.P.

AxisPerpendiculartoV.P.

This is one of the basic positions of the solid. It is evident that if the axis of a right solid isperpendicular to the V.P., its base will be parallel to the V.P. The true shape and size of thebasecanbeviewedinthefrontview.Therefore,firstobtainthefrontviewofthesolidandthenproject it to obtain the topview.

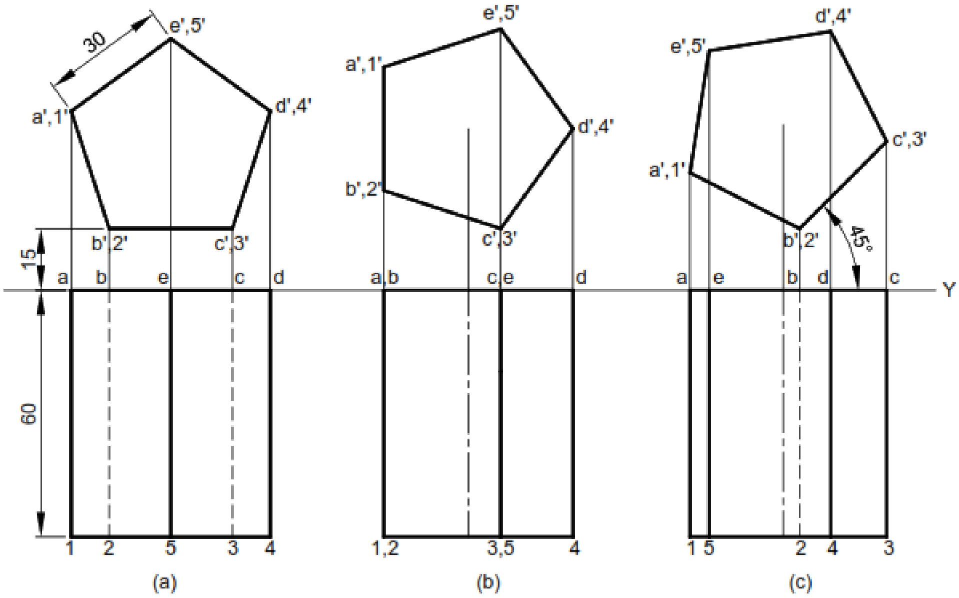


Figure3.11 AxisPerpendiculartoV.P.

AxisParallel to bothH.P. and V.P.

Itisevidentthatiftheaxisofrightsolidsisparalleltobothh.P.andV.P.,thebaseofthesolidwillbeperpendiculartothereferenceplanesandparalleltotheprofileplane.Thetrueshape andsizeofthebase canbeviewedinthesideview.Therefore, firstobtainthesideviewofthesolidand then project it to obtain the frontand thetop views.

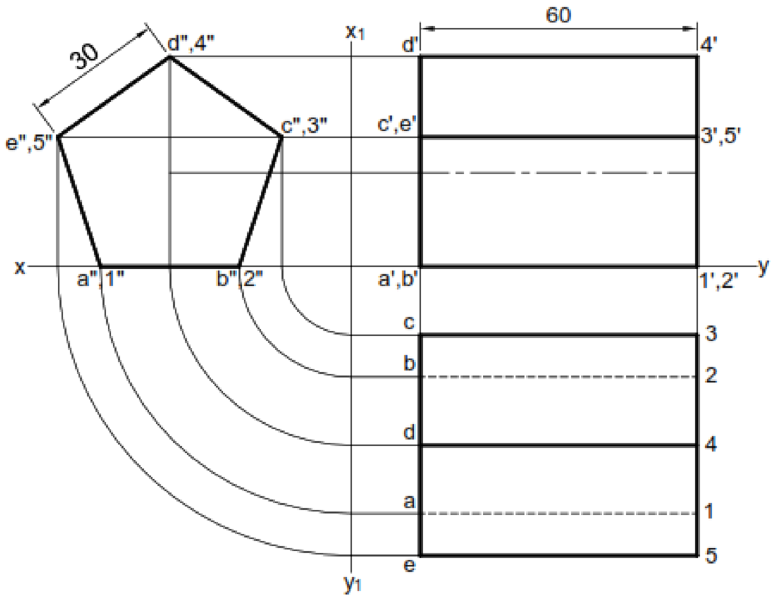
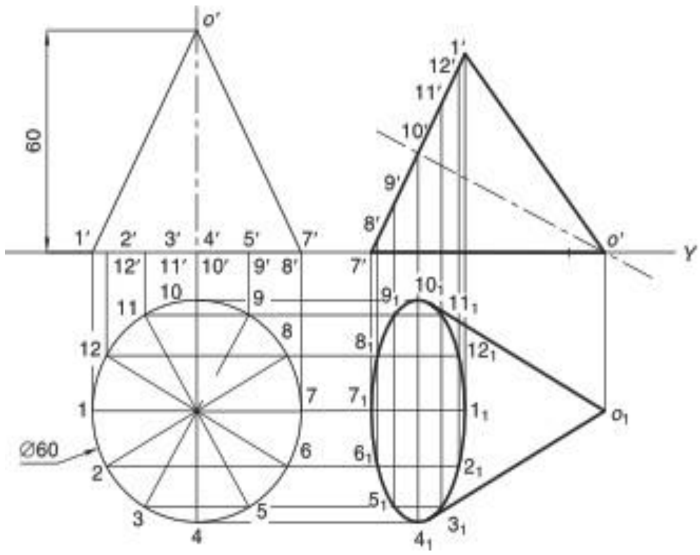


Figure3.12 AxisParallel to both H.PandV.P.

AxisinclinedtotheR.P.andparallel totheR.P.

IftheaxisofasolidisinclinedtooneRPandparalleltotheotherRPthentheproblemissolvedintwostages.Inthefirststage,theaxisisassumedtobeperpendiculartotheRPtowhichitisfinally inclined. The view obtained on that RP will give the true shape of the base. Thecorresponding other view will give the TL of the axis. In the second stage, the other view isredrawnin such awaythat theaxis willmaketherequiredanglewith the givenRP.

Here,itshouldbenotedthattheinclinationoftheaxiswithaparticularRP mightnotbegivendirectly.Instead,it maybeexpressed interms ofotherparameters,asmentioned



earlier.

Figure3.13 Axisinclined totheH.P.andparalleltotheV.P.

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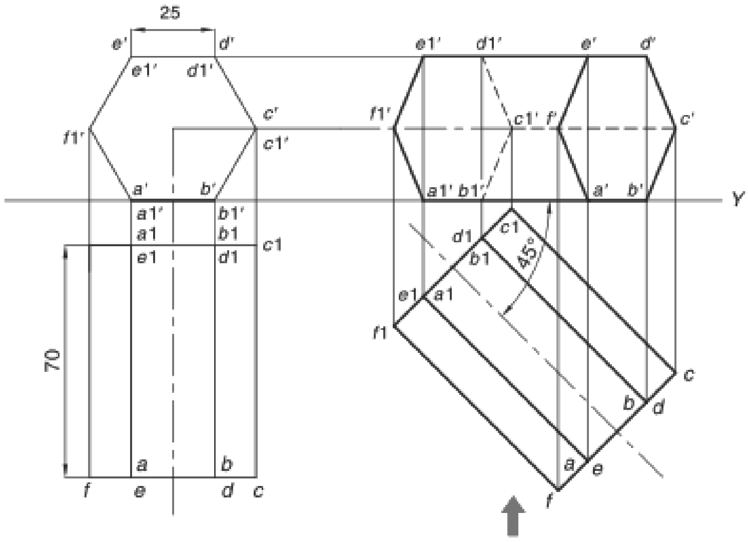


Figure3.14 Axisinclined totheV.P.andparalleltotheH.P.

AxisinclinedtothebothR.P'S.

If the axis of a solid is inclined to both the RPs then the problem is solved in three stages. Asalready mentioned, the inclinations of the axes may not be given directly. Instead, it may beindirectly mentioned by means some other parameters. If the inclinations are given directlythen,inthefirststage,theaxisisassumedtobeperpendiculartoanyoneRP.Theviewobtainedon that RP will give the true shape of the base. The corresponding other view will give the TLoftheaxis.Inthesecondstage,theotherviewisredrawnsothattheaxiswillmaketherequiredangle with the RP to which it was initially perpendicular. The corresponding next view isobtained in the second stage. In the third stage, the next view is redrawn so as to make the'desiredinclination'oftheaxiswiththeotherRP.Here,the'desiredinclination'istheapparentinclination of the axis which is obtained by using the theory of projections of the lines.Theview thus obtained satisfies all the conditions, i.e., inclinations with both the RPs, and hencerepresents the final view. This view is then projected to obtain the other corresponding finalview.

Iftheinclinationsarenotgivendirectlythenthefirststagemustbedecidedcarefully.Oftenaninclination of the axis with one RP is given and the inclination with the other RP is given interms of the inclination of an edge or face of the solid. In such a case, the first stage is to keepthe axis perpendicular to that RP with which its inclination is known. In the second stage, therequired inclination with that RP is obtained. In the third stage, the other condition, viz.,inclination of the face or inclination of an edge, is established. It must be remembered that, inthe first stage, the solid is always kept in such a way that the true shape of the base and TL oftheaxisarevisible.Thishelpstosatisfytheconditionontheaxis(mentioneddirectlyor indirectly)easilyinthesecondstage.NotethatoneviewinthesecondstagealwaysgivesTLoftheaxis (sinceit is simply redrawn from thefirststage).

Otherpossibilitiesareexplainedwiththehelpofexamples.

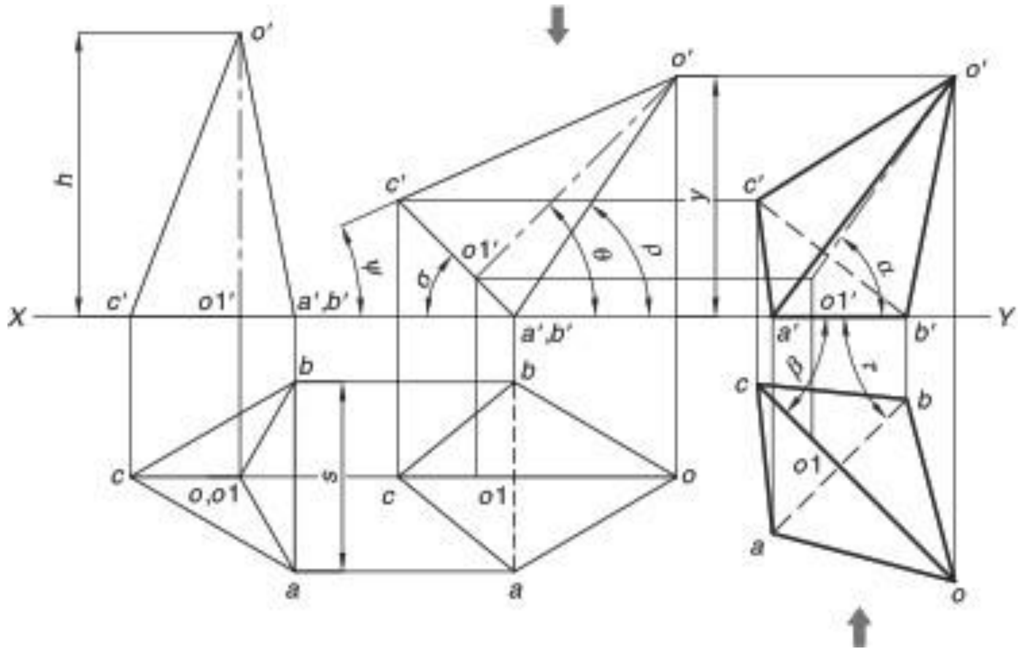
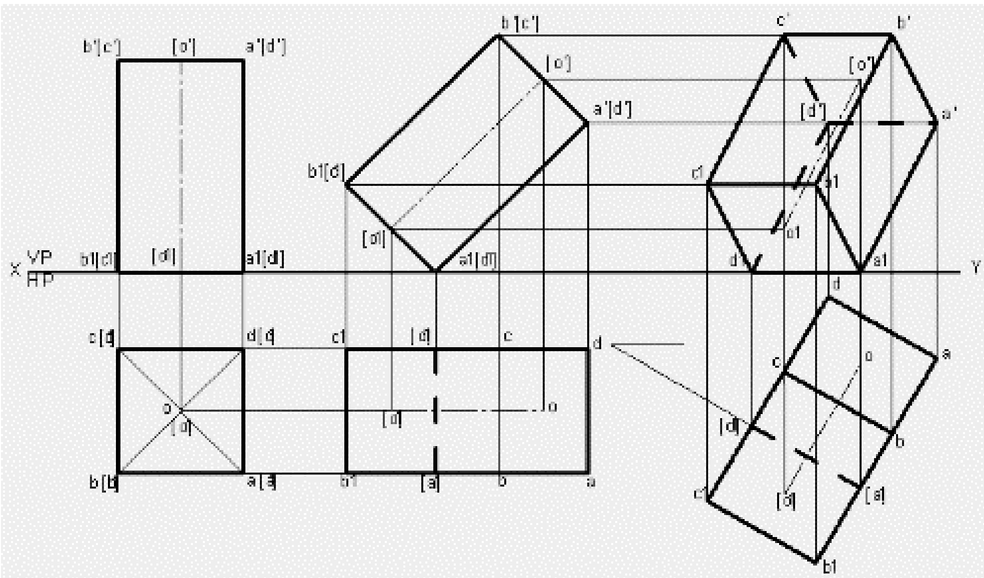


Figure3.15 Axisinclined tothebothR.P.

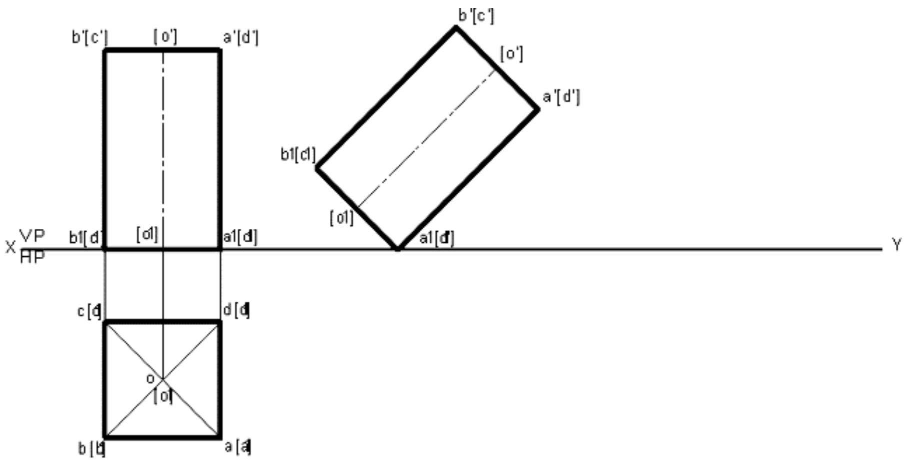
SolvedProblems

1.A square prism 35 mm side of base and 60 mm axis length rests on HP on one of its edgesof the base which is inclined to VP at 30º. Draw the projections of the prism when the axisisinclined to HP at 45º.



Solution

1. Open the Software.Click on the Application Menu and click on New and select “acad “intheopen dialog box andclick Open.
2. Enterthecommand“UNITS“incommandbarandSelectunitsas“Millimetersandclickok.
3. Enter the command “LIMITS “in command bar and enter 0,0 click enter and enter upperrightcorneras 100,100 and clickenter
4. Enterthecommand“ZOOM“incommandbar andenterAandclickenter
5. Draw a XY line by using line command. Mark VP and HP above and below it by using“XTEXT” command in command bar
6. AsperTheproblemdrawasquarelaminaof35mminHPusingRECTANGLEcommandand in format select first corner and click enter and select Area, Now enter X size = 35,Ysize=35andsimilarlylabelthebottomfaceasa1b1c1d1centeraso1usingXTEXTComman d
7. Draw the horizontal line at a distance of 60 mm i.e., equal to height of the square prismabove the XY line using LINE COMMAND and enter 60 in mini dialog box. Draw thevertical projection upwards from top view, until they intersect horizontal line at 60 mmaboveXYlineusingPOLYLINEcommand.Marktheintersectionpointsasa'b'c'd'ando'for thetop faceanda1'b1'c1' d1' and o1' for bottom ofthesquareprism.
8. Sincethesquareprismaxisisinclinedat45°toHP.ByusingPOLYLINEcommandandinformatselectPLenter lengthequaltolength(60)offirststagefrontviewandangleas45in mini dialog



box draw alineof 45°. Mark the annotations asshown below.

9. Draw vertical projectors downwards from the second stage front view using POLYLINEcommand and in format select PL. Draw horizontal projectors from top view to intersectverticalprojectorstogetrequiredsecondstagetopviewbyjoiningintersectionpoints

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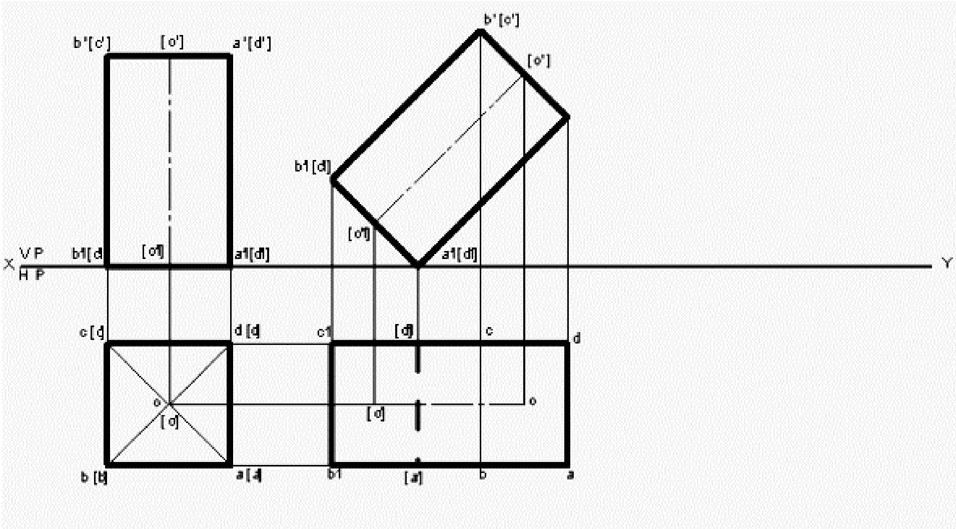
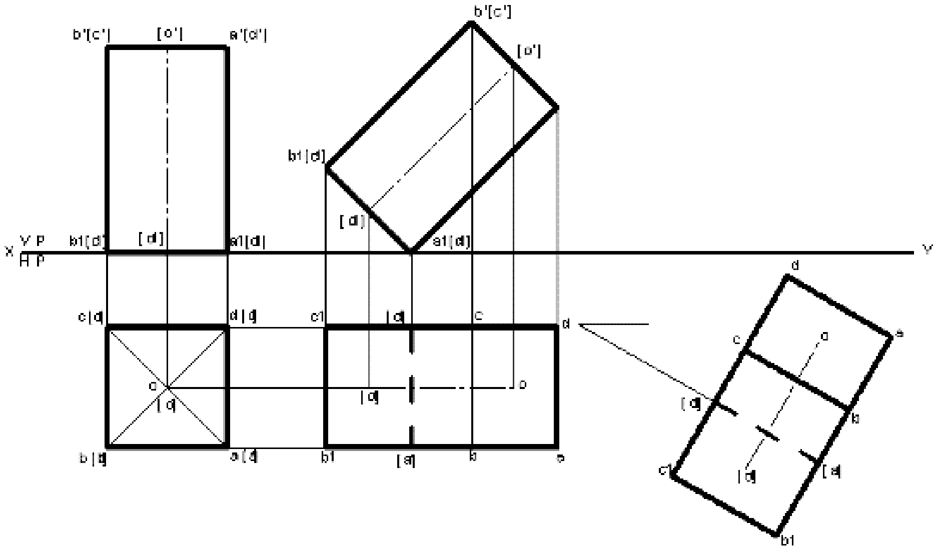
by

usingLINECommandandinformatselectVLasshownbelow.Notetheinvisible(hidden)linesaretobedotted.HencedrawinvisiblelineusingPOLYLINEcommandandinformatselectDL.



10. Since the edge on which prism rests is inclined to VP at 30°. Draw a line of 30° in HPusingPOLYLINEcommandandinformatselectPL.Markannotationsasshownbelow.



11. Draw the vertical projection upwards from the third stage top view using POLYLINEcommand and in format select PL. Again, draw horizontal projectors from second stagefrontviewtointersectverticalprojectorstogetthefinalfrontview.Joinalltheintersectionpointsusing LINECommand and in format select VL.
12. UsingDIMENSIONCommandinAnnotationtoolbarorEnterDIMcommandincommandbardimensionthe drawing

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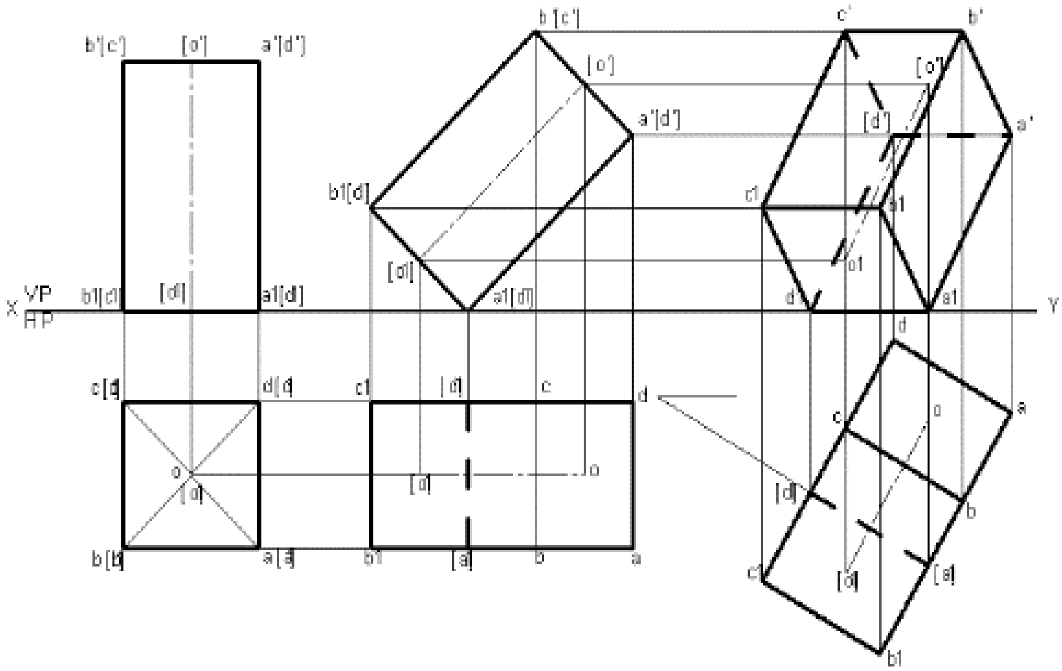
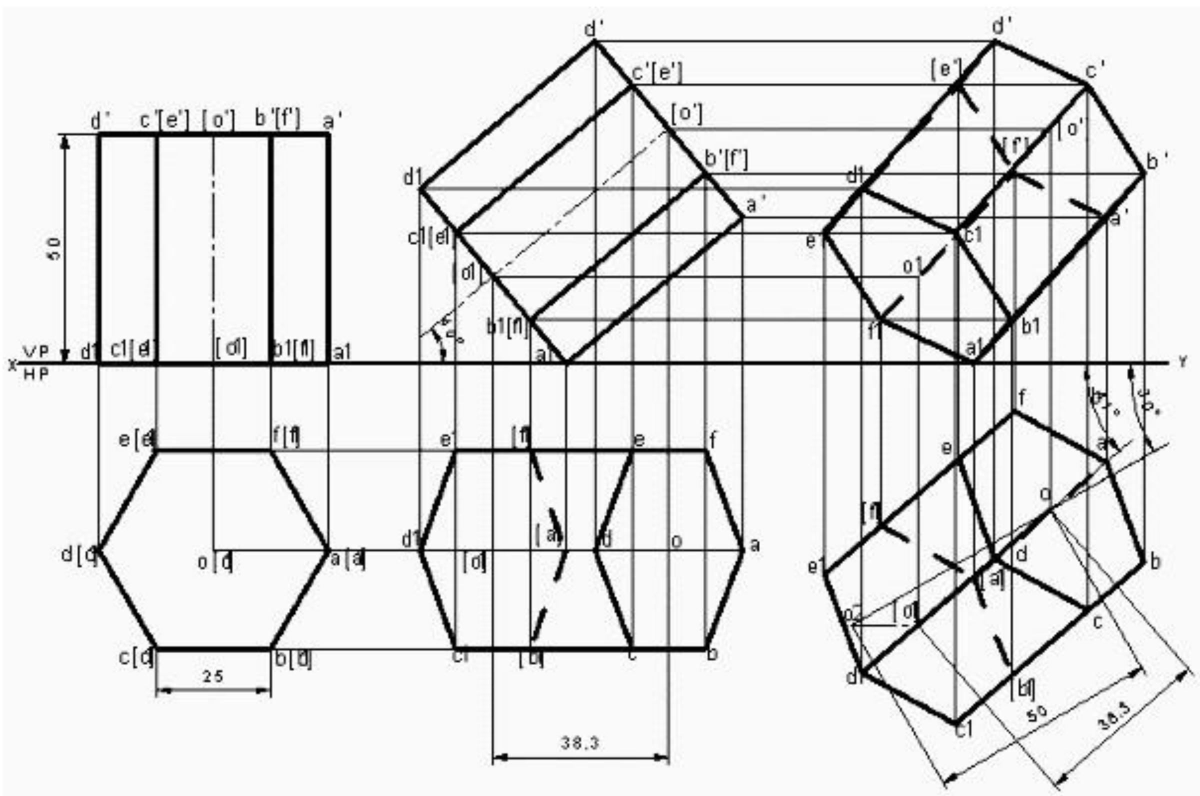
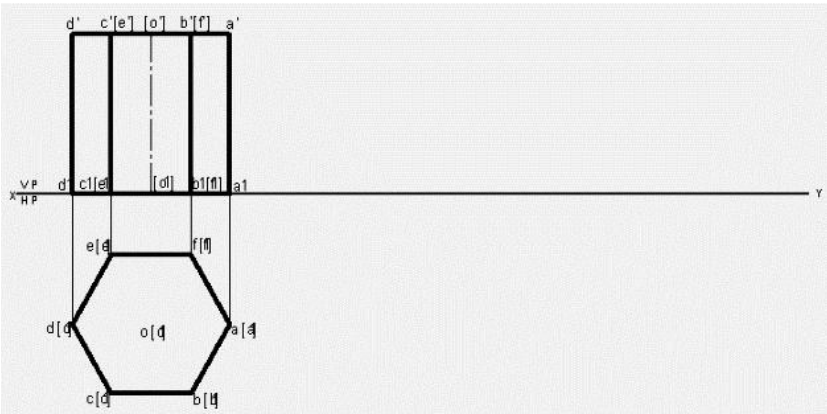


2.A hexagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of itscorners of the base such that the two base edges containing the corner on which it restsmake equal inclinations with HP. Draw the projections of the prism when the axis of theprismis inclined to HP at40º and to VP at 30º.



Solution

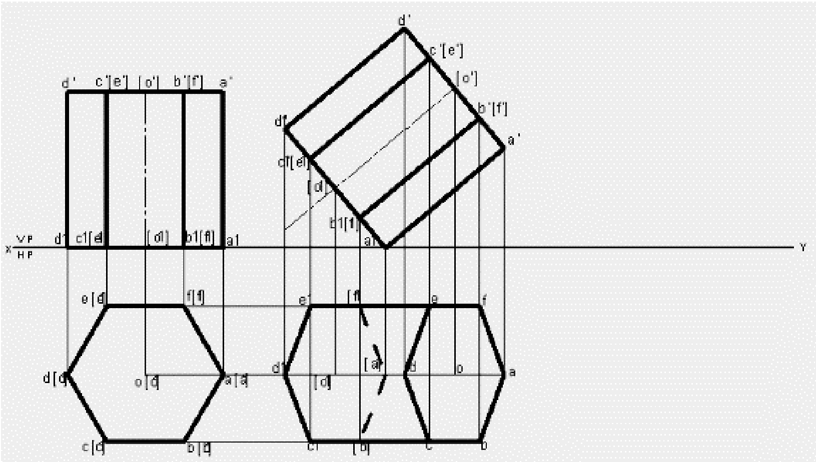
1. Open the Software.Click on the Application Menu and click on New and select “acad “intheopen dialog box andclick Open.
2. Enterthecommand“UNITS“incommandbarandSelectunitsas“Millimetersandclickok.
3. Enterthecommand“LIMITS“incommandbarandenter0,0clickenterandenterupperrightcorneras 100,100 and click enter
4. Enterthecommand“ZOOM“incommandbar andenterAandclickenter
5. Draw a XY line by using line command. Mark VP and HP above and below it by using“XTEXT” command in command bar
6. Aspertheproblemdrawahexagonallaminaof25mminHPusingPOLYLINEcommandand in format select VL and enter edges as 6, radius as 25. Mark the corner points of topfaceasabcdefandcenteraso.Similarlylabelthebottomfaceasa1b1c1d1e1f1centeraso1 using XTEXT Command
7. Drawthehorizontallineatadistanceof50mmi.e.,equaltoheightofthehexagonalprismabovetheXY lineusingPARALLEL LINECOMMANDand enter50in minidialogbox.Draw the vertical projection upwards from top view, until they intersect horizontal line at50 mm above XY line using POLYLINE command. Mark the intersection points as a' b'



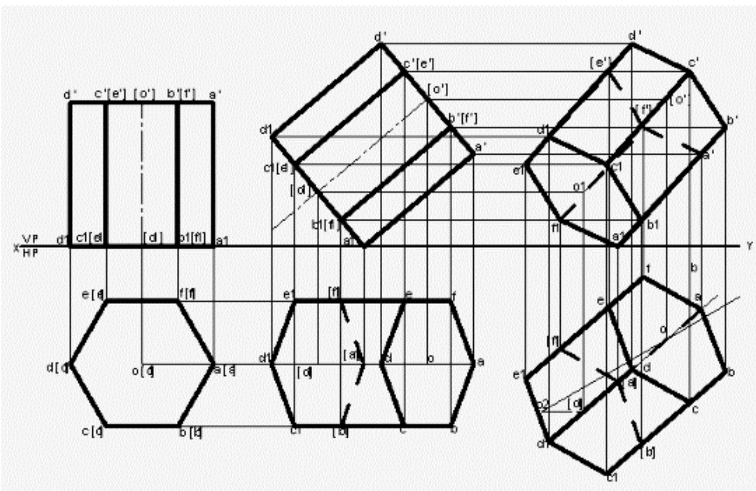
c'd'e'f'ando'forthetopfaceanda1'b1'c1'd1'e1'f1'ando1'forbottomofthesquareprism.

8. Since the hexagonal prism axis is inclined at 40° to HP. By using POLYLINE commandandinformatselectPLenterlengthequaltolength(50)offirststagefrontviewandangleas40 inmini dialog boxto draw alineof40°. Mark theannotations as shownbelow.
9. Draw vertical projectors downwards from the second stage front view using POLYLINEcommand and in format select PL. Draw horizontal projectors from top view to intersectvertical projectors to get required second stage top view by joining intersection points

byusingLINECommandandinformatselectVLasshownbelow.Notetheinvisible(hidden) linesaretobedotted.HencedrawinvisiblelineusingPOLYLINEcommandandinformatselect DL.



10. As per the problem draw a line of 30° in HP using POLYLINE command and in formatselectPL.Drawanarcofradiusequaltoaxisofprismfromfirststagefrontviewtocuton30° line drawn. Draw a locus from point o1, now with radius equal to axis of prism fromsecondstagetopview tocuton thelocus.Join o o1to get theaxis ofthird stagetopview.
11. Draw the vertical projection upwards from the third stage top view using POLYLINEcommand and in format select PL. Again, draw horizontal projectors from second stagefrontviewtointersectverticalprojectorstogetthefinalfrontview.Joinalltheintersection points using LINE Command and in format select VL and draw invisible line usingPOLYLINEcommandand in format select DL.



12. UsingDIMENSIONCommandinAnnotationtoolbarorEnterDIMcommandincommandbardimension the drawing

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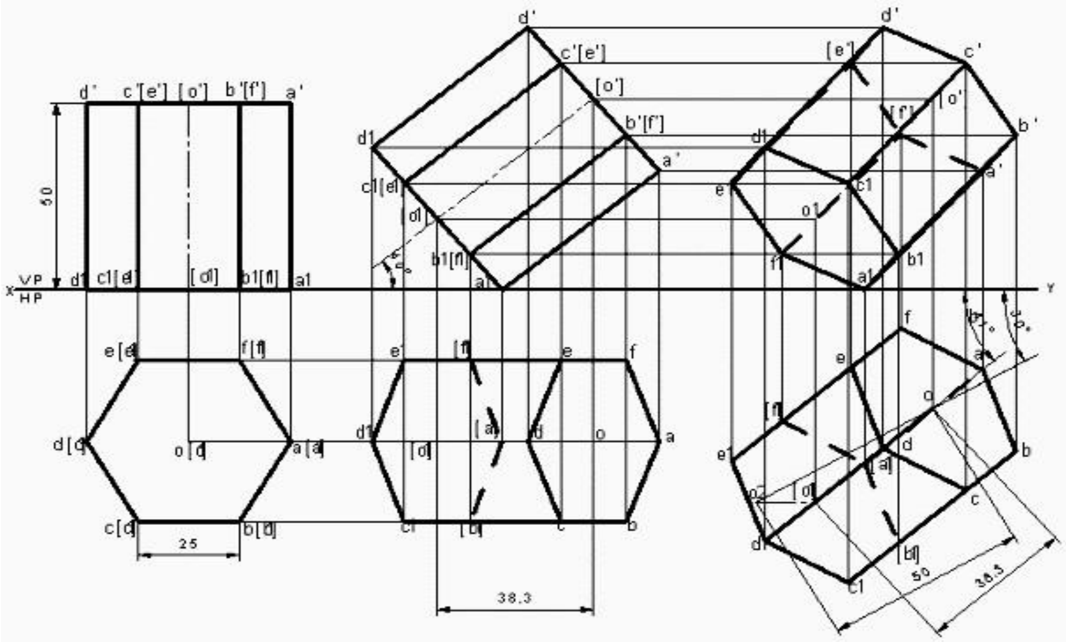


PracticeProblems

1. A Square Pyramid,havingbase witha40mmsideand60mmaxisisrestingonitsbaseontheHP. Draw its Projectionswhen
   (a) Asideofthebaseis parallelto theVP.
   (b) Aside of thebaseis inclined at30^{0}to theVPand
   (c) Allthesides ofbaseare equally inclinedto the VP
2. ApentagonalPrismhavingabasewith30mmsideand60mmlongAxis,hasoneofItsbasesin theVP. DrawItsprojections When
   (a) Rectangularfaceis parallelto and 15 mmabovetheHP
   (b) Arectangularfaceperpendicular to HP and
   (c) Arectangularfaceisinclined at45^{0}totheHP
3. A pentagonal Prism having a base with a 30 mm side and 60 mm long axis, is resting ononeofits rectangularfaceson theHP.with axisparallelto theVP.Draw itsprojections?
4. A hexagonal Prism having a base with a 30 mm side and 75 mm long axis, has an edge itsbase on the HP, its axis parallel to the VP and inclined at 45^0 to the HP. Draw itsprojections?
5. A hexagonal Prism having a base with a 30 mm side and 65 mm long axis, has an edge itsbase on the VP, its axis parallel to the HP and inclined at 30^0 to the VP. Draw itsprojections?
6. A cube of 50 mm long edges is so placed on HP on one corner that a body diagonal isParallel to HP and perpendicularto VP. Draw itsprojections.

7. A cone 40 mm diameter and 50 mm axis are resting on one of its generators on HP whichmakes30^{0}inclinationswith VP. Drawits projections.
8. A circular cone, 40 mm base diameter and 60 mm long axis is resting on HP, on one pointofbasecircle such thatits axis makes45^{0}inclination withHP and40^{0}inclination withVP.Drawits projections.
9. Acylinder40mmbasediameterand50mmlongaxisisrestingononepointofbasecircleonVP,while itsaxismakes45^{0}inclinationwithVPandFVoftheaxis30^{0}inclinationwithHP.Draw its projections.
10. A cone of base diameter 50 mm and height 60 mm is rests on the ground on a point of itsbase circle such that the axis of the cone inclined at 45° to the H.P. and inclined at 45° totheH.P. Draw its front and top views.
11. A hexagonal Prism having a base with a 40 mm side and 80 mm long axis, has an edge itsbase on the HP. The end containing that edge is inclined at 30^0 to the HP and axis paralleltotheVP.ItiscutaplaneperpendiculartotheVPandparalleltotheHP.Thecuttingplanebisectstheaxis. andinclined at 45^{0}totheHP. Draw itsfront and sectional topviews.
12. Asquarepyramidofbaseside30mmandaltitude50mmliesononeofitstriangularfaceson the HP with its axis parallel to the VP. It is cut by a vertical plane inclined at 30^0 to theVPandmeetingtheaxisat40mmfromthevertexmeasuredintheplan.Drawthetopview,sectionalfront viewand thetrueshapeofthesection.
13. A cone, diameter of base 50 mm and axis 65 mm long .is lying on the HP on one of itsgenerators with the axis parallel to the VP. It is cut by a horizontal Section plane 12 mmabovetheground.Draw itsfront andsectional topviews.
14. Draw the projections of a hexagonal pyramid of side of base 30mm and axis 60 mm longresting on one of its base edges in HP with its axis inclined at 30^0 to HP and the top viewofaxis is 45^{0}to VP.
15. Draw the projections of a pentagonal prism, base 25 mm side and axis 50 mm longrestingononeofitsrectangularfacesonHP,withtheaxisinclinedat45degreestoVP.

UNIT4

DEVELOPMENT OF SURFACE

In industrial world, an engineer is frequently confronted with problems where the development of surfaces ofanobjecthastobemadetohelphimtogoaheadwiththedesignandmanufacturingprocesses.Forexample,in sheet metal work, it plays a vital role, thus enabling a mechanic to cut proper size of the plate from thedevelopment and then to fold at proper places to form the desired objects, namely, boilers, boxes, buckets,packingboxes, chimneys, hoppers, air-conditioningductsetc.

"**The development of surface of an object means the unrolling and unfolding of all surfaces of theobjecton a plane.**"

"Ifthesurfaceofasolidislaidoutonaplainsurface,theshapethusobtainediscalledthedevelopment of that solid." In other words, the development of a solid is the shape of a plain sheet that byproperfoldingcouldbe convertedintothe shape of theconcernedsolid.

ImportanceofDevelopment:

Knowledge of development is very useful in **sheet metal work**, **construction of storage vessels**, **chemicalvessels**, **boilers**, and **chimneys**. Such vessels are manufactured from plates that are cut according to thesedevelopmentsand then properlybend into desiredshaped.Thejointsare then**weldedor riveted**.

Principleof Development:

Every line on the development should show the true length of the corresponding line on the surface whichis developed.

MethodsofDevelopment:

(a) Parallel-linedevelopment
(b) Radial-linedevelopment
(c) Triangulationdevelopment
(d) Approximatedevelopment

Parallel-lineMethod:

Itis usedfordevelopingprisms andsingle curvedsurfaceslikecylinders, inwhich all the edges/generationoflateralsurfacesare parallelin each other.

Radial-lineMethod:

Itisemployedforpyramidsandsinglecurvedsurfaceslikeconesinwhichtheapexistakenascenterandtheslantedge or generatoras radiusofits development.

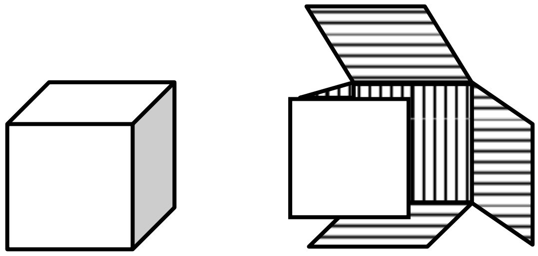
TriangulationMethod:

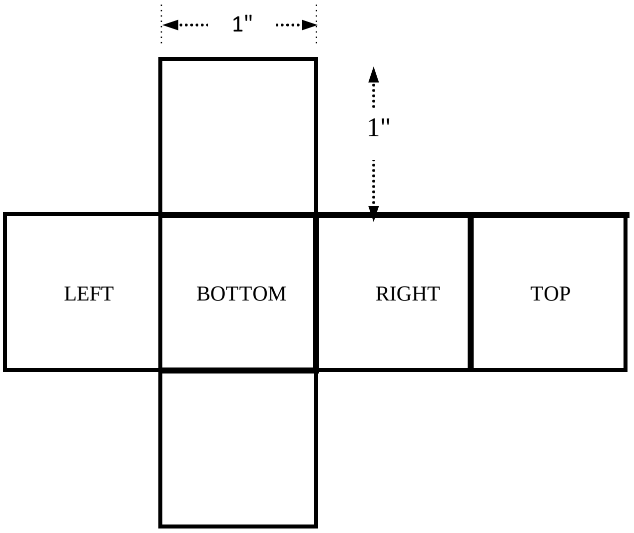
Itisusedfordevelopingtransitionpieces.

ApproximateMethod:

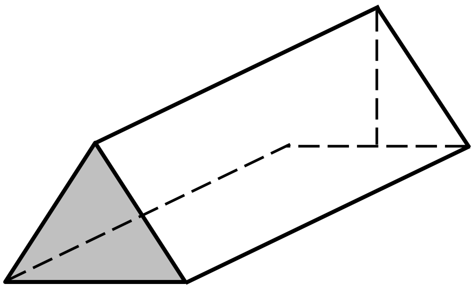
It is employed for double curved surfaces like spheres, as they are theoretically not possible to develop. Thesurface of the sphere is developed by approximate method. When the surface is cut by a series of cuttingplanes,the cutsurfaces is called a zone.

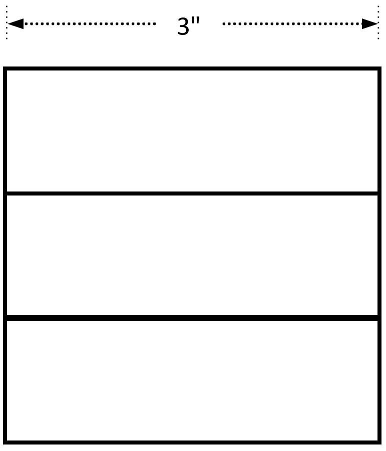
Developthesurfacesof the cube of 1"



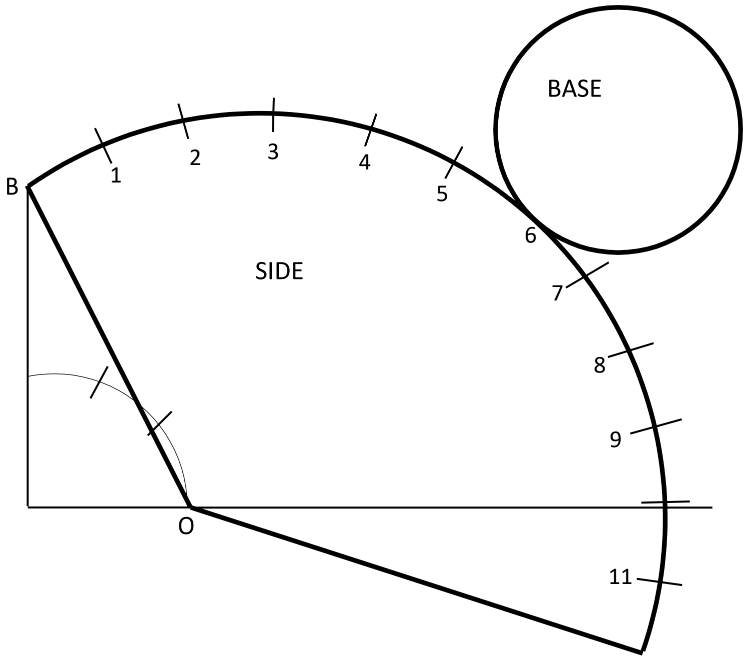


Developthesurfacesofatriangular prism





Draw thedevelopmentofaconeofdiameter1.5" andinclinedheightof 2"



Drawthedevelopmentofasquarepyramidfromitsplanandfrontelevationwhichstandsvertic allyon its base onH.Pwithone edgeof the base parallelto V.P.

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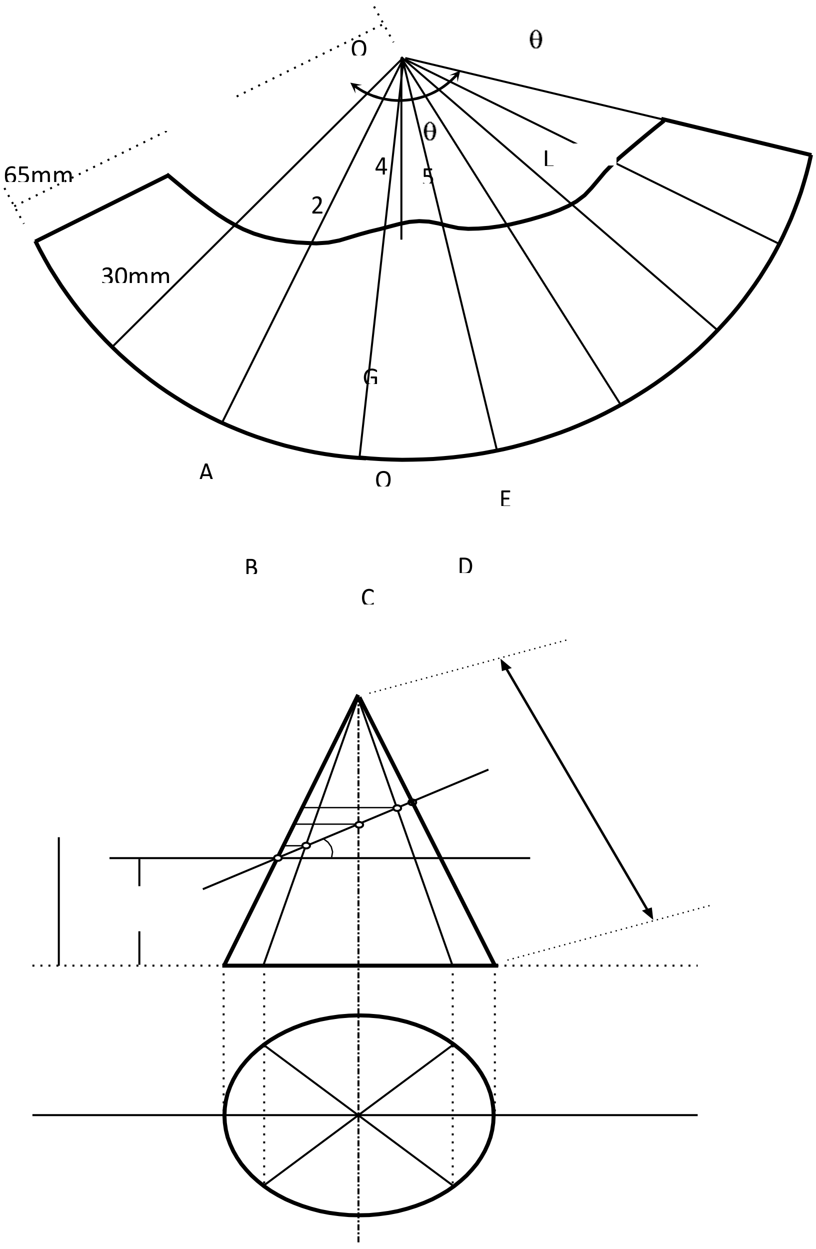
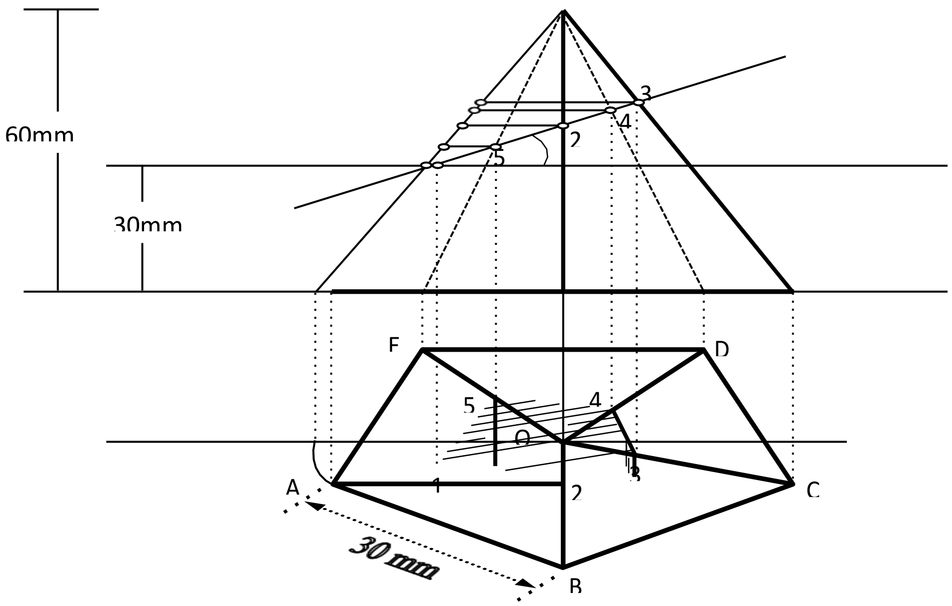
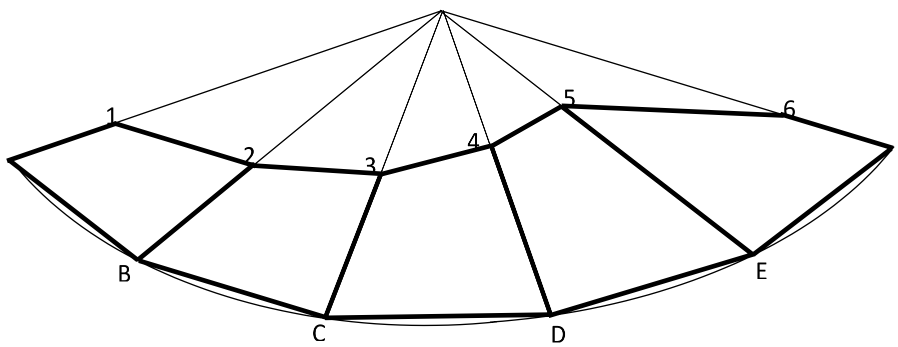
A coneofbase50mmdiameterandheight65mmrestswithitsbaseonH.P.Asectionplaneperpendicularto V.Pandinclinedat30^otoH.Pbisectstheaxisofthecone.Drawthedevelopmentofthelateralsurfaceofthetruncatedcone.



A pentagonal pyramid, side of base 30 mm and height 60 mm, stands with its base on H.P and an edge of thebase is parallel to V.P. It is cut by a plane perpendicular to V.P, inclined at 40° to H.P and passing through apoint on the axis, 32 m above the base. Draw the sectional top view and develop the lateral surface of thetruncatedpyramid.





UNIT5

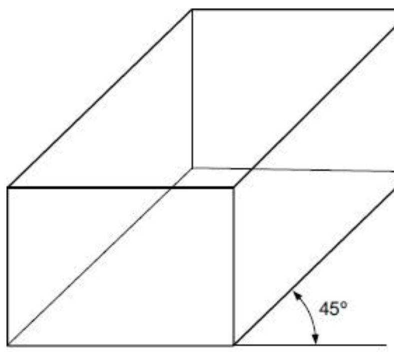
ISOMETRIC PROJECTION

IsometricProjection

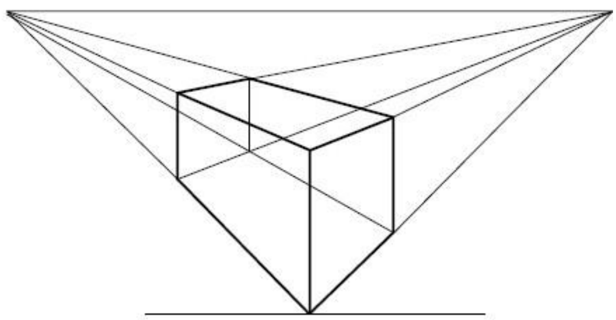
In engineering drawing, orthographic projection of a solid is best way of projecting the detailsof an object when a solid is resting in its simple position. As the front view or top view takenseparately, gives an incomplete idea of the object, a pictorial projection is the best method toshow the object in one view only. Basically, pictorial projection represents three dimensionalshape of an object and represents real things in one view only, which indicates length, breadthand height of the object. Therefore, the object is easily visualized from a pictorial projectionthanfrom its orthographicprojection.

Thepictorialprojection maybedividedas:

1. Obliqueprojection
2. Perspectiveprojection
3. Axonometricprojection.



(i) Oblique Projection

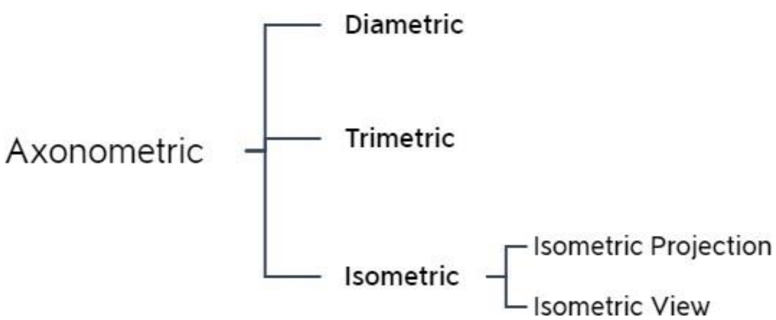


(ii) Perspective Projection

AxonometricProjection

Anaxonometricprojectionisatypeofsingle-viewparallelprojectionusedtocreateapictorialdrawingofanobject.Theobjectisplacedinsuchapositionthatthethreemutuallyperpendicular faces are visible from a single direction. The word ‘axonometric projection’means measuring along axis in which “axon” means axis while metron means measuring.Axonometricprojectionsarecommonlyusedtodrawmechanicalpartsofanobjectfortheclearpicture of an object which are visualized from the orthographic projection. In this projectiontheobject canbedrawnat differentanglesand havingthedifferent lengthof edges.

Axonometricprojectionsareagainclassifiedas:



TrimetricProjection

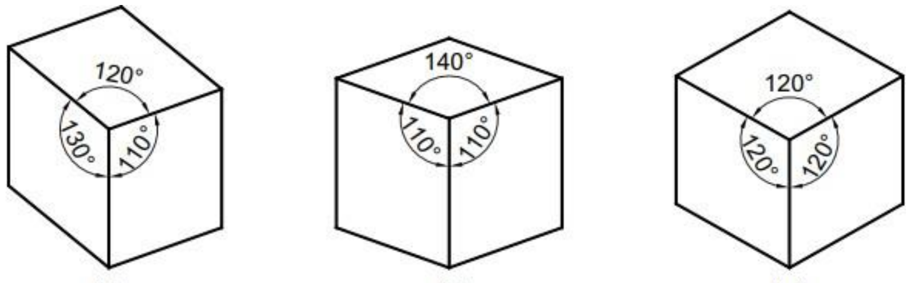
In this type, an object is placed in such a way that no two axes make an equal angle with theplaneof projection.

DimetricProjection

In this type of projection, an object is placed in such a way that two of its axes make equalanglewith theplaneofprojection andthe thirdaxismakeseither asmalleroragreaterangle.

IsometricProjection

Inthistypeofprojection,anobjectisplacedinsuchawaythatallthreeaxesmakeequalanglewith theplaneof projection.



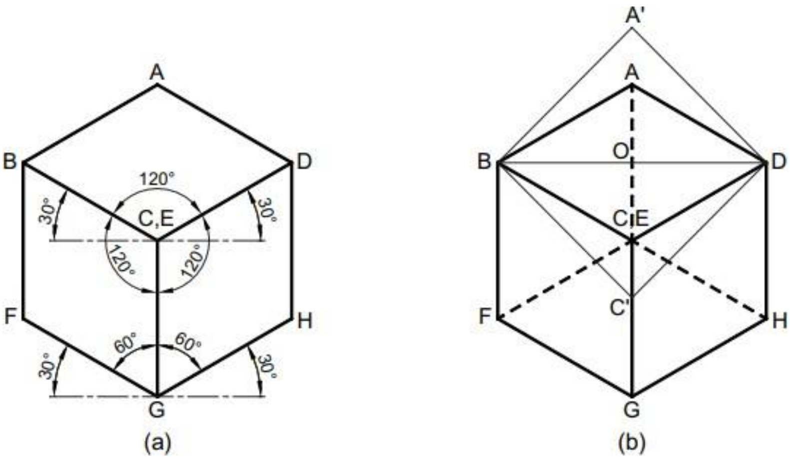
The isometric projection is the most common pictorial representation used in industries wherevisualizationofthethreedimensionsofasolidarenotonlyshowninoneview,buttheiractualsize scanbemeasureddirectlyfromit.Asitshowsviewsofthreefacesofanobjectequally,itis very helpful to even a layman to understand the shape of the object. A multiview drawingrequires two or more orthographic projections to define the exact shape of a three dimensionalobject. Each orthographic view is a two-dimensional drawing showing only two out of threedimensionsof theobject.

PrincipleofIsometricProjection

The isometric projection can be visualized is by considering a view of a cube with one of thesolid diagonals perpendicular to the vertical plane and the three axes equally inclined to theverticalplane.Thefinalfrontviewistheisometricprojectionofthecube.Figure15.3(a)showsthe front view when hidden lines are removed. It gives the realistic view of the cube. Thecornersarerenamedincapitalletters.Akeenstudyofthisviewrevealsthefollowinginformation.

1. Theouterboundary ABFGHDAis a regularhexagon.
2. Allthefaces ofthecube which areactually squarein shapeappear asrhombus.
3. The three lines CB, CD and CG meeting at C, represent the three mutually perpendicularedgesof thecube.
    a. Theymakeequal anglesof120°witheachother.
    b. Theyareequal inlengthbut smallerthanthe true lengthoftheedgeofthecube.
    c. ThelineCGis vertical, andthe other linesCB and CDmake30°withthehorizontal.
4. Allotherlinesrepresentingtheedgesofthecubeareparalleltooneortheotheroftheabovethre elines, i.e., CB, CD andCG, and areequally foreshortened.
5. ThediagonalBDofthetopfaceABCDisparallel toV.P.,andhenceshowsitstruelength.

AcomparisonoftherhombusABCDofthefrontviewwiththesquarefaceofthecubeisshowninbelow figure.



IsometricAxes,LinesandPlanes

1. ThethreelinesCB,CD,CGmeetingatapointCandmakingananangleof120^0witheachotherarecalled **Isometric axes.**
2. Thelines(AB,BF,FG,GH,DHandAD)paralleltotheIsometricaxisaretermedas **Isometriclines.**
3. Thelines(BD,AC,CF,BG,etc.,)whicharenotparalleltotheisometricaxesareknownas**Non-Isometric lines**
4. Theplane(ABCD,BCGF,CGHD,etc.,) representinganyfaceofthecube aswellasotherplaneparallel to it is called an**Isometric Plane.**
5. Theplane(ABGH,CDEF,AFH,CFH,etc.,)whichisnotparalleltoisometricplanesareknownas **Non-IsometricPlanes.**
6. Thescalewhichisusedtoconvertthetruelengthintoisometriclengthisknownas **IsometricScale.**

IsometricScale

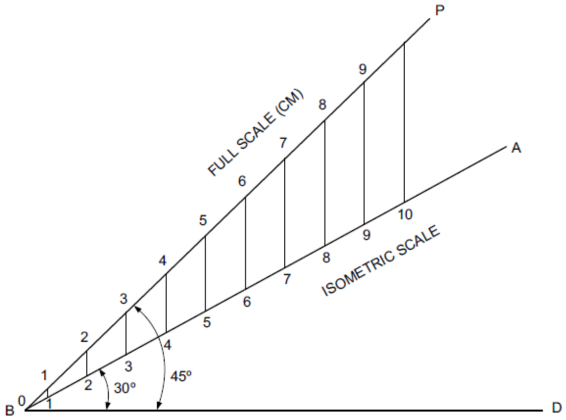
Referring to the above Fig., all the edges of the cube are equally foreshortened. Therefore, thesquare faces are seen as rhombuses in the isometric projection. The foreshortening of the edgecanbecalculatedas follows:

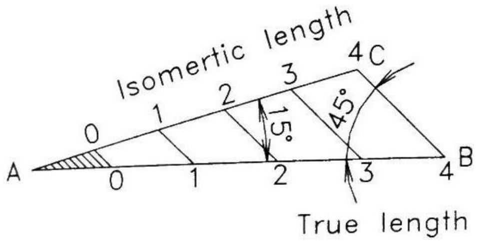
In triangleABO, $\frac{BA}{BO} = \frac{1}{\cos 30^0} = \frac{2}{\sqrt{3}}$

IntriangleA’BO, $\frac{BA^F}{BO} = \frac{1}{\cos 45^0} = \frac{\sqrt{2}}{1}$

Therefore, $\frac{Isometriclength}{Truelenght} = \frac{BA}{BA^F} = \frac{2}{\sqrt{3}} \times \frac{1}{\sqrt{2}} = \frac{9}{11}$

Department of Mechanical Engineering





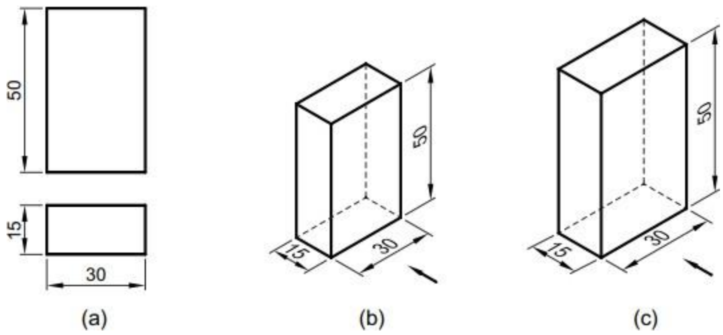
ConventionalIsometricScale SimplifiedIsometricScale

This reduction of the true length can be obtained either by multiplying it by a factor 0.816 orbytaking the measurement with the helpof an isometricscale.

IsometricProjectionandView

Isometric projection of an object is the front view of the object placed in isometric position.Isometric projection is the actual projection of the object on V.P. Here as the edges of thetransparentcubeareinclined$35^0$16'toV.P.,theirprojectionon VPwillhavealength ofabout82%of thetruelength, when measured in theisometricposition.

Isometric projection can be drawn directly, using the true length of the dges of the cube alongthe isometric axes. As a result, the projection obtained is larger in size than the actual. Thisprojectionis called isometricVieworIsometricDrawing.



(a) Multiviewprojection (b)Isometricprojection (c)isometricview

Dimensioning

Thegeneralrulesforthedimensioningofmultiviewprojectionisapplicableforisometricprojection,except thefollowing:

1. Alltheextensionlines anddimensionlinesshould beparallelto theisometricaxesandtheyshould beon any ofthe isometricplanes.
2. Thetextshouldbeplacedatthemiddleofthedimensionline,afterbreakingittoashortlength.
3. ThedimensionalvaluesinXdirectionshouldbereadablefromtherightside.WhiletheYdirection fromleft side andZ directionfrom therightsiderespectively.
4. Thenumeralsplacedalongthethreeaxesshouldbealignedwiththedirectionoftheaxes.

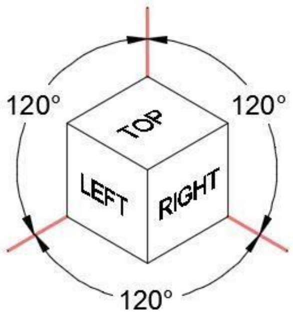
SystemofNotation

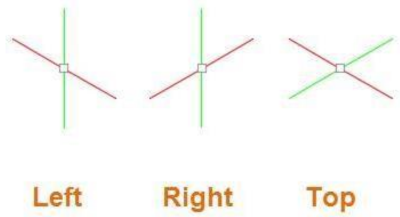
1. The actual solid in space is denoted by capital letters A1 , B1, C1 and D1 etc for Base ofsolidand A, B, C and D etcfor top faceof thesolid and axisas o1 and o.
2. The front view (FV) of a solid is denoted by their corresponding lower case letters withdashes as a1′, b1′, c1′ and d1′ etc for base of solid and a′, b′ c′ and d′ etc for top face of thesolidand for axis as o1′and o′.
3. The top view (TV) of a solid is denoted by their corresponding lower case letters withdashes as a1, b1, c1 and d1 etc for bottom of solid and a, b c and d etc for top face of thesolidand for axis as o1 and o.
4. Projectorsarealwaysdrawn ascontinuousthinlines.
5. Isometricprojection annotationsaremadewith thecorresponding lettersofthesolid.
6. Linewith specificthickness foraparticulartypeof line.

IsometricDrawingusingAutoCAD

In Computer Aided Engineering Graphics for isometric projections following commands areused other than evoking software, opening file, saving file and giving print command.A 2Disometricdrawingisaflatrepresentationofa3Disometricprojection.Thismethodofdrawingprovides a fast way to create an isometric view of a simple design. Distances measured alongan isometric axis are correct to scale, but the 3D distances and areas cannot be extracted sincethe drawings will be in 2D, display objects from different viewpoints, or remove hidden linesautomatically.

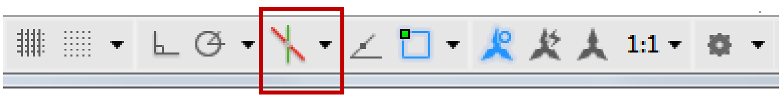
By using the ISODRAFT command, several system variables and settings are automaticallychangedtovaluesthatfacilitateisometricangles.Isoplanespecifiesthecurrentisometricplane.Thestandard isometric planes, called**isoplanes**, areas follows:

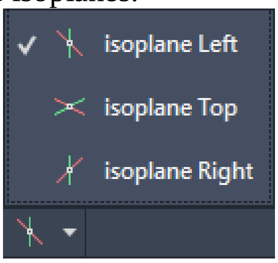




- Right.:Selects theright-hand plane,defined bythe 30-and 90-degreeaxespair
- Left:Selectstheleft-hand plane,definedby the90-and 150-degree axes pair.
- Top:Selectsthetopface,calledthetopplane,definedbythe30-and150-degreeaxispair.

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





Usingthesefollowingcommandsandfeaturesarethemostcommonlyusedonestomaintainprecision in isometricdrawings:

- Polartrackinganddirectdistanceentry
- Objectsnaps andgrid snaps
- Objectsnaptracking
- Moveand Copy

Extrude

TheEXTRUDEcommandcreatesasolidorsurfacethatextendstheshapeofacurve.Opencurvescreatesurfacesand closed curvescreate solids or surfaces
Whenyouextrudeobjects,youcan specifyanyofthefollowingoptions:

Mode. Setswhetherthe extrudecreatesasurface orasolid.
Specify a path for extrusion. With the Path option, create a solid or surface by specifying anobject to be the path for the profile, or shape, of the extrusion. The extruded object starts fromtheplaneoftheprofileandendsonaplaneperpendiculartothepathattheendpointofthepath.Forbestresults, useobjectsnaps tomakesurethatthepath isonorwithinthe boundaryoftheobjectbeing extruded.

Taper angle. Tapering the extrusion is useful for defining part that require a specific taperangle,such asamold used tocreate metal products in a foundry.

Direction. WiththeDirectionoption,youcanspecifytwopointstosetthelengthanddirectionof theextrusion.

Expression. Enteramathematicalexpressionto constraintheheightoftheextrusion.

Revolve

Open profiles create surfaces and closed profiles can create either a solid or a surface. TheMOdeoptioncontrolsisasolidofsurfaceiscreated.Whencreatingasurface,SURFACEMODELINGMODE system variable controls if a procedural or NURBS surface iscreated.
Revolvepathandprofile curvescanbe:

- Openorclosed
- Planarornon-planar
- Solidandsurface edges
- Asingleobject(toextrudemultiplelines,convertthemtoasingleobjectwiththeJOINcommand)
- Asingleregion(toextrudemultipleregions,firstconvertthemtoasingleobjectwiththeUNIONcommand)

Thefollowing aretheoptions forrevolving:

ObjectstoRevolve
Specifiestheobjectstoberevolved aboutan axis.

Mode

Controlswhethertherevolveactioncreatesasolidorasurface.SurfacesareextendedaseitherNURBS surfaces or procedural surfaces, depending on the SURFACEMODELINGMODEsystemvariable.

AxisStartPoint

Specifiesthefirstpointoftheaxisofrevolution.Thepositiveaxisdirectionisfromthefirsttothesecond point.

AxisEndpoint

Setstheendpoint forthe axis ofrevolution.

StartAngle

Specifiesan offsetfortherevolution from theplaneoftheobjectbeing revolved.

AngleofRevolution

Specifieshow fartheselectedobject revolvesabout theaxis.

Loft

Createsa3Dsolidorsurfacebyspecifyingaseriesofcrosssections.Thecrosssectionsdefinethe shape of the resulting solid or surface. Loft cross sections can be open or closed, planar ornon-planar, and can also be edge subobjects. Open cross sections create surfaces and closedcrosssections create solids orsurfaces, depending on thespecifiedmode.

Thefollowingprompts areused under loft:

CrossSectionsin LoftingOrder

Specifies open or closed curves in the order in which the surface or solid will pass throughthem.

Point

Specifiesfirst orlast pointoftheloftingoperation.Ifyoustart withthePointoption,youmustnextselect aclosed curve.

JoinMultipleEdges

Handlesmultiple,end-to-endedgesasone crosssection.

Mode

Controlswhetherthelofted object isasolid orasurface.

Continuity

ThisoptiononlydisplaysiftheLOFTNORMALSsystemvariableissetto1(smoothfit).Specifieswhether thecontinuity is G0,G1, orG2 wherethe surfacesmeet.

BulgeMagnitude

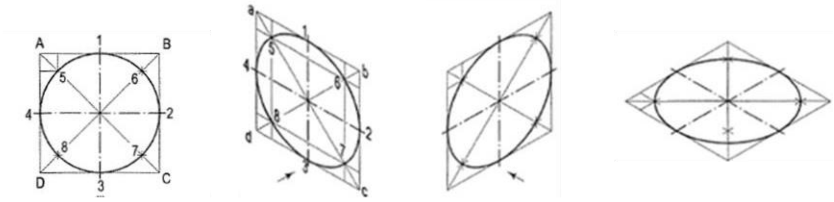
This option only displays if the LOFTNORMALS system variable is set to 1 (smooth fit).Specifiesabulgemagnitudevalue forobjects thathaveacontinuity ofG1 or G2.

Guides

Specifiesguidecurvesthatcontroltheshapeoftheloftedsolidorsurface. Guidecurvescanbeusedtocontrolhowpointsarematcheduponcorrespondingcrosssectionstopreventundesiredresults,such as wrinklesin theresulting solid or surface.

Problem:

1. DrawtheisometricviewofaCircle(Isocircle)witha60mmDiameteronallthreePrinciplePlanes Using Co-ordinate methods?

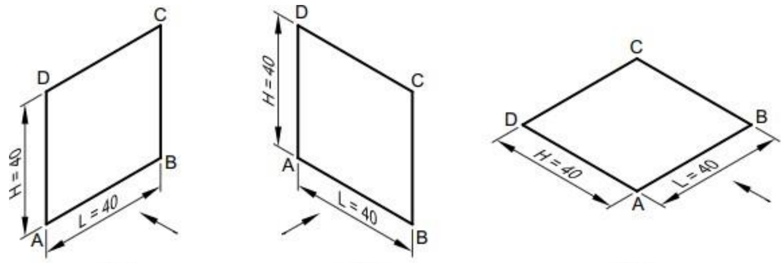


(a) (b) (c) (d)

Solution:

1. Do oneof thefollowing:
    - Onthestatusbar,click  Find.
    - AttheCommandprompt,enterISODRAFT.
2. Choosewhich isoplaneorientation that youwant touse: Left, Right,or Top.
    - PressF5orCtrl+E tocyclethrough thedifferentisoplanes
    - Onthestatusbar,Isodraft button,clickthedropdown arrow andchooseanoption
    - AtheIsodraft promptinthe Commandwindow,enteranoption
3. AttheCommandprompt,enterELLIPSE.
4. Atprompt,enteri(Isocircle).
5. The Isocircleoptionisavailableonlywhenanisometricdrawingplaneisactive.
6. Specifythecenteroftheisocircle.
7. Specifytheradiusor diameteroftheisocircle.

2. Drawtheisometricviewofasquareofside40mmkeptin(a)verticalPositionand(b)horizontalpo sition

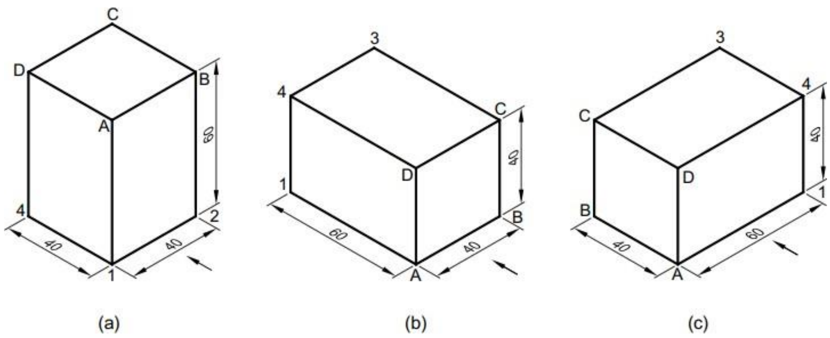


(a) (b) (c)

Solution:

1. Do oneof thefollowing:
    - Onthestatusbar,click  Find.
    - AttheCommandprompt,enterISODRAFT.
2. Choosewhich isoplaneorientation that youwant touse: Left, Right,or Top.
    - PressF5orCtrl+Eto cyclethroughthedifferentisoplanes
    - Onthestatusbar,Isodraft button,clickthedropdown arrow andchooseanoption
    - Atthe Isodraftprompt inthe Commandwindow, enteran option
3. AttheCommand prompt,enterLine.
4. ThePolylineoption isavailableonly whenan isometricdrawingplaneisactive.
5. Specifythecoordinates of thesquareto draw thesquare.

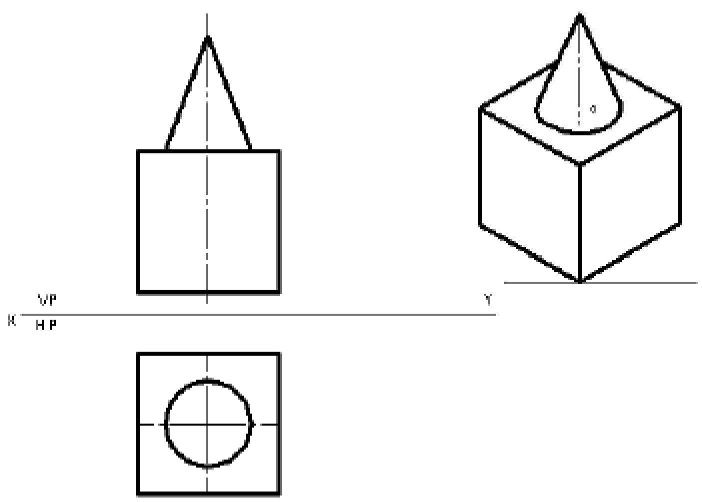
3. Draw the isometric view of a square prism of base side 40 mm and axis 60 mm resting onthe H.P. on the (a) base with axis perpendicular to the H.P., (b) rectangular face with axisperpendicularto theV.P.,and (c)rectangularface with axis parallel totheV.P.



Solution:

1. At first, you need to change your snap settings to isometric. Type DS on the commandlineand press enter.
2. Drafting settings window will pop up from this window select snap and grid tab andmake sure Isometric snap radio button is checked. Click OK to exit drafting settingswindow.
3. Now make sure ortho mode is turned on from the status bar, if it is not turned on thenpressF8 to turn it on.
4. YoucannowselectisometricplaneforyourdrawingbypressingtheF5key.ThethreeIsoplanesavailableforselection areIsoplanetop, right and left.
5. PressF5keytoactivate Isoplanetopandthenselectlinecommandandclickanywherein the drawing area to start your line. Specify a direction and type 5 on the commandlinethenpressenter,repeatthisprocessbychangingdirectionsoflinetomakeaclosedsquare

4. Aofconebasediameter30mmandheight40mmrestscentrallyoveracubeofside50mm.Drawtheisometricprojection ofcombination ofsolids.

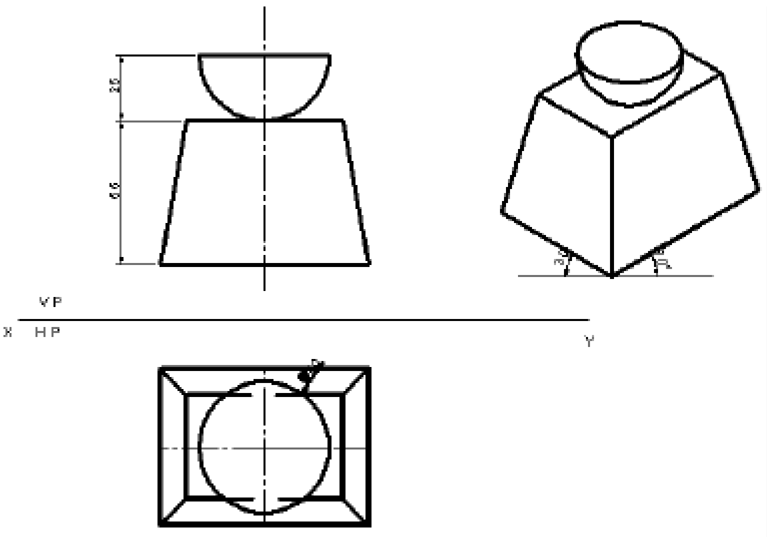


Solution:

1. OpentheSOFTWARE.Clickonthe DRAWING intheopendialog boxandsayOK.
2. Tosetupthesheetofrequiredsize(Ex:A4)byselectingTOOLSfromMainMenuBarandclickonOPTIONS/PROPERTIES.Selectdocumentpropertiesindialogboxappeared and then select drawing in selection panel. Select the required size say A4,andclick OK.

3. Astheproblemdrawtopandfrontviewofcombinedsolidsusingsuitablecommands.
4. Draw the isometric scale, as per the dimensions of the problem using **POLYLINE**commandandinformatselectPLforconstructionlinesdrawtwolinesofisolength of50 mm along 30° line as shown. Draw another two lines, using **PARALLEL LINECOMMAND**andusing**TRIM/EXTENDCURVES,**sothattheyareconnectedsystematically**.**
5. Draw the vertical lines at corners of parallelogram equal to isometric height of squareprismof 50 mmusing POLYLINEcommandandin formatselect VL.
6. Join all the top end points using 2 POINT LINE Command and in format select PL togettop faceas shown below.
7. Since the axis of solids is collinear (square prism and cone), identify the center ofrectanglerepresentitaso.Withoascenterconstructaboxofisolengthofside30mmsimilartobasedrawnearlierasshownusingPOLYLINEcommandandinformatselectPL.
8. Using 3 POINT CIRCLE command in drafting tool bar. In mode option select arc, andusethreecentermethoddraw anellipse toget thebottom ofcone.
9. UsingPOLYLINEcommandandinformatselectALdrawverticallineupwardsatthecenterofrectangle, equalto theheightof cone40mm(given)to getapex ofthecone.
10. UsingPOLYLINEcommandandinformatselectVLdrawtangentiallinefrombottomof cone to apex as shown. Trim all the unwanted construction lines by using SMARTDELETECOMMAND.
11. UsingSMARTDIMENSIONCommandindrawingtoolbardimensionthedrawingasshown. To get a Hard Copy of the standard drawing select print from file menu bar.Printdialogwindowwillappearselectpageandchangewidthtoentitiesandselecttheactivatedbuttonnowsubstitutewidth1as0.15mm,width2as0.05mm,width3as0.5mm, width 4 as 0.35 mm and say OK. Select print to get a hard copy and finally savethefile. Therequired standard drawing is as shownbelow.

5. A hemisphere diameter 50mm is resting on its curved surface centrally on the top face offrustum of a rectangular pyramid base 80mm x 60mm and top 60mm x 40mm, height55mm.Draw theisometric projection ofcombined solids.



Solution:

1. Openthe**SOFTWARE**.Clickonthe**DRAWING** intheopendialogboxandsay**OK**.
2. To set up the sheet of required size (Ex: A4) by selecting **TOOLS** from Main MenuBarandclickon**OPTIONS/PROPERTIES**.Selectdocumentpropertiesindialogboxappeared and then select drawing in selection panel. Select the required size say A4,andclick **OK**.
3. Aspertheproblemdrawtopandfrontviewofcombinedsolidsusingsuitablecommands.
4. Drawtheisometricscale, asper thedimensionsof theproblem.
5. Using**POLYLINE**commandandinformatselectVLforvisibleedgesdrawtwolinesof iso length of 80 mm and 60 mm along 30° line as shown. Draw another two lines,using **PARALLEL LINE COMMAND** and using **TRIM/EXTEND CURVES** sothat,they are connected systematically.
6. UsingPOLYLINEcommandandinformatselectALdrawverticallineupwardsatthecenterof rectangle, equalto theheight ofrectangularfrustum 55 mm(given).
7. Attopendofverticallinedrawn,usingPOLYLINEcommandandinformatselectVLfor visible edges draw two lines of iso length of 60 mm and 40 mm along 30° line asshown. Draw another two lines, using PARALLEL LINE COMMAND and usingTRIM/EXTENDCURVES so that, theyareconnected systematically.
8. Joinalltherelevantcornersoftoptobasefrustumusing2POINTLINEcommandandinformat select VL to get frustum as shown below.
9. Since the axis of solids is collinear (hemisphere and rectangular pyramid), identify thecenter of rectangle represent it as o. With o as center using POLYLINE command andin format select AL draw vertical line upwards at the center o of height equal to heightof hemisphere 25 mm (given). Construct a box of iso length of side 50 mm to fit topfaceof hemisphereusing POLYLINEcommandand in formatselect PL.
10. Using 3 POINT CIRCLE command in drafting tool bar. In mode option select arc, andselect3 points on rectangle drawatopfaceofhemisphere.
11. UsingCENTERCIRCLEcommandindraftingtoolbar.Inmodeoptionselectarc,withcenter as center of top face of hemisphere and radius as actual radius of hemispheredrawan arc,sothatittouchesthetopfaceofhemisphereandpassesthroughthecenteroftop faceof therectangle frustum.
12. Trim all the unwanted construction lines by using SMART DELETE COMMAND.Using SMART DIMENSION command in drawing tool bar dimension the drawing asshown. To get a Hard Copy of the standard drawing select print from file menu bar.Printdialogwindowwillappearselectpageandchangewidthtoentitiesandselecttheactivatedbuttonnowsubstitutewidth1as0.15mm,width2as0.05mm,width3as0.5mm, width 4 as 0.35 mm and say OK. Select print to get a hard copy and finally savethefile. Therequired standard drawing is as shownbelow.

PracticeExercises:

PlaneSurface

1. DrawtheisometricviewofahexagonofSide30mmwhosesurfaceisparalleltotheV.P.andaside perpendicularto theH.P.
2. Drawisometricviewsofatriangleofsides80mm,60mmand50mmonallthethreeprincipalplan es.
3. Drawtheisometricviewofacubeofside50mm.Alsoshowintheview,circlesofdiameter50mm marked on all thevisible faces ofthecube.
4. Drawisometricviewofahexagonalplaneofside40mmwithacentralholeofdiameter40mm when the surfaceof theplaneis parallel tothe H.P.
5. Drawisometricviewofacompositeplanemadeupofarectangleofsides60mmand40mmwith a semicircle onits longer side.

SimpleSolid

1. Drawtheisometricviewofacylinderofbasediameter50mmandaxis60mmlyingononeof its generator on theH.P
2. Asquareprismofbaseedge40mmandaxis60mmhasanedgeofitsbaseontheH.P.Theaxisis parallel tothe V.P. andinclined at 30°to theH.P.Draw its isometric view
3. Draw an isometricviewof a pentagonalprism ofbaseside30 mm andaxis 60 mmrestingonits basein theH.P. with afaceparallel andnearer to theV.P.
4. A pentagonalpyramidofbase side 30mmandaxis60mmlongisrestingona face onthe H.P.withaxisparallel totheV.P. Drawitsisometric viewinthe statedcondition.

TruncatedPrism

1. Draw isometric projection of the frustum of a pentagonal pyramid of base side 40 mm, topside20 mm and height 35 mm resting on its baseon the H.P
2. A triangular pyramid having a base 50 mm side and axis 65 mm long is resting on its basein the H.P. with a side of the base parallel to the V.P. It is cut by an A.I.P. inclined at 45°withtheH.P. and bisecting the axis. Draw its isometricview
3. Apaperweightisintheformofasphereofdiameter50mmtruncatedbyahorizontalplaneatadis tanceof40mmfromthetopmostpointofthesphere.Drawitsisometricprojection.

CombinedSolids

1. Aconeofbasediameter30mmandaxis50mmrestscentrallyoverasquareprismofbaseside50 mm andaxis 30 mm.Draw theisometricprojectionofthe arrangement
2. Asphericalballofdiameter60mmisplacedcentrallyoverasquareblockofside60mmandthickn ess 30 mm. Draw theisometricviewofthe arrangement
3. A hexagonal prism of base side 30 mm and axis 50 mm has an axially drilled circular holeofdiameter 30 mm. Draw its isometricprojection.

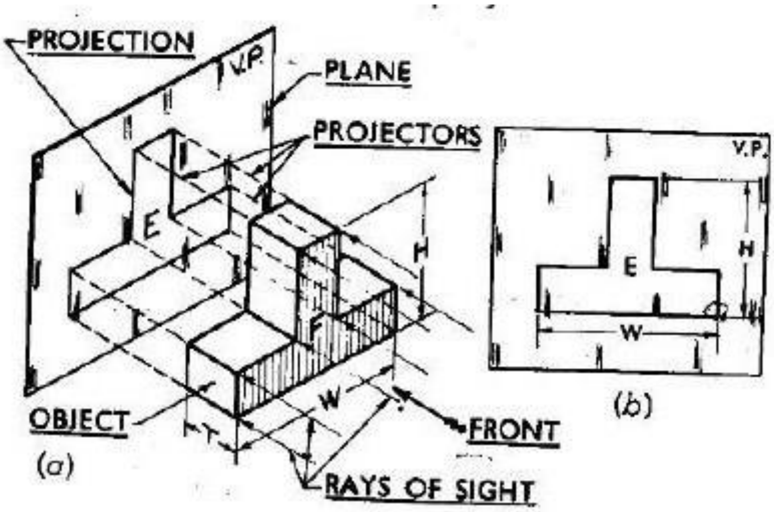
TRANSFORMATIONOFPROJECTIONS

Department of Mechanical Engineering

TransformationofProjections

Introduction

Projection:ProjectionisdefinedasanImageordrawingoftheobjectmadeonaplane.Thelinesform theobject to thePlanearecalled projectors.



MethodsofProjections: InEngineeringdrawingthefollowingfourmethodsofProjectionarecommonlyused they are

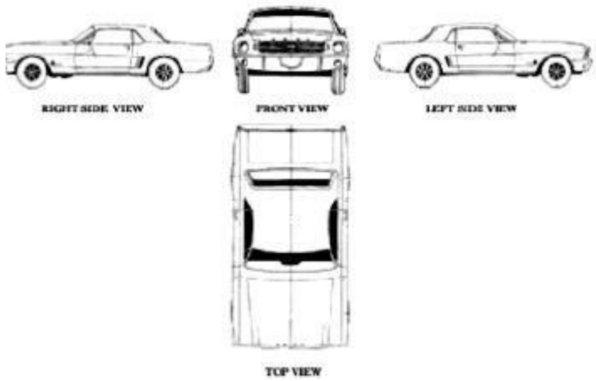
Orthographic
ProjectionIsometric
projectionOblique
projectionPerspectivePr
ojection

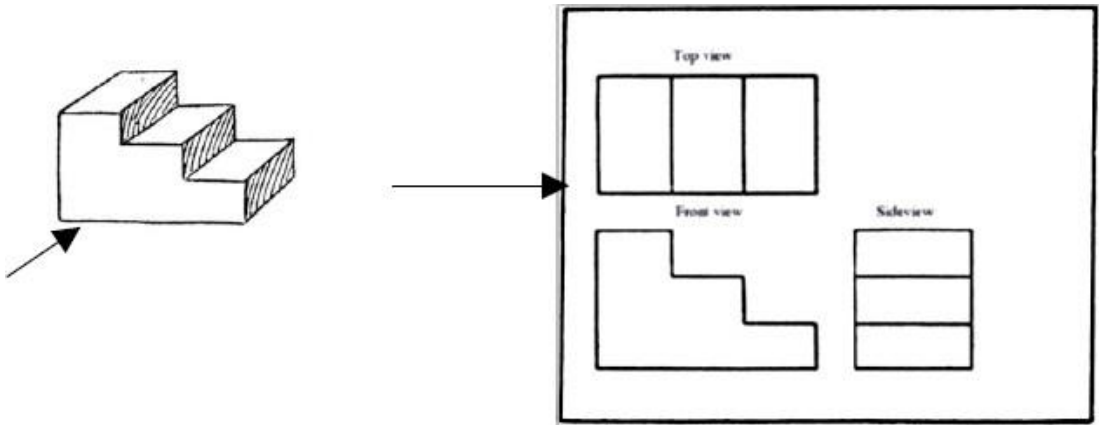
Inorthographicprojectionanobjectisrepresentedbytwoarethreeviewsonthemutualperpendicularprojection planeseachprojectionviewrepresents twodimensionsofanobject.

Iniso,obliqueandperspectiveprojectionsrepresentstheobjectbyapictorialviewaseyesseeit.Inthese methodsofprojectsinthreedimensionalobjectisrepresentedonaprojectionplaneby oneviewonly.

OrthographicProjection

WhentheProjectorsareparalleltoeachotherandalsoperpendiculartotheplanetheprojectioniscalled orthographicProjection
Example:Orthographicprojectionofa carshowninbelowfigure



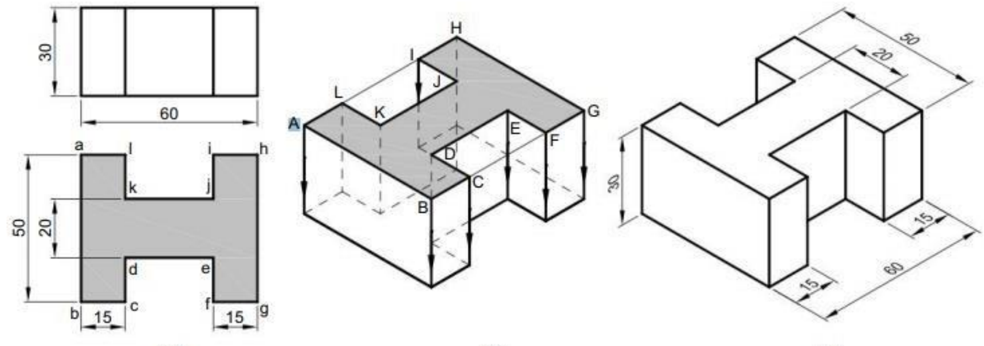


Orthographic Projection is a way of drawing an 3D object from different directions.Usually a front, side and plan view is drawn so that a person looking at the drawing canseealltheimportantsides.Orthographicdrawingsareusefulespeciallywhenadesignhasbeendevelopedto astagewhereby it isalmostready to manufacture.

Plane of projection: Two planes employed for the purpose of orthographic projectionsarecalledreferenceplanesorplanesofprojection.Theyareintersectingeachotheratrightangletoeachotherthe verticalplaneofprojectionisusuallydenotedbythelettersVPandthe other Plane is horizontal plane of Projection is denoted by HP. The line in which theyintersectis termed as thereferencelineand isdenoted by theletters XY.

Problems

1. Thefront andtopviewsof acasting areshown inFig.Draw itsisometricview.



(a) (b) (c)

2. Thefront andtop viewsofacastingareshown inFig. Drawits isometricview

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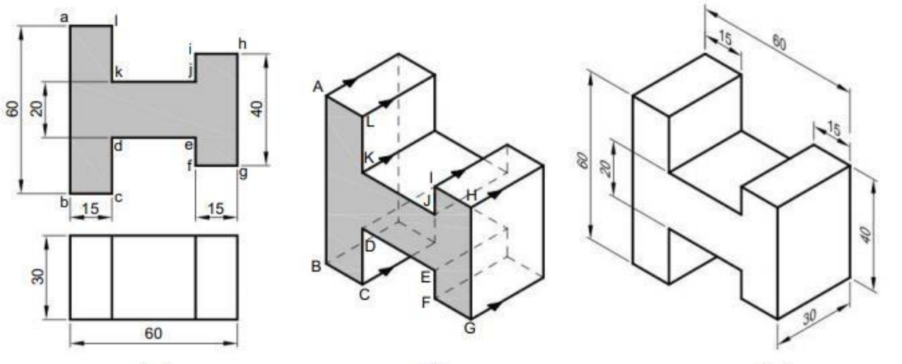
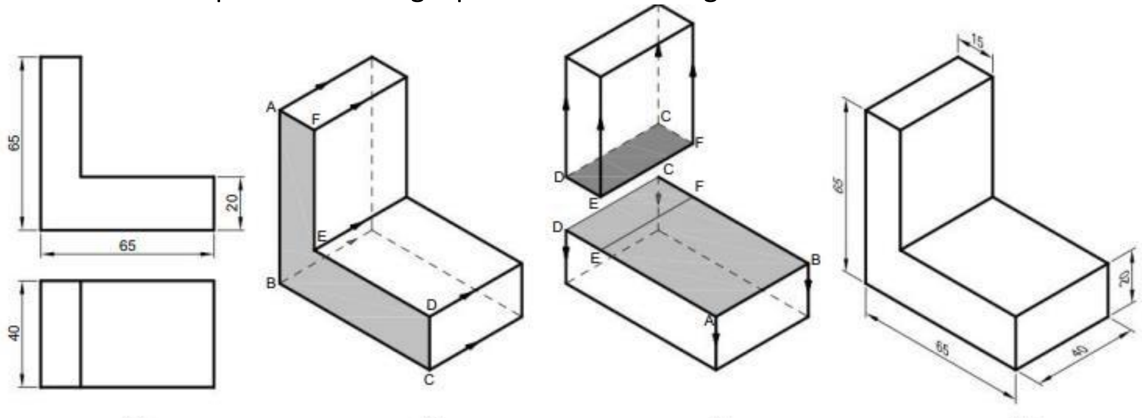


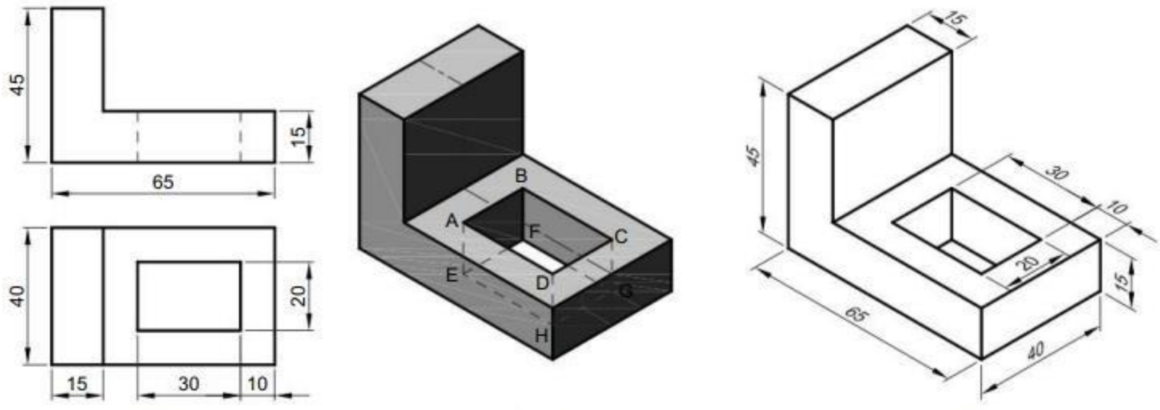
(a) (b) (c)

3. Thefront andtop viewsof anangle plateareshown inFig. Drawits isometricview.



(a) (b) (c) (d)

4. Thefront andtopviewsof anangle plateareshown inFig. Drawits isometricview.



(a) (b) (c)

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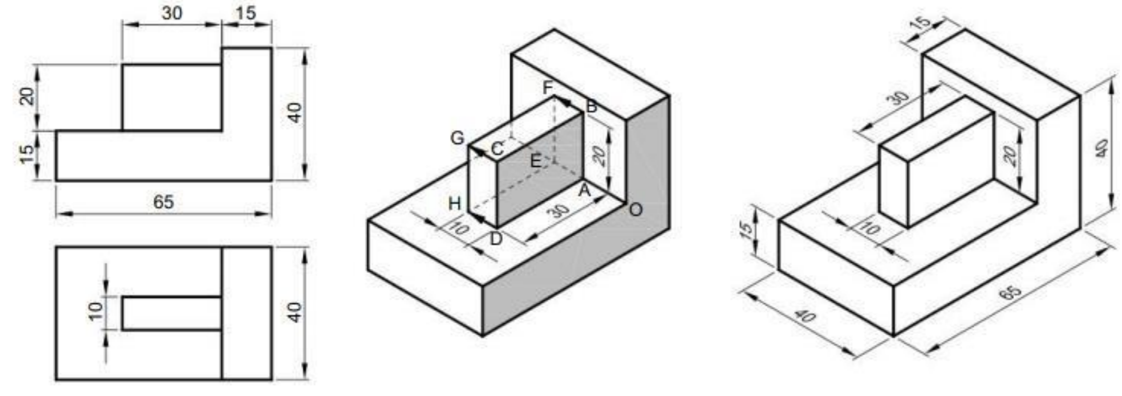
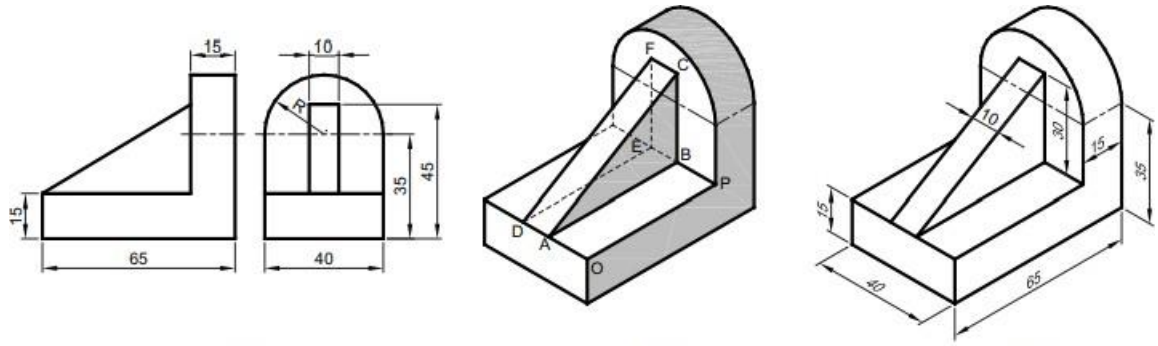
5. Thefront andtop viewsof an angleplateareshown inFig. Draw itsisometricview.



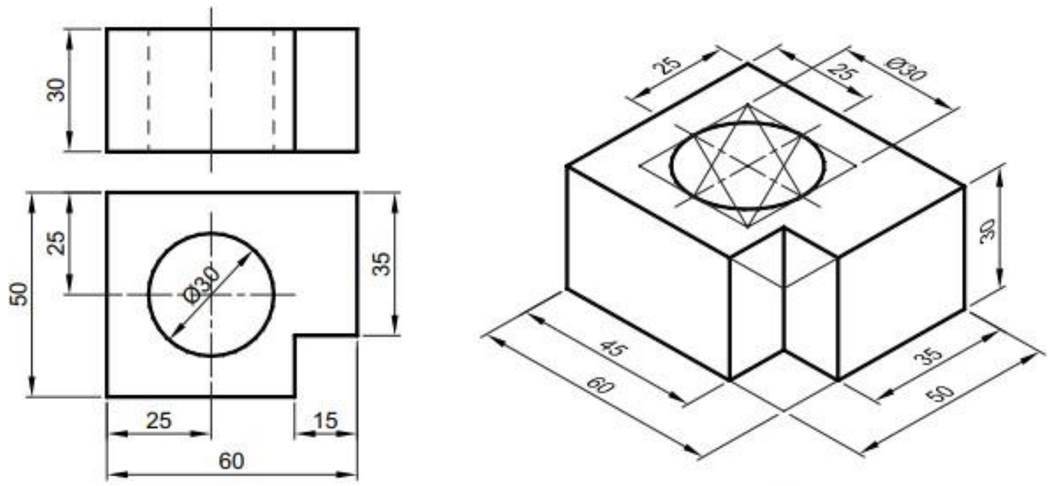
(a) (b) (c)

6. Thefront and sideviewsof anangle plateareshown in Fig. Drawits isometricview.



(a) (b) (c)

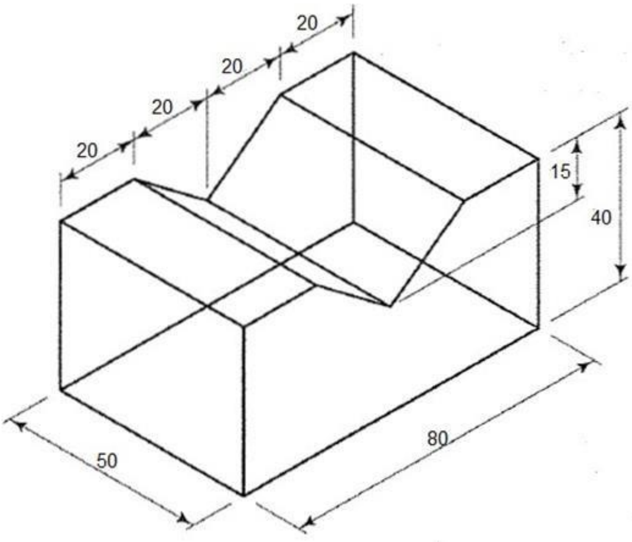
7. Thefront andtopviewsofacastingareshowninFig.Draw itsisometricview.



(a) (b)

SolvedProblems

1. Togenerate3DWireframemodelasshowninfigure,using3DAbsoluteCoordinateMetho dand 3DRectangularCoordinate Method.



Solution

Command:-VPOINT(□)

- Currentviewdirection:VIEWDIR=0.0000,0.0000,1.0000
- Specifyaviewpoint or[Rotate] <displaycompass andtripod>: 1,-1,1(□)
  - Regenerating

model.Command:□UCS()

- Currentucsname:*WORLD*
  - Enteranoption[New/Move/orthoGraphic/Prev/Restore/.../World]<World>:()

C□ommand: ZOOM() □

- Specify corner of window, enter a scale factor or nXP), or (nX[All/Center/Dynamic/Extents/Previous/Scale/...]<realtime>:ALL(C □

ommand:LINE(□)

- Specifyfirstpoint: 0,0,0(□)
- Specifynextpoint or[Undo]:50,0,0(□)
- Specifynextpoint or[Undo]: 50,80,0(□)
- Specifynextpointor[Close/Undo]:0,80,0(□)
  - Specifynextpointor[Close/Undo]:C(

) Co□mmand: LINE() □

- Specifyfirst point:50,0,0() □
- Specifynextpointor [Undo]:@0,0,40(□)
- Specifynextpointor[Undo]:@0,20,0(□)
- Specify next point or [Close/Undo]: @0,20,-15(□)
- Specifynextpointor[Close/Undo]:@0,20,15(□)
- Specifynextpointor[Close/Undo]:@0,20,0(□)

- Specifynextpointor[Close/Undo]:@0,0,-40( )
  - Specify next point

or[Close/Undo]:() Command:
LINE()

- Specifyfirstpoint: 0,0,0( )
- Specifynextpointor [Undo]:@0,0,40( )
- Specifynextpointor [Undo]:@0,20,0( )
- Specify next point or [Close/Undo]: @0,20,-15( )
- Specifynextpointor[Close/Undo]:@0,20,15( )
- Specifynextpointor[Close/Undo]:@0,20,0( )
- Specifynextpointor[Close/Undo]:@0,0,-40( )
- Specifynextpointor[Close/Undo]:( )

Command:
_qsaveCommand:_dima
ligned
Specifyfirstextensionlineoriginor<select object>:
Specifysecondextensionlineorigin:
Command:_dimlinear
Specifyfirstextensionlineoriginor<select object>:
Specifysecondextensionlineorigin:
Specify dimension line location or
[Mtext/Text/Angle/Horizontal/Vertical/Rotated]:Dimensiontext = 48.0000
Command:_dimedit
Enter type of dimension editing [Home/New/Rotate/Oblique] <Home>:
_oSelectobjects: 1 found
Enterobliquing angle(press ENTERfornone):30
Command:_qsave

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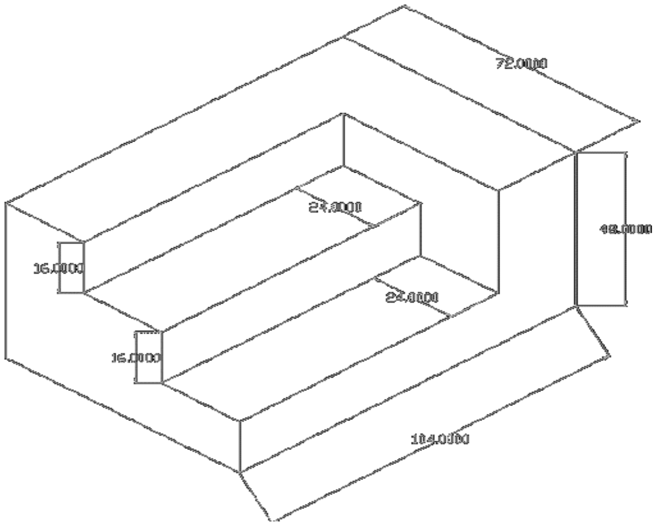
2. Drawthefollowingfigureusing ACAD



Solution

COMMANDSUSED

Line,Dimensions,Draftingcommands

PROCEDURE

Command:-VPOINT( )

- Currentviewdirection:VIEWDIR=0.0000,0.0000,1.0000
- Specifyaviewpointor[Rotate] <displaycompassand tripod>:1,-1,1( )
  - Regenerating

model.Command:UCS()

- Currentucsname:*WORLD*
  - Enter

anoption[New/Move/orthoGraphic/Prev/Restore/.../World]<World>:()Command: ZOOM()

- Specify corner of window, enter a scale factor or nXP), or (nX[All/Center/Dynamic/Extents/Previous/Scale/...]<realtime>:ALL(

<Ortho on><Isoplane Top><Osnap on>Command:LINE()
Specify next point or [Undo]: @ 0,0,0Specify next point or [Undo]: @ 72,0,0Specify next point or [Undo]: @ 72,104,0Specify next point or [Undo]: @ 0,104,0Specifynextpoint)
or[Close/Undo]:C(

Command:LINE()
Specify next point or [Undo]: @ 0,0,0Specifynextpointor[Undo]:@0,48,0

Specify next point or [Undo]: @
24,0,0Specify next point or [Undo]: @
24,-16,0Specify next point or [Undo]: @
24,0,0Specify next point or [Undo]: @
24,-16,0Specify next point or [Undo]: @
24,0,0Specify next point or [Undo]: @
24,-16,0Specify next point or □)
[Close/Undo]: C (Command:LINE()
Specify next point or [Undo]: @
0,0,0Specify next point or [Undo]: @
72,16,0Specify next point or [Undo]: @
80,0,24Specify next point or [Undo]: @
-80,0,0Specify next point or □)
[Close/Undo]: C (Command:LINE()
Specify next point or [Undo]: @
72,32,24Specify next point or [Undo]: @
80,0,24Specify next point or [Undo]: @ -
80,0,0Specify next point or □)
[Close/Undo]: C (Command:LINE()
Specify next point or [Undo]: @
0,48,0Specify next point or [Undo]: @
104,0, 72Specify next point or [Undo]: @
-24,0, 72Specify next point or [Undo]: @
-24,0, 48Specify next point or [Undo]: @
24,0, 0Specifynextpoint or[Close/Undo]:□)
C(

Command:
_qsaveCommand:_dima
ligned
Specifyfirstextensionlineoriginor<select object>:
Specifysecondextensionlineorigin:
Command:_dimlinear
Specifyfirstextensionlineoriginor<select object>:
Specifysecondextensionlineorigin:
Specify dimension line location or
[Mtext/Text/Angle/Horizontal/Vertical/Rotated]:Dimensiontext = 48.0000
Command:_dimedit
Enter type of dimension editing [Home/New/Rotate/Oblique] <Home>:
_oSelectobjects: 1 found
Enterobliquing angle(press ENTERfornone):30
Command:_qsave

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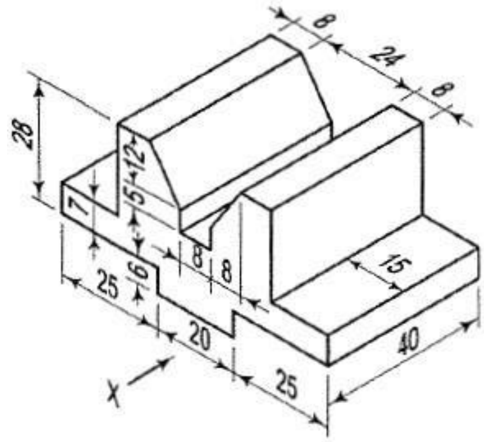
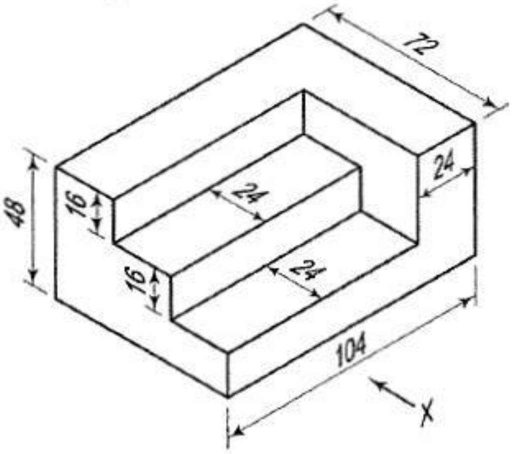
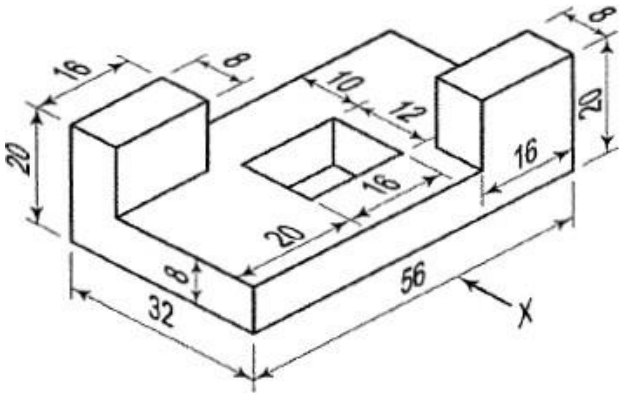
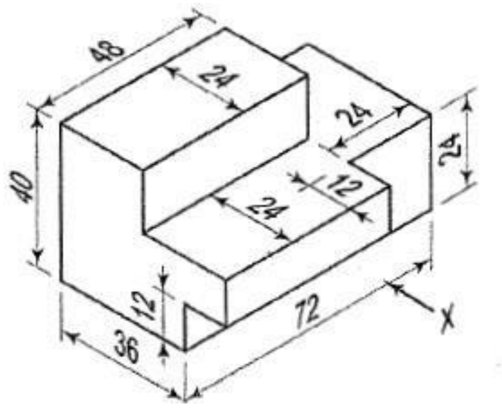
ConvertIsometrictoOrthographic

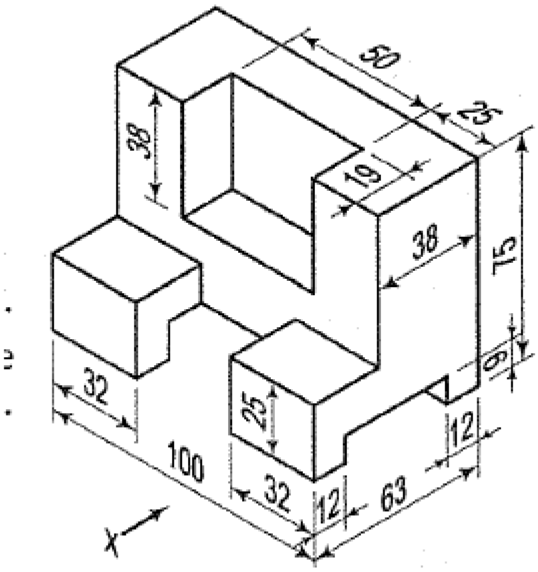
1. Drawthe(i)Frontview(ii)TopView(iii)SideviewoftheFollowing IsometricDrawingsusing AutoCAD

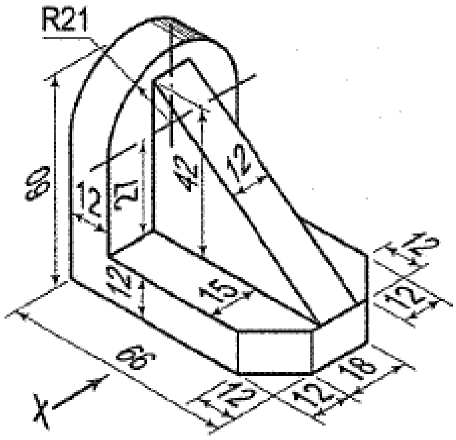












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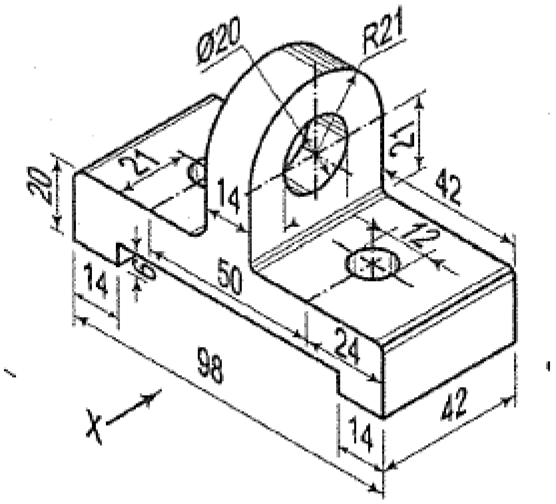

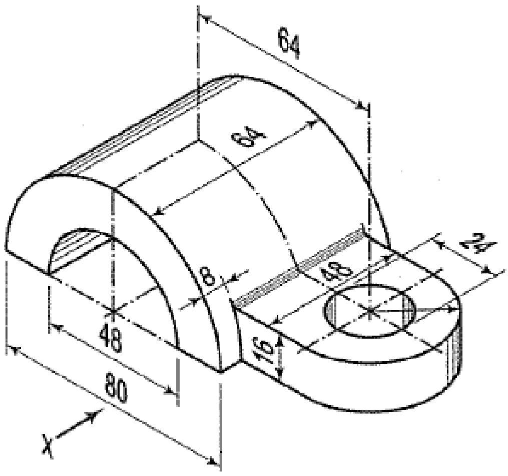

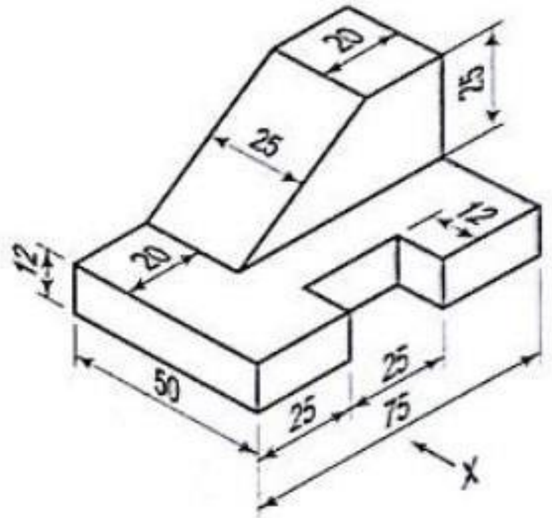

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