Subject Title	COMPUTER AIDED MACHINE DRAWING		
Subject Code	**17ME36A**	**IA Marks**	40
Number of Lecture Hrs / Week	05	**Exam Marks**	60
Total Number of Lecture Hrs	50	**Exam Hours**	03
CREDITS – 04			

FACULTY DETAILS:		
Name: Prof.Mahantesh Tanodi	**Designation:** Asst.Professor	**Experience:**06
No. of times course taught: 07	**Specialization:** Machine Design	

4.0 Course Content

PART A

INTRODUCTION TO COMPUTER AIDED SKETCHING

Review of graphic interface of the software. Review of basic sketching commands and navigational commands. **(2 Hours)**

Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problemson, axis inclinations, spheres and hollow solids), True shape of section. **(4 Hours)**

Orthographic views: Conversion of pictorial views into orthographic projections of simple machine parts with or without section.(Bureau of Indian Standards conventions are to be followed for the drawings), Hidden line conventions, Precedence of lines. **(4 Hours)**

Thread forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal and External),square, Acme and Sellers thread, American Standard thread.

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simpleassembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grubscrew, Allen screw. **(8 Hours)**

PART B

Keys and Joints: Parallel, Taper, Feather Key, Gib head key and Woodruff key
Riveted joints: Single and double riveted lap joints, Butt joints with single/double cover straps (Chain and zigzag using snap head riveters).

Joints: Cotter joint (socket and spigot), Knuckle joint (pin joint) for two rods. **(8 Hours)**

Couplings: Split muff coupling, Protected type flange coupling, Pin (bush) type flexible coupling, Oldham's coupling and Universal coupling (Hook's Joint). **(6 Hours)**

PART C

Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry. **(3 Hours)**

Assembly Drawings: (Part drawings shall be given)

1. Plummer block (Pedestal Bearing)
2. Rams Bottom Safety Valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Tailstock of lathe
6. Machine vice
7. Lathe square tool post **(15 Hours)**

PART A

Sections of Solids:

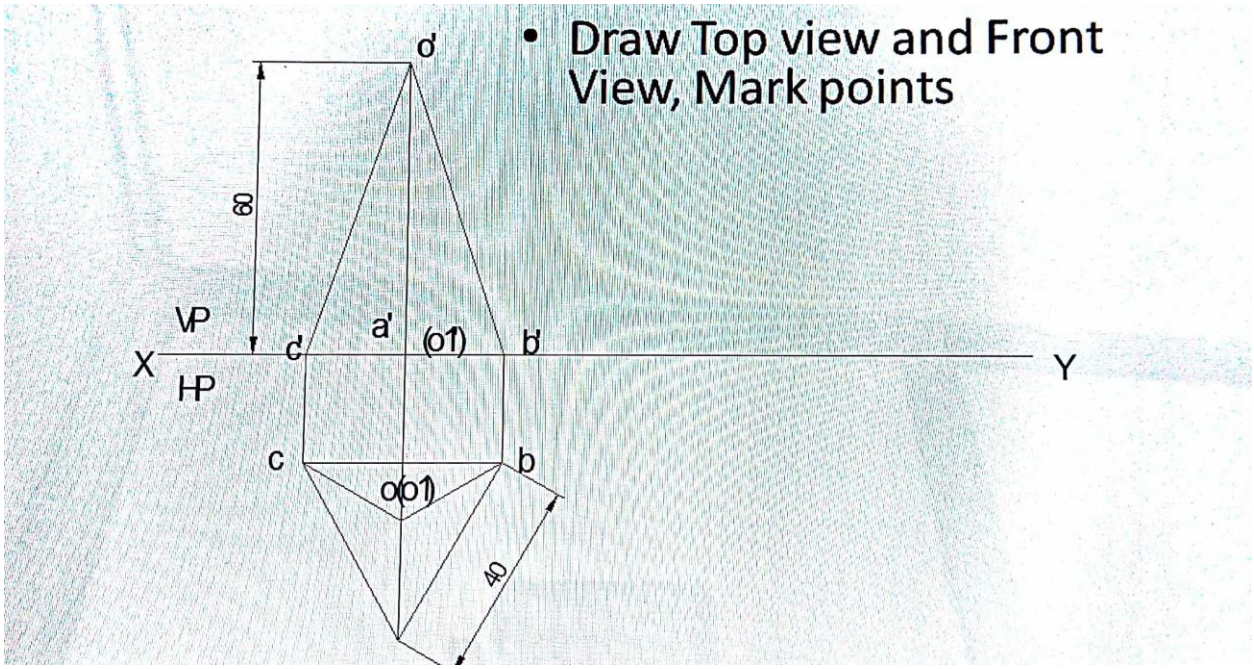
Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problemson, axis inclinations, spheres and hollow solids), True shape of section. **(4 Hours)**

Problem 1: A triangular pyramid, base 40mm sides and axis 60mm long, resting on its base on the HP with one of its edges parallel to the VP. A section plane passing through one of the base corners of the pyramid and the two slant edges at 20mm and 30mm above HP cuts the pyramid .Draw the front view, sectional top view and true shape of the section. Determine the inclitation of the section plane with the reference plane.

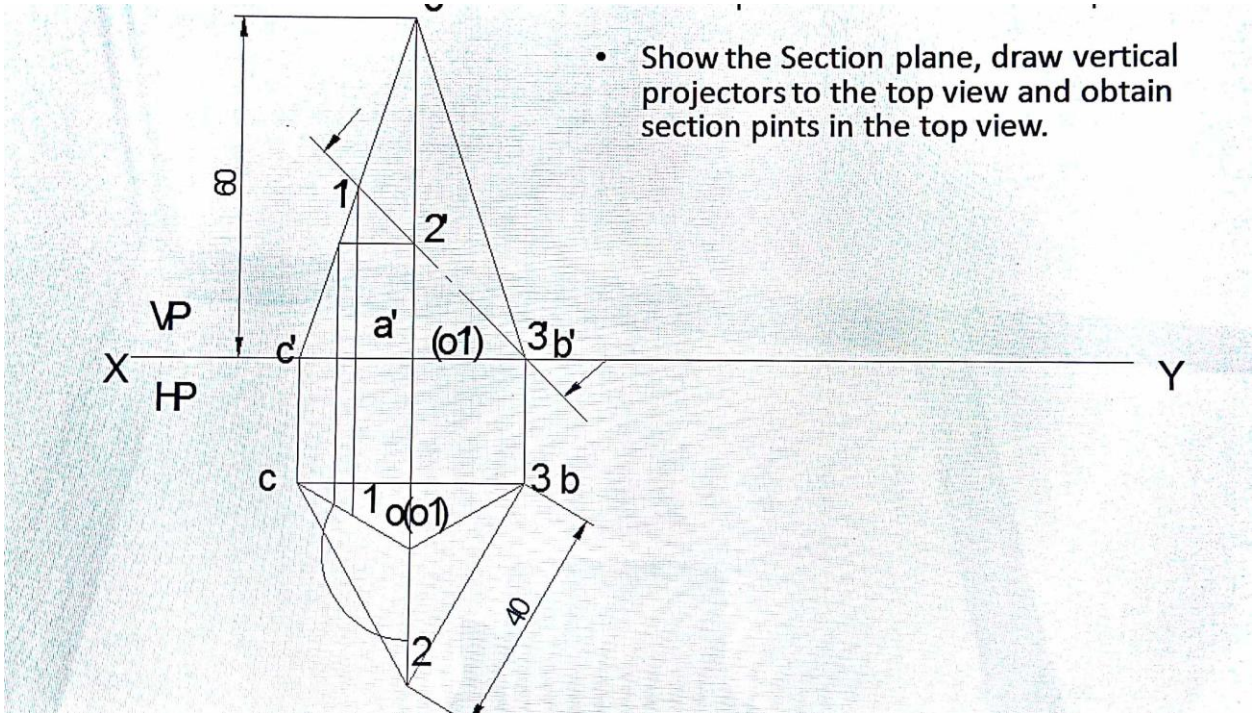
Step 1

Draw XY line, mark HP and VP.

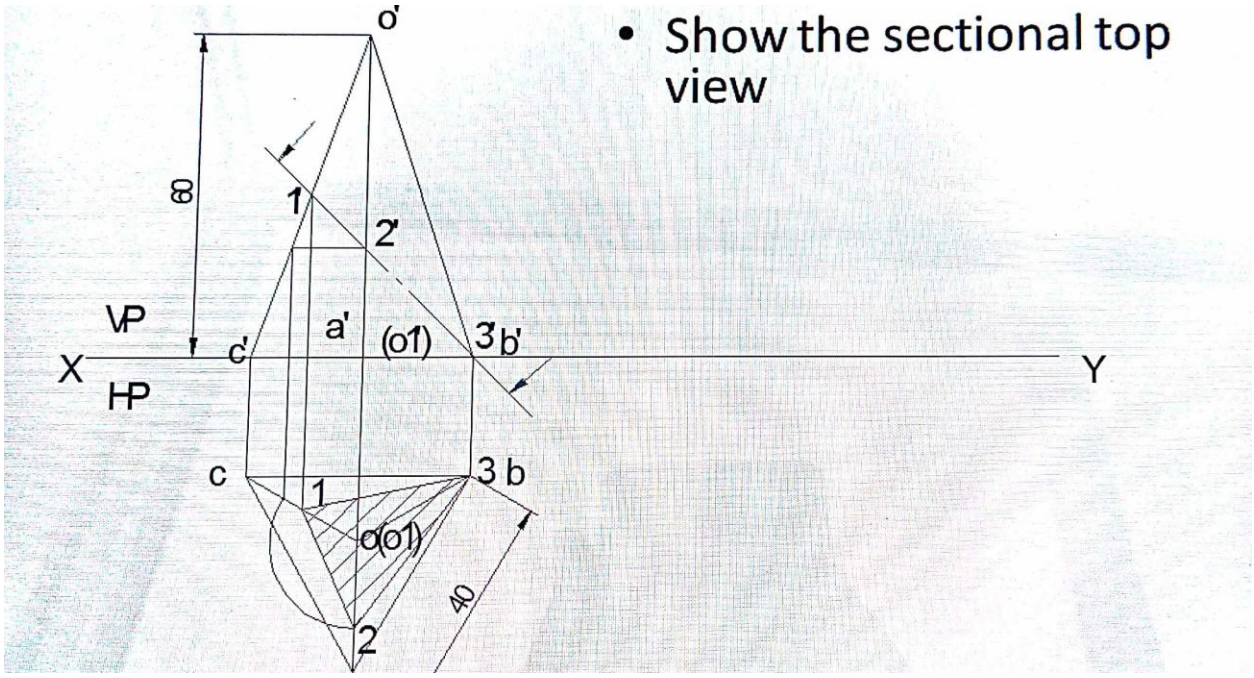
Step 2



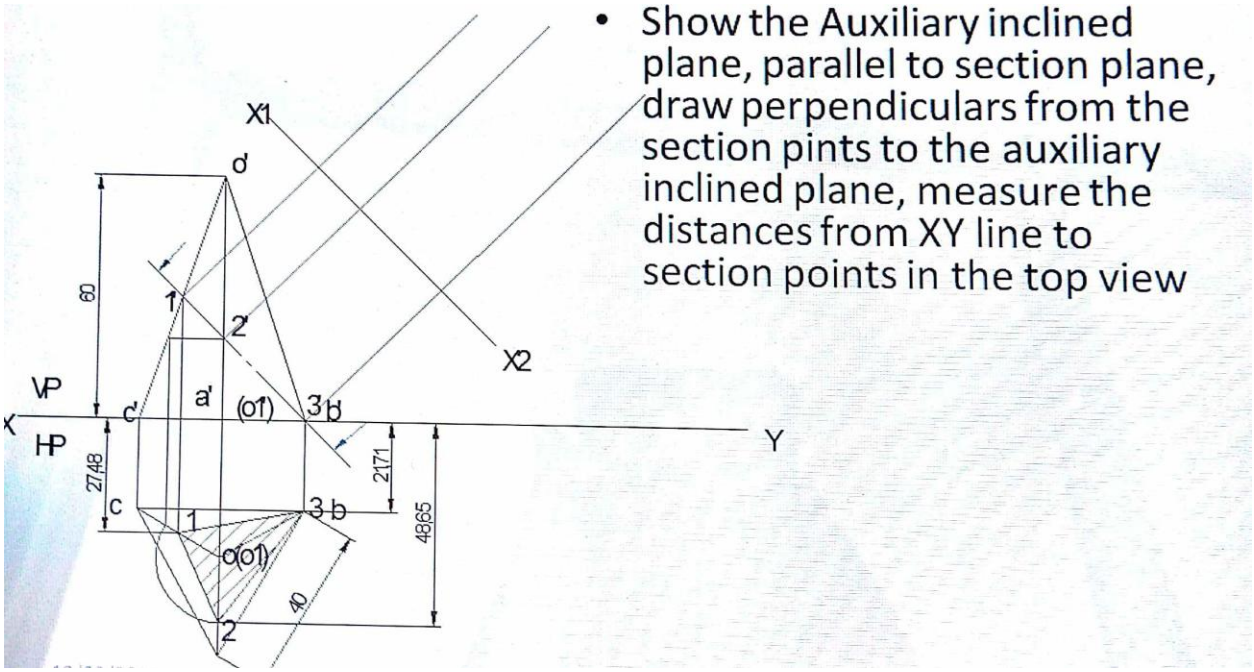
Step 3


• Show the Section plane, draw vertical projectors to the top view and obtain section pints in the top view.
60
1
2'
VP
a'
(o1)
3 b'
X
HP
c'
Y
c
1
o(o1)
3 b
40
2

Step 4

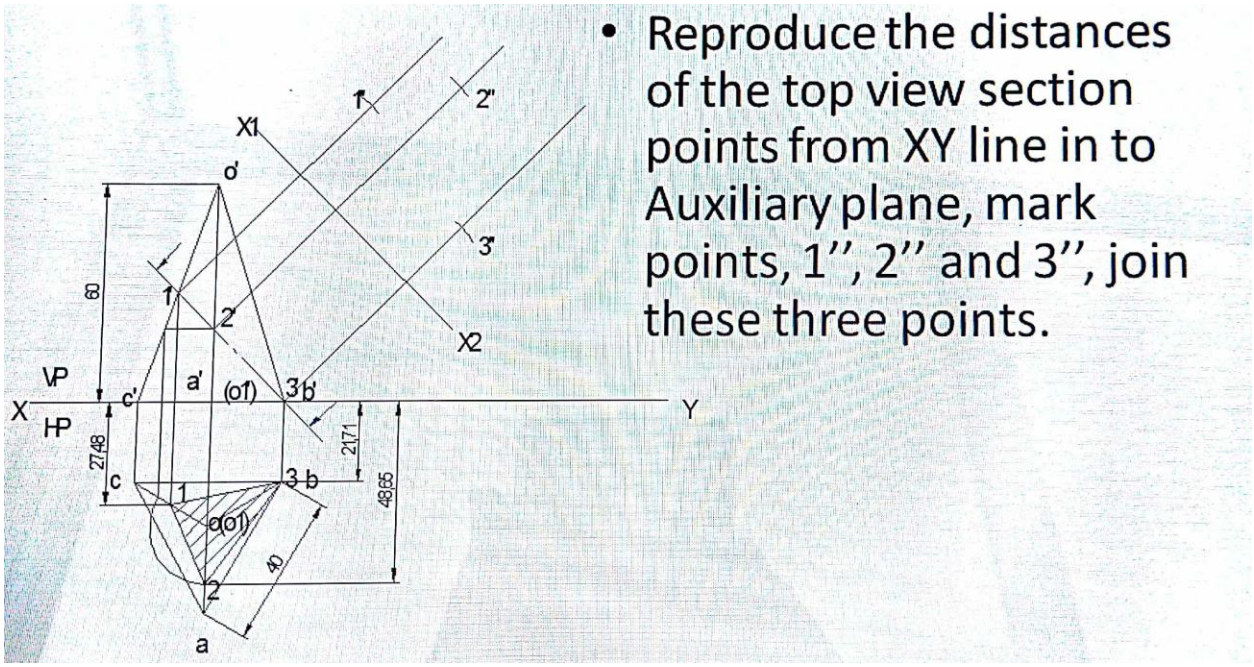

o'
• Show the sectional top view
60
1
2'
VP
a'
(o1)
3 b'
X
HP
c'
Y
c
1
3 b
o(o1)
40
2

Step 5



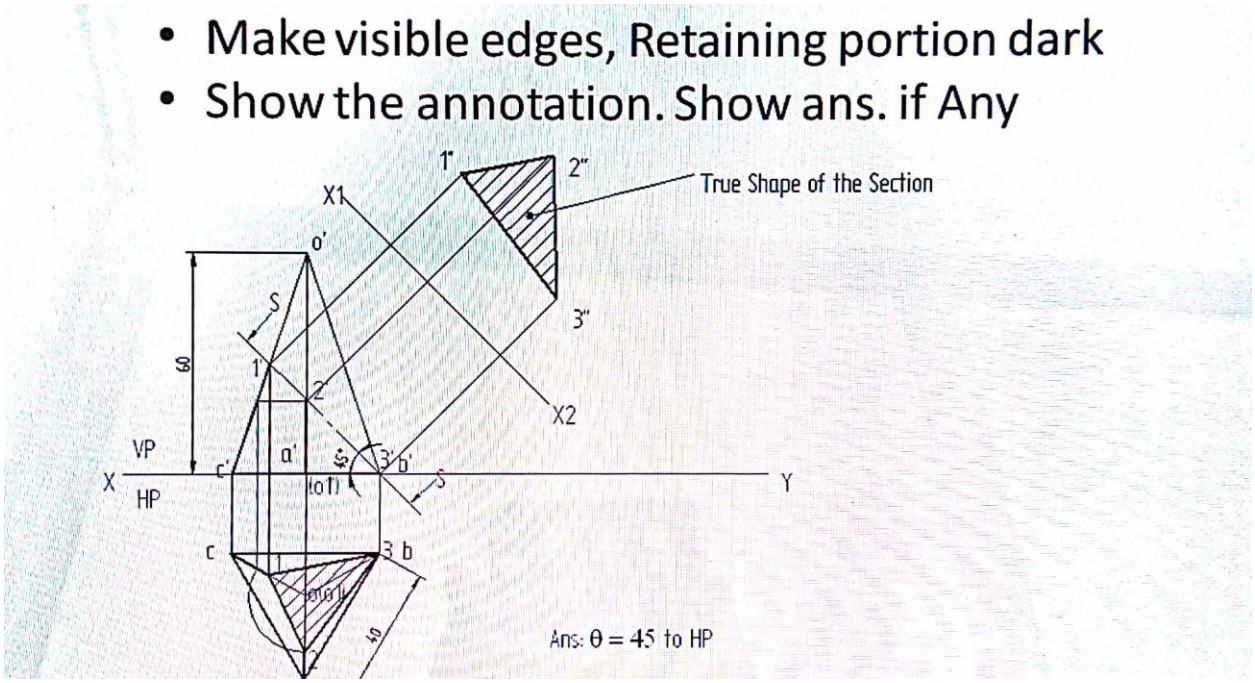
- Show the Auxiliary inclined plane, parallel to section plane, draw perpendiculars from the section pints to the auxiliary inclined plane, measure the distances from XY line to section points in the top view

Step 6

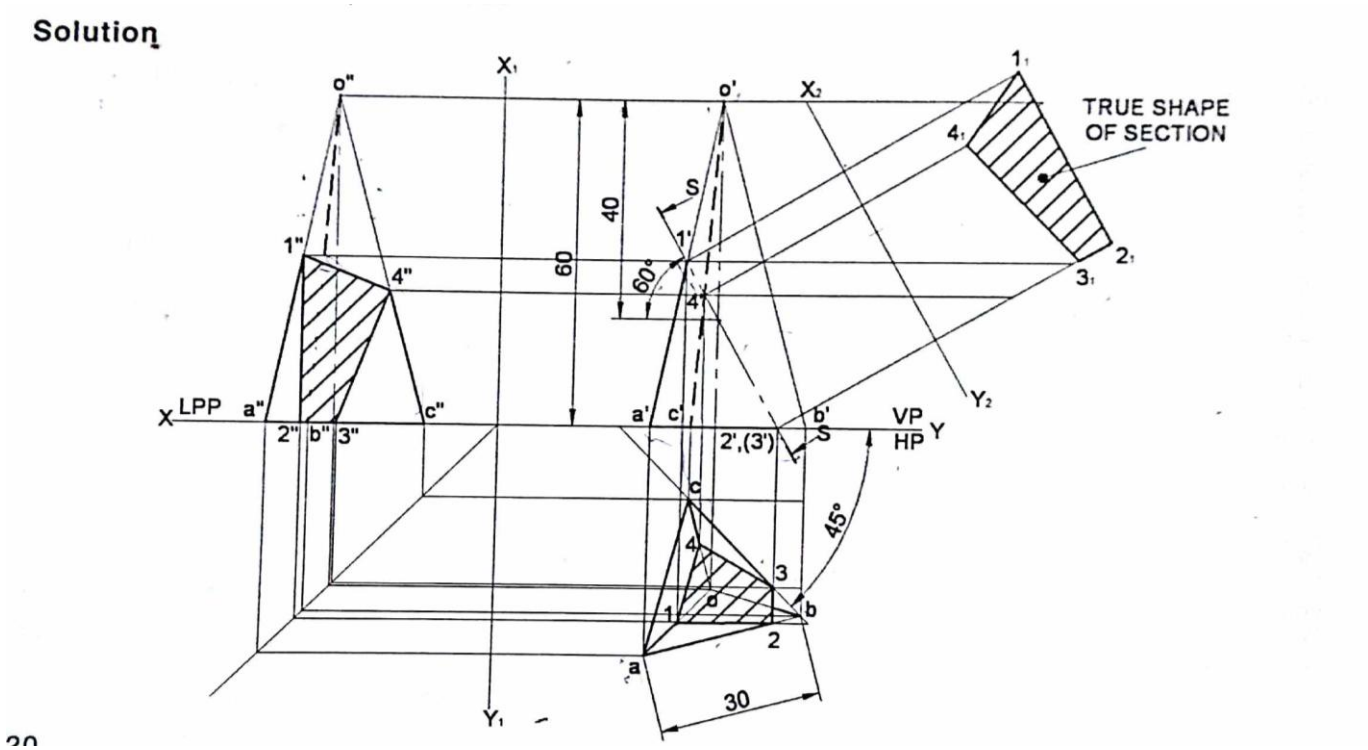


- Reproduce the distances of the top view section points from XY line in to Auxiliary plane, mark points, 1'', 2'' and 3'', join these three points.

Step 7

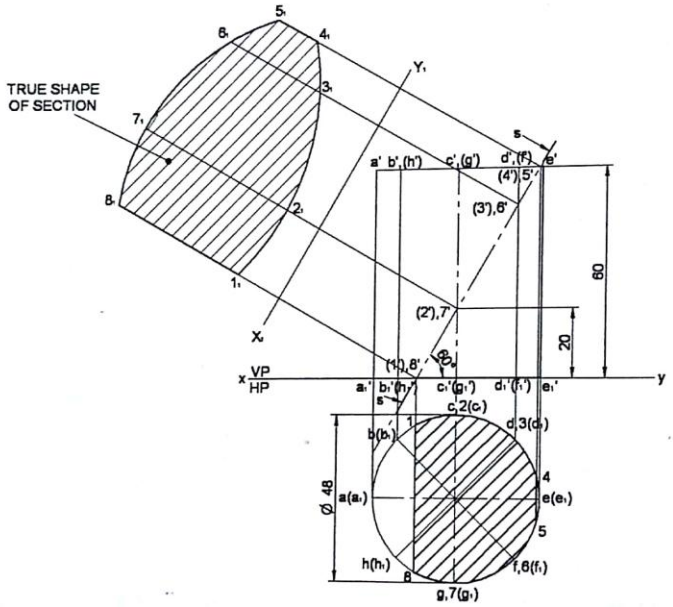


Problem 2: An equilateral triangular pyramid of 30mm side of base and axis 60mm long rests with its base on HP such that one of the base edges is inclined at 45o to the VP and nearer to it. It is cut by a section plane inclined at 60o to the HP and perpendicular to the VP, intersecting the axis at 40 mm from the vertex. Draw the front view, sectional views looking from the top and right side along with the cut solid. Also project the true shape of section.

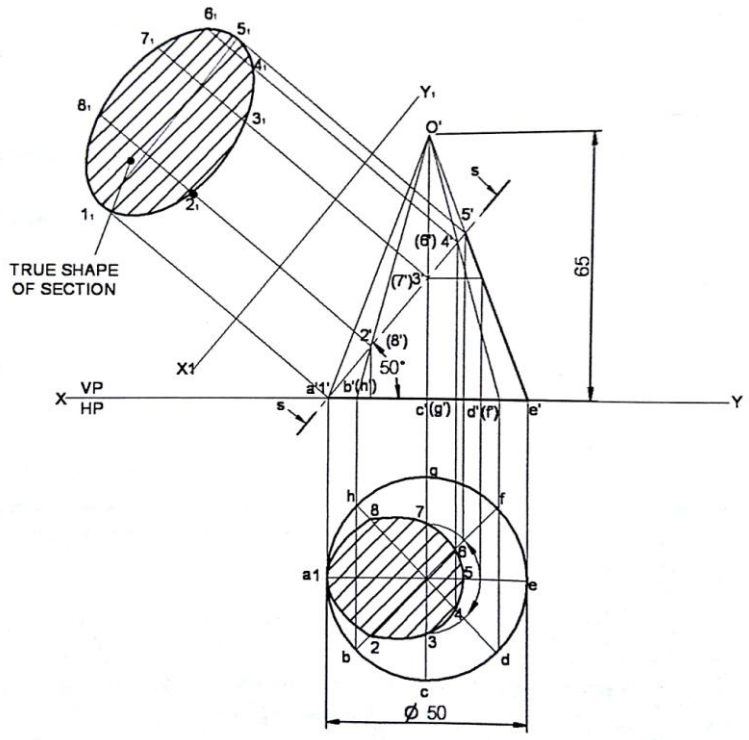


Problem 2.39. A cylinder 48mm diameter of base and 60mm long rests vertically on the HP. It is cut by a section plane perpendicular to VP inclined at 60° to the HP in such a way that it meets the axis at a point 20mm from the base. Draw the apparent sectional view and true shape of section.

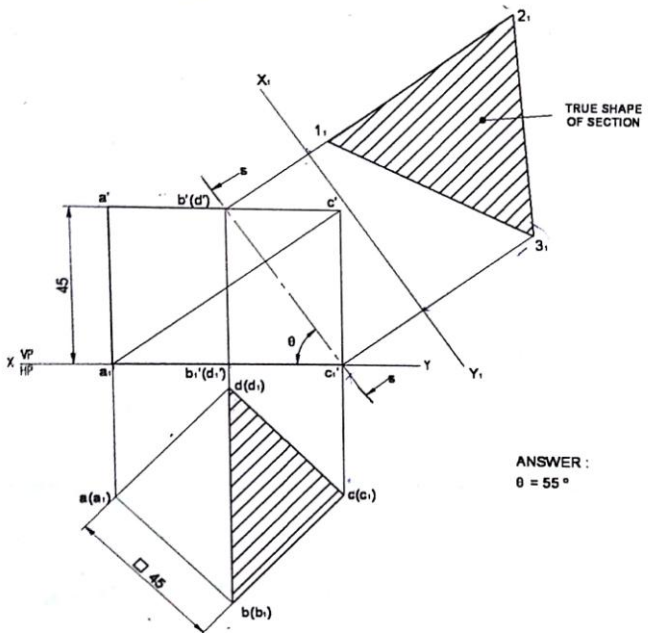
Solution



Problem 2.18. A cone of base diameter 50mm and axis length 65mm rests with its base on the HP. Draw the true shape of section made by a section plane perpendicular to the VP and inclined to the HP at 50° and passing through an end point on the circumference of the base circle of the cone.



Problem 2.23. A cube of 45mm edge rests on one of its faces on the ground with its base edges equally inclined to the VP. A VT perpendicular to one of the solid diagonals cuts the solid through one of its base corners. Draw the sectional top view, true shape of section and determine the inclination of the section plane with the reference plane.



ANSWER :
θ = 55 °

Orthographic views: Conversion of pictorial views into orthographic projections of simple machine parts with or without section.(Bureau of Indian Standards conventions are to be followed for the drawings), Hidden line conventions, Precedence of lines. **(4 Hours)**

Problem 3.38. Fig P3.38 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

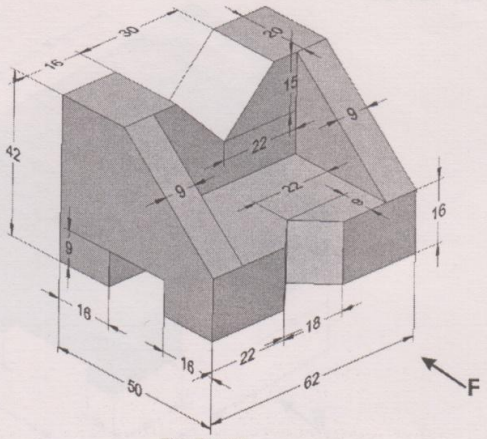
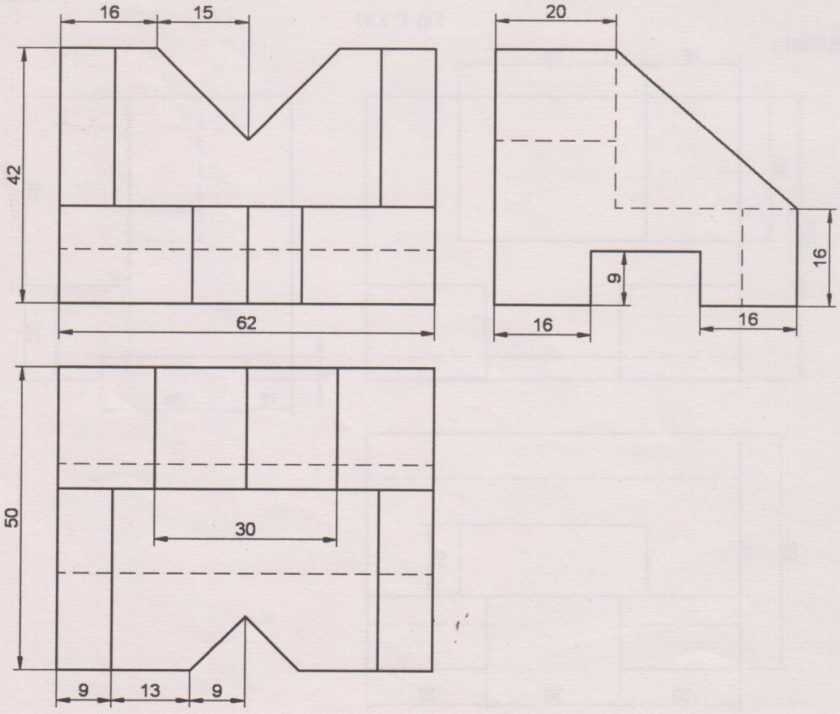


Fig. P 3.38

Solution :



Problem 3.9. Fig. P3.9 shows a machine component. Draw the following views:

(a) Sectional front view
(b) Top view and
(c) Side view from left

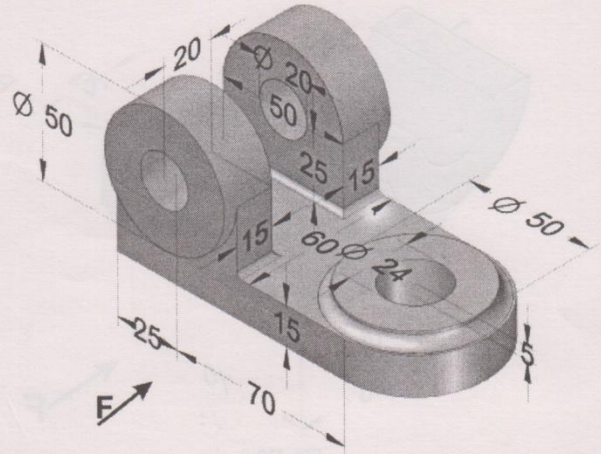
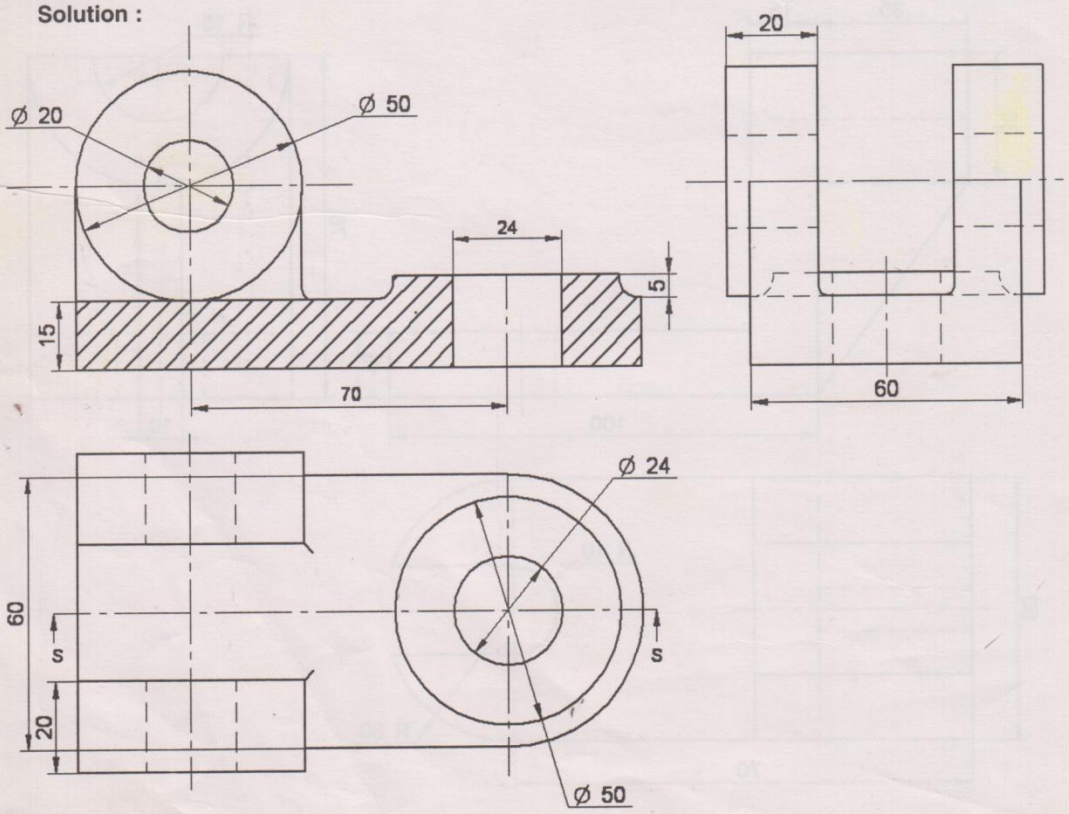


Fig. P3.9

Solution :



Problem 3.8. Fig. P3.8 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

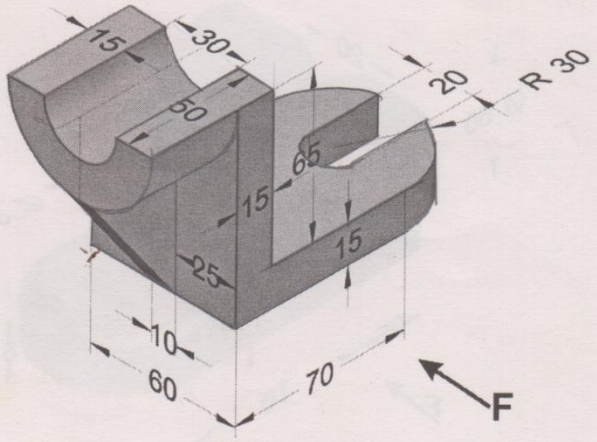
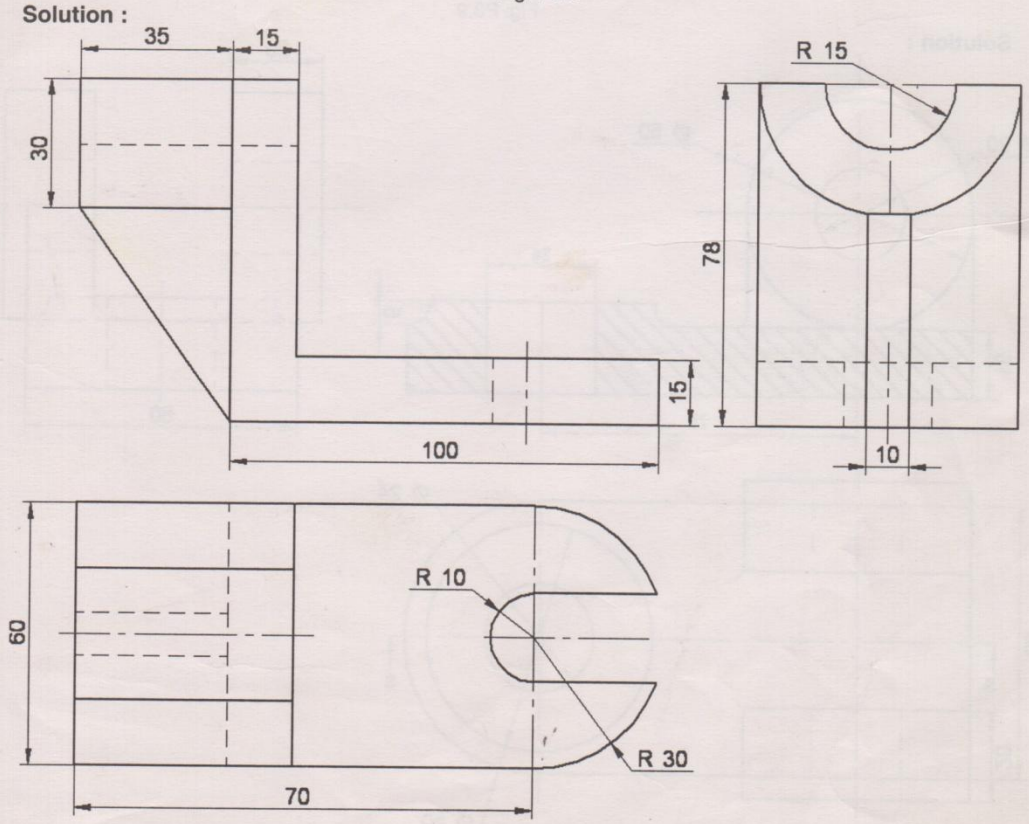


Fig. P3.8

Solution :



Problem 3.7. Fig. P3.7 shows a machine component. Draw the following views:

(a) Sectional front view
(b) Top view and
(c) Left side view

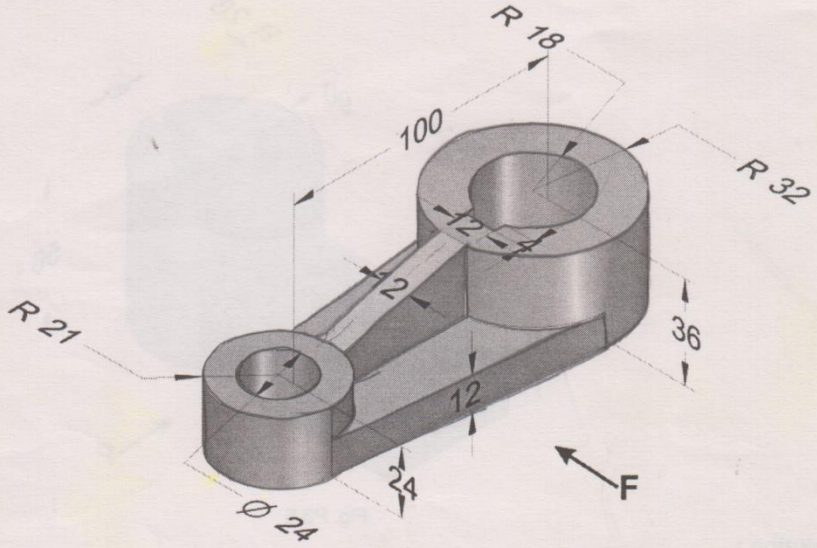
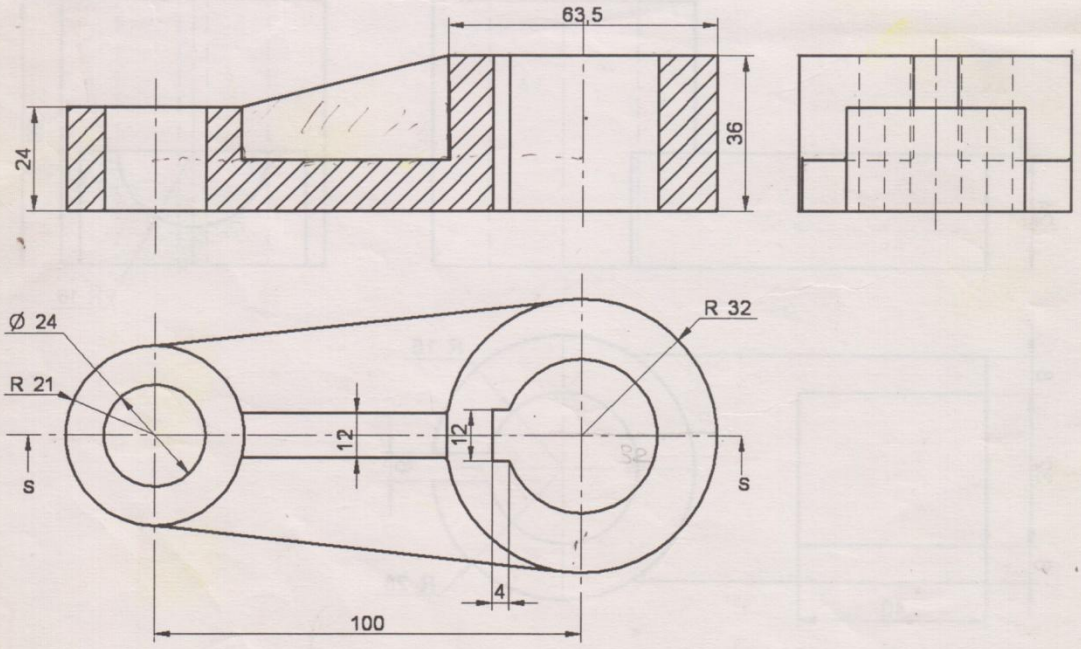


Fig. P3.7

Solution :



Problem 3.6. Fig. P3.6 shows a machine component. Draw the following views:

(a) Front view
(b) Side view from left and
(c) Top view

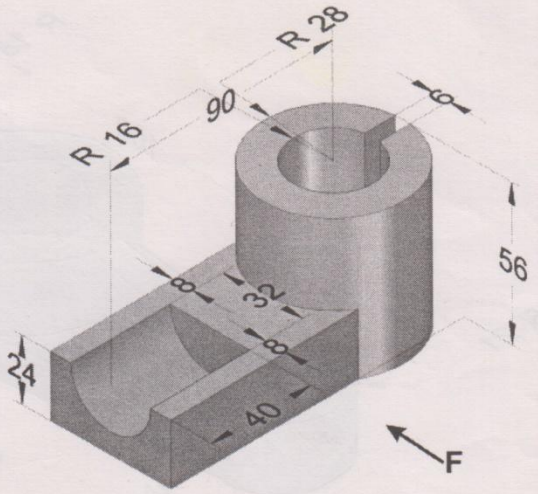
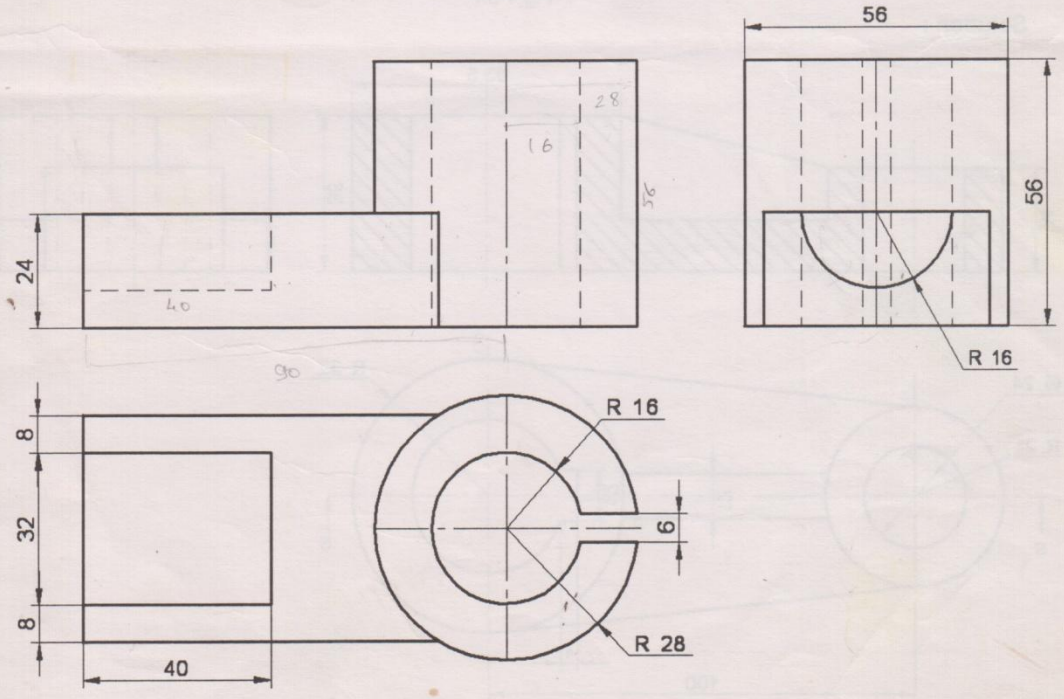


Fig. P3.6

Solution :



Problem 3.10 Fig. P3.10 shows a machine component. Draw the following views:

(a) Sectional front view
(b) Top view and
(c) Left side view

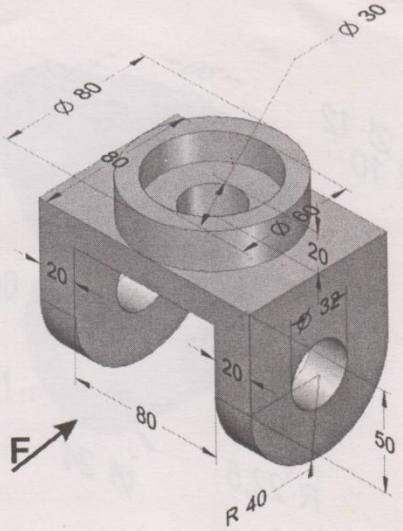
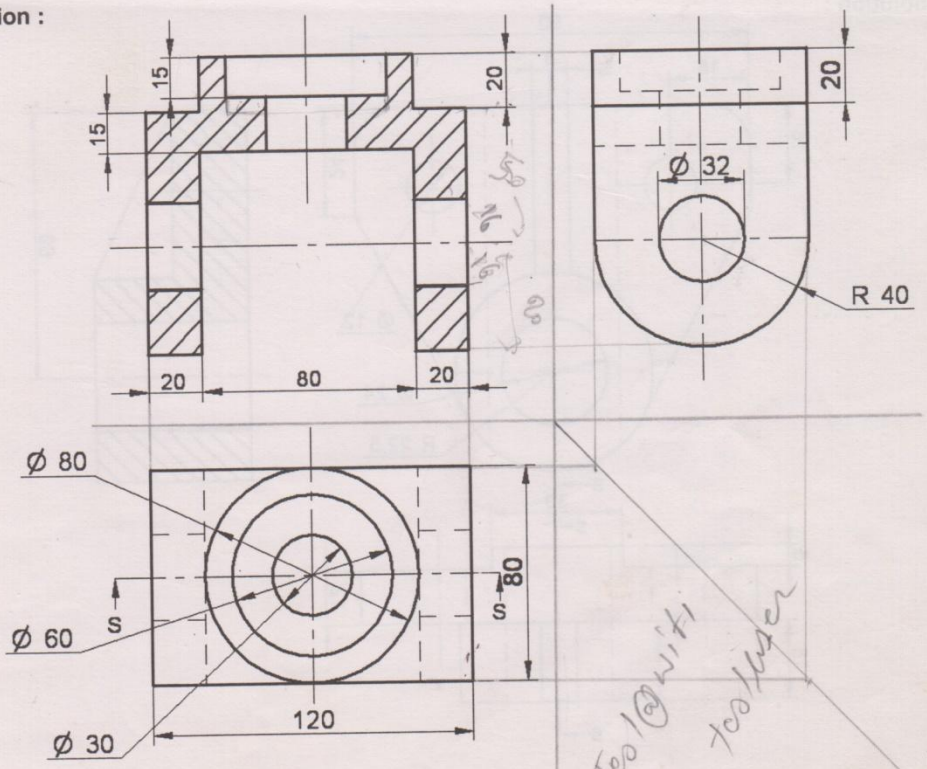


Fig. P3.10

Solution :



Problem 3.31. Fig P3.31 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

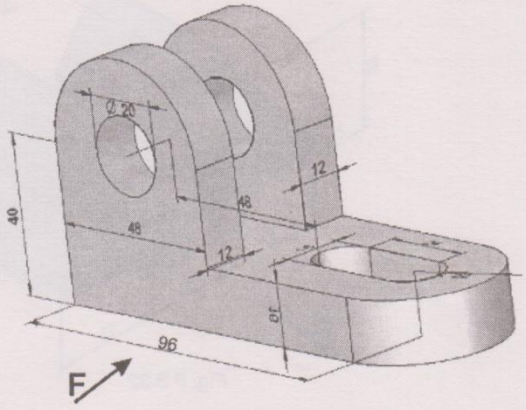
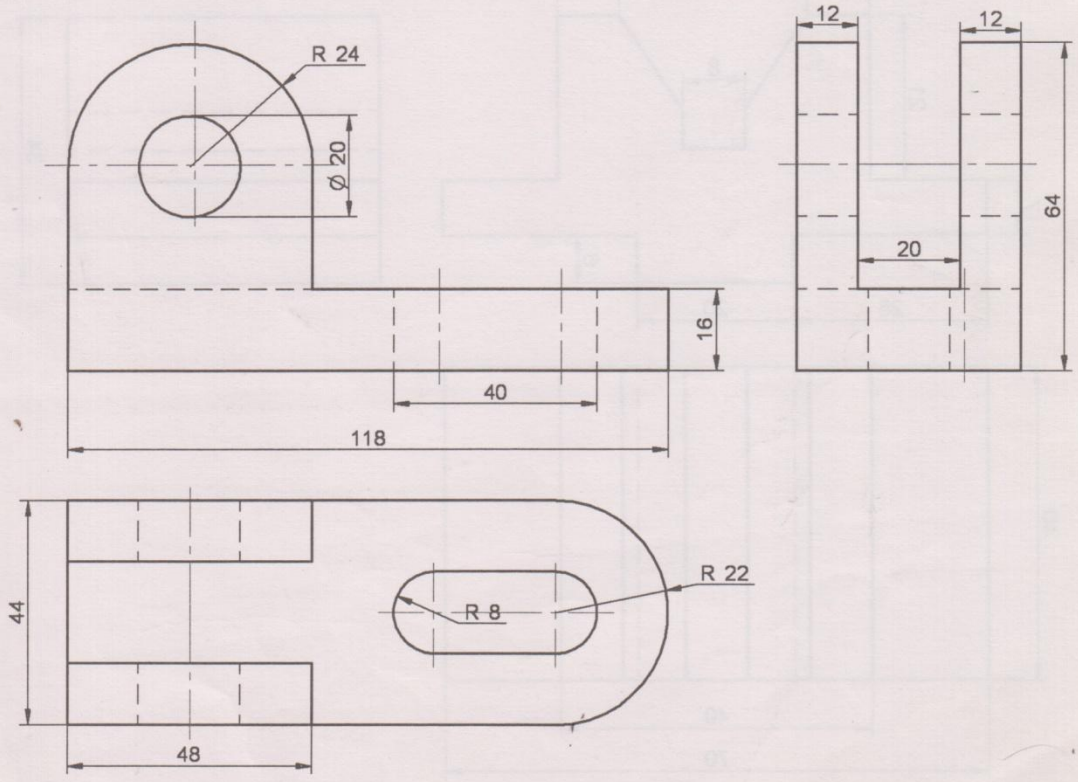


Fig. P 3.31

Solution :



Problem 3.32. Fig P3.32 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

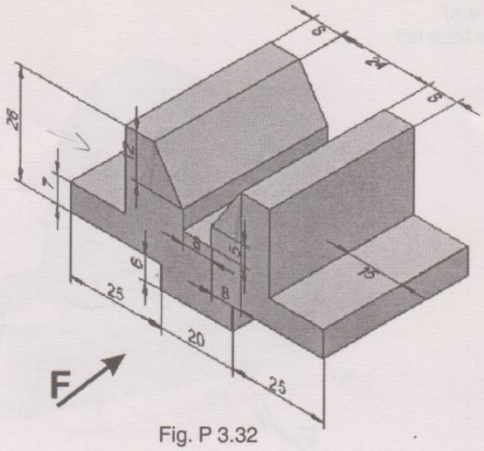
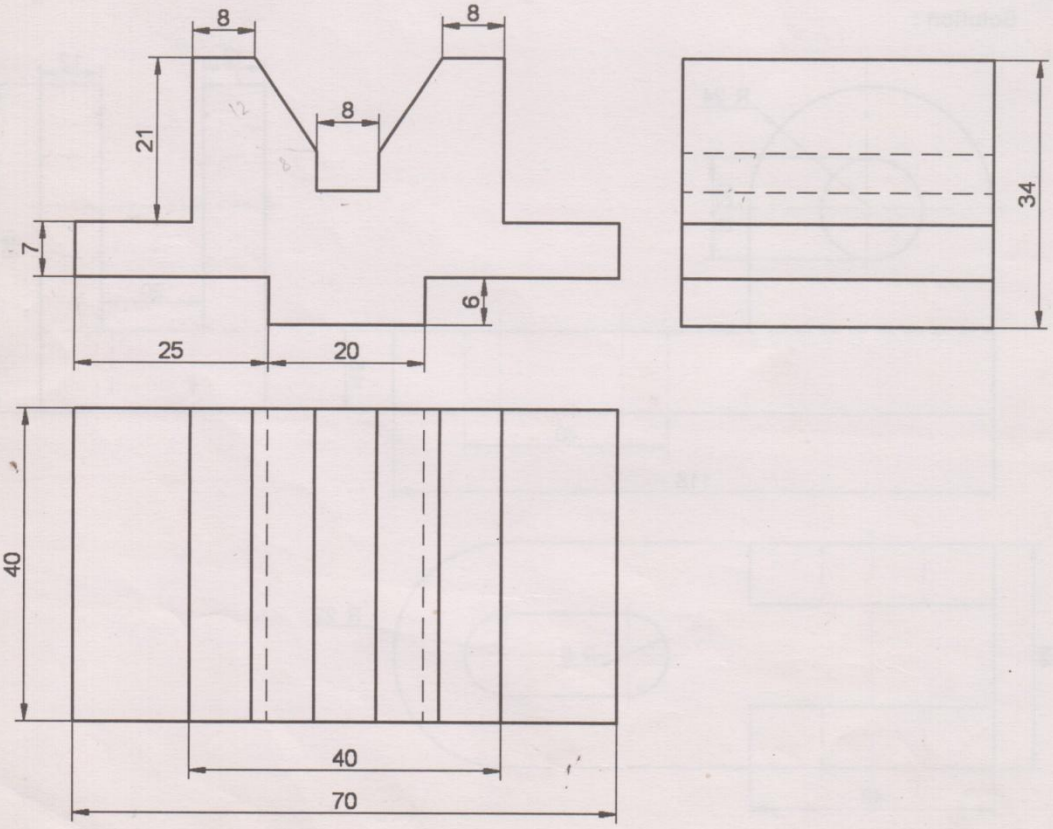


Fig. P 3.32

Solution :



Problem 3.37. Fig P3.37 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

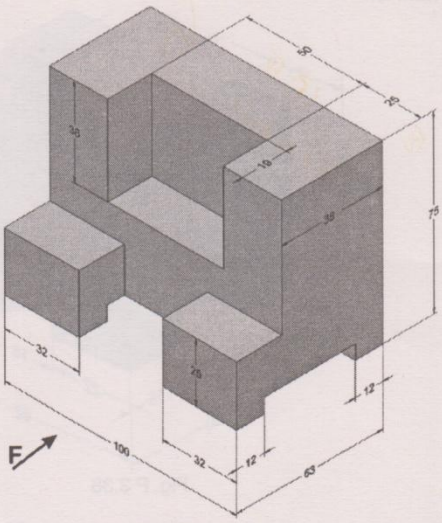
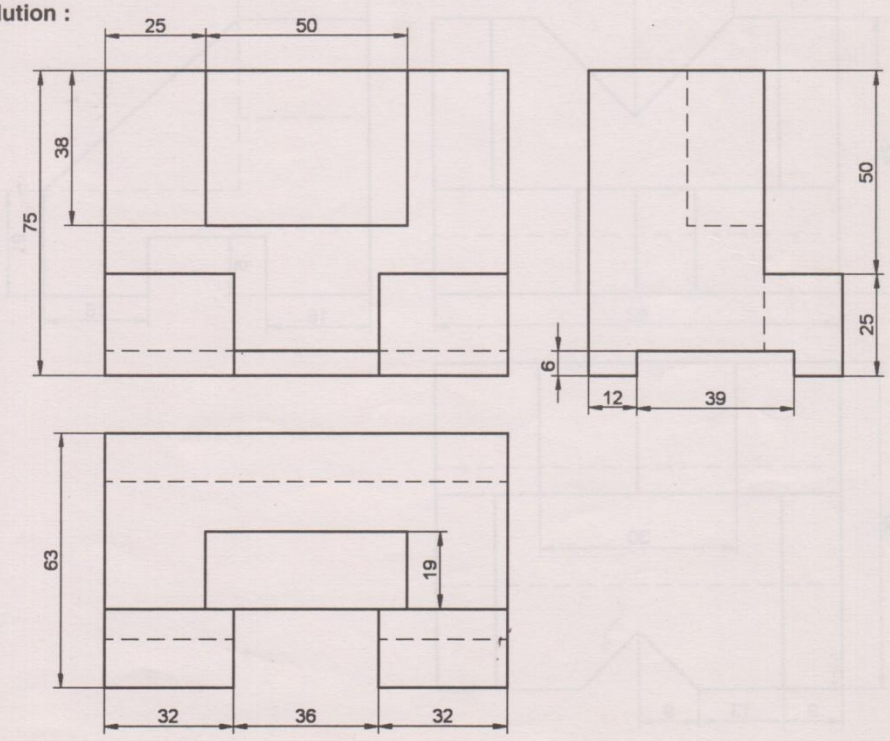


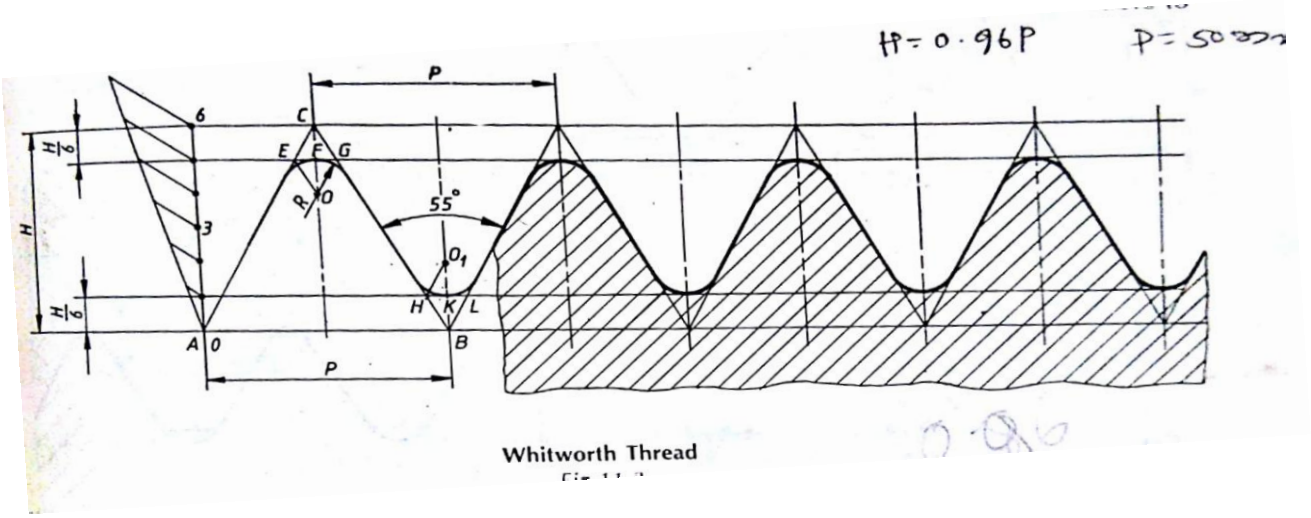
Fig. P 3.37

Solution :



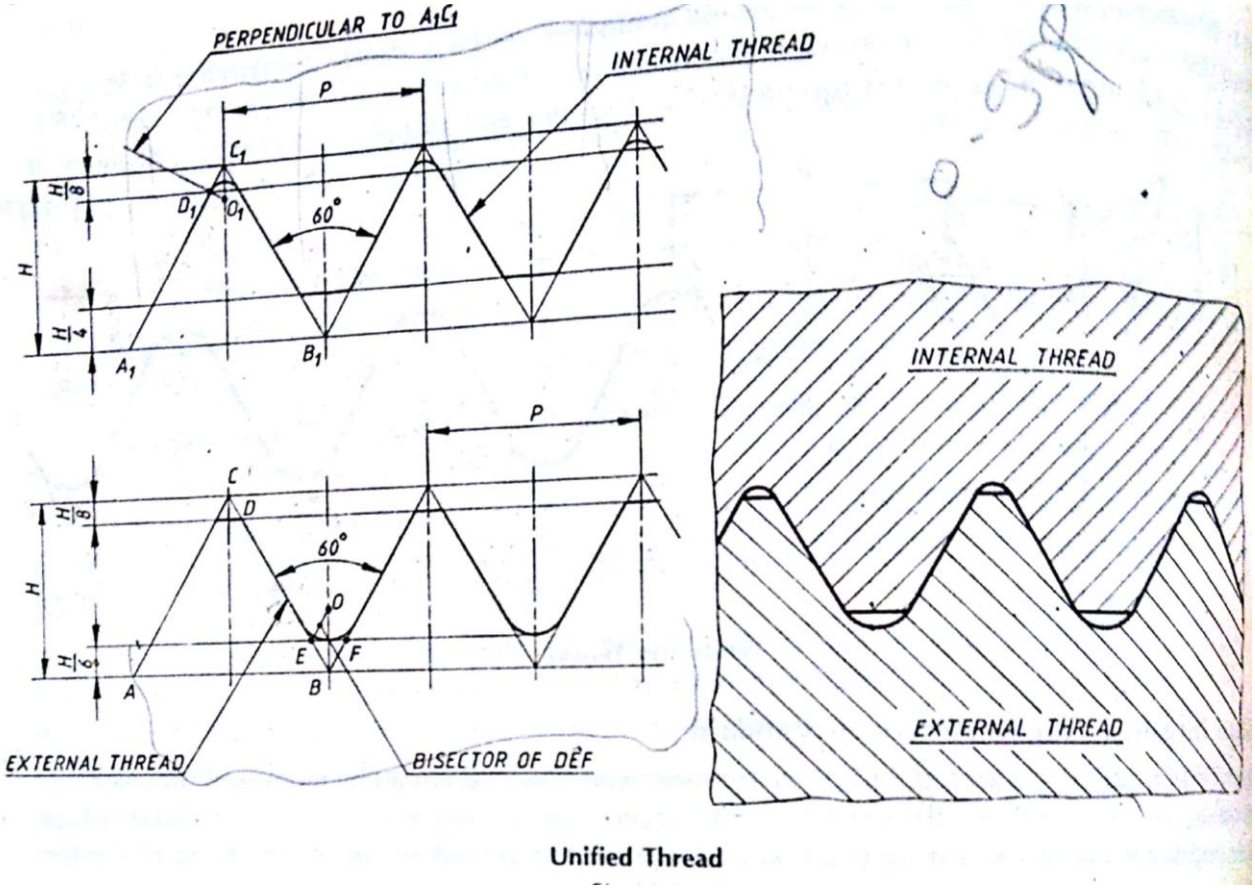
Thread forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal and **External),square, Acme and Sellers thread, American Standard thread.**

Whitworth Thread



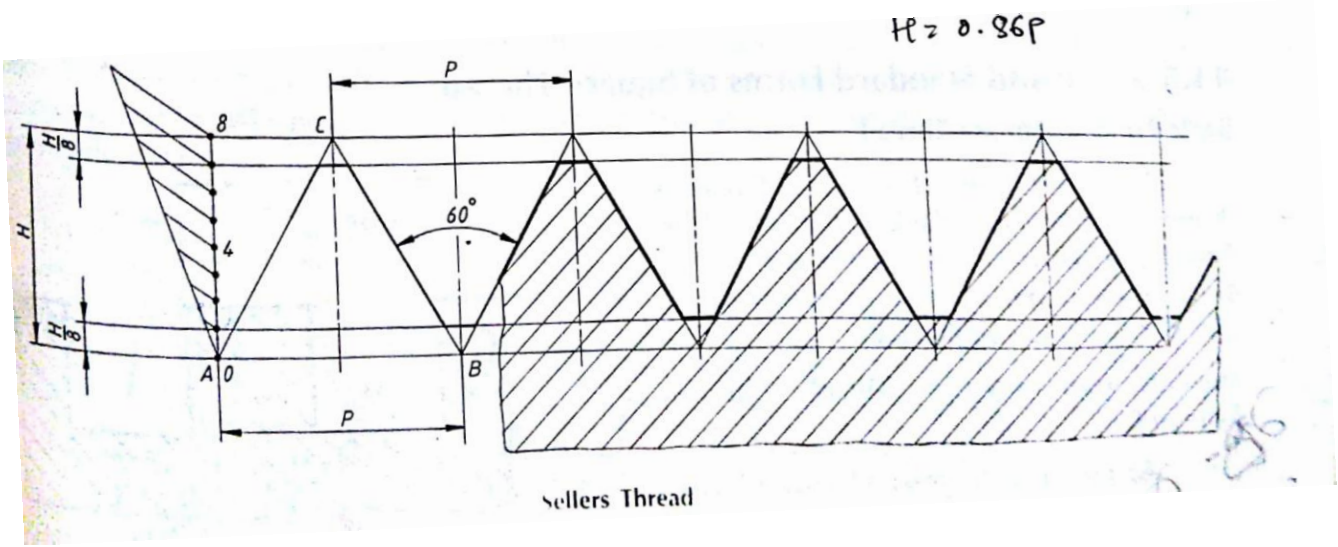
Whitworth Thread

ISO Metric thread



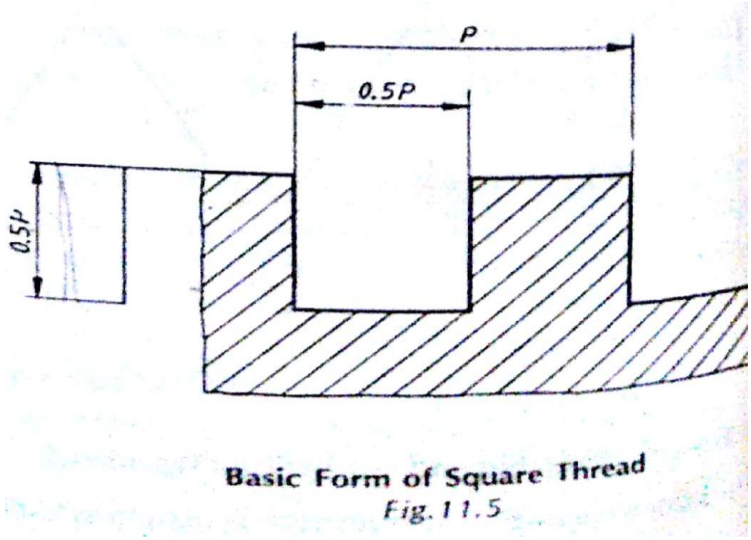
Unified Thread

Sellers Thread(American Standard)



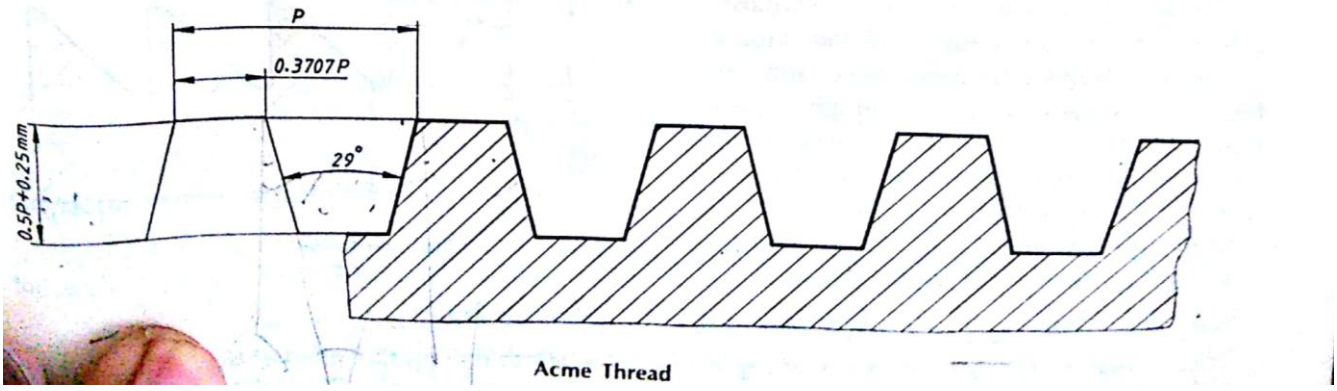
Sellers Thread

Square Thread



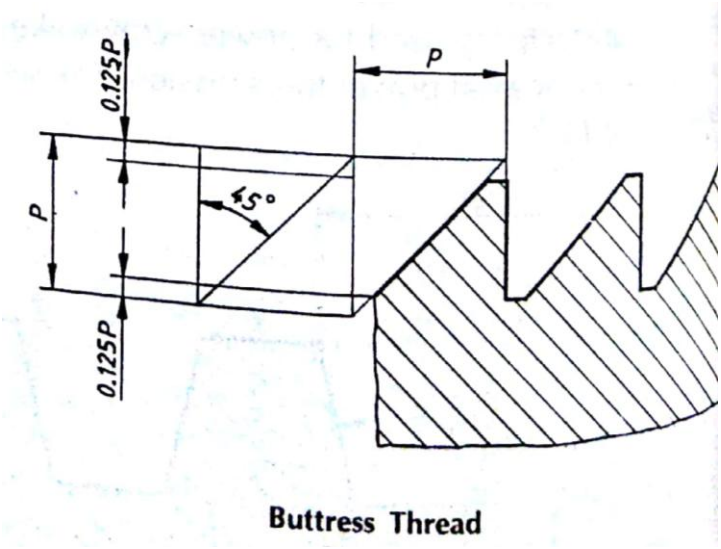
Basic Form of Square Thread
Fig. 11.5

Achme Thread



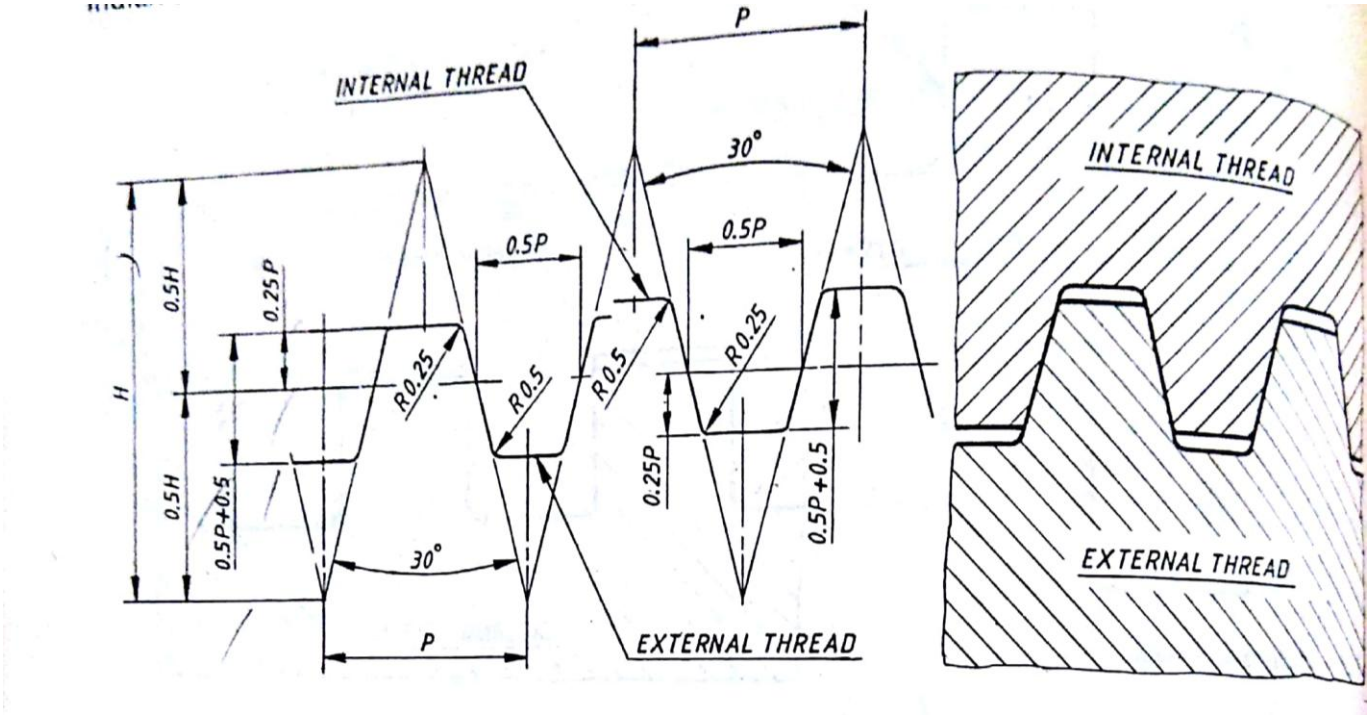
Acme Thread

Butress Thread

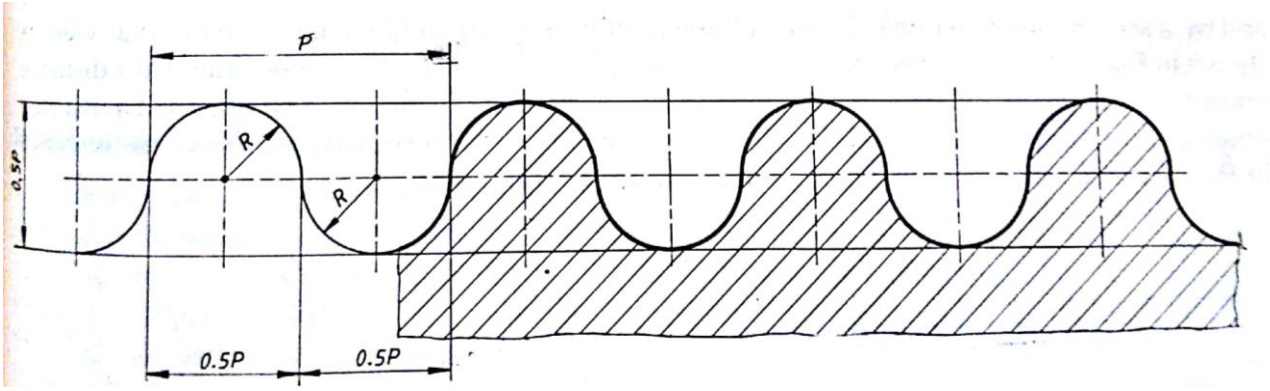


Buttress Thread

Trapezoidal Thread



Knuckle Thread



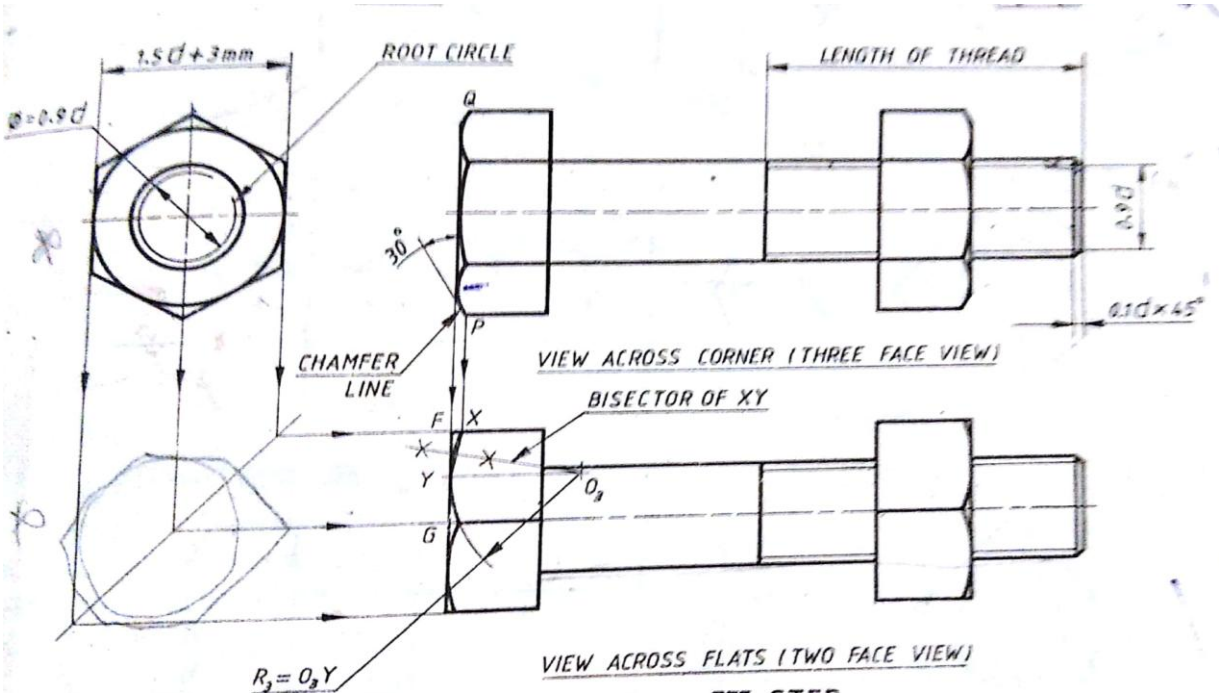
Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simpleassembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grubscrew, Allen screw. **(8 Hours)**

TABLE 11.1
Empirical Proportions of Hexagon and Square Head Bolt & Nut

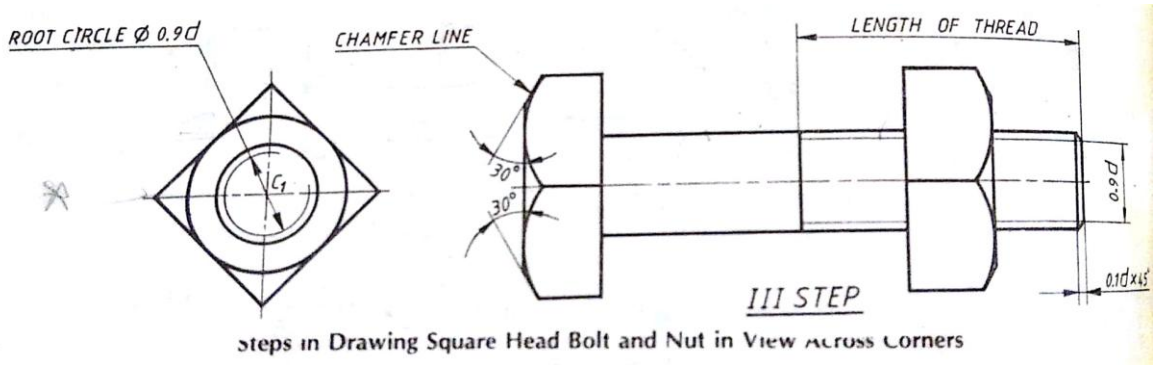
Detail	*Proportion*
Nominal Diameter	d = Size of Bolt or Nut, mm
Width Across Flats	s = 1.5d + 3mm
Width Across Corners	e = 2d
Thickness of Bolt Head	k = 0.8d
Thickness of Nut	m = 0.9d
Root Diameter	d_1 = d — (2 x Depth of Thread) or = d — (4 x Thickness of lines) or = 0.9d (approximate)
Length of Bolt	l = As specified
Thread Length	b = 2d + 6mm (for l < 150mm) = 2d + 12mm (for l > 150mm)
Radius of Bolt End	r = d (for spherical ends)
Chamfer of Bolt End	z = Depth of Thread x 45° or = 0.1d (Approximate)
Chamfer Angle of Bolt Head & Nut	= 30°

...bolt and nut assembly is drawn as follows. With any point C on the axis

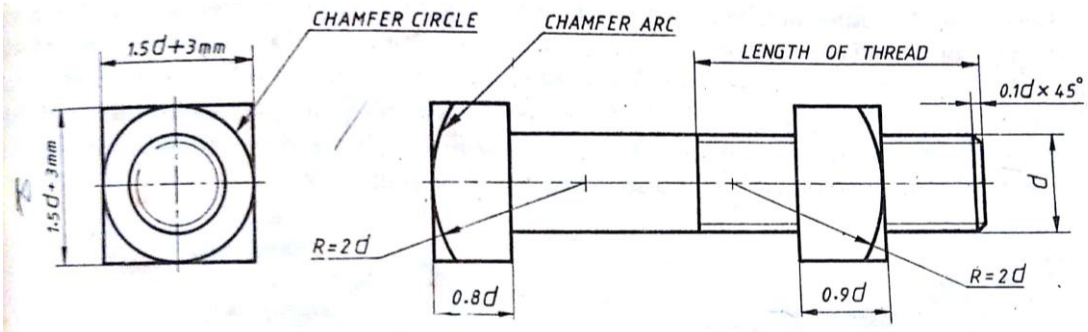
Hexagonal Headed Nut and Bolt



Square Headed Nut and Bolt



Steps in Drawing Square Head Bolt and Nut in View Across Corners

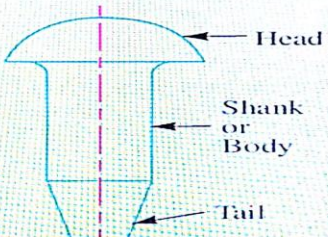


Square Head Bolt and Nut in View Across Flats

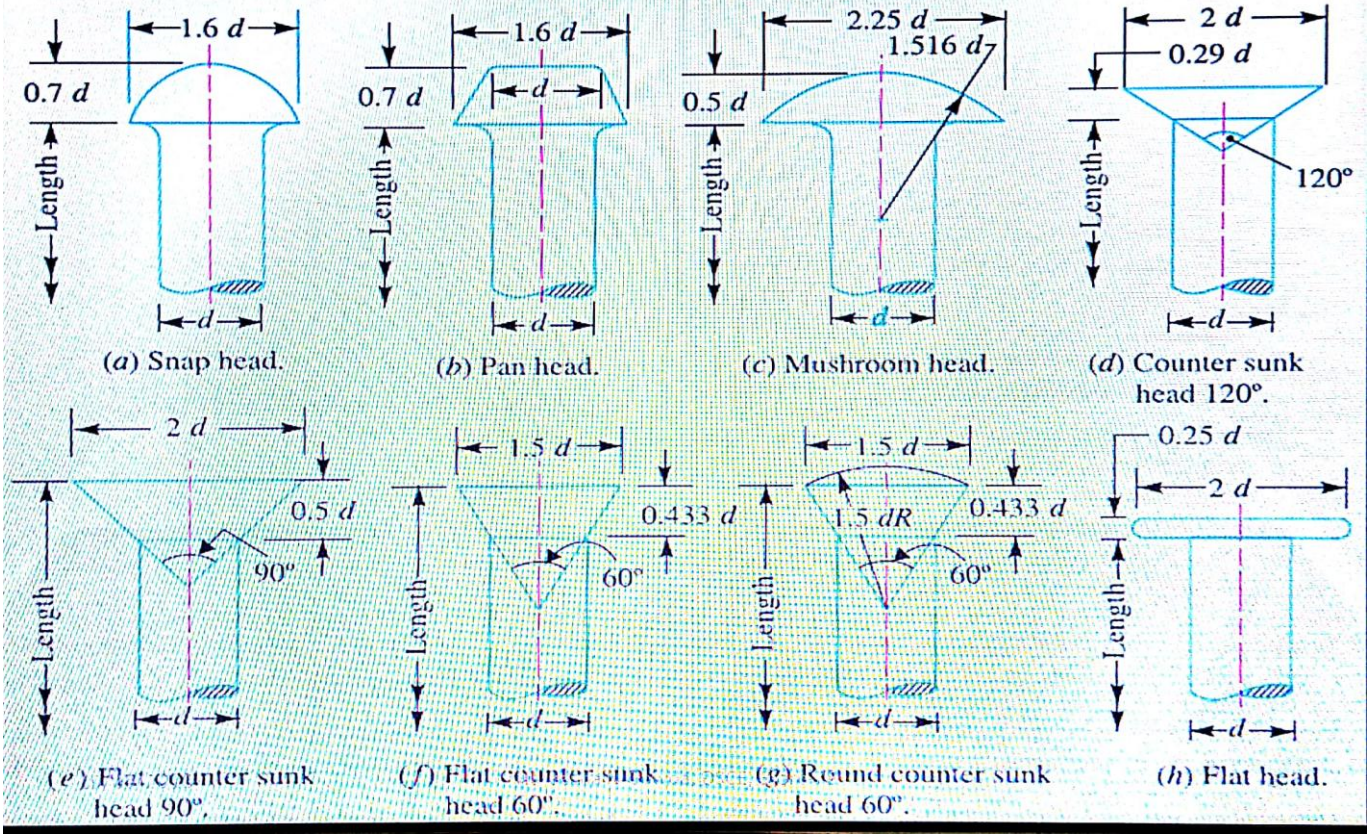
Riveted joints: Single and double riveted lap joints, Butt joints with single/double cover straps (Chain and zigzag using snap head riveters).

Introduction

- A rivet is a short cylindrical bar with a head integral to it. The cylindrical portion of the rivet is called ***shank or body***
- and lower portion of shank is known as ***tail***.
- The rivets are used to make permanent fastening between the plates such as in structural work, ship building, bridges, tanks and boiler shells.
- The riveted joints are widely used for joining light metals.



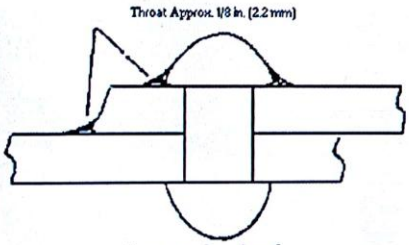
Types of Rivet Heads



Types of riveted joints

1. Lap joint
2. Butt joint

- Lap joint: A lap joint is that in which one plate overlaps the other and the two plates are then riveted together.
- Butt joint: A butt joint is that in which the main plates are kept in alignment butting (*i.e. touching) each other and a cover plate (i.e. strap) is placed either on one side or on both sides of the* main plates. The cover plate is then riveted together with the main plates.



Lap joint

Butt joint

Important Terms Used in Riveted Joints

- The following terms in connection with the riveted joints are important from the subject point of view :

1. *Pitch. It is the distance from the centre of one rivet to the centre of the next rivet measured* parallel to the seam as shown in Fig. It is usually denoted by *p.*
2. *Transverse pitch. It is the perpendicular distance between the centre lines of the successive rows* as shown in Fig. It is usually denoted by *pt.*
3. *Diagonal pitch. It is the distance between the centres of the rivets in adjacent rows of zig-zag* riveted joint as shown in Fig. It is usually denoted by *pd.*
4. *Margin or marginal pitch. It is the distance between the centre of rivet hole to the nearest* edge of the plate as shown in Fig. It is usually denoted by *m.*

Proportions of dimensions of riveted joints

- **Thickness of plate**

  t = Thickness of the plate

- **Diameter of rivets.**

the diameter of the rivet hole (*d*) may be determined by using

$$d = 6\sqrt{t}$$

- Distance of centre of the rivet from edge of the plate = 1.5d
- Margin , m=d
- Longitudinal Pitch p=3d
- Transverse pitch pt = 0.8P for chain riveting
  = 0.6P for zig-zag riveting
- Thickness of butt strap.

  Single cover plate t1 = 1.125 t

  Double cover plate t2 = 0.7 to 0.8t

Problem 1

Draw to 1:1 scale, the top view and sectional front view of a sirigle riveted lap joint. The thickness of plates is 9 mm. Show atleast three rivets. Indicate all the dimensions. Use snap head rivets.

Solution : *Fig.12.7*

$t = 9$ mm

$d = 6\sqrt{t}$

$= 6\sqrt{9}$

$= 18$ mm

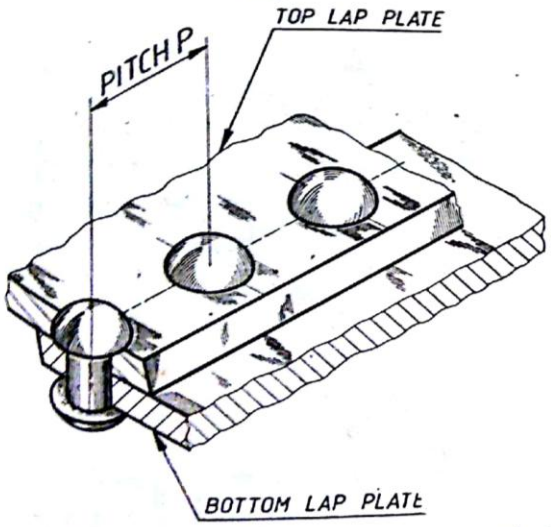
$p = 3d$

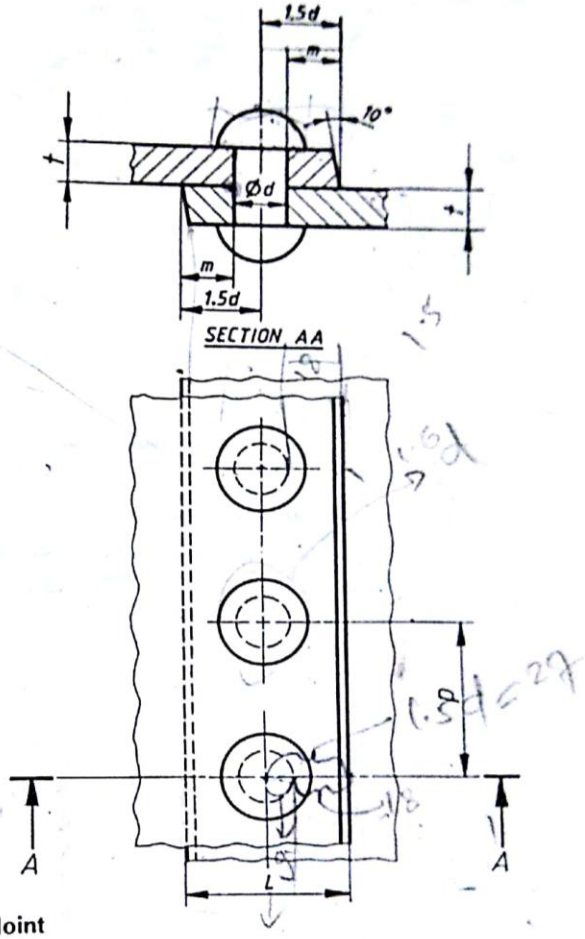
$= 3 \times 18$

$= 54$ mm

$1.5d = 1.5 \times 18$

$= 27$ mm





Single Riveted Lap Joint

Fig.12.7

Problem 2

Draw 1 : 2 scale, the top view and sectional front view of a double riveted lap joint with (i) Chain and (ii) Zig-zag riveting. The thickness of plates is 9 mm. Show atleast three rivets in each row. Indicate all the dimensions. Use snap head for rivets.

Solution : *Fig.12.8A* Chain Riveting and *Fig.12.8B* Zig-zag Riveting

$t = 9$ mm

$d = 6\sqrt{t}$

$= 6\sqrt{9}$

$= 18$ mm

$p = 3d$

$= 3 \times 18$

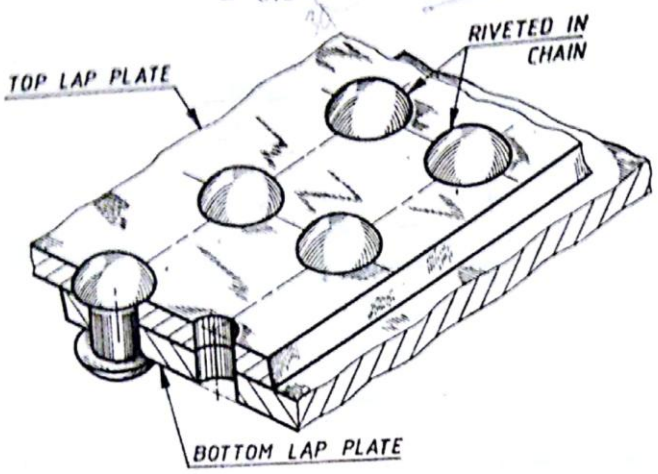
$= 54$ mm

$1.5d = 1.5 \times 18$

$= 27$ mm

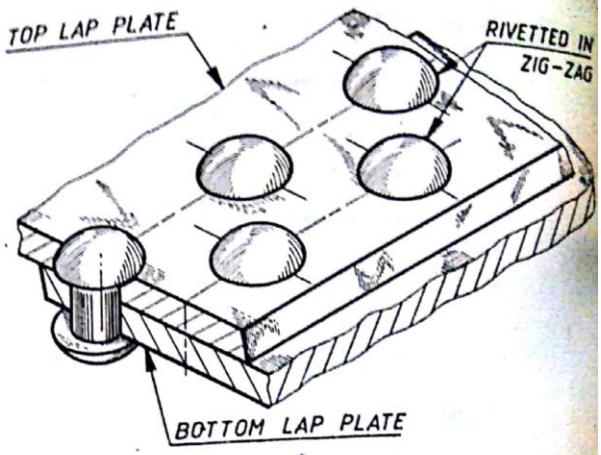
p_t = 0.8p for Chain Riveting

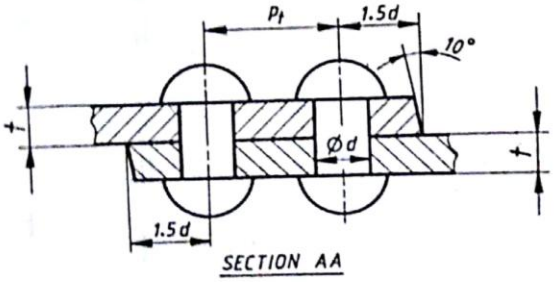
= 0.8 x 54 = 43.2 mm



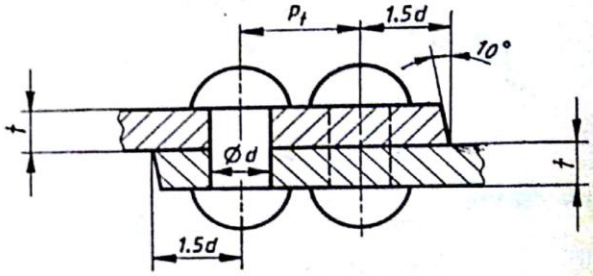
p_t = 0.6p for Zig-zag Riveting

= 0.6 x 54 = 32.4 mm

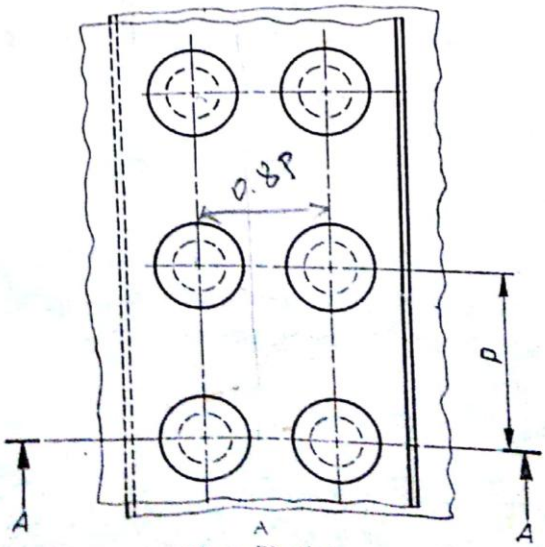




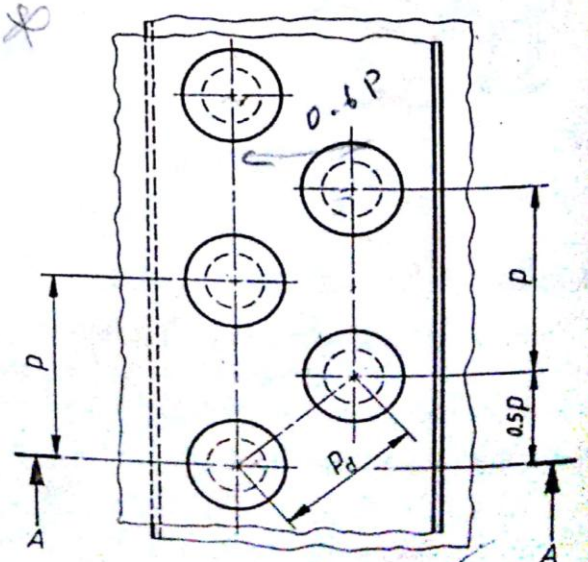
SECTION AA



SECTION AA



A
Chain Riveting



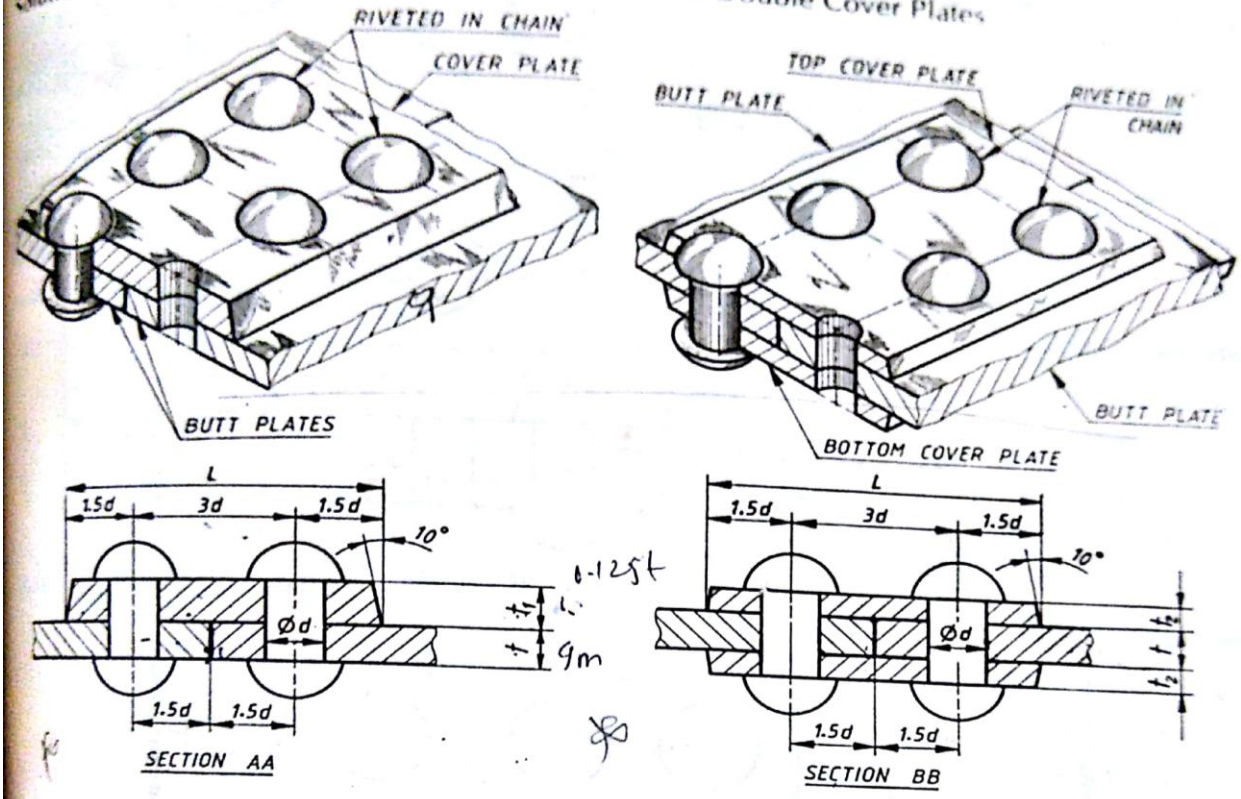
B
Zig-zag Riveting

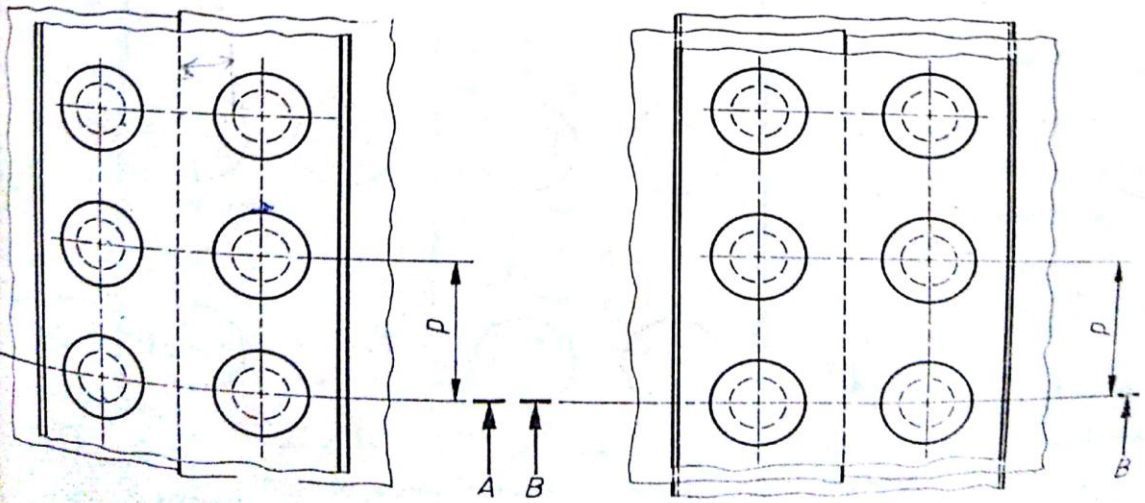
Double Riveted Lap Joint

Problem 3

Draw to 1 : 1 scale, the top view and sectional front view of a single riveted butt joint with : (i) Single cover plate and (ii) Double cover plates. The thickness of plates is 9 mm. Show atleast three rivets in each row. Indicate all dimensions. Use snap head rivets.

Solution *Fig. 12.9A* Single Cover Plate and *Fig. 12.9B* Double Cover Plates





A
Single Cover Plate

B
Double Cover Plates

Single Riveted Butt Joint

Problem 4

Draw to 1 : 1 scale the top view and sectional front view of double riveted butt joint with double cover plates with chain riveting. The thickness of the plates is 9 mm. Show atleast three rivets in each row. Indicate all the dimensions. Use snap head rivets.

Solution : *Fig. 12.10*

Diameter of Rivet :

$d = 6\sqrt{t}$

$= 6\sqrt{9}$

$= 18$ mm

Longitudinal Pitch :

$p = 3d$

$= 3 \times 18$

$= 54$ mm

Transverse Pitch :

$p_t = 0.8\,p$

$= 0.8 \times 54$

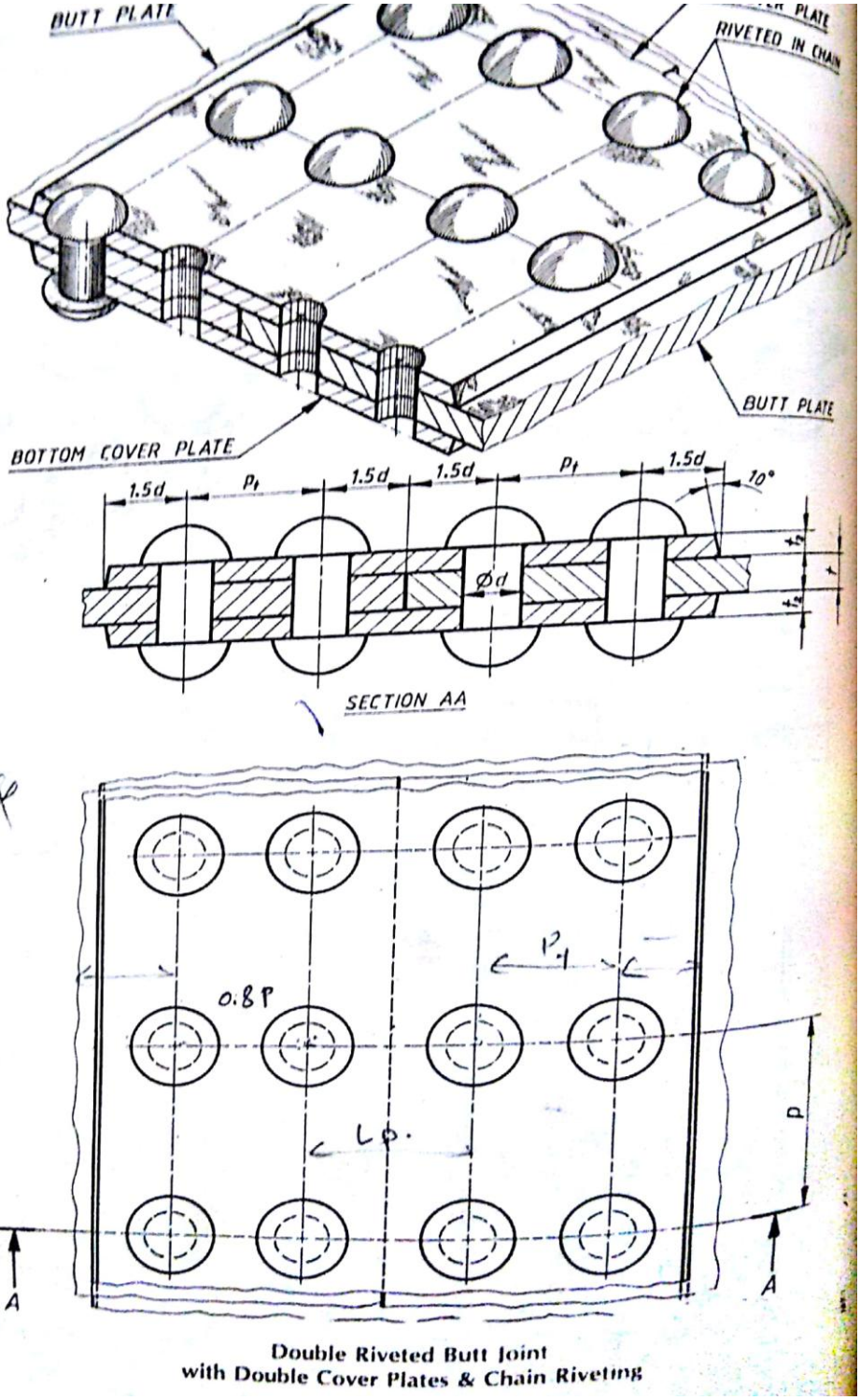
$= 43.2$ mm

Thickness of Cover Plates :

$t_2 = 0.8\,t$

$= 0.8 \times 9$

$= 7.2$ mm



Double Riveted Butt Joint with Double Cover Plates & Chain Riveting

Problem

Draw to 1 : 2 scale the top view and sectional front view of double riveted butt joint with double cover plates with zig-zag riveting. The thickness of plates is 14 mm. Show atleast three rivets in one row and two rivets in the adjoining rows. Indicate all the dimensions. Use snap head rivets.

Solution : Fig.12.11

Diametre of Rivet :

$d = 6\sqrt{t}$

$= 6\sqrt{14}$

$= 22$ mm

Longitudinal Pitch :

$p = 3d$

$= 3 \times 22$

$= 66$ mm

Transverse Pitch :

$p_t = 0.6p$

$= 0.6 \times 66$

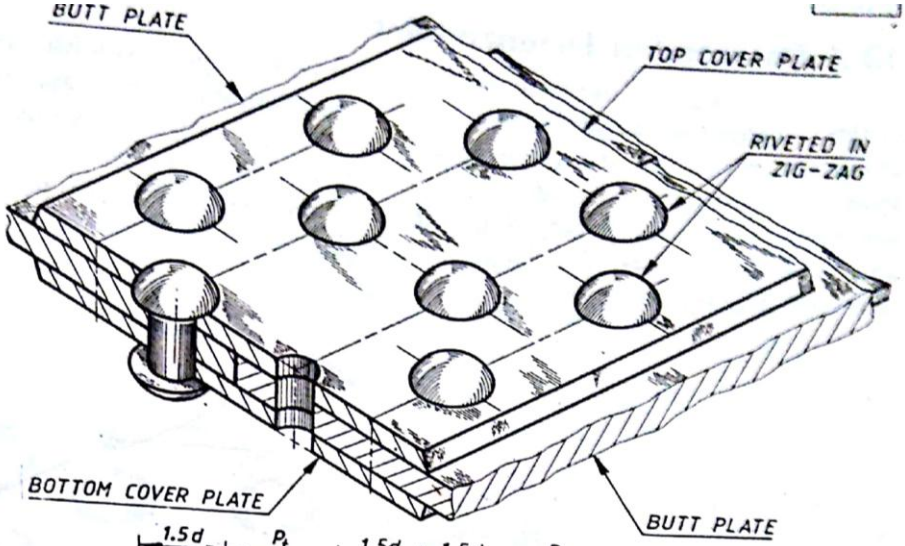
$= 39.6$ mm

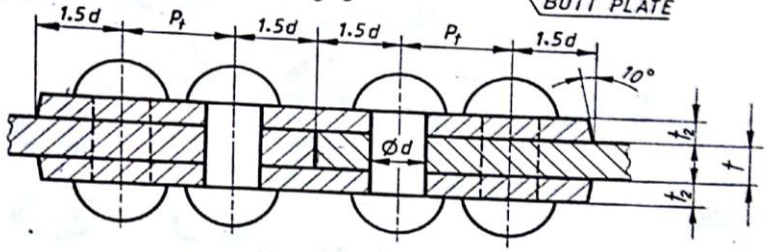
Thickness of Double Cover Plates :

$t_2 = 0.8\,t$

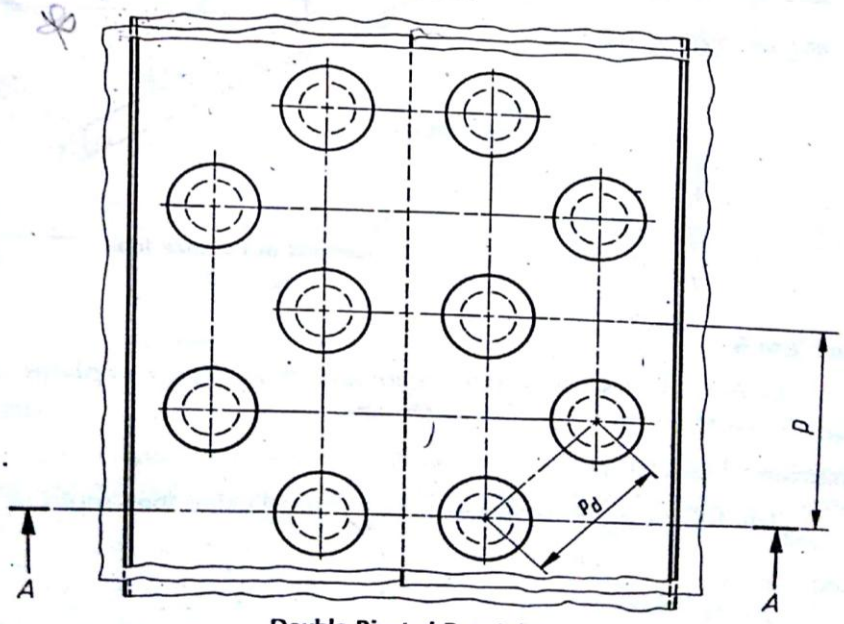
$= 0.8 \times 14$

$= 11.2$ mm





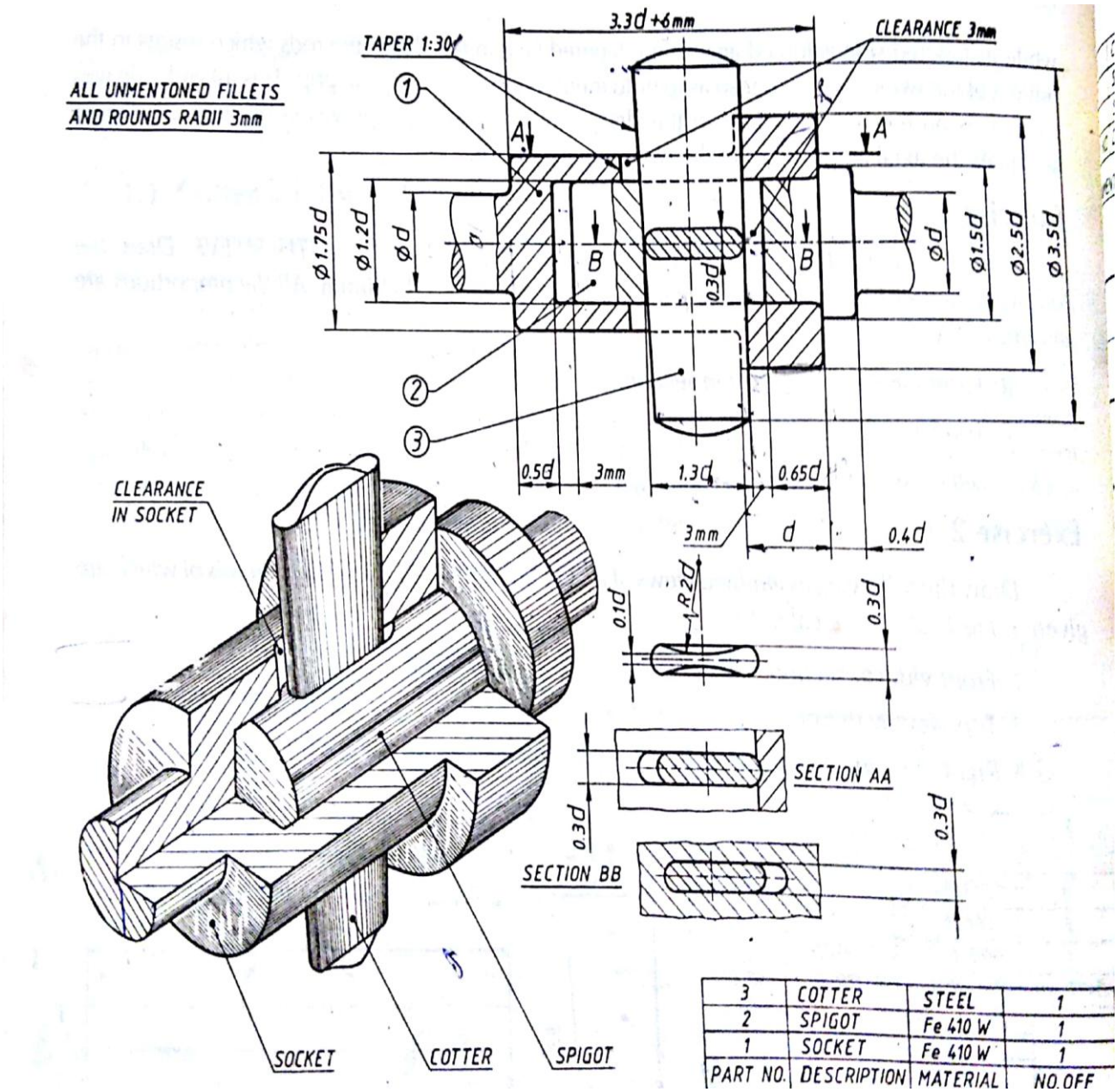
SECTION AA



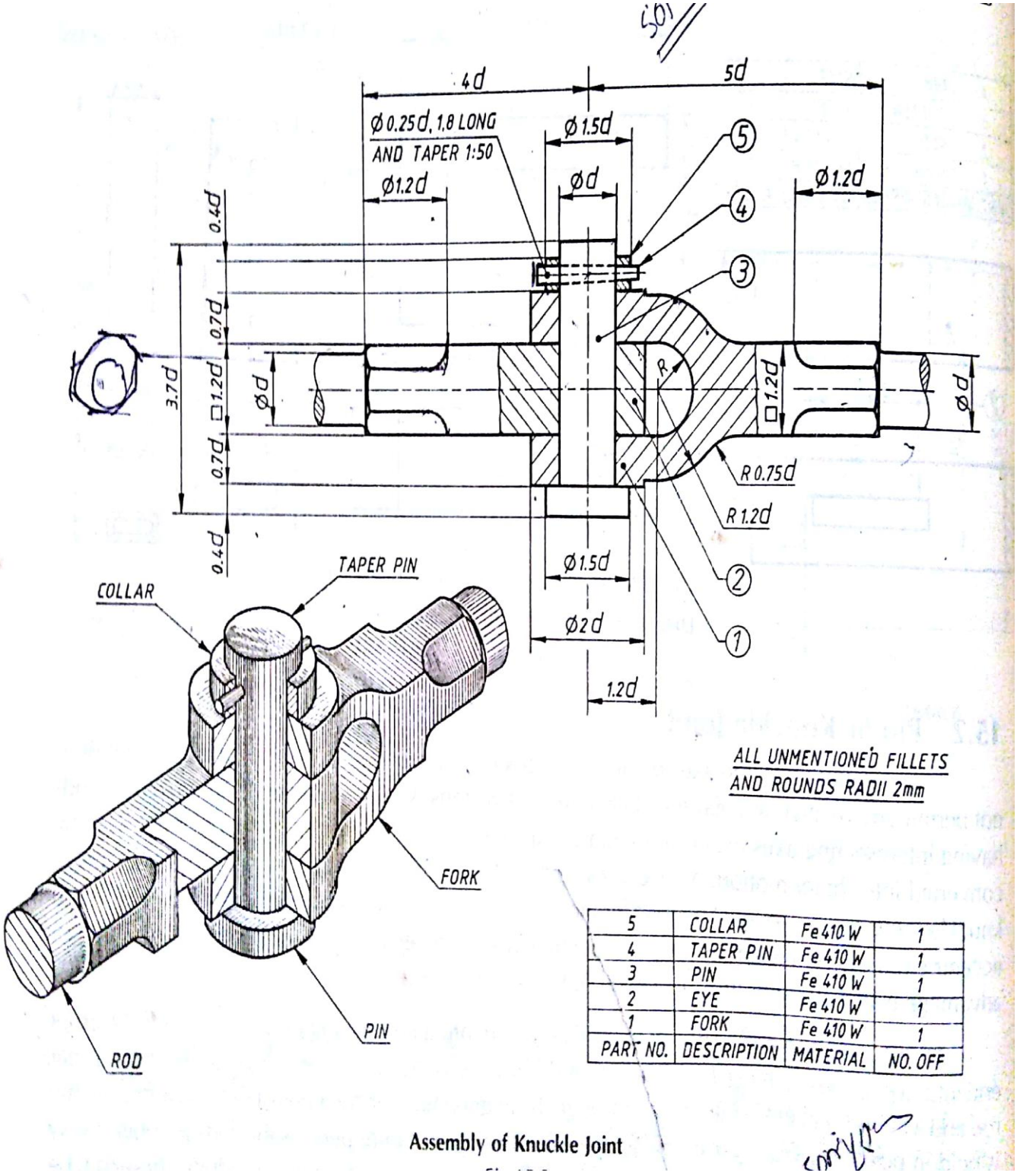
Double Riveted Butt Joint with Double Cover Plates & Zig-zag Riveting

Joints: Cotter joint (socket and spigot), Knuckle joint (pin joint) for two rods. **(8 Hours)**

Socket and Spigot Joint



Knuckle Joint



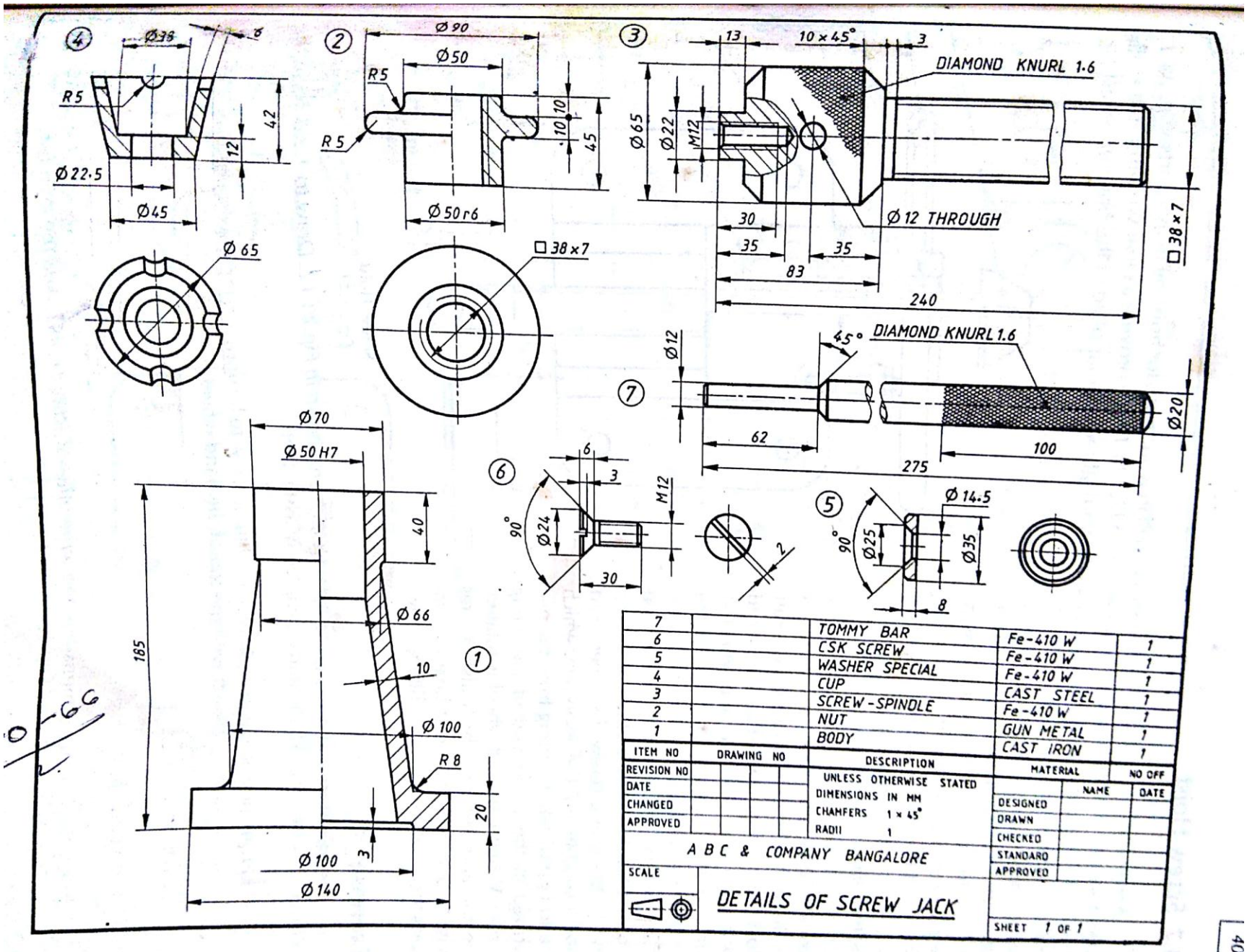
PART NO.	DESCRIPTION	MATERIAL	NO. OFF
5	COLLAR	Fe 410 W	1
4	TAPER PIN	Fe 410 W	1
3	PIN	Fe 410 W	1
2	EYE	Fe 410 W	1
1	FORK	Fe 410 W	1

Assembly of Knuckle Joint

PART C

Assembly Drawings: (Part drawings shall be given)

1. Plummer block (Pedestal Bearing)
2. Rams Bottom Safety Valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Tailstock of lathe
6. Machine vice
7. Lathe square tool post **(15 Hours)**



ITEM NO	DRAWING NO	DESCRIPTION	MATERIAL	NO OFF
7		TOMMY BAR	Fe-410 W	1
6		CSK SCREW	Fe-410 W	1
5		WASHER SPECIAL	Fe-410 W	1
4		CUP	CAST STEEL	1
3		SCREW-SPINDLE	Fe-410 W	1
2		NUT	GUN METAL	1
1		BODY	CAST IRON	1

			NAME	DATE
REVISION NO		UNLESS OTHERWISE STATED	DESIGNED	
DATE		DIMENSIONS IN MM	DRAWN	
CHANGED		CHAMFERS 1 × 45°	CHECKED	
APPROVED		RADII 1	STANDARD	
			APPROVED	

A B C & COMPANY BANGALORE

SCALE

DETAILS OF SCREW JACK

SHEET 1 OF 1

Details of a Screw Jack

ITEM NO	DRAWING NO	DESCRIPTION	NO OFF
9		CLAMPING PLATE	1
8		LOCK NUT	1
7		NUT	1
6		WASHER	1
5		SCREW ROD	1
4		SCREW M6	6
3		JAW GRIP	2
2		MOVABLE JAW	1
1		BODY OF VICE	1

REVISION NO	DATE	CHANGED	APPROVED

UNLESS OTHERWISE STATED
DIMENSIONS IN MM
CHAMFERS 1 × 45°
RADII 1

MATERIAL	NAME	DATE
Fe 410 W		
Fe 410 W		
Fe 410 W		
Fe 410 W		
Fe 410 W		
CAST STEEL		
CAST IRON		
CAST IRON		

DESIGNED		
DRAWN		
CHECKED		
STANDARD		
APPROVED		

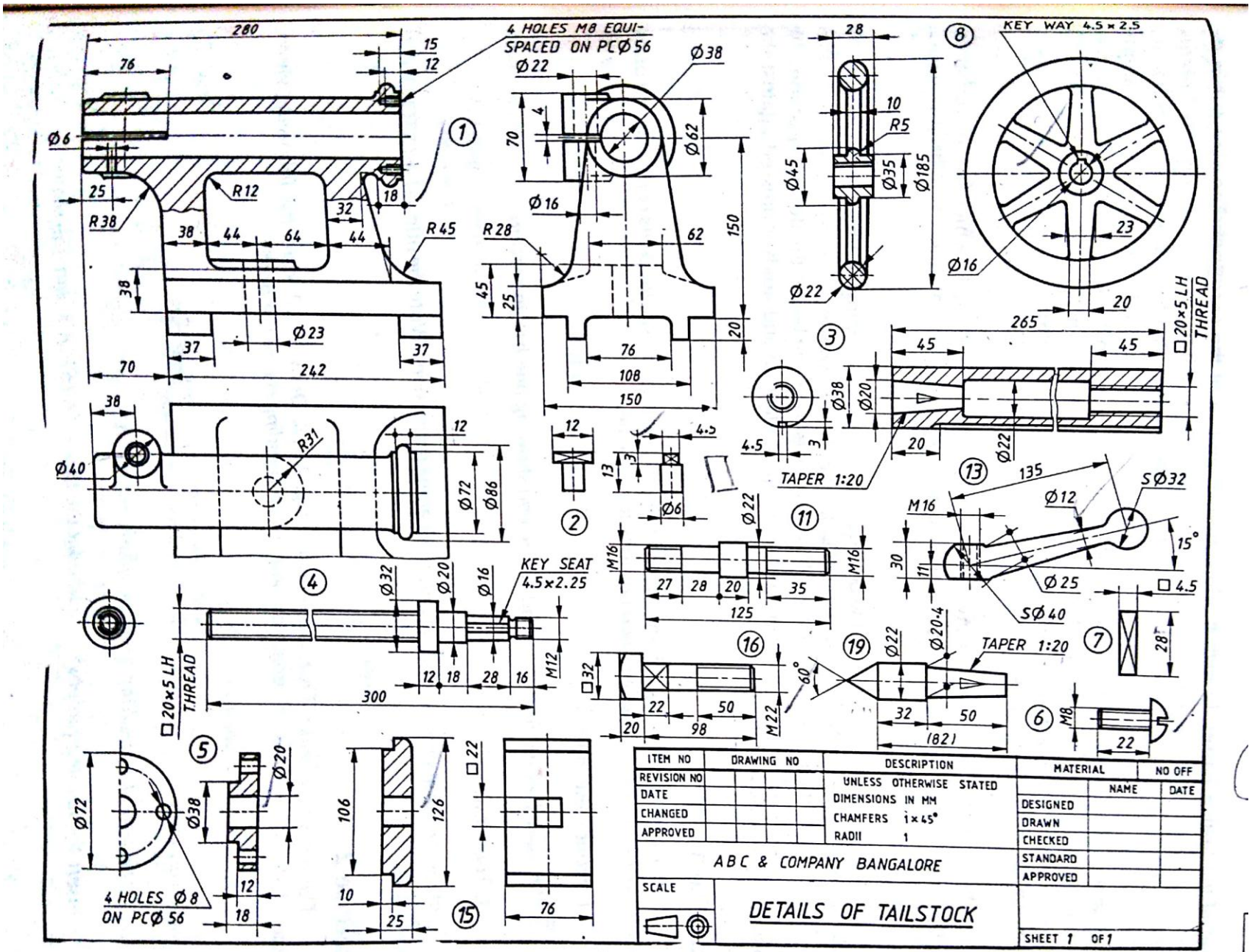
A B C & COMPANY BANGALORE

SCALE

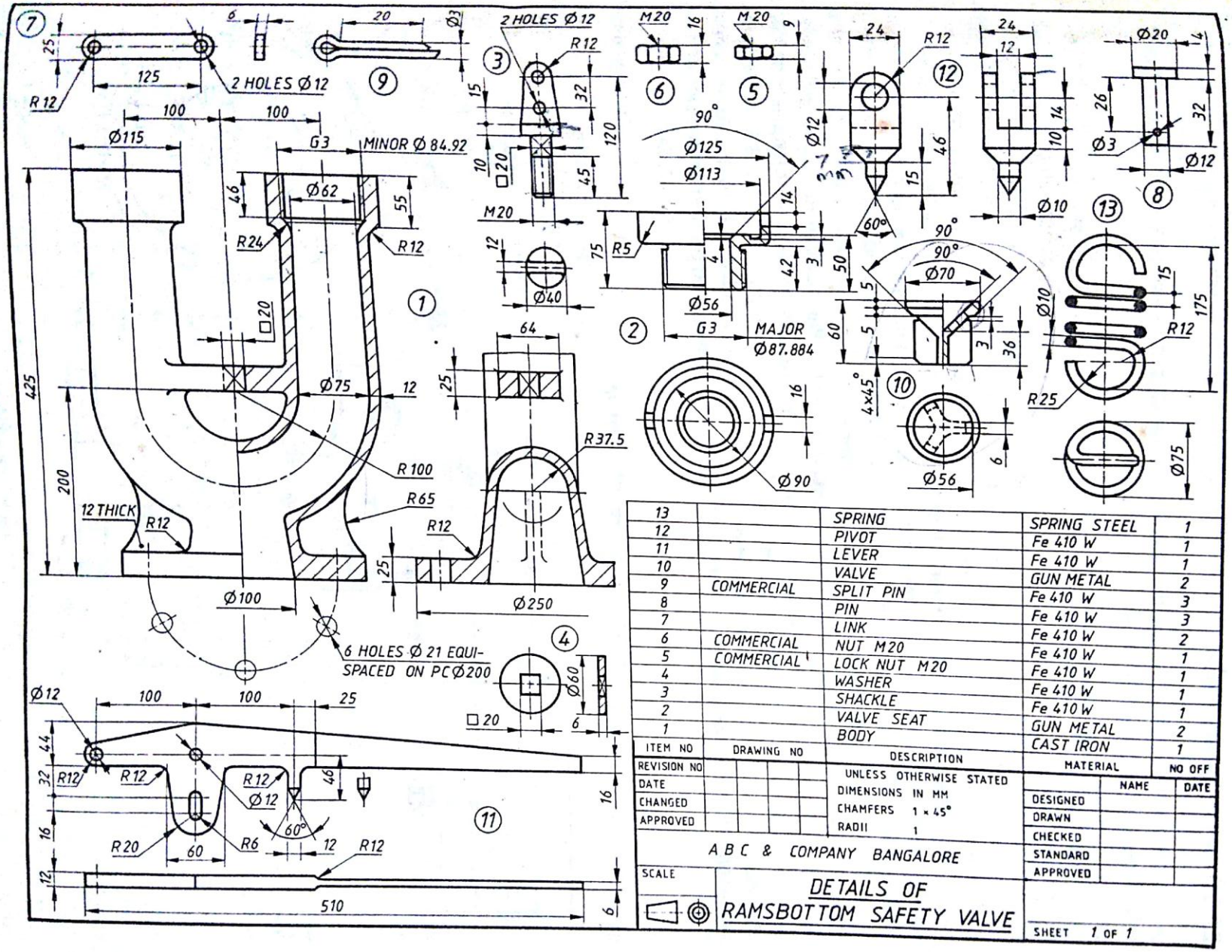
DETAILS OF MACHINE VICE

SHEET 1 OF 1

Details of a Machine Vice

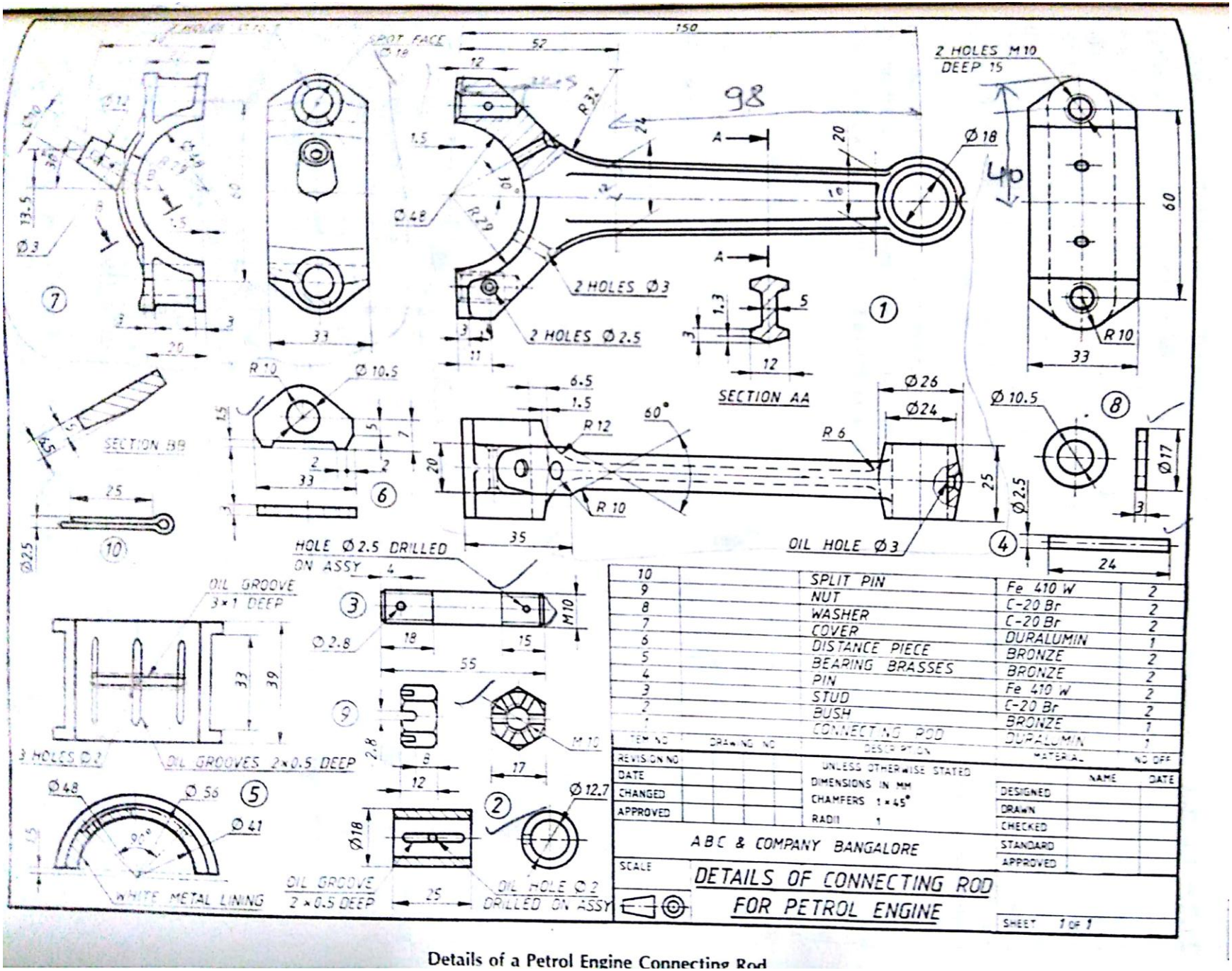


Details of a Tailstock



Details of a Ramsbottom Safety Valve

Fig. 22.14



10		SPLIT PIN	Fe 410 W	2
9		NUT	C-20 Br	2
8		WASHER	C-20 Br	2
7		COVER	DURALUMIN	1
6		DISTANCE PIECE	BRONZE	2
5		BEARING BRASSES	BRONZE	2
4		PIN	Fe 410 W	2
3		STUD	C-20 Br	2
2		BUSH	BRONZE	1
1		CONNECTING ROD	DURALUMIN	1
ITEM NO	DRAWING NO	DESCRIPTION	MATERIAL	NO OFF

REVISION NO				
DATE				
CHANGED				
APPROVED				

UNLESS OTHERWISE STATED
DIMENSIONS IN MM
CHAMFERS 1×45°
RADII 1

	NAME	DATE
DESIGNED		
DRAWN		
CHECKED		
STANDARD		
APPROVED		

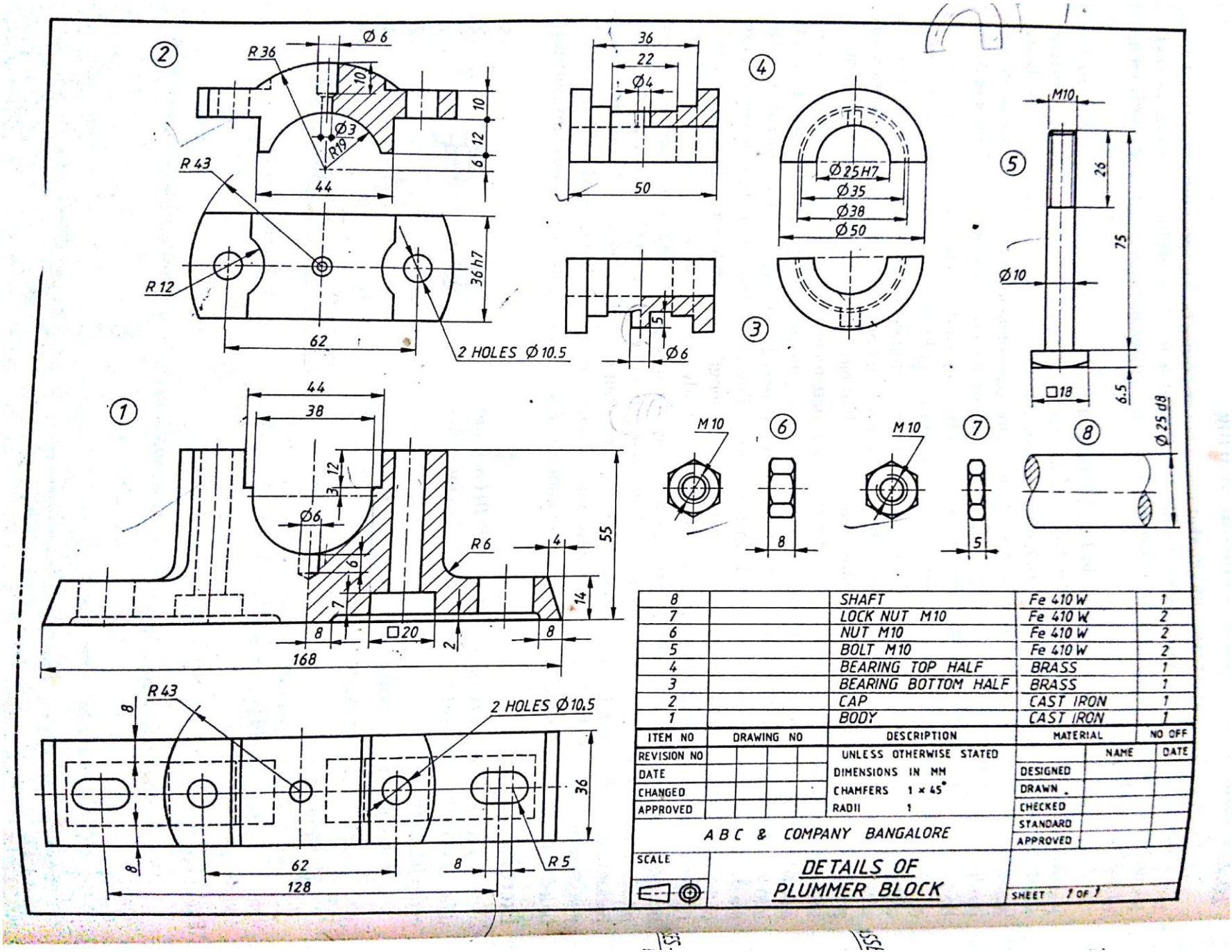
ABC & COMPANY BANGALORE

SCALE

DETAILS OF CONNECTING ROD FOR PETROL ENGINE

SHEET 1 OF 1

Details of a Petrol Engine Connecting Rod



8		SHAFT	Fe 410 W	1
7		LOCK NUT M10	Fe 410 W	2
6		NUT M10	Fe 410 W	2
5		BOLT M10	Fe 410 W	2
4		BEARING TOP HALF	BRASS	1
3		BEARING BOTTOM HALF	BRASS	1
2		CAP	CAST IRON	1
1		BODY	CAST IRON	1
ITEM NO	DRAWING NO	DESCRIPTION	MATERIAL	NO OFF

				NAME	DATE
REVISION NO		UNLESS OTHERWISE STATED			
DATE		DIMENSIONS IN MM	DESIGNED		
CHANGED		CHAMFERS 1 × 45°	DRAWN		
APPROVED		RADII 1	CHECKED		
			STANDARD		
			APPROVED		

A B C & COMPANY BANGALORE

SCALE

DETAILS OF PLUMMER BLOCK

SHEET 1 OF 1