H. T. I.

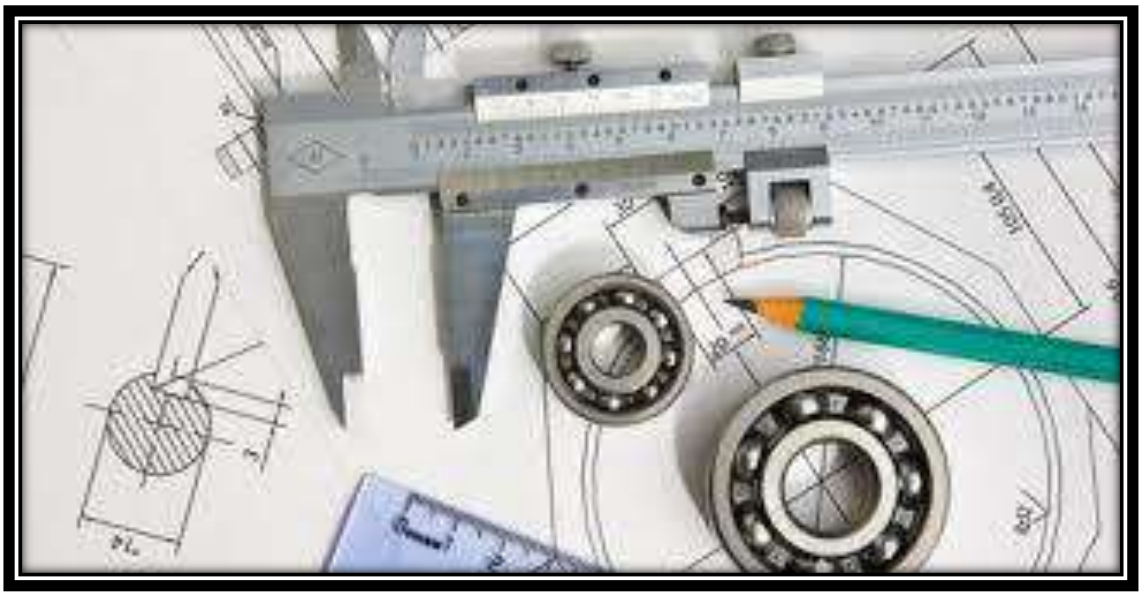
THE HIGHER TECHNOLOGICAL INSTITUTE – TENTH OF RAMADAN CITY

Lecture notes in

Engineering Drawing& Projection (2)

Course Code: ENG 004

Course Name: Engineering Drawing& Projection (2)



By

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Preface

The previous course of Engineering Drawing and projection 1 shows clearly that it is a universal language of engineers irrespective of the language spoken. The course covered the basic aspects of engineering drawing practice required for first level in engineering.

This second course of Engineering Drawing and projection 2 is designed to be a comprehensive guide consists of 6 chapters that covering basic topics and also includes selection of the examples given experience to develop the professional level drawing skills. Drawing for more complicated geometrical shapes such as machine parts will be studied.

The first chapter gives more practice in deducing the missing view for machine parts and presents the theory of sectioning for Sections and sectional views to showhidden detail more clearly. Types of Sectioning Views were also discussed. The process of unfolding the three-dimensional 'solid' which is called 'development' is presented in chapter two that deals with the development of the shapes.

The basics of drawing steel structure sections are presented in chapter three and followed by methods and parts used for fastening of different parts together in chapter four. The process of putting component parts together in which is called anassembly drawing by using fasteners is explained in chapter five.

In conclusion, may we wish all readers every success in their studies and careers. We hope they will obtain much satisfaction from employment in the absorbing activities related to constructing and presenting accurately defined engineering drawings.

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مقدمة

توضح المادة السابقة للرسم الهندسي والإسقاط 1 بوضوح أنها لغة عالمية للمهندسين بغض النظر عن اللغة المستخدمة. غطت الدورة الجوانب الأساسية لممارسة الرسم الهندسي المطلوبة للمستوى الأول في الهندسة.

تم تصميم هذه المادة الثانية للرسم الهندسي والإسقاط 2 لتكون دليلاً شاملاً يتكون من **6** فصول تغطي موضوعات أساسية وتتضمن أيضًا اختيار الأمثلة المعطاة للخبرة لتطوير مهارات الرسم على المستوى المهني. سيتم دراسة الرسم لأشكال هندسية أكثر تعقيدًا مثل أجزاء الآلة.

يقدم الفصل الأول مزيدًا من التدريب على استنتاج المسقط المفقود لأجزاء الآلة ويقدم نظرية التقسيم للأقسام والمشاهد المقطعية لإظهار التفاصيل المخفية بشكل أكثر وضوحًا. أنواع تقسيم وجهات النظر تمت مناقشتها أيضا. إن عملية كشف "الصلب" ثلاثي الأبعاد والتي تسمى "التطور" يتم عرضها في الفصل الثاني الذي يتناول تطور الأشكال.

تم عرض أساسيات رسم مقاطع الهيكل الفولاذي في الفصل الثالث، ويتبعها الطرق والأجزاء المستخدمة لربط الأجزاء المختلفة معًا في الفصل الرابع. يتم شرح عملية تجميع الأجزاء المكونة معًا والتي تسمى رسم التجميع باستخدام المثبتات في الفصل الخامس.

وفي الختام نتمنى لجميع القراء التوفيق والنجاح في دراستهم وحياتهم المهنية. نأمل أن ينالوا قدرًا كبيرًا من الرضا من التوظيف في الأنشطة الممتعة المتعلقة ببناء وتقديم الرسومات الهندسية المحددة بدقة.

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د. احمد حسين الفقى

د. احمد شعبان محمد

د.حسام الدين محمد رمضان

د. محمد على رمضان

Chapter 1

The Missing View and Sectioning

1.1 The Missing View

Constructing a third projection from two given projections is a basic step in making and reading drawings. To successfully solve the required exercise, you have to read the given two views and look for their dimensions to draw an area for the third one as a first step to find the missing view as plan or side view.

Follow the following method to deduce the missing view without the need to imagine the isometric of the object.

1.1.1 Deducing the Plan

To find the plan form given elevation and side view, follow the following steps.

1- Draw the maximum three views area as in fig.1.1.

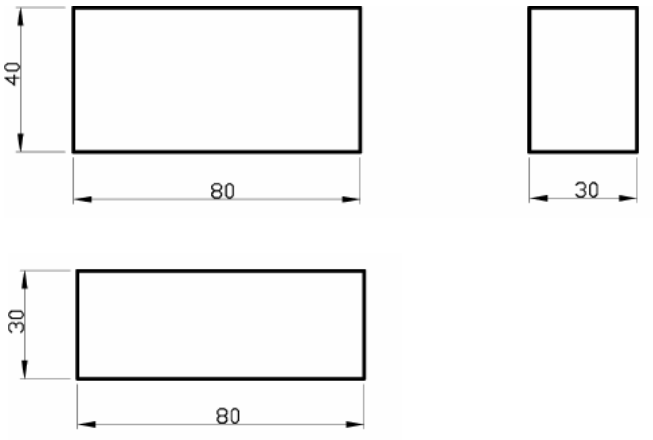

Fig. 1.1. The maximum area for the three views.

This step provides you with the **area** of the missed view and its **position** according to the other two given views, as shown in fig.1.2.

2- Draw the given two views to start deducing the third one, fig. 1.3.

3- Find the first horizontal plane dimensions from the elevation and side view. This plane is represented as a horizontal line in the elevation with length (L1) and width (W1), it will be positioned as the arrow's direction shown in fig.1.4.

4- Repeat the processes again for the next horizontal line to draw the second plane in themissing view, fig. 1.5.

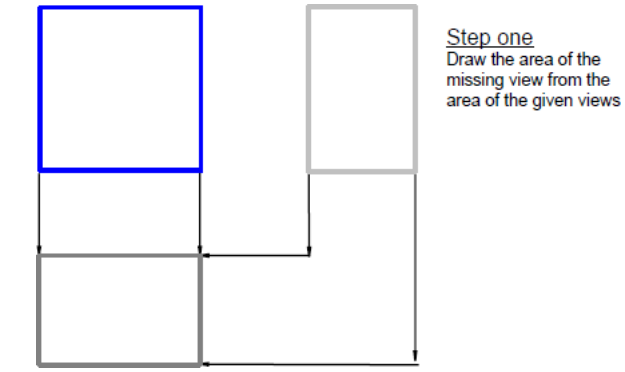

Fig. 1.2. Area and position for missing plan

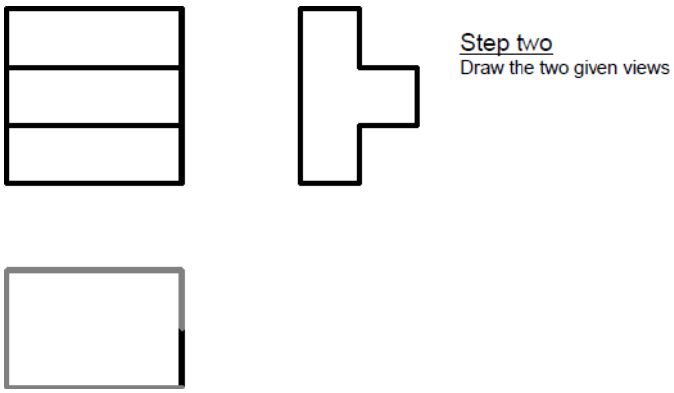

Fig. 1.3. Elevation and side view drawing step.

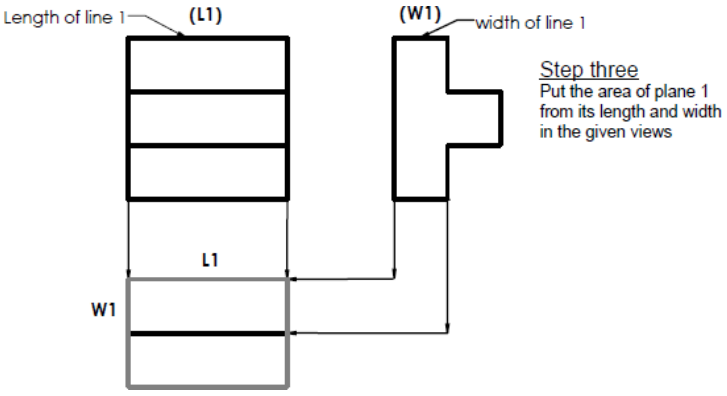

Fig. 1.4. Draw the first horizontal plane.

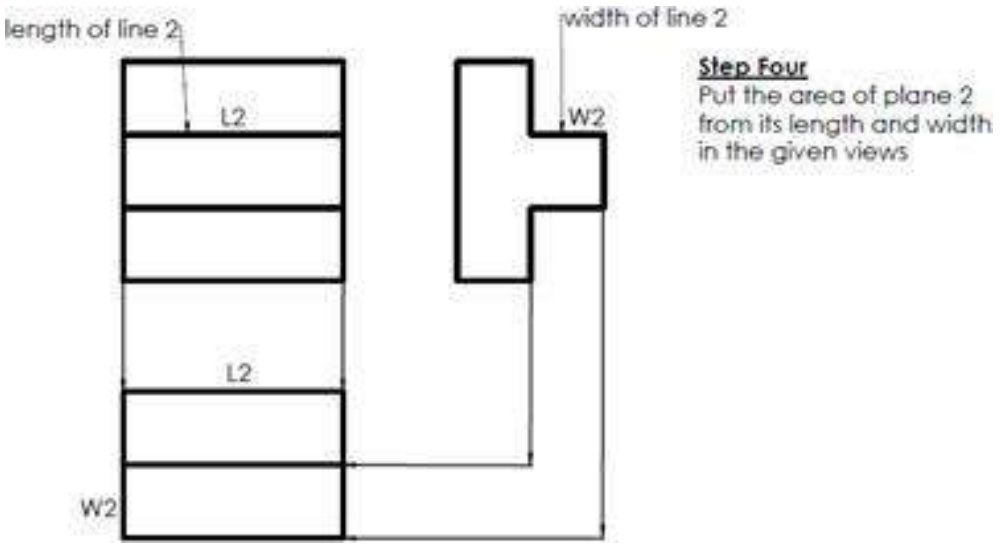

Fig. 1.5. Draw the second horizontal plane.

Step three can be repeated a number of times for all horizontal lines in elevation and side view.

1.1.2 Deducing the Side View

To find the side view from given elevation and plan, follow the following steps.

1- Draw the maximum three views area as in fig.1.6.

2- Draw the given two views to start deducing the third one, fig.1.7.

3- Find the first vertical plane dimensions from the elevation and plan.

This plane is represented as a vertical line in the elevation with Hight (H1) and plan with width (W1), it will be positioned as the arrow's direction shown in fig.1.8.

4- Repeat the processes again for the next vertical line to draw the second vertical planein the missing view, fig.1.9.

Step three can be repeated a number of times for all vertical lines in elevation and plan, fig.1.10.

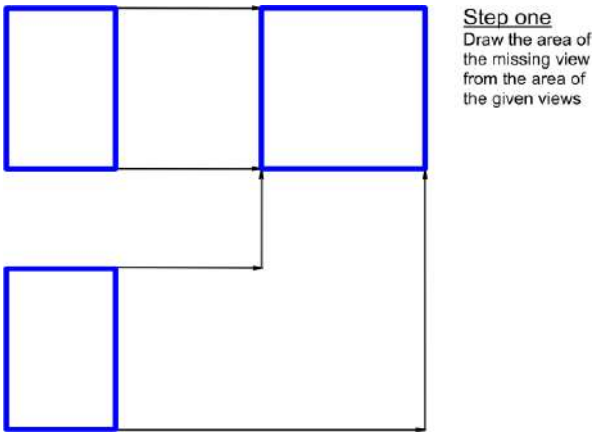

Fig. 1.6 Area and position for missing plan.

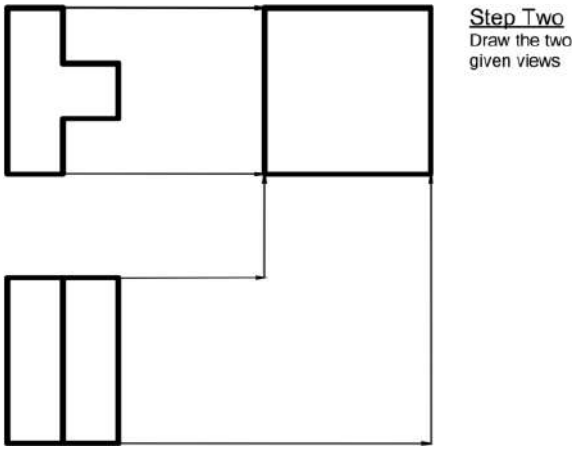

Fig. 1.7. Elevation and plan views drawing step.

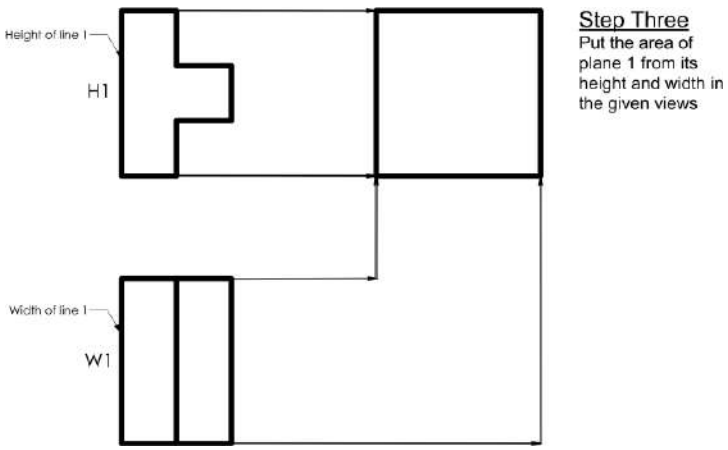

Fig. 1.8. Draw the first vertical plane.

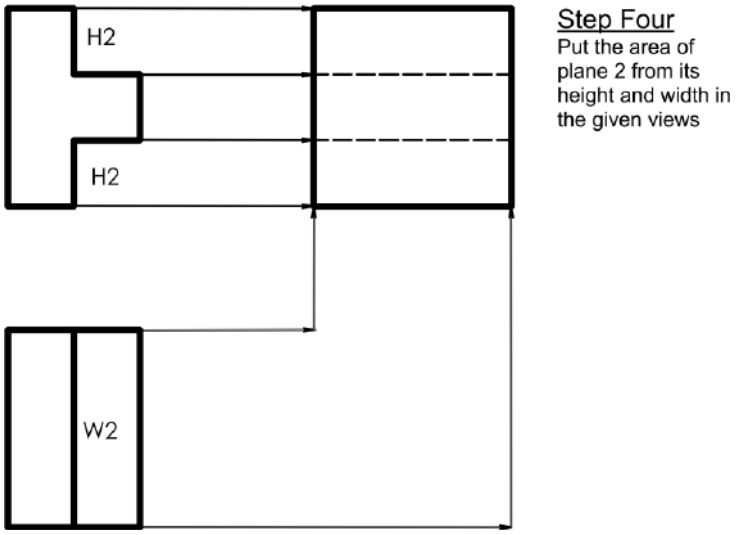

Fig.1.9. Draw the second horizontal plane.

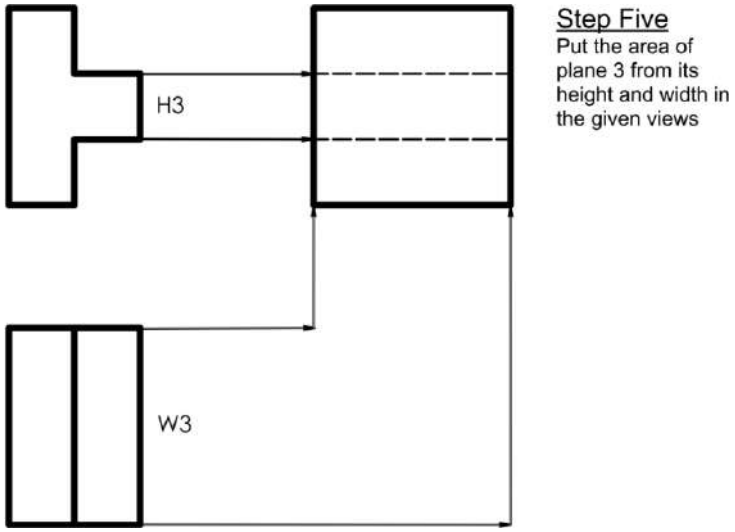

Fig. 1.10. Draw the third horizontal plane

1.1.3 Solved Examples

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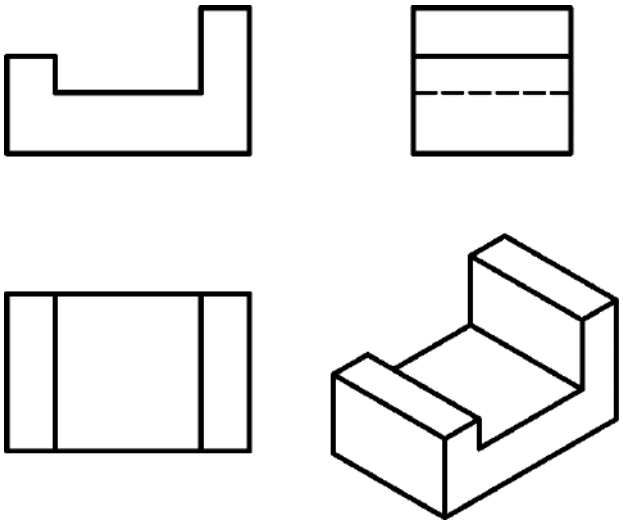

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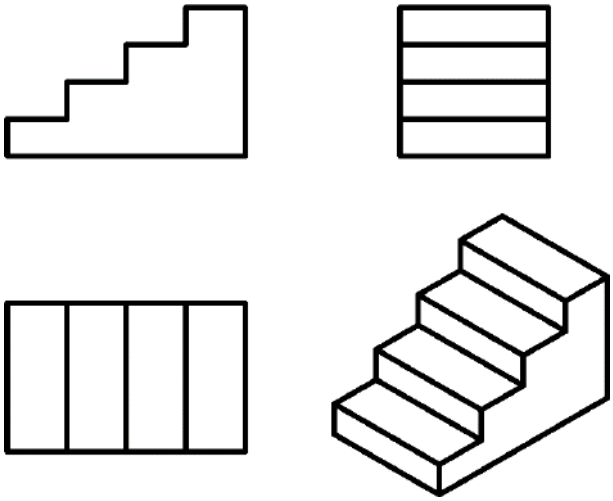

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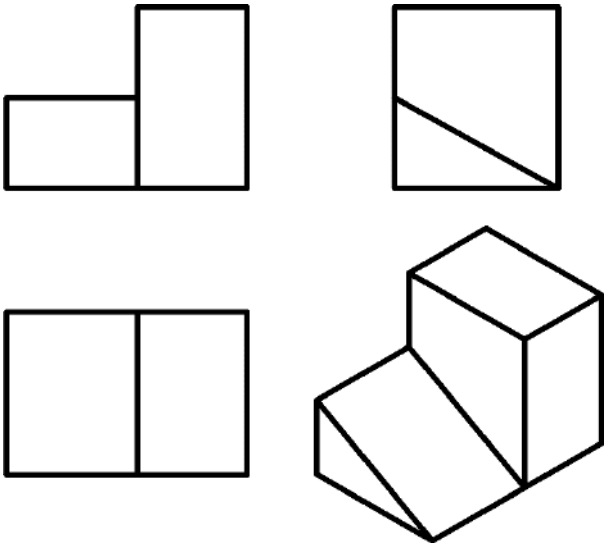

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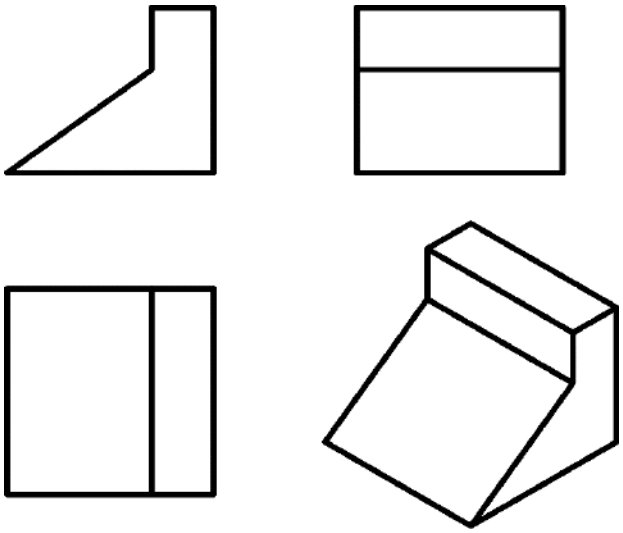

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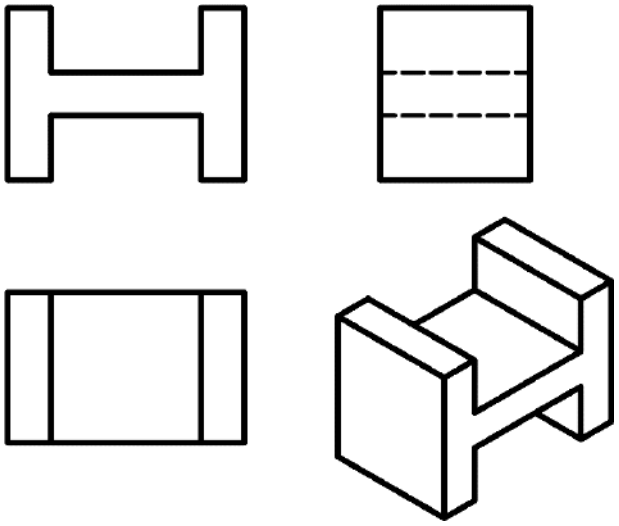

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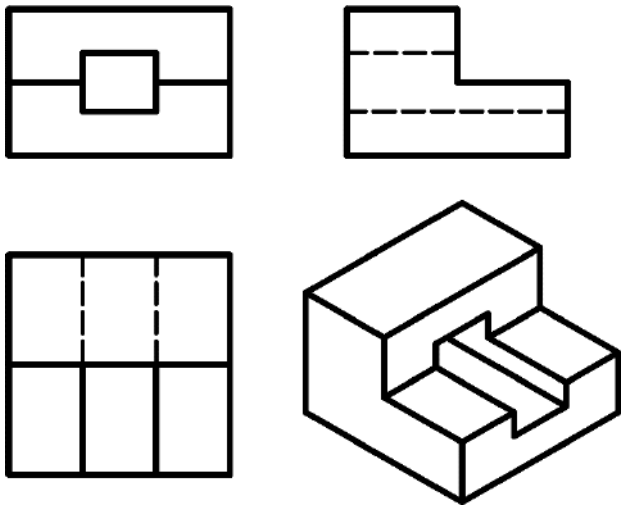

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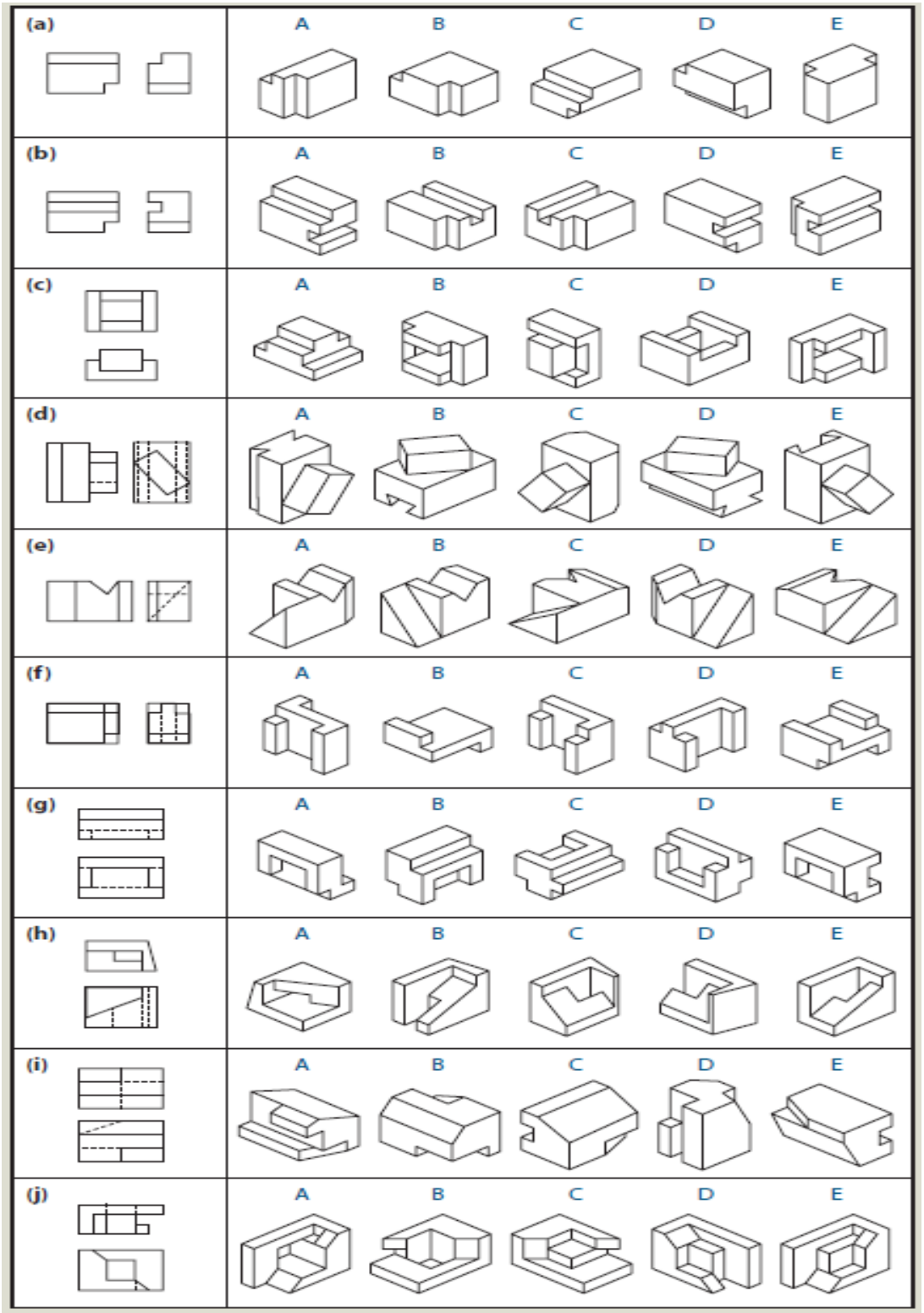
1.1.4 Exercise

1. For each row shown in the following figure, select the suitable view of the object that willproduce the orthographic views that are given.



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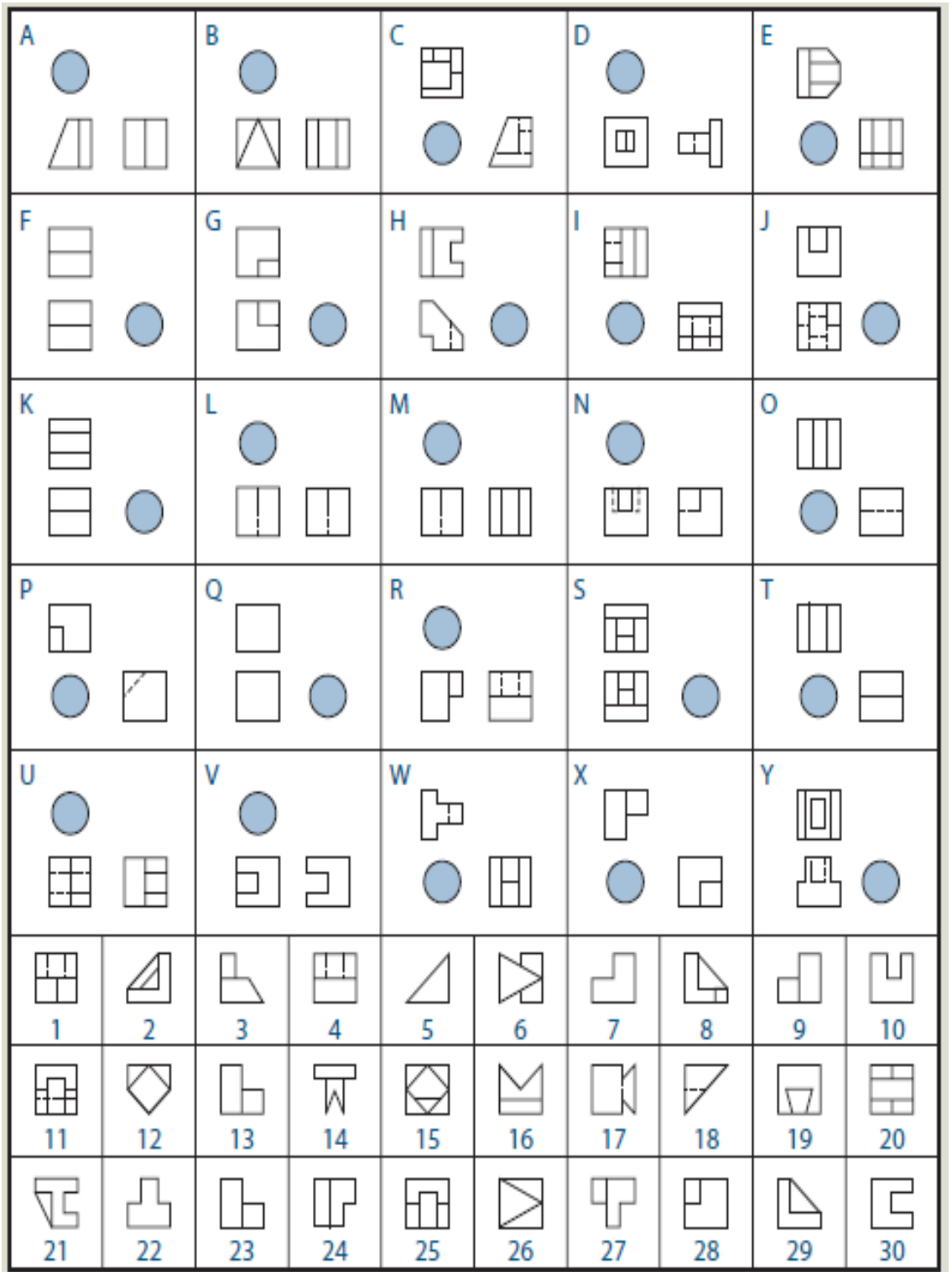
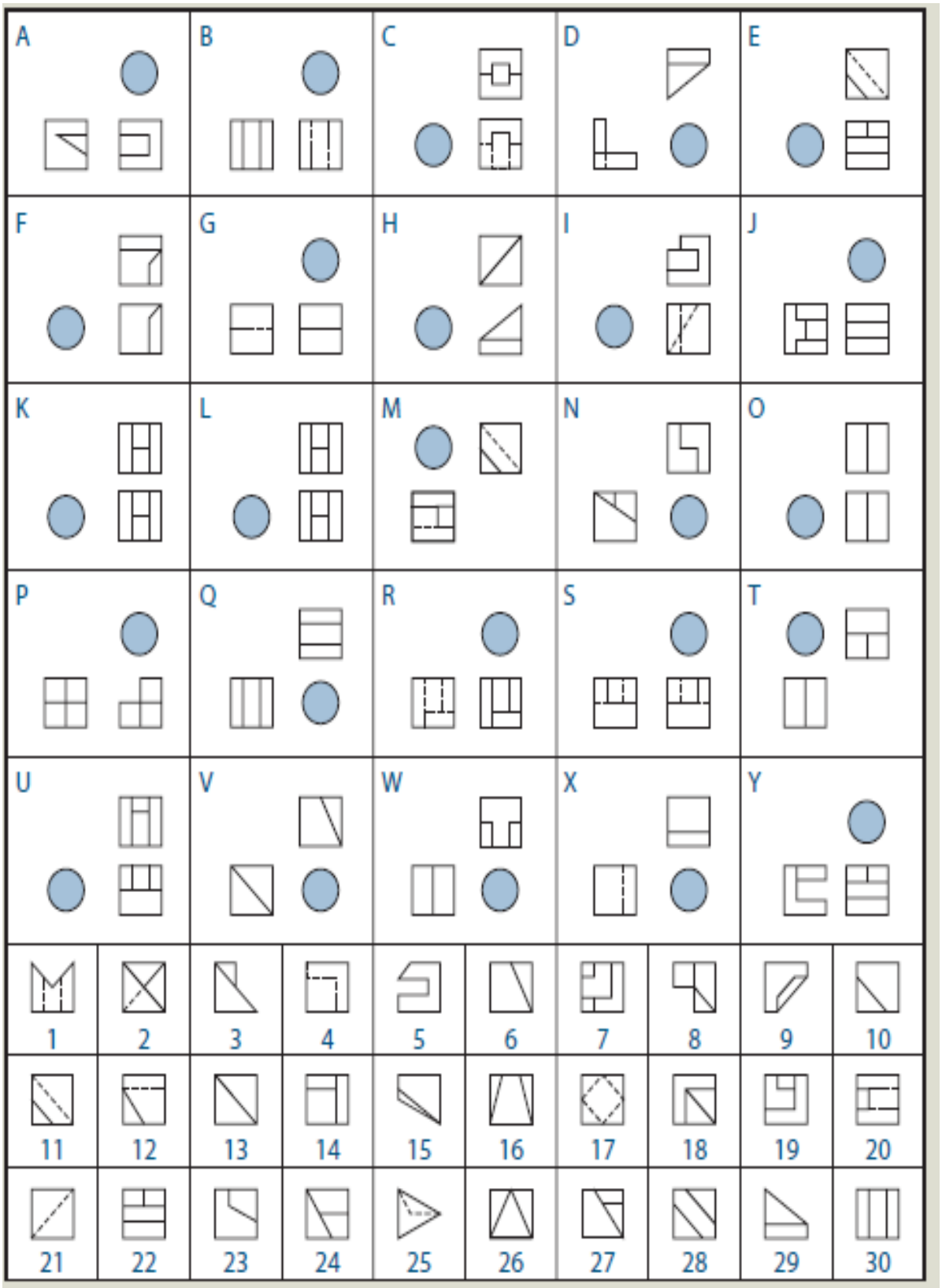
2. In each lettered cell shown in the following figure, the circle represents the location of a missing view. Select the correct view from the thirty views proposed. A view may be used morethan once.



1. In each lettered cell shown in Figure P11.4, the circle represents the location of a missing view. Select the correct view from the thirty views proposed. A view may be used more than once.



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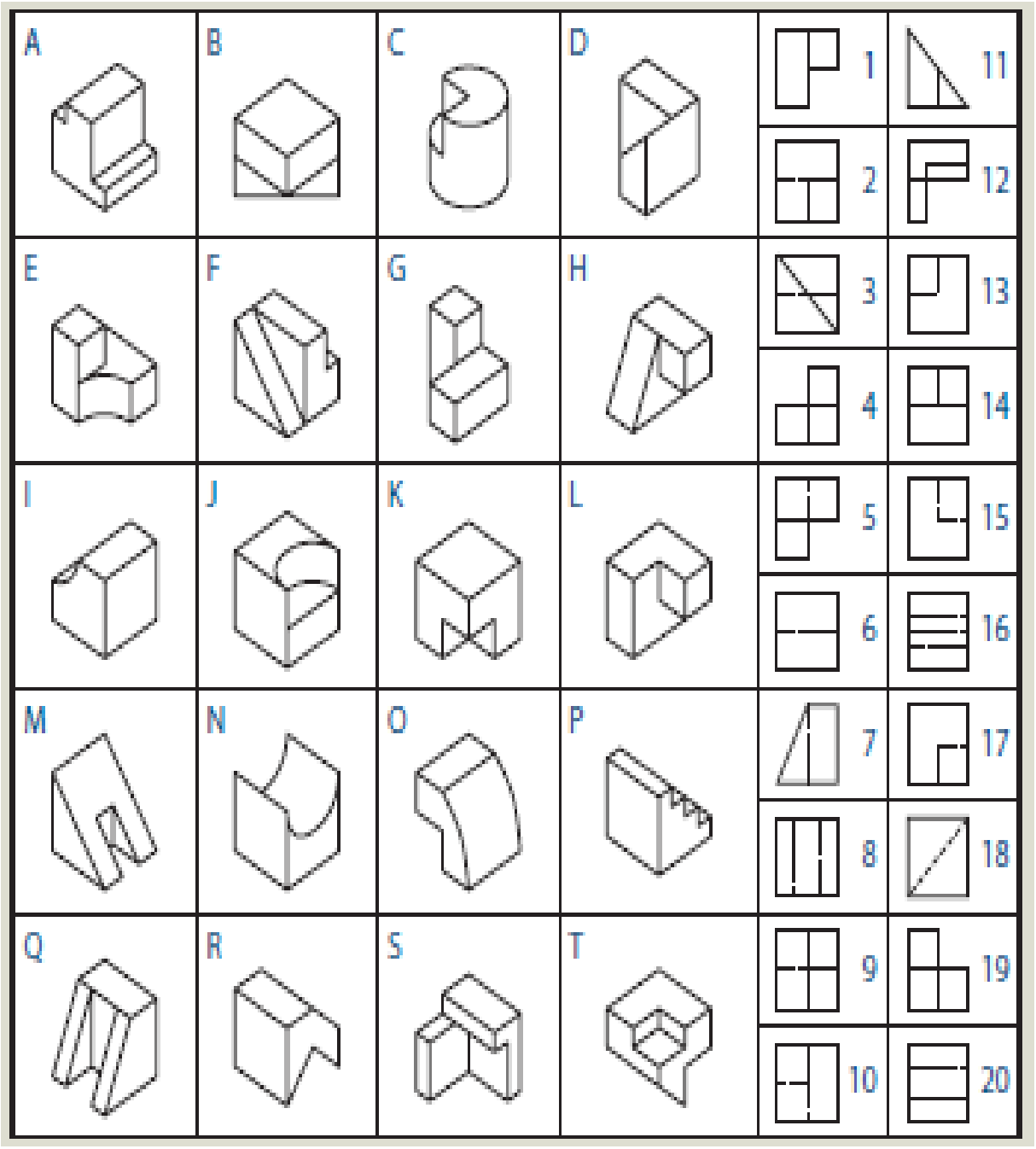
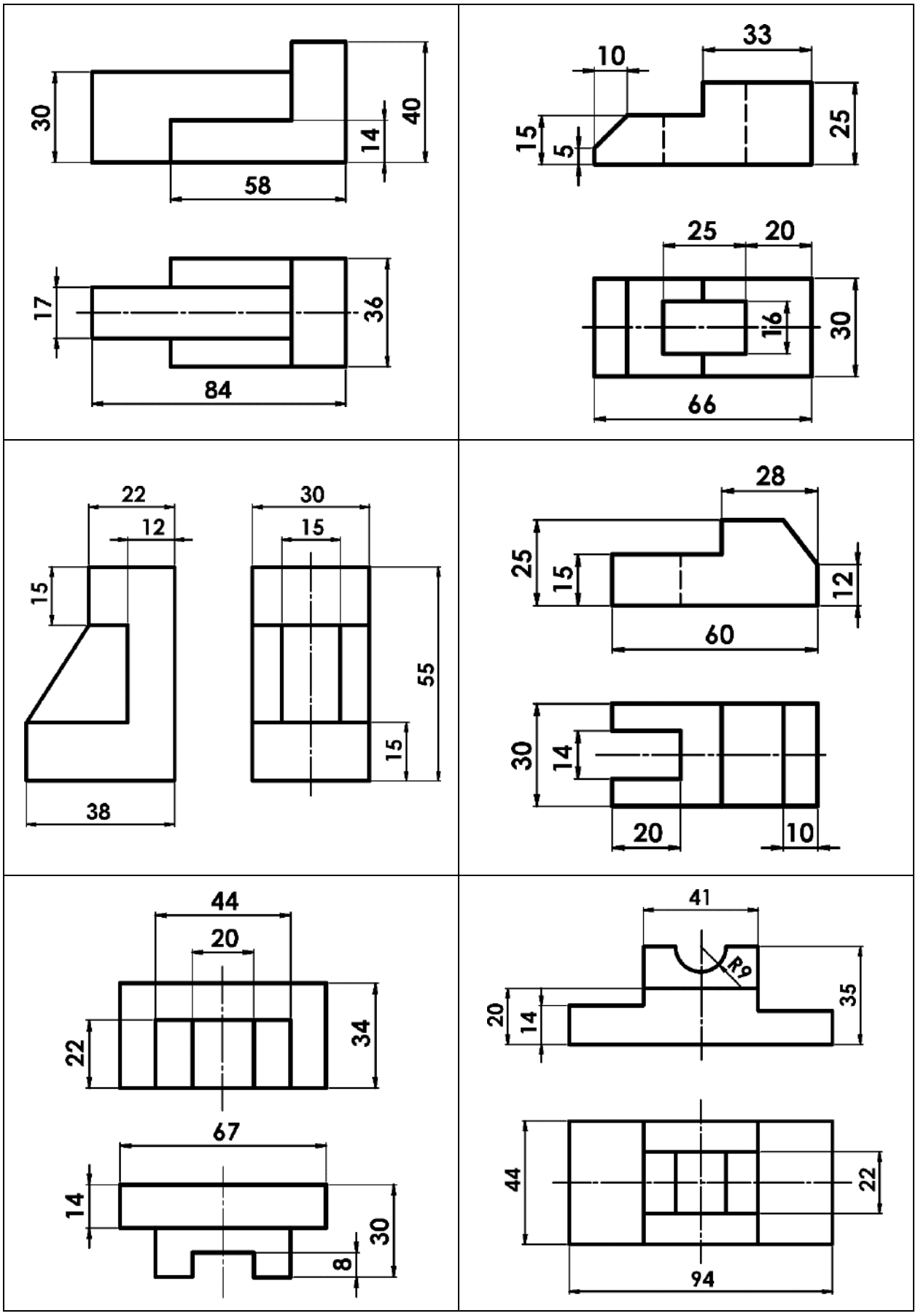
2. For the object shown in each lettered cell shown in the following figure, select one of the twenty views that correctly shows a top, front, or right-side view of the object having one or more hidden lines.



3. For the given views find the third view



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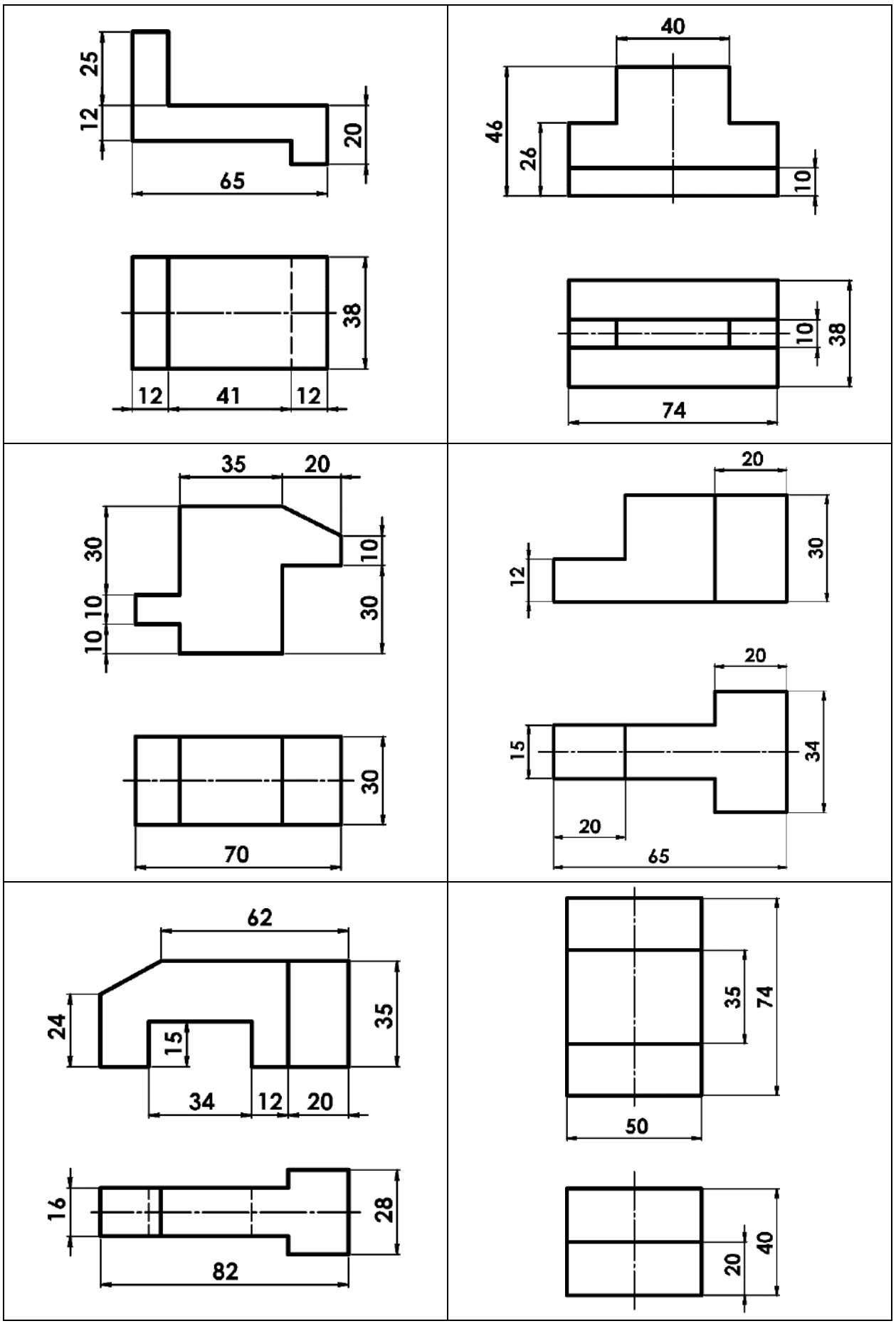
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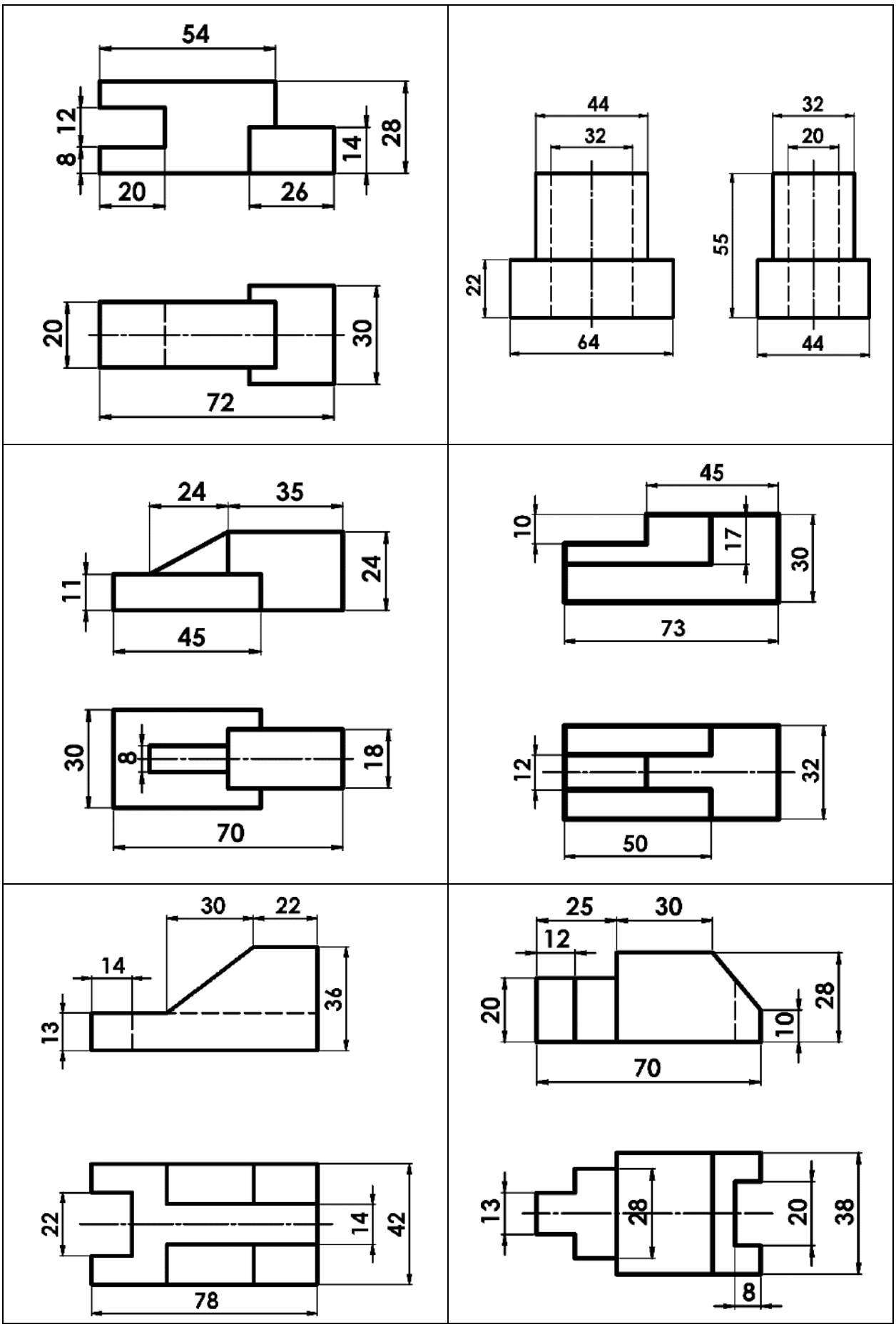
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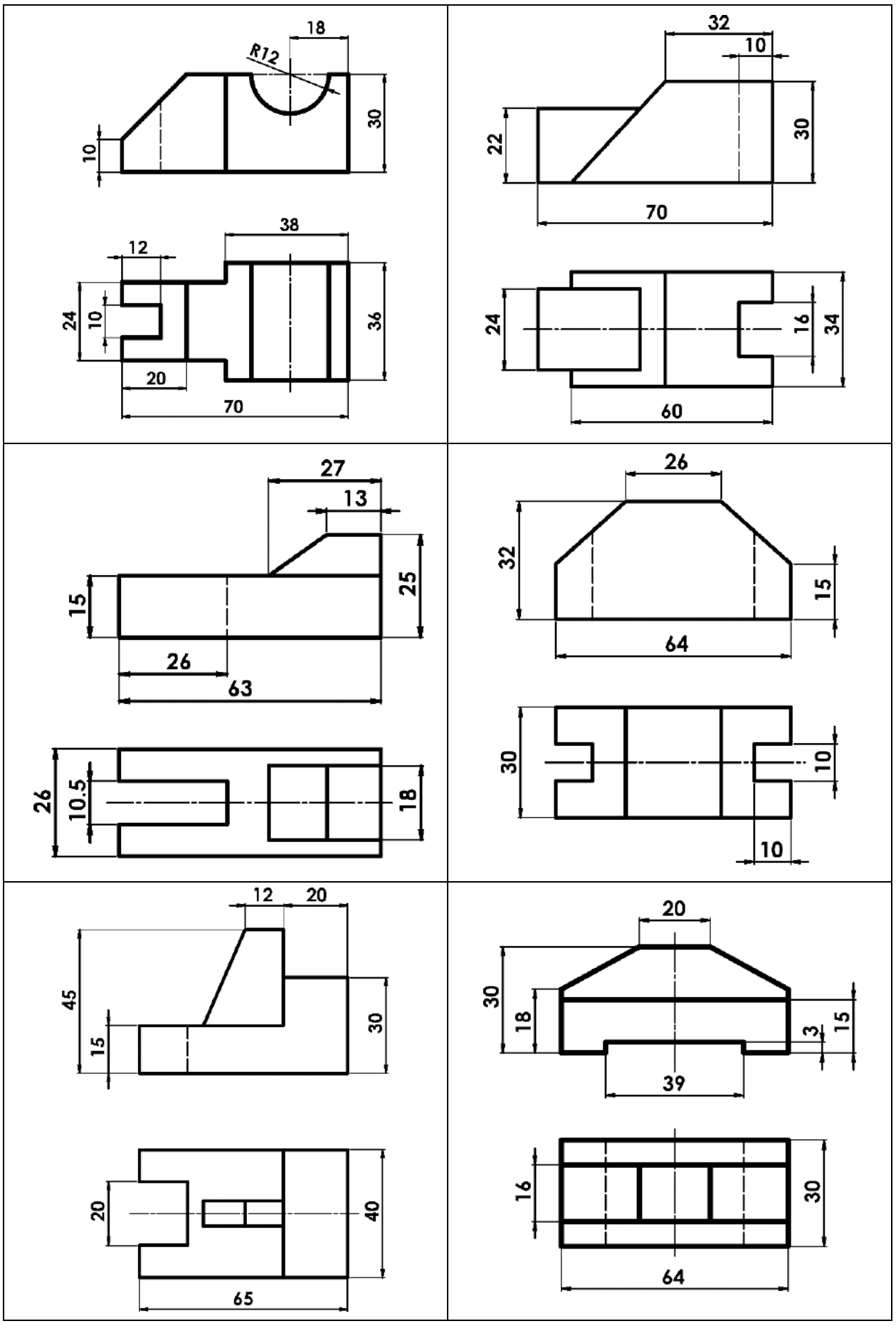
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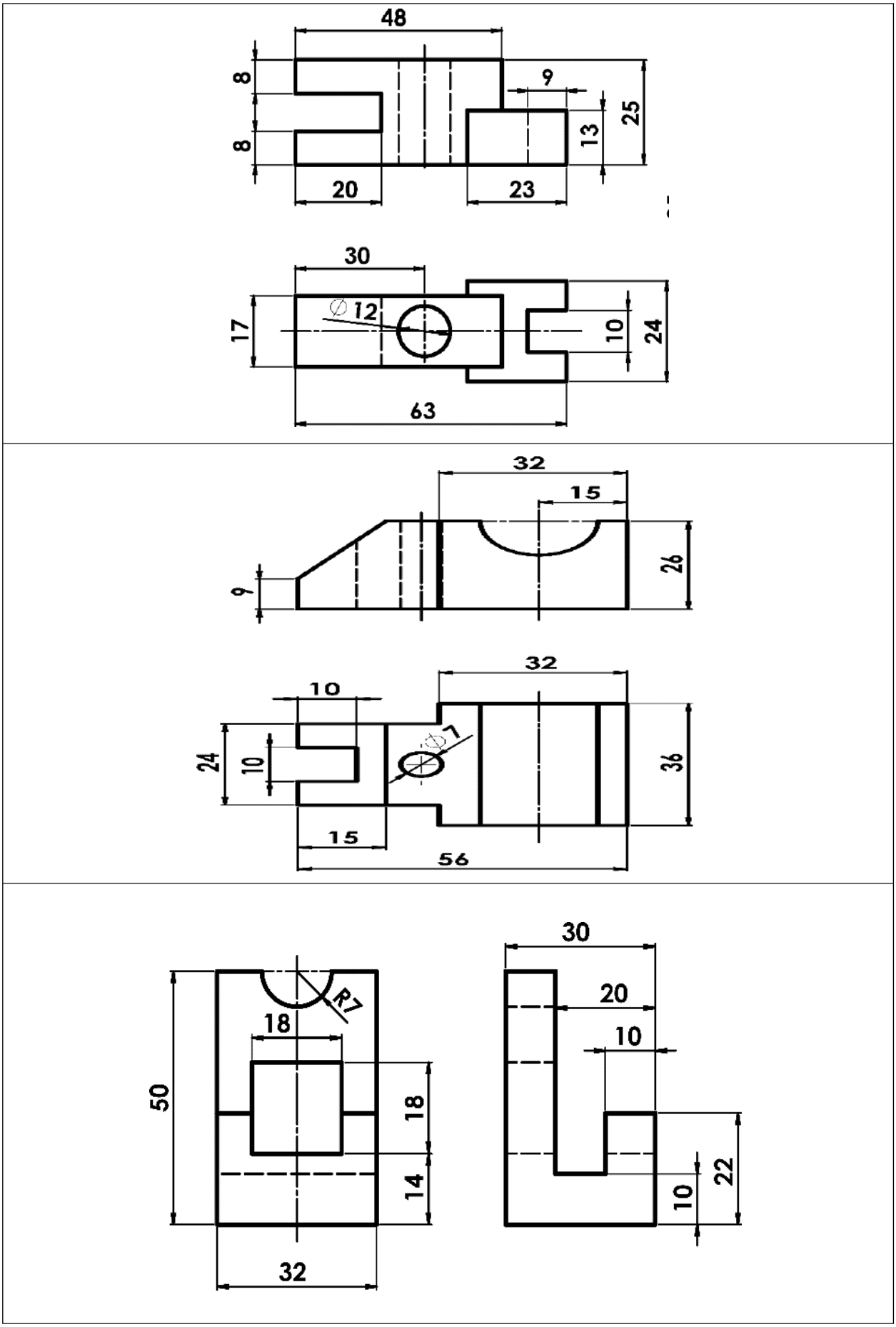
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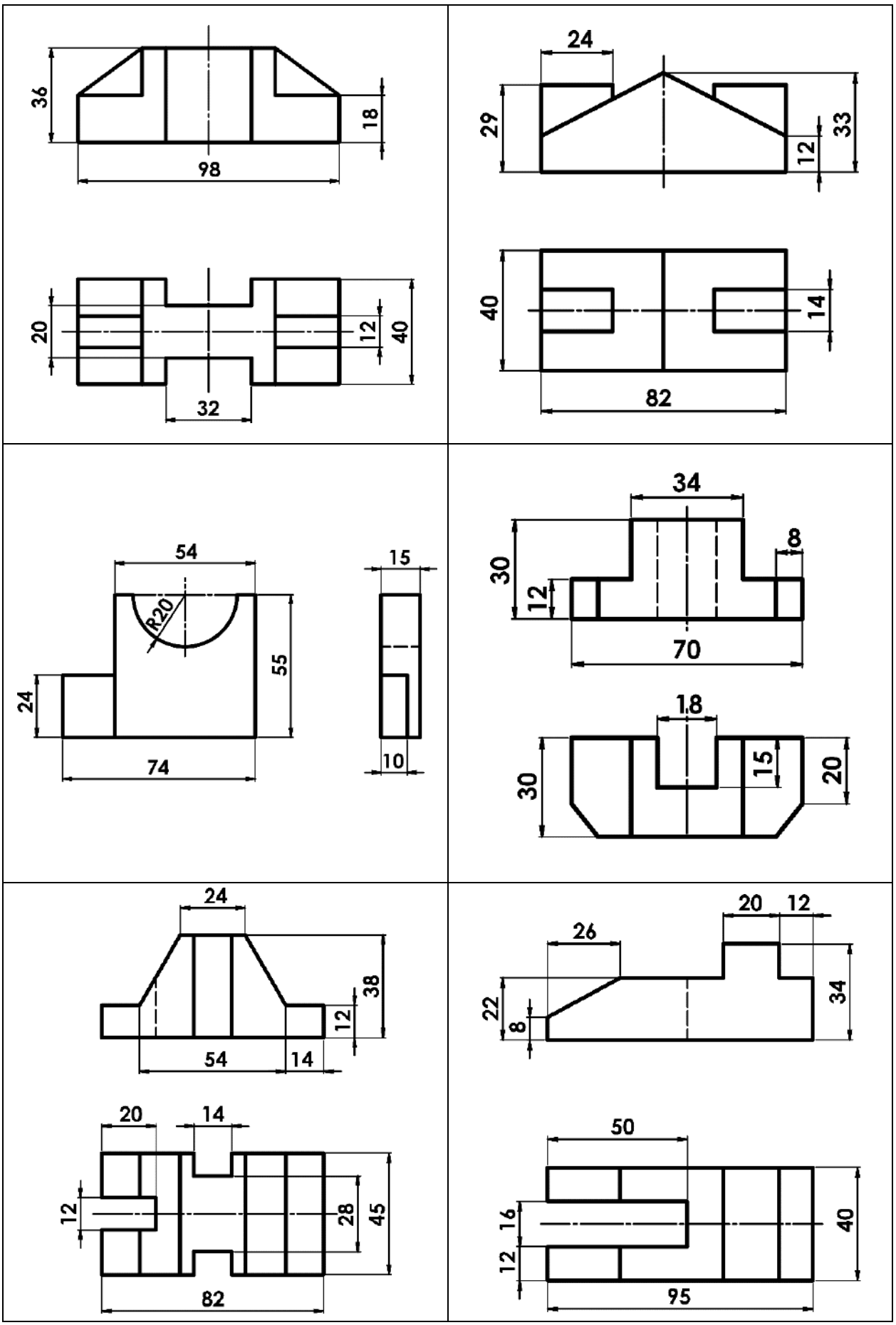
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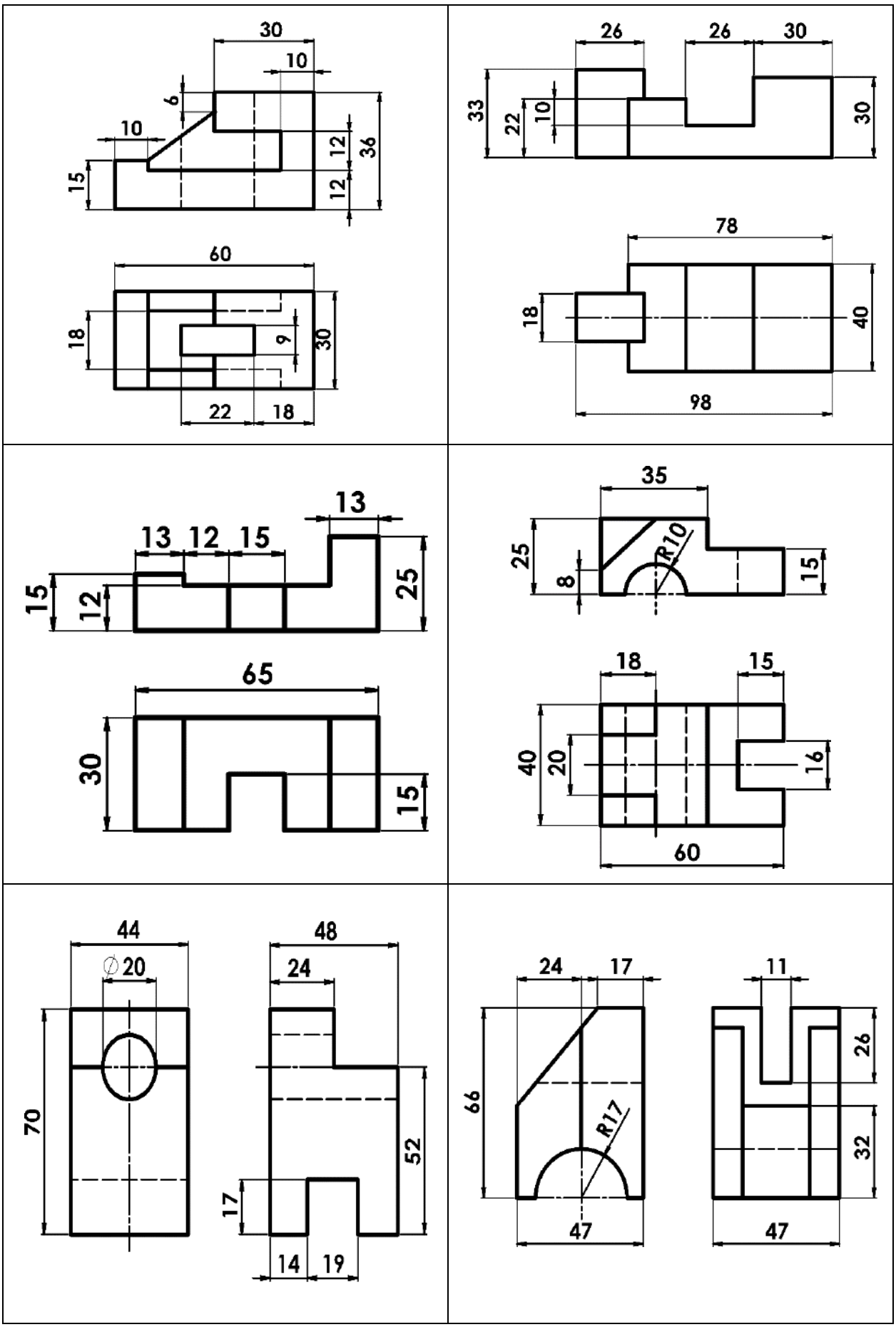
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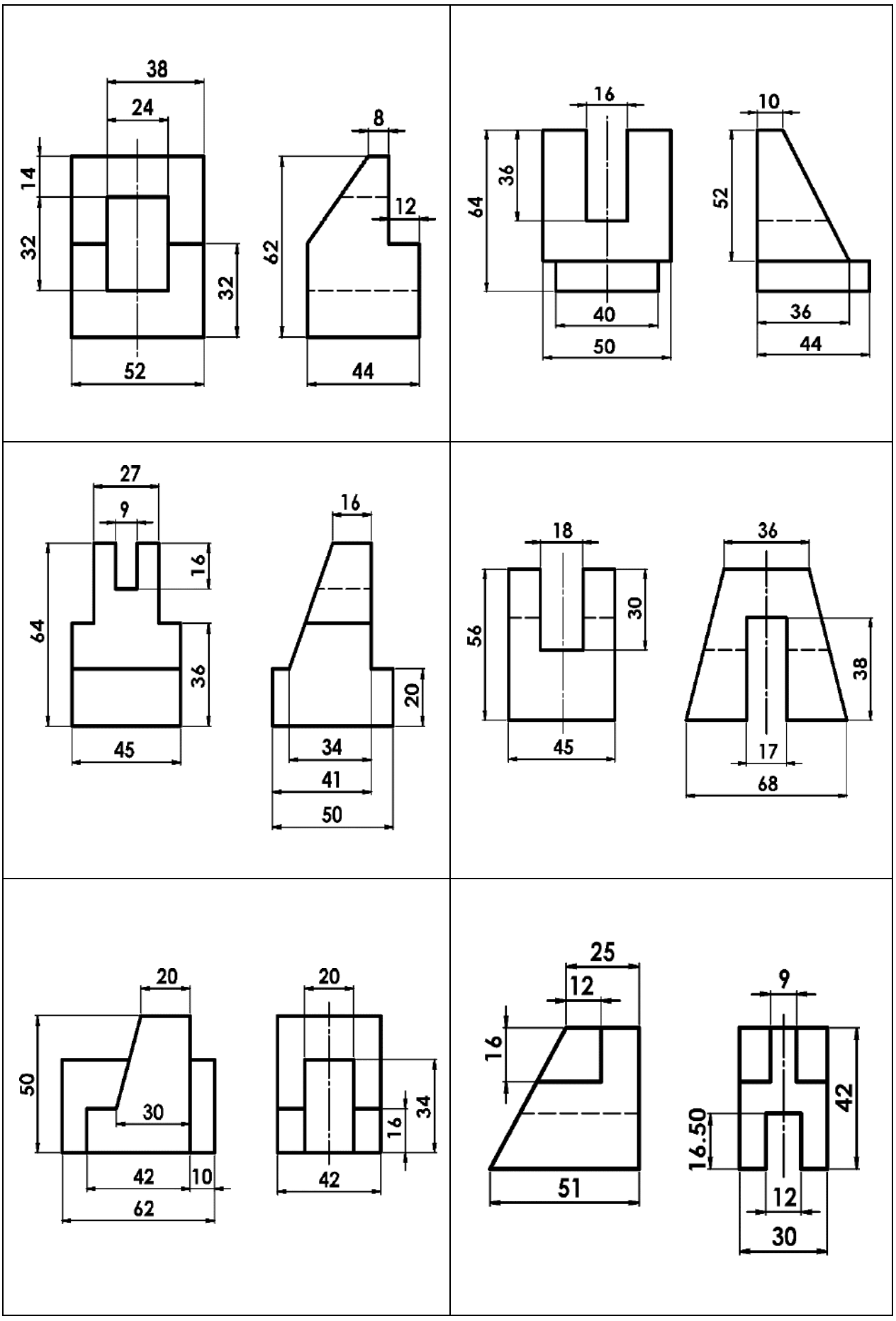
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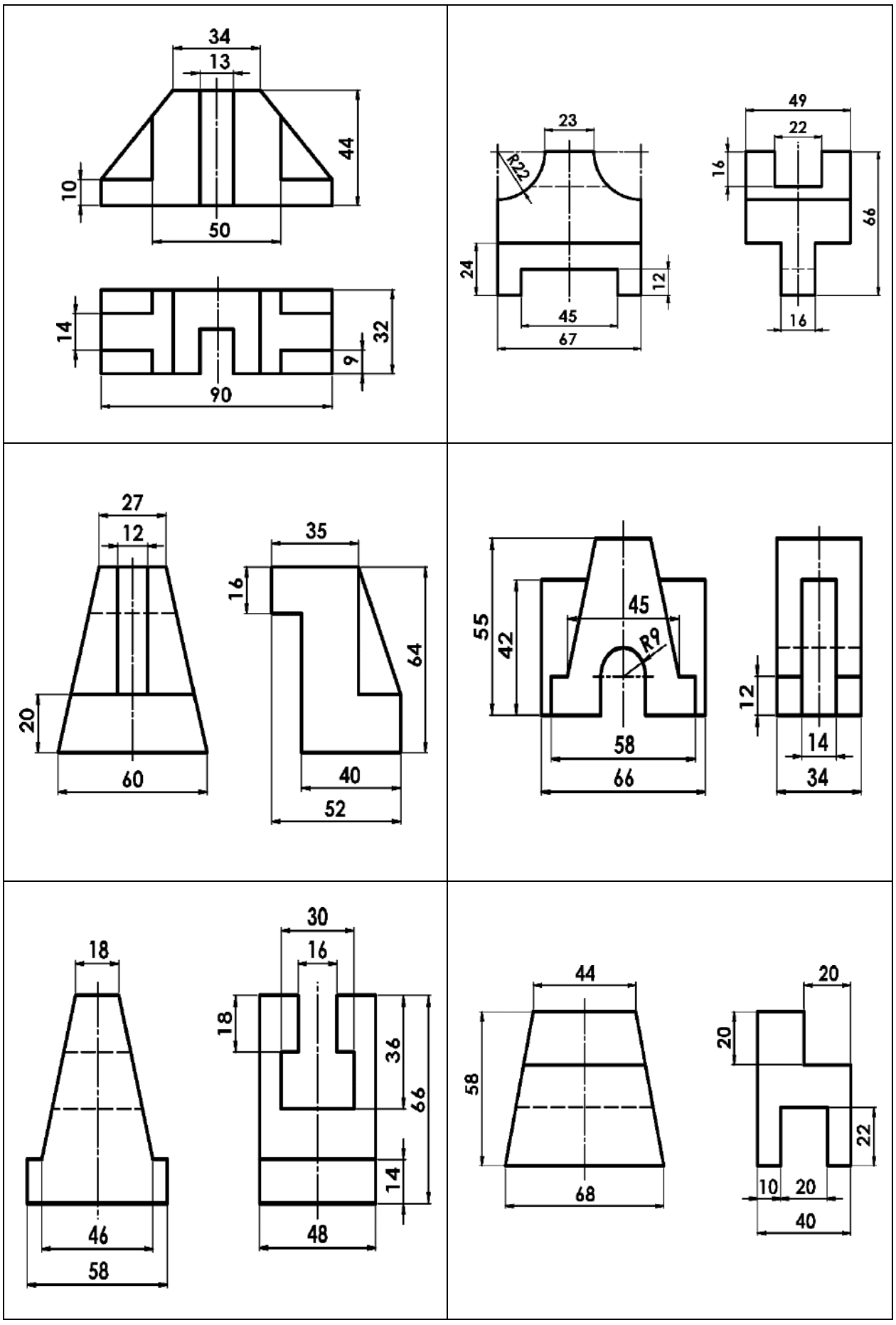
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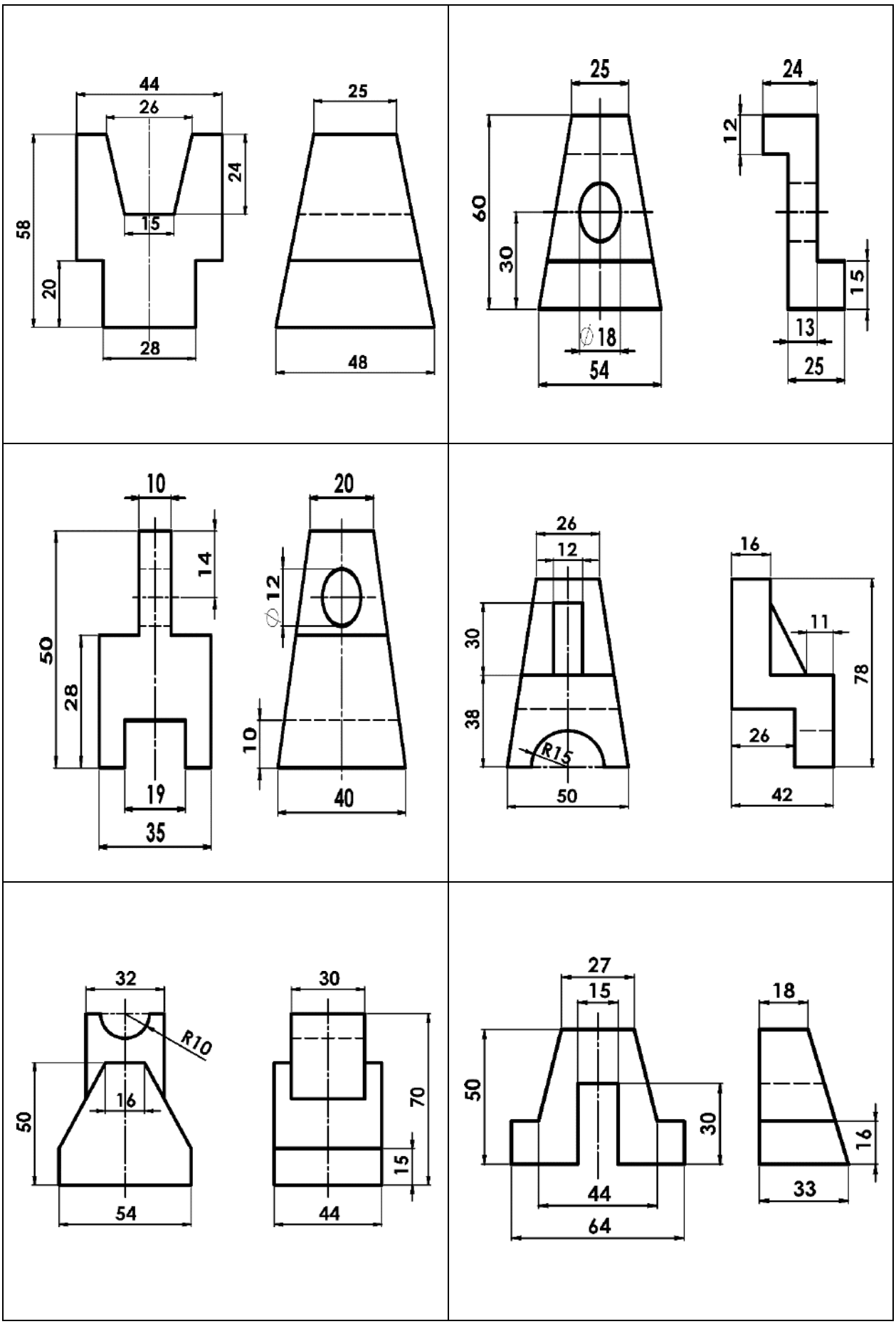
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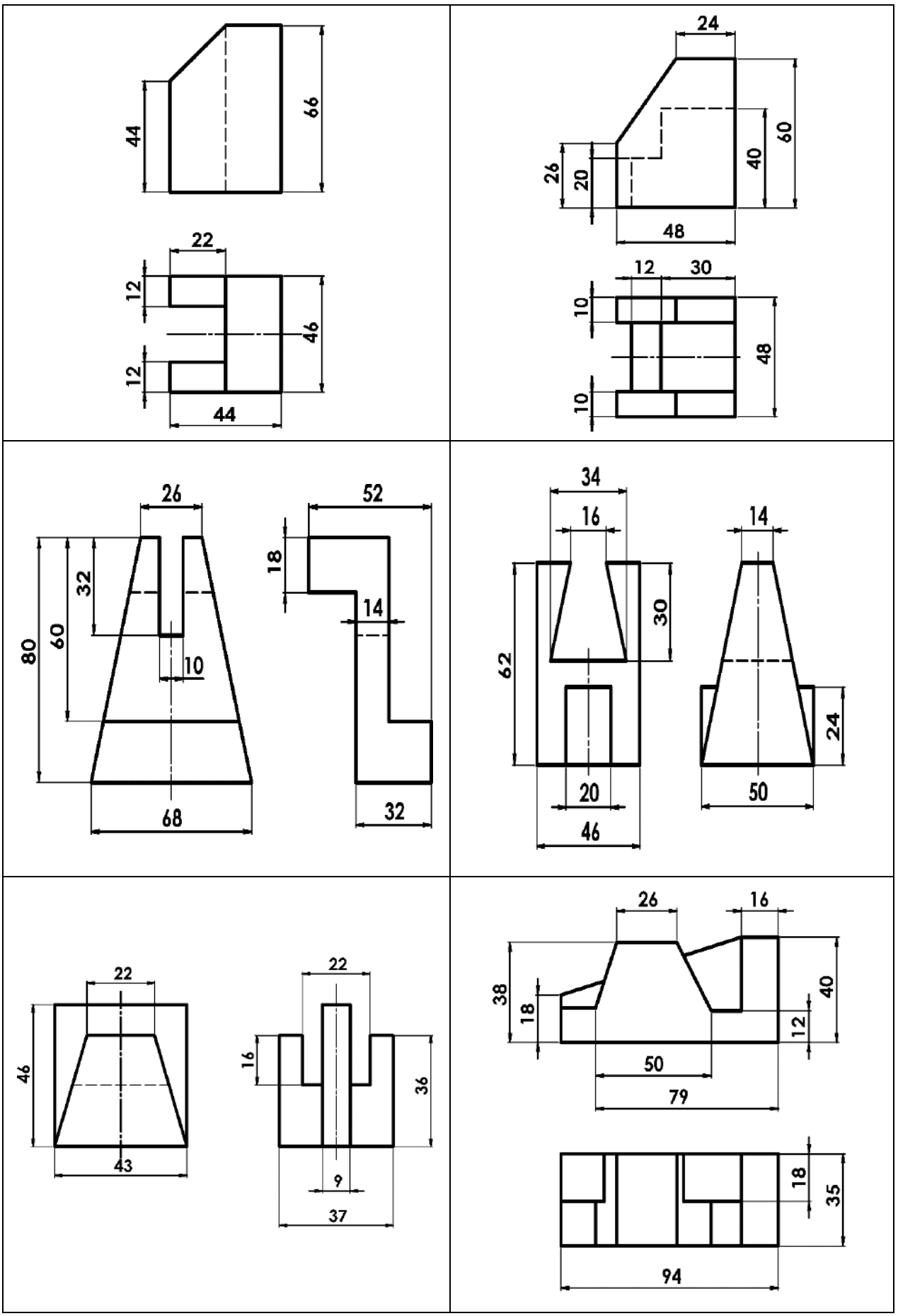
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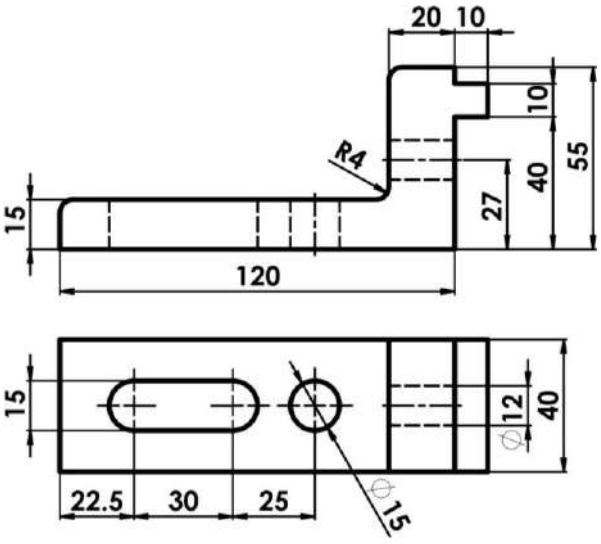
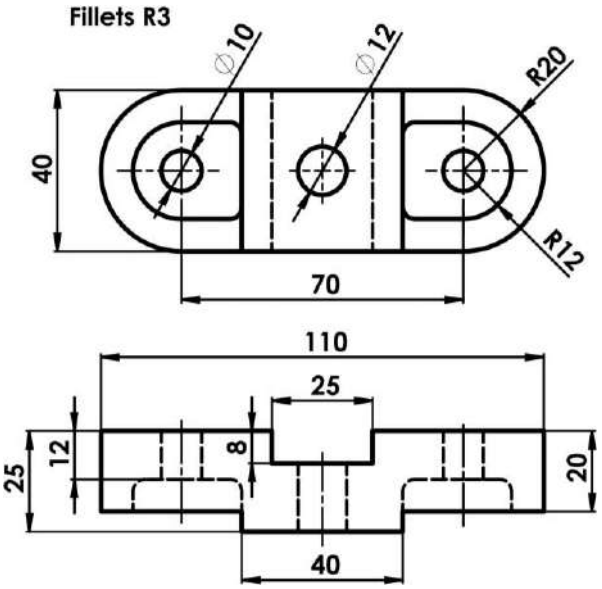
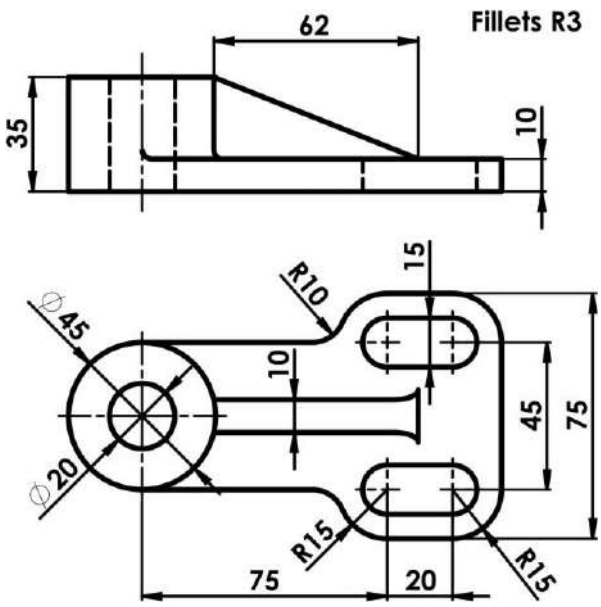
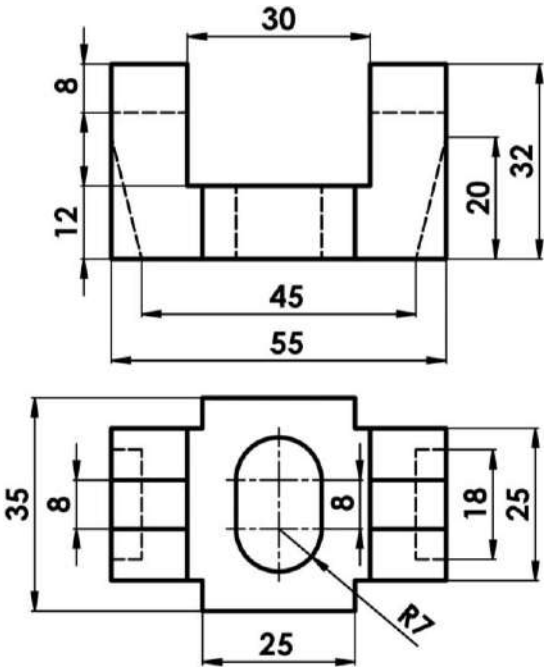
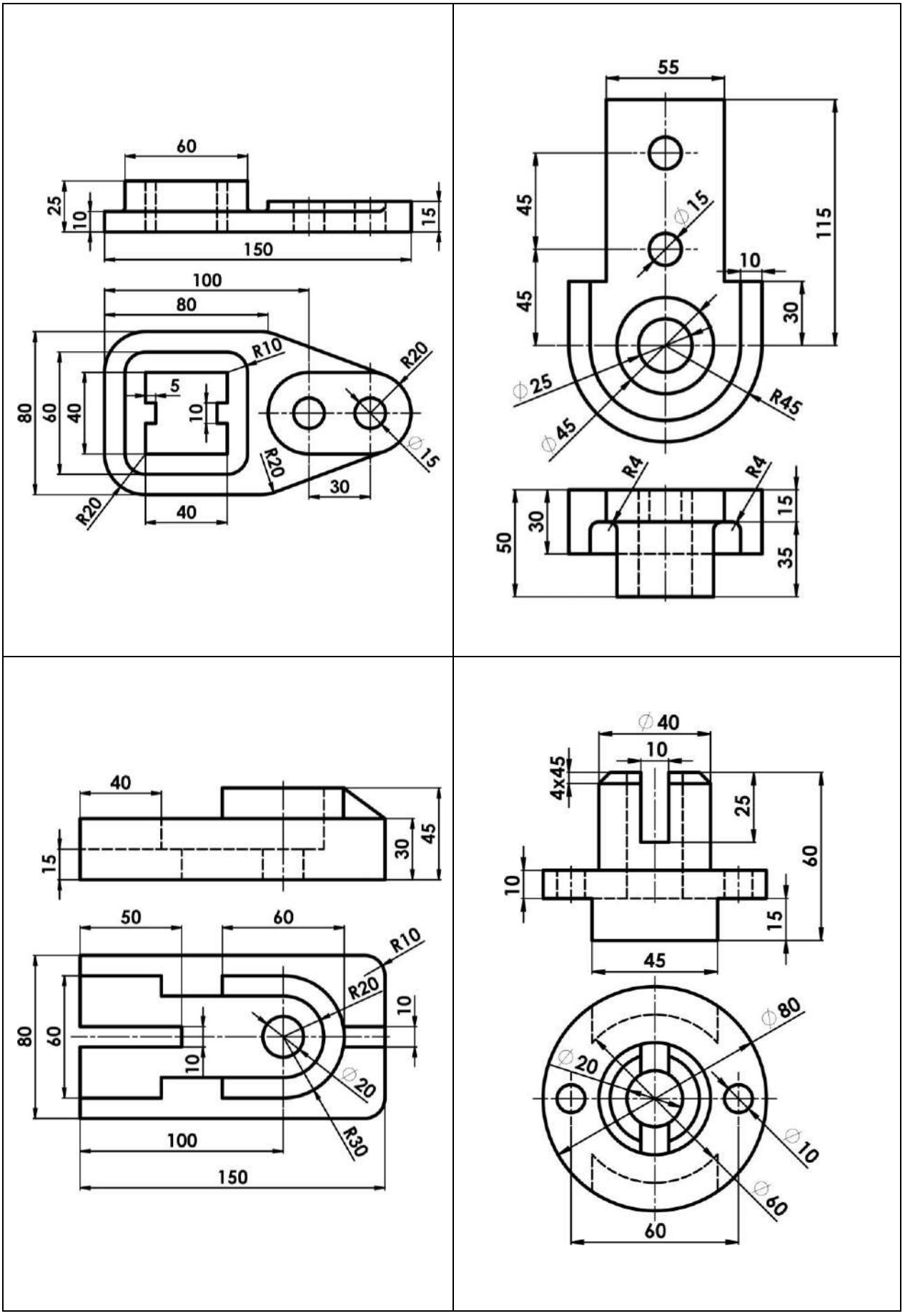
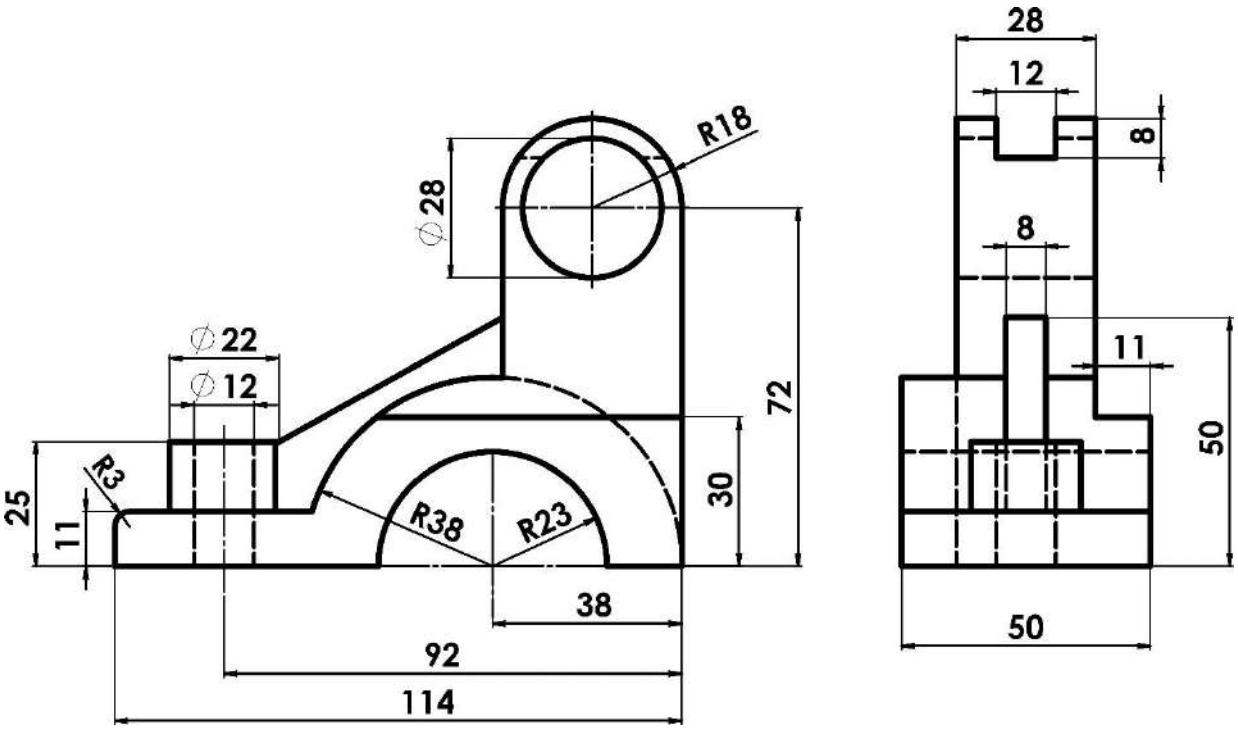

20
10
10
55
40
27
R4
15
120
15
12
40
22.5
30
25
15

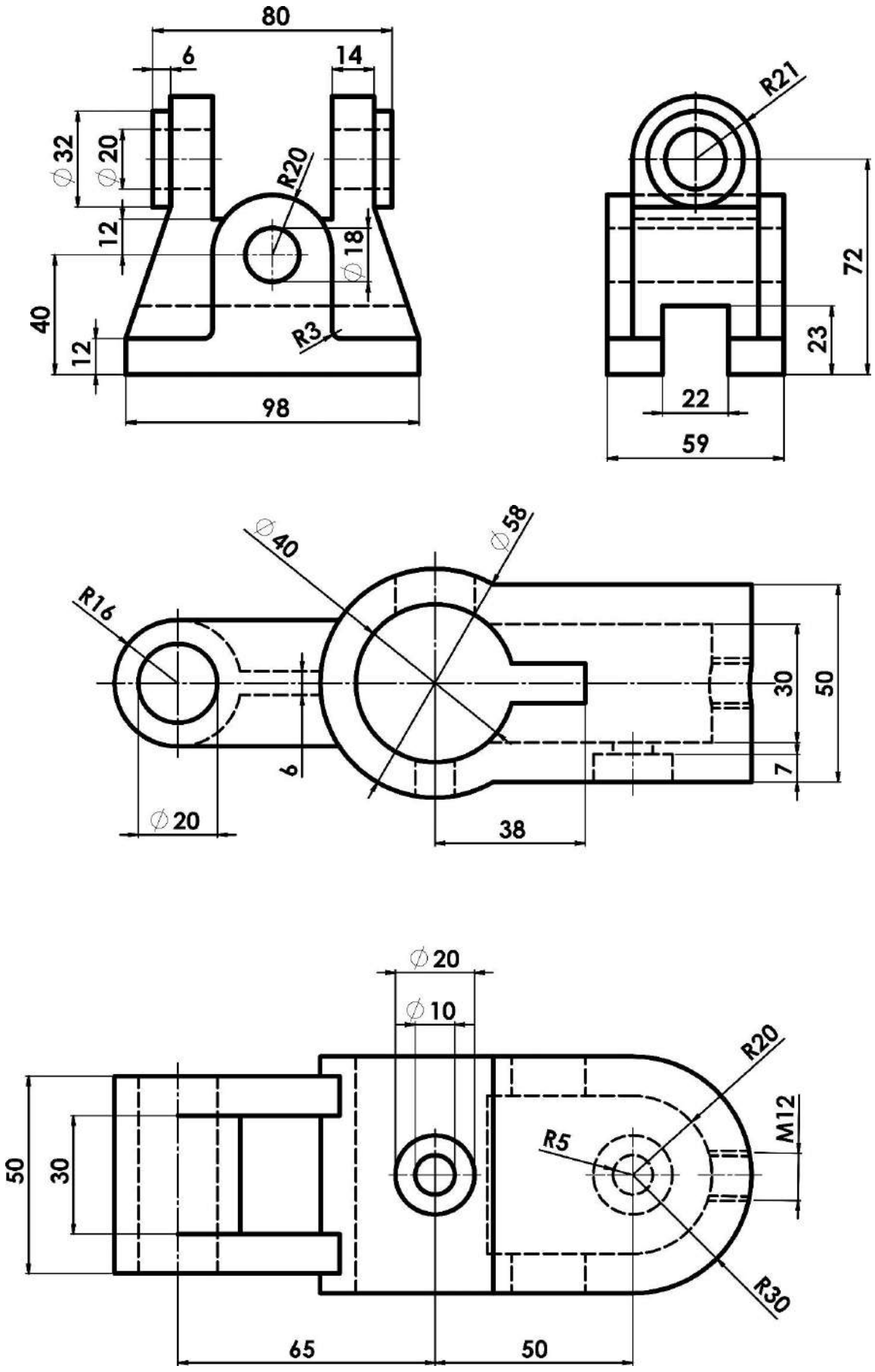

Fillets R3
10
12
R20
40
R12
70
110
25
12
8
25
20
40

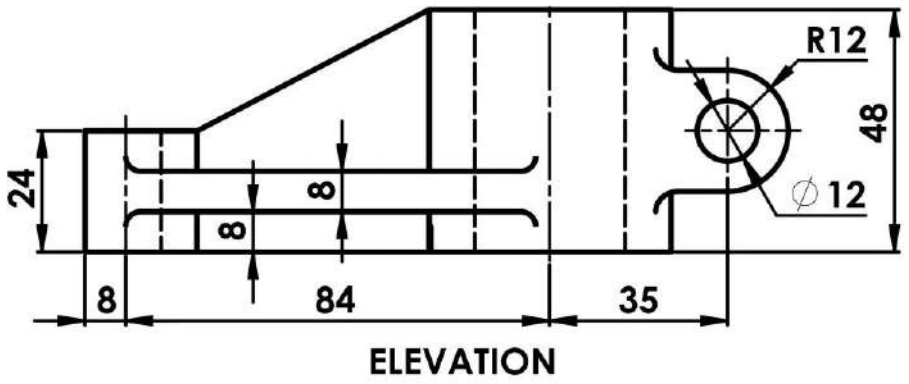

62
Fillets R3
35
10
15
R10
45
10
45
75
20
R15
R15
75
20


30
8
12
20
32
45
55
35
8
8
18
25
R7
25

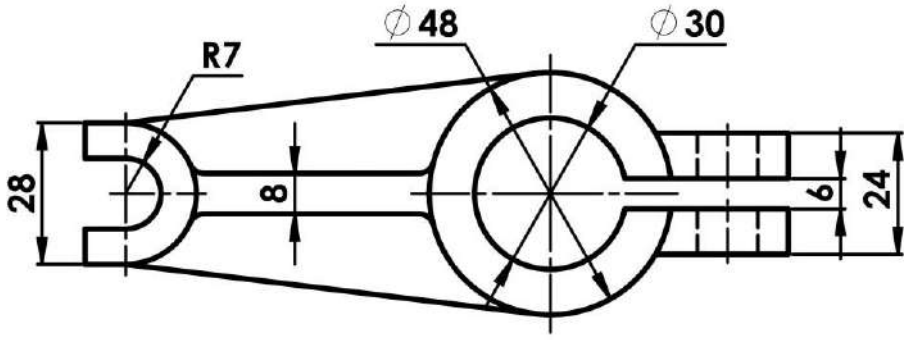

60
25
10
15
150
100
80
R10
R20
5
10
80
60
40
R20
15
30
R20
40
55
45
15
115
10
45
30
25
R45
45
R4
R4
50
30
15
35
40
10
4x45
25
60
10
15
45
80
20
10
60
60
40
45
30
15
50
60
R10
R20
80
60
10
10
20
R30
100
150


28
12
8
8
11
50
50
R18
∅28
∅22
∅12
72
30
25
11
R3
R38
R23
38
92
114

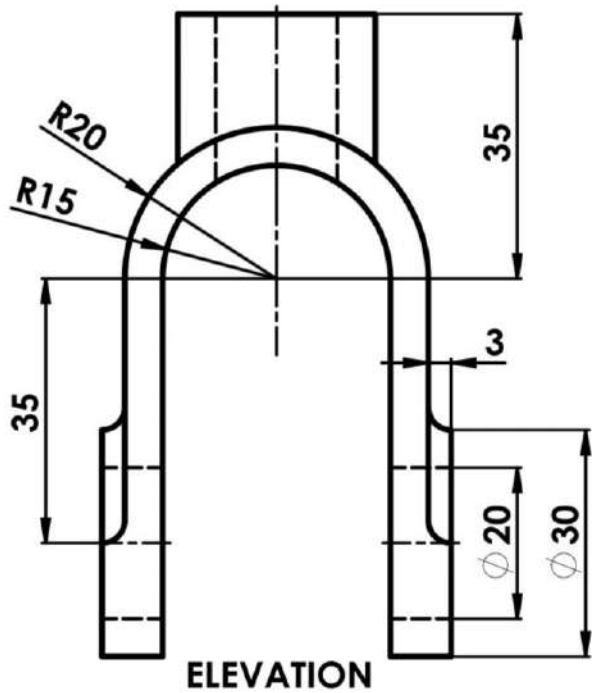

80
6
14
∅32
∅20
R20
12
18
∅
40
12
R3
98
R21
72
23
22
59
∅40
∅58
R16
30
50
6
7
∅20
38
∅20
∅10
R20
M12
R5
50
30
R30
65
50



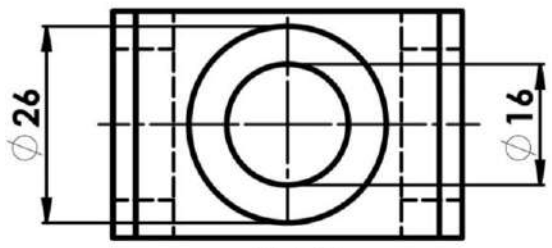
ELEVATION



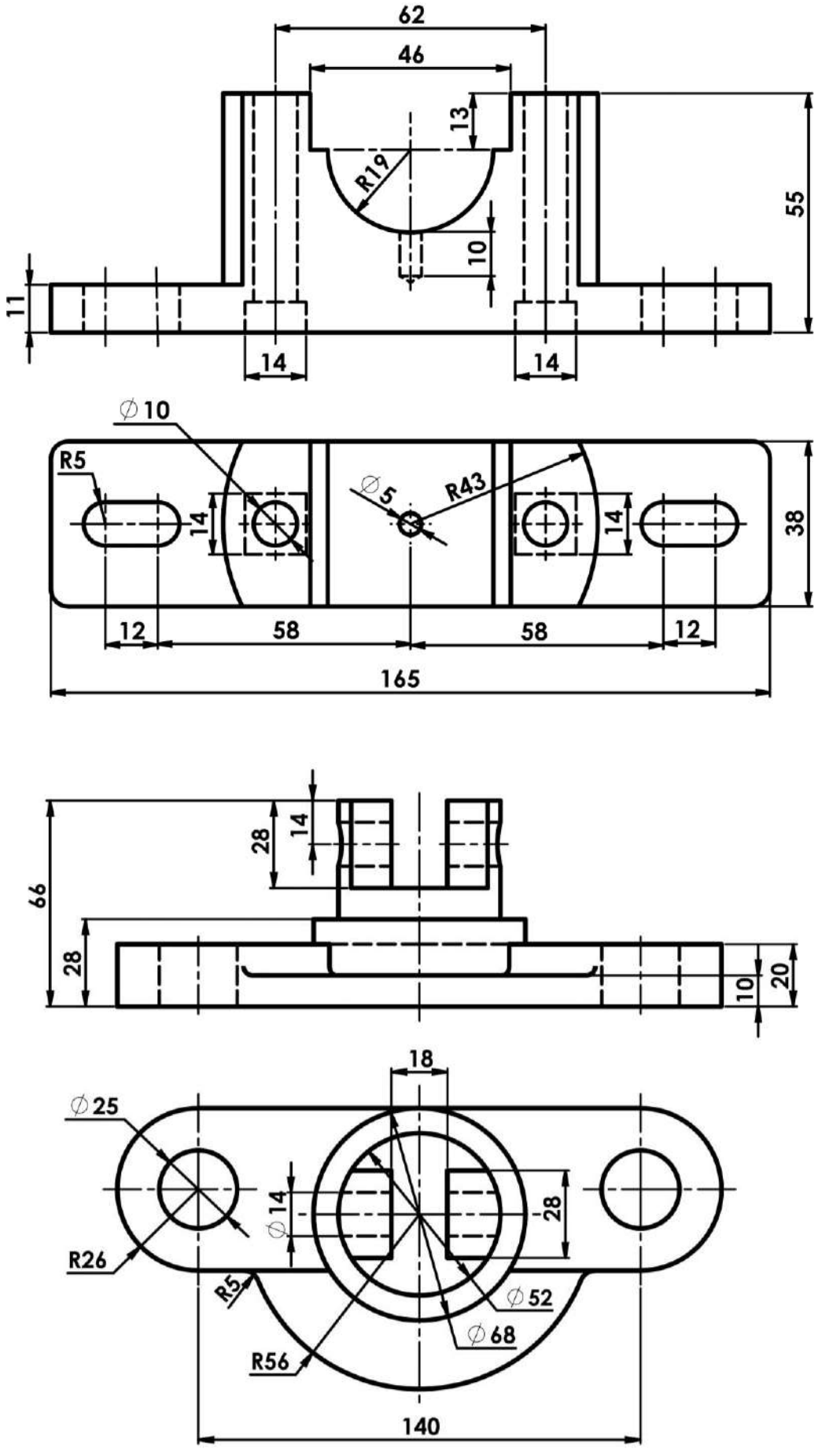
PLAN



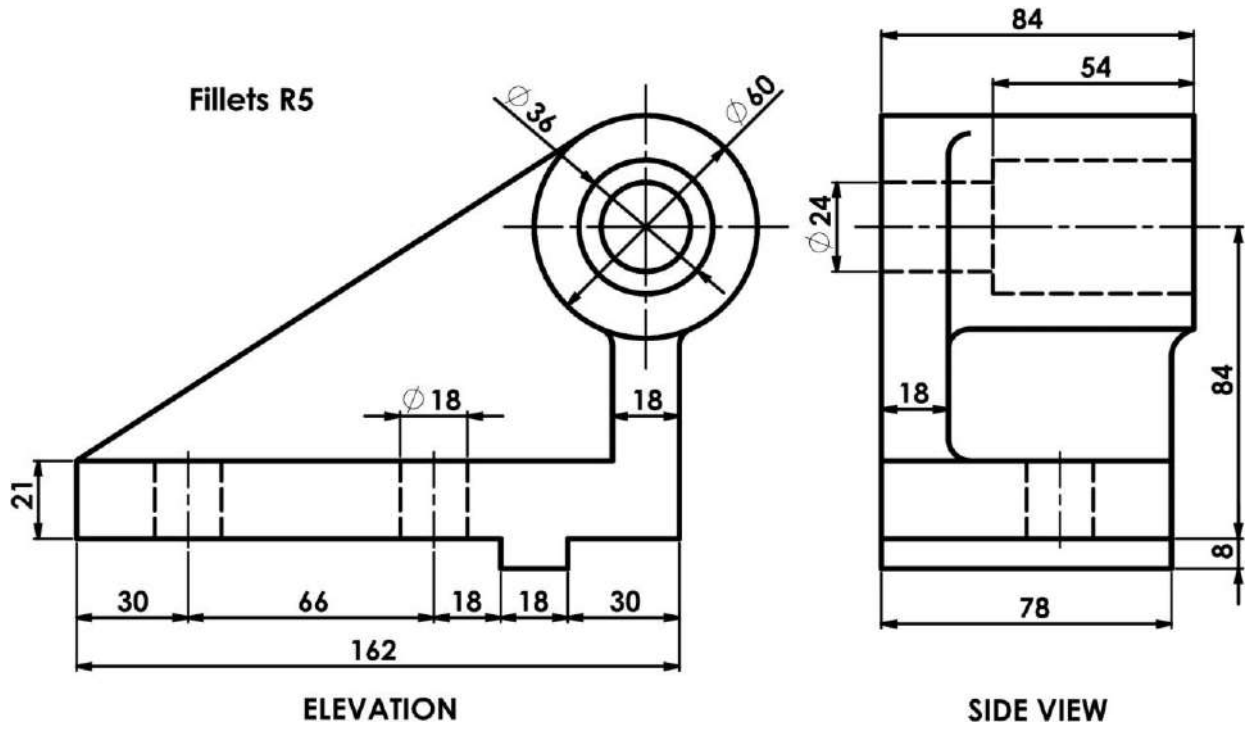
ELEVATION



PLAN

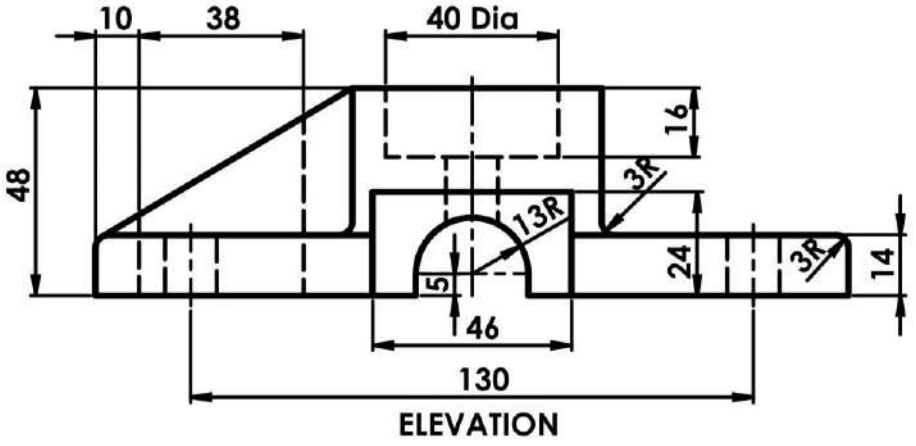

62
46
13
R19
55
10
11
14
14
∅10
R5
∅5
R43
14
14
38
12
58
58
12
165
28
14
66
28
10
20
18
∅25
14
28
R26
R5
∅52
∅68
R56
140

[28]

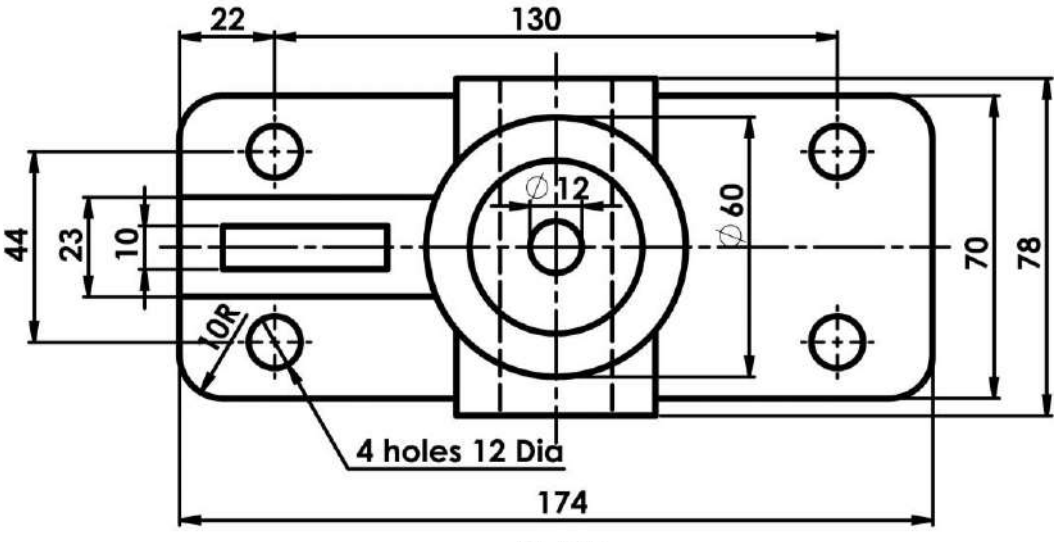


ELEVATION

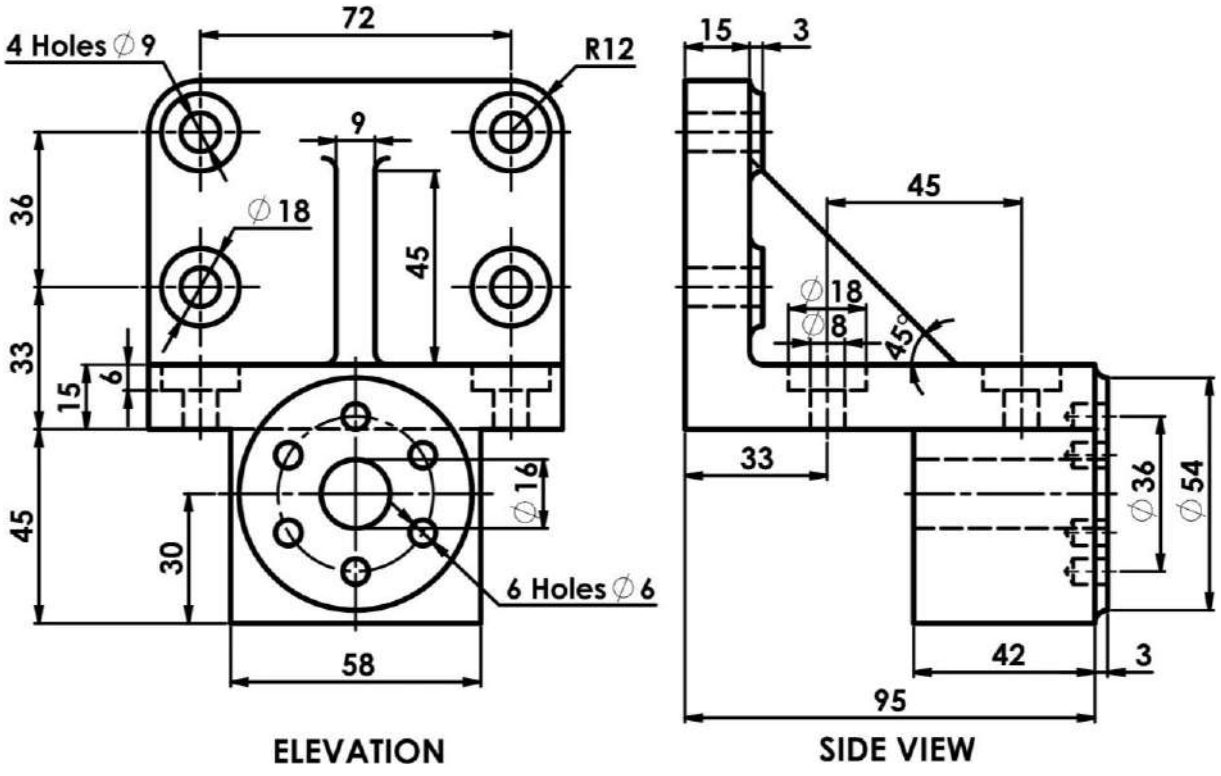
SIDE VIEW

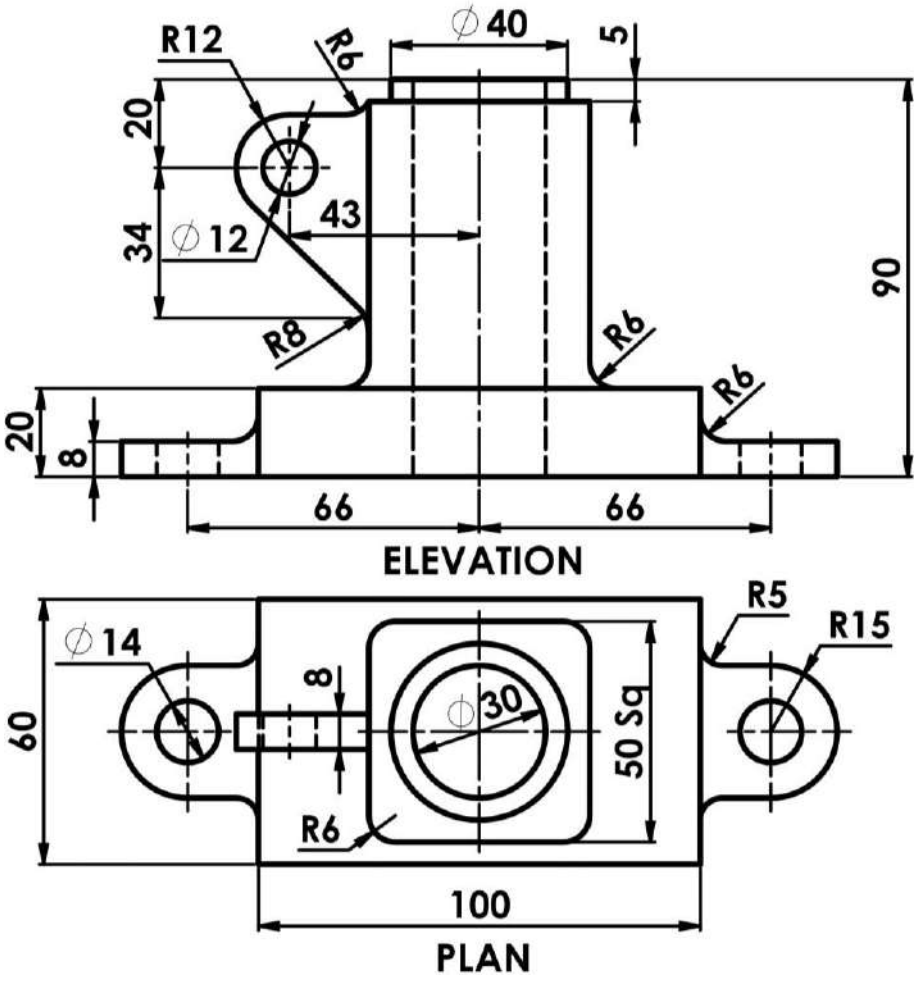


ELEVATION

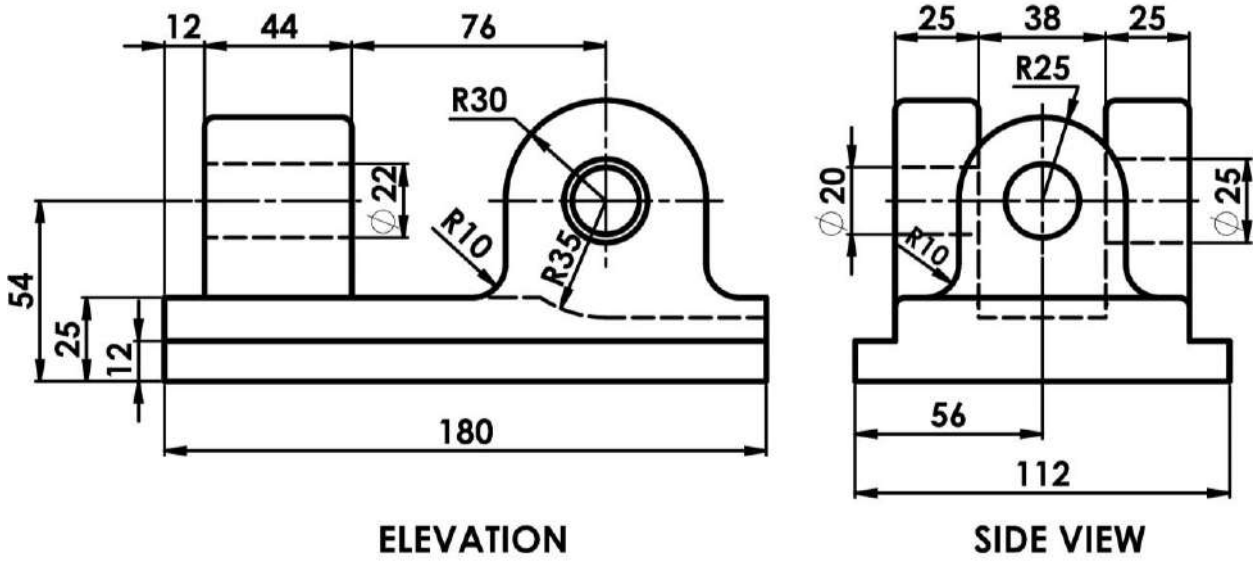


PLAN


4 Holes ∅9
72
R12
9
∅18
36
45
33
15
6
45
30
∅16
6 Holes ∅6
58
ELEVATION
15
3
45
∅18
∅8
45°
33
∅36
∅54
42
3
95
SIDE VIEW

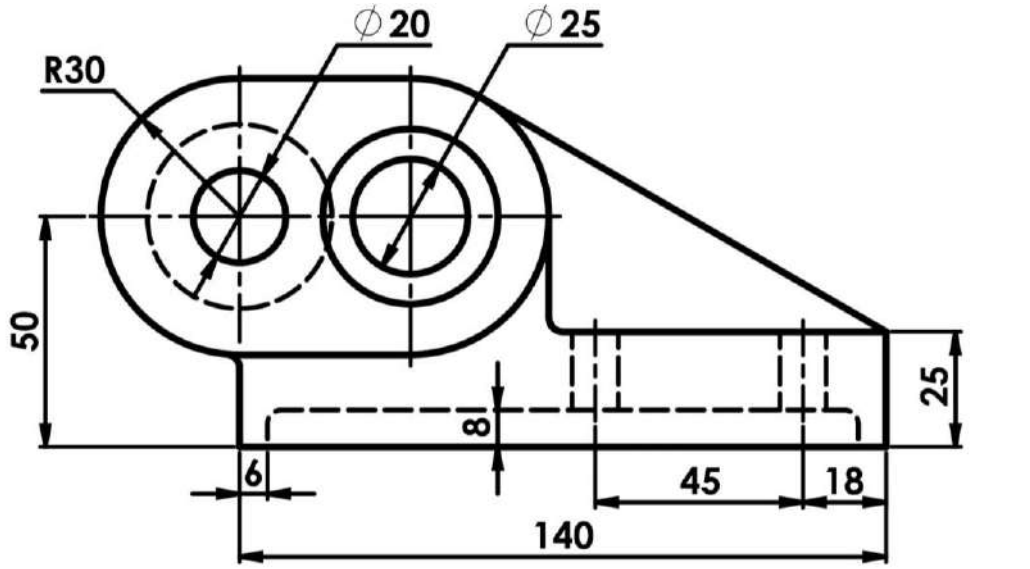

R12
R9
∅40
5
20
34
∅12
43
90
R8
R6
R6
20
8
66
66
ELEVATION
∅14
8
∅30
R5
R15
60
50 Sq
R6
100
PLAN

[30]

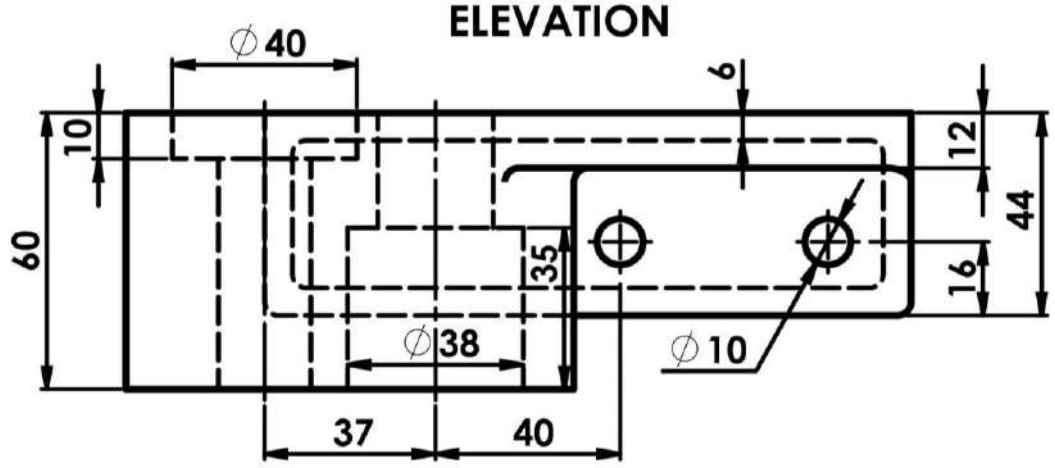


ELEVATION

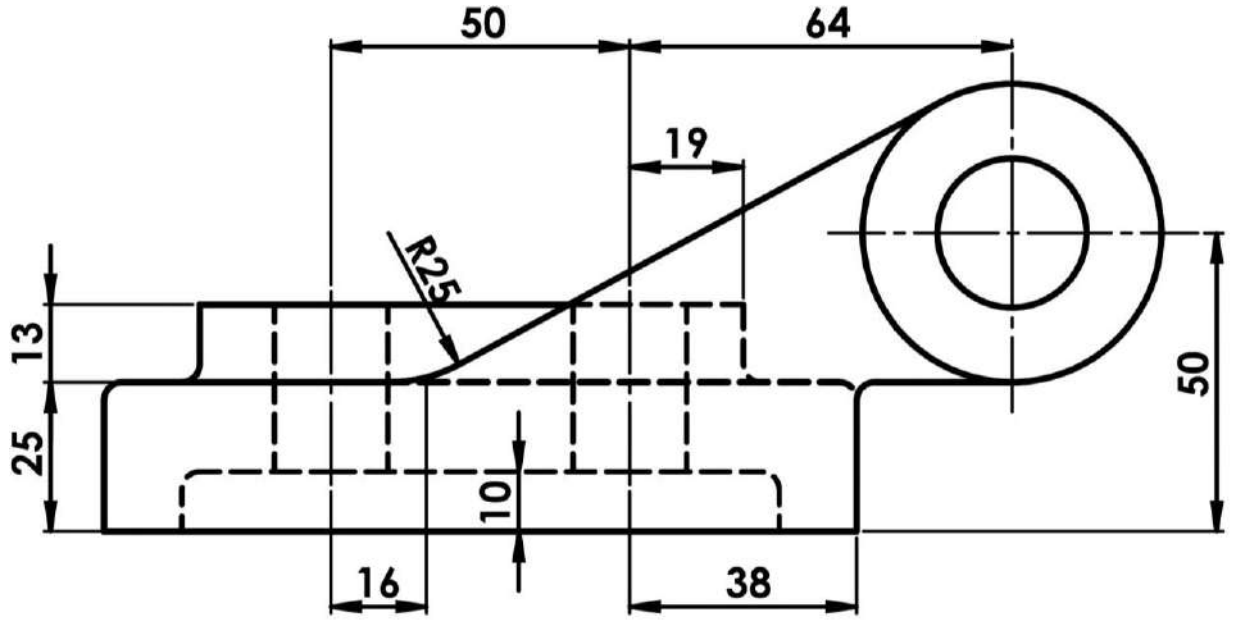
SIDE VIEW



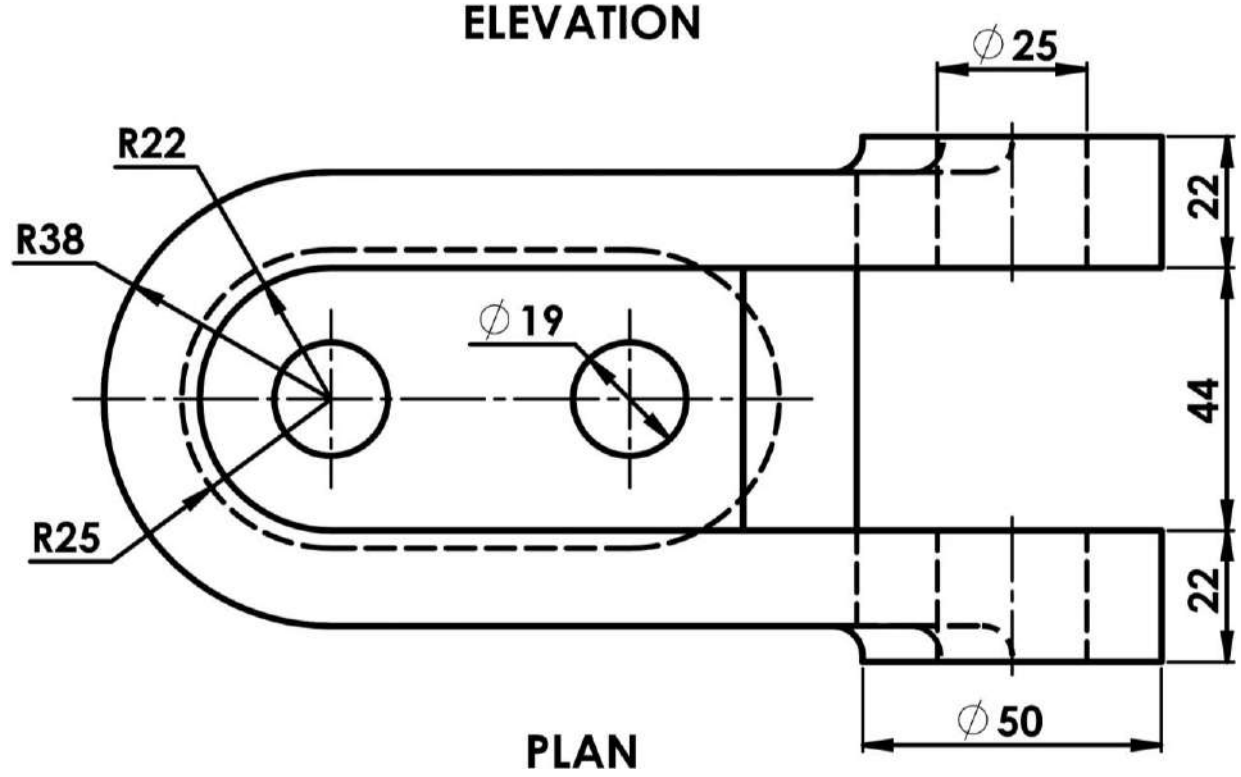
ELEVATION



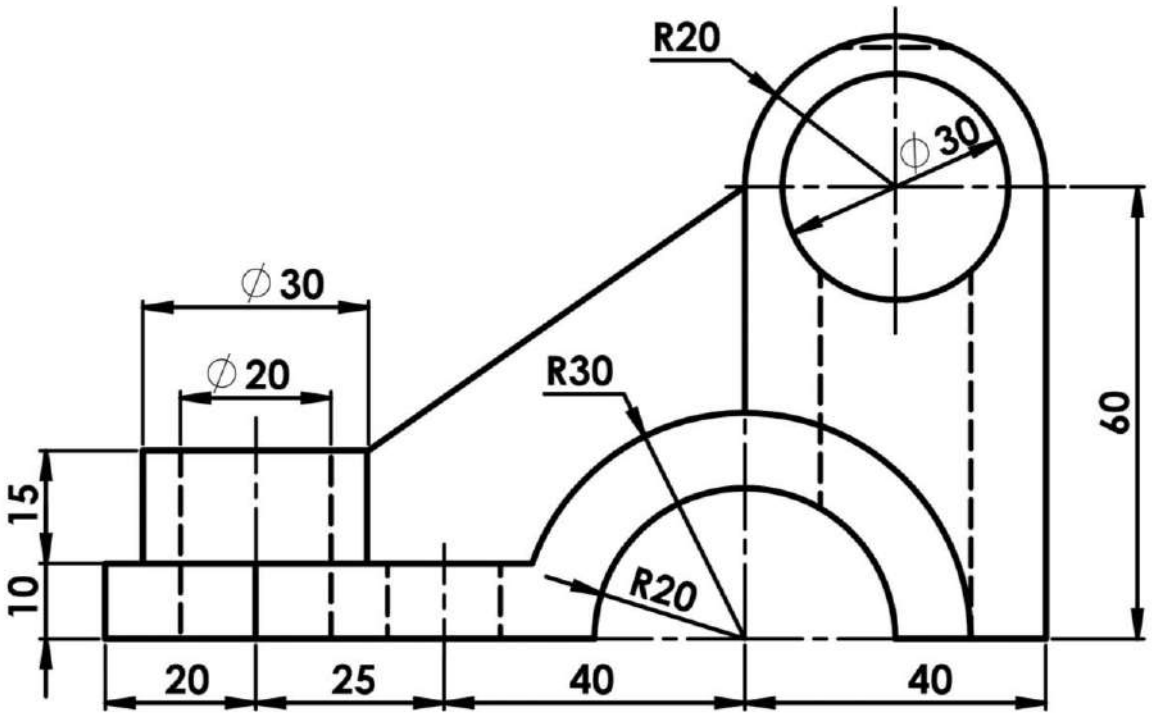
PLAN



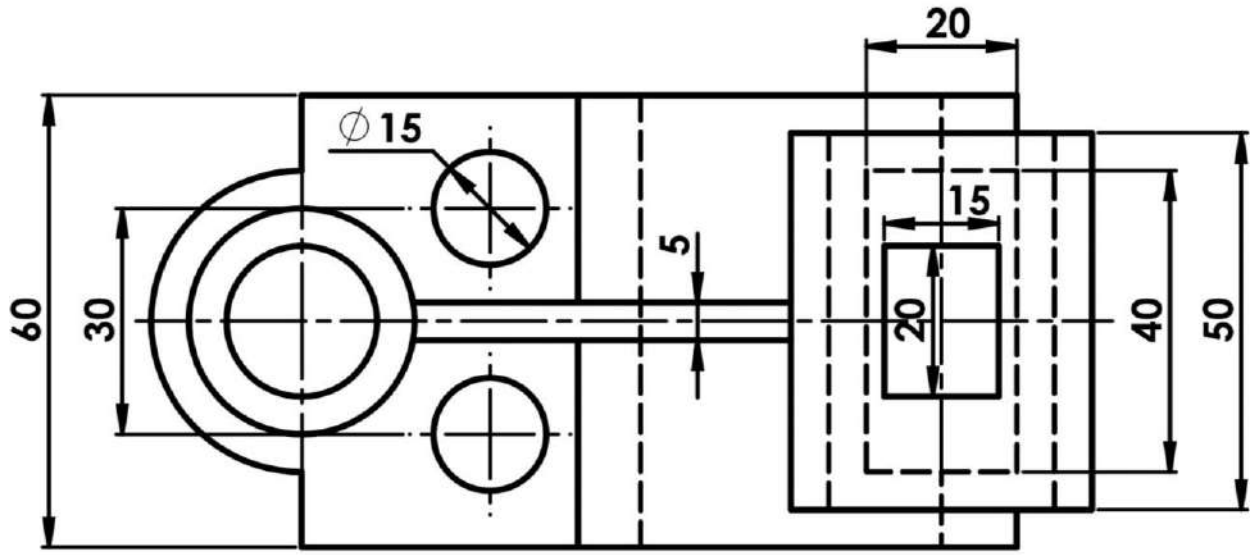
ELEVATION



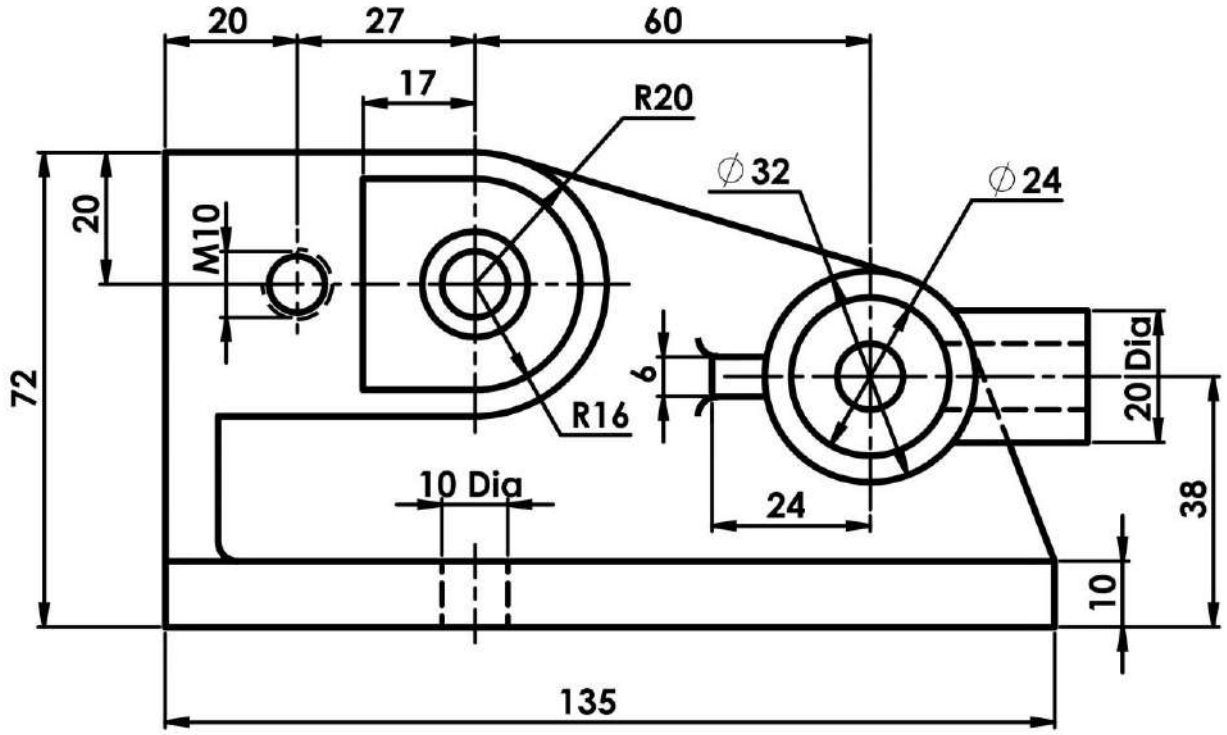
PLAN



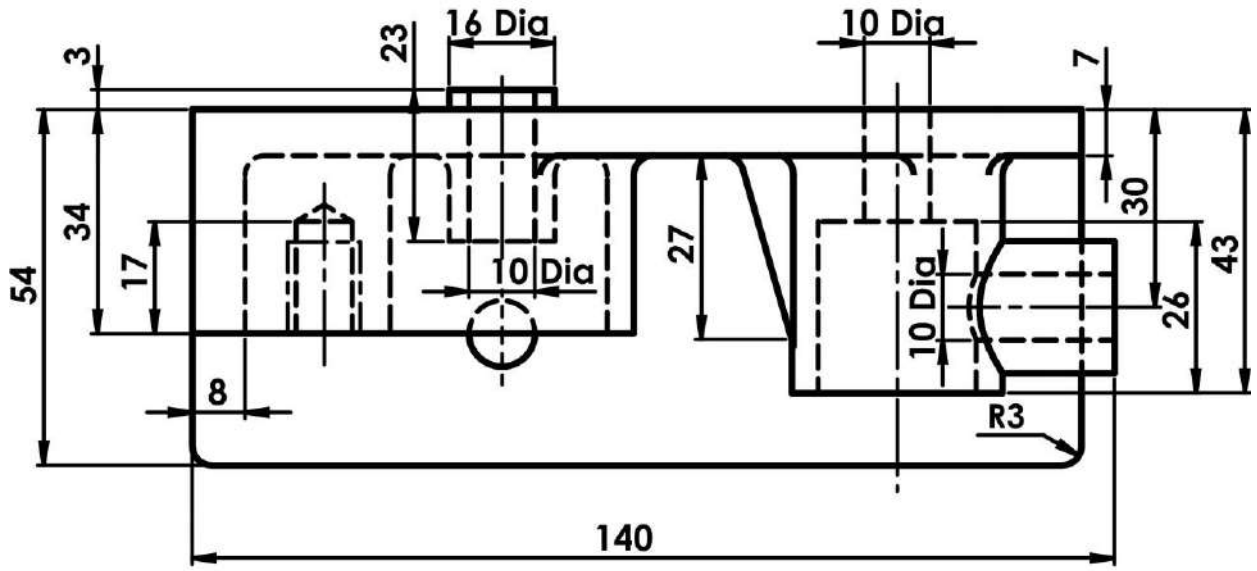
ELEVATION



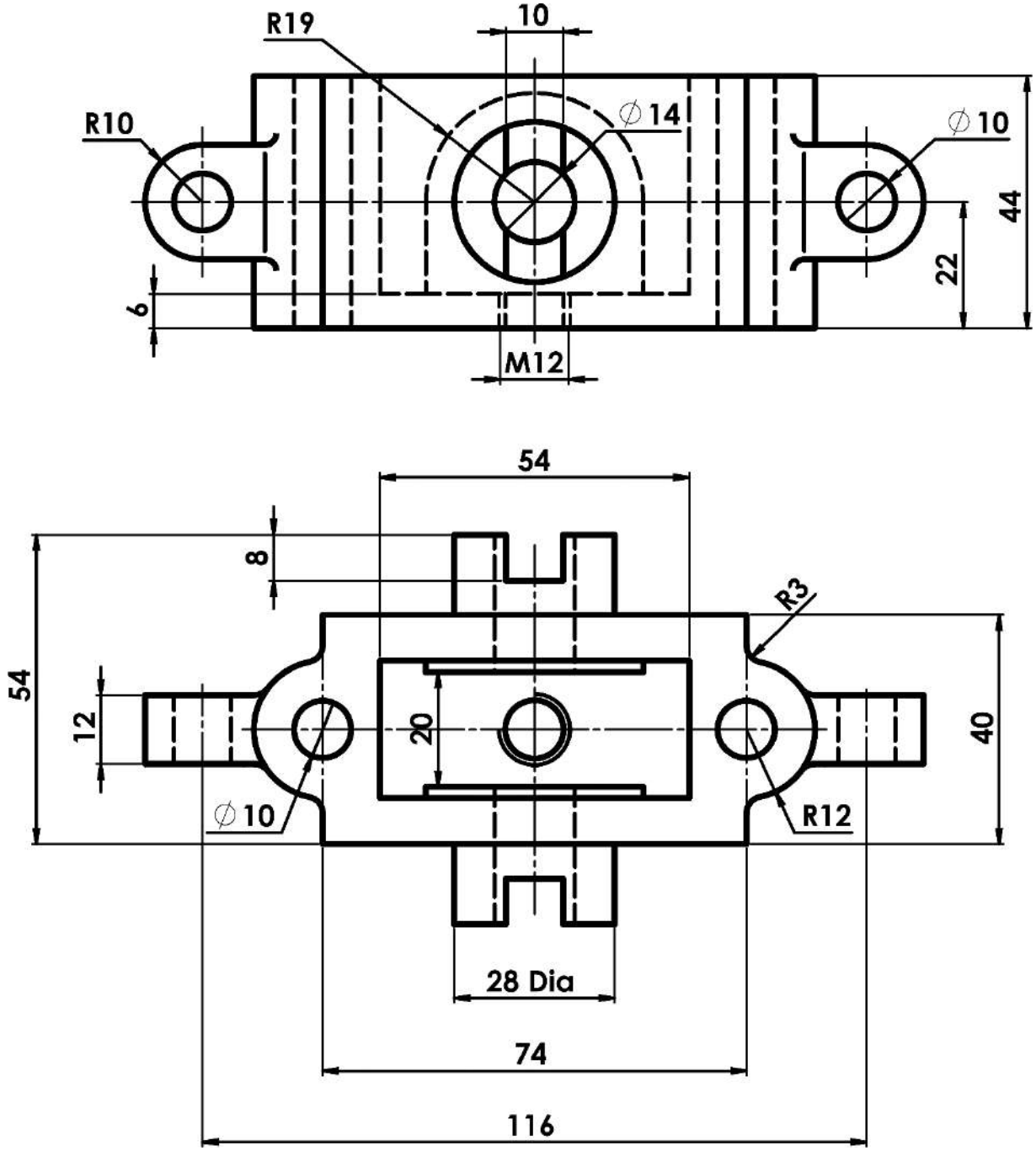
PLAN

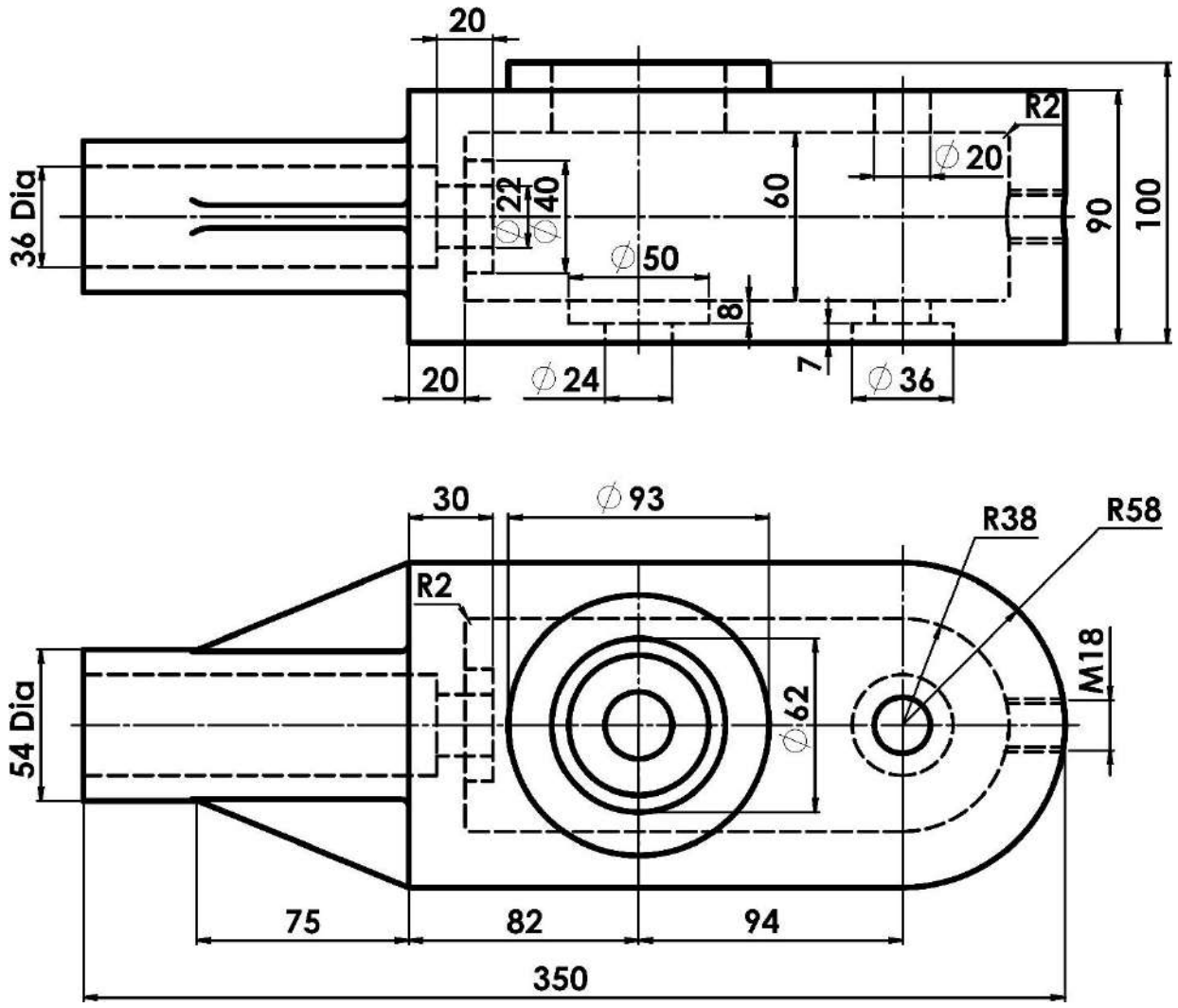


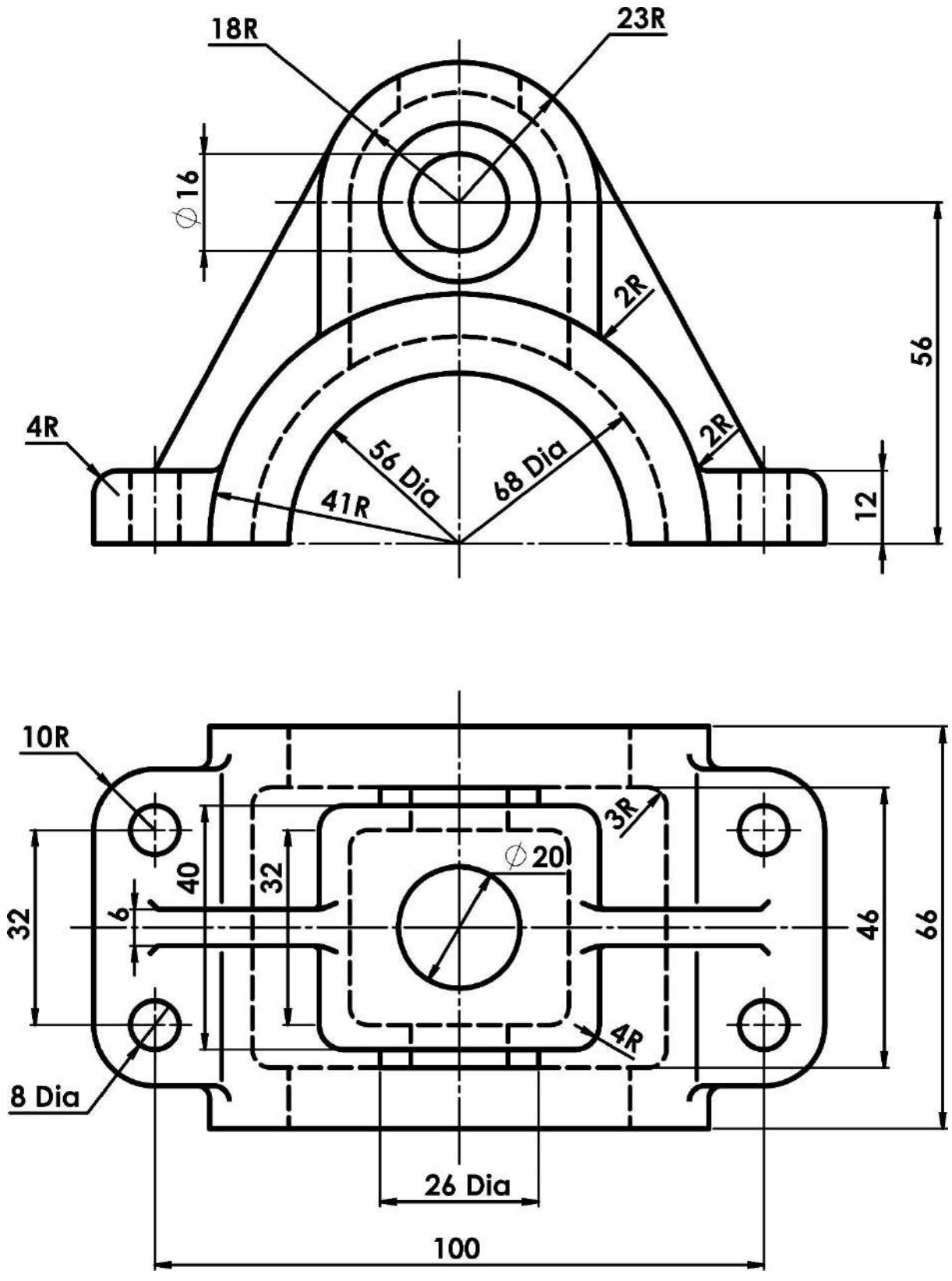
ELEVATION

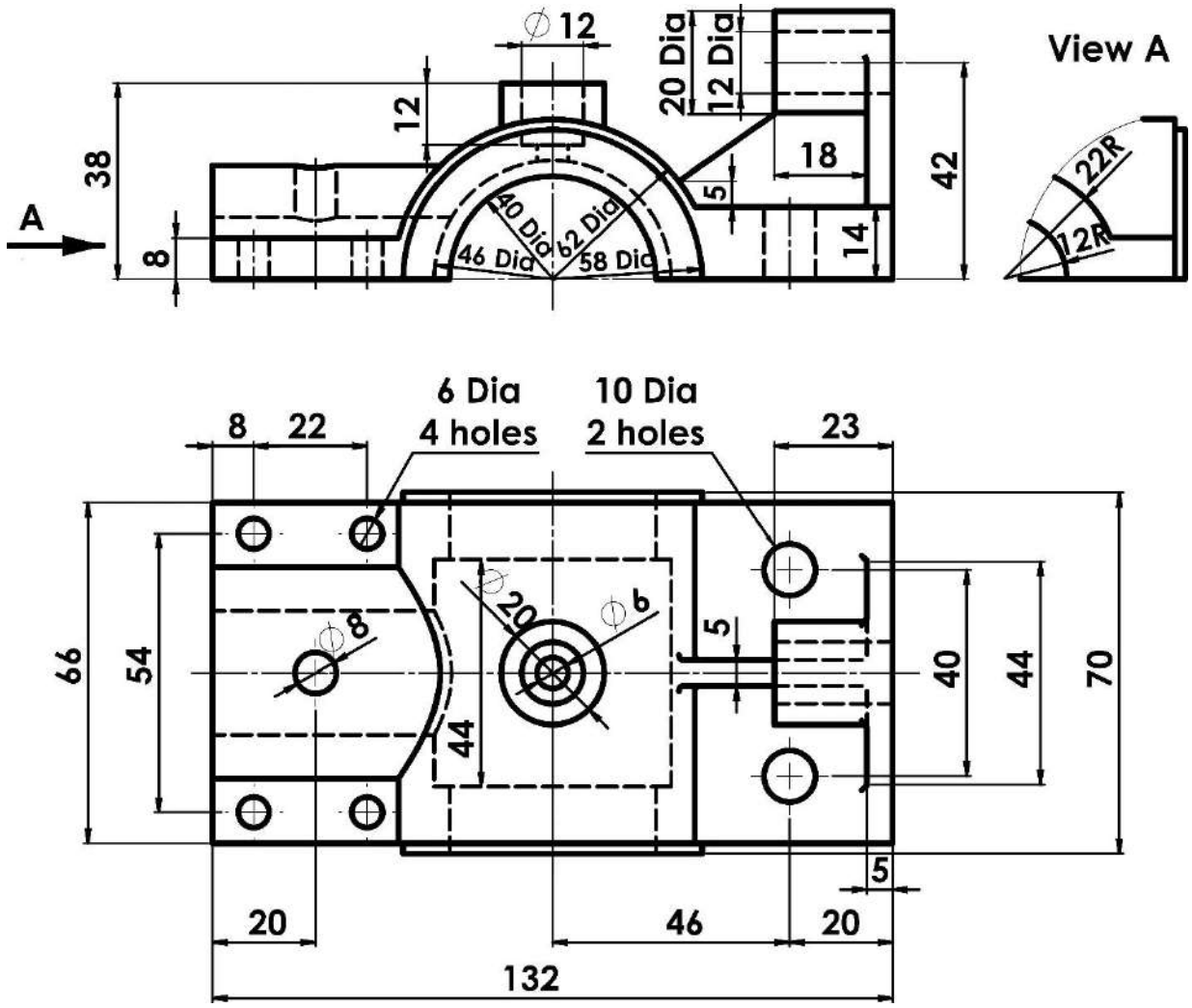


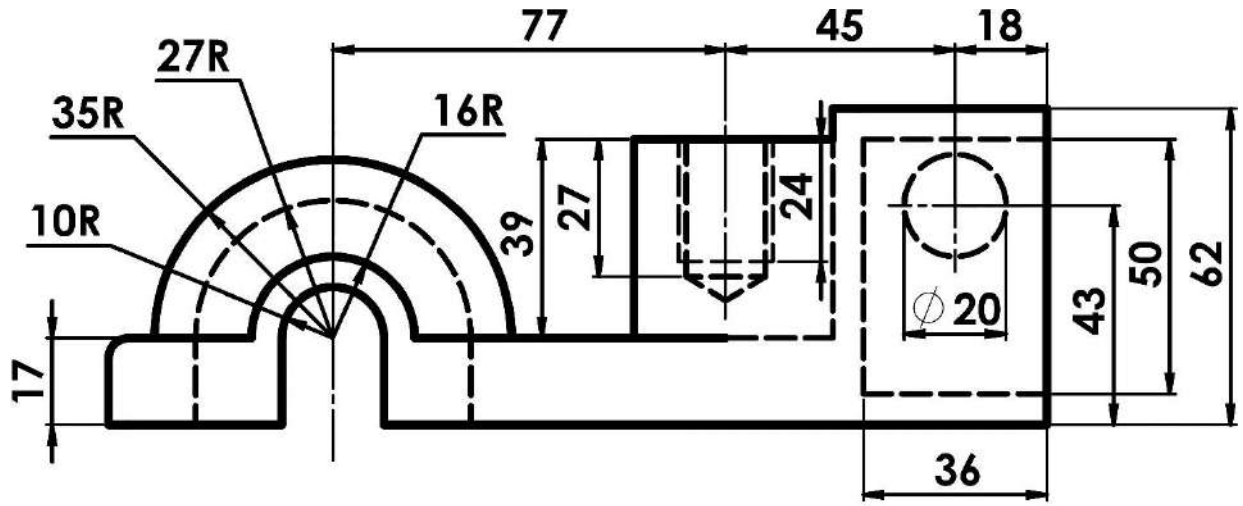
PLAN

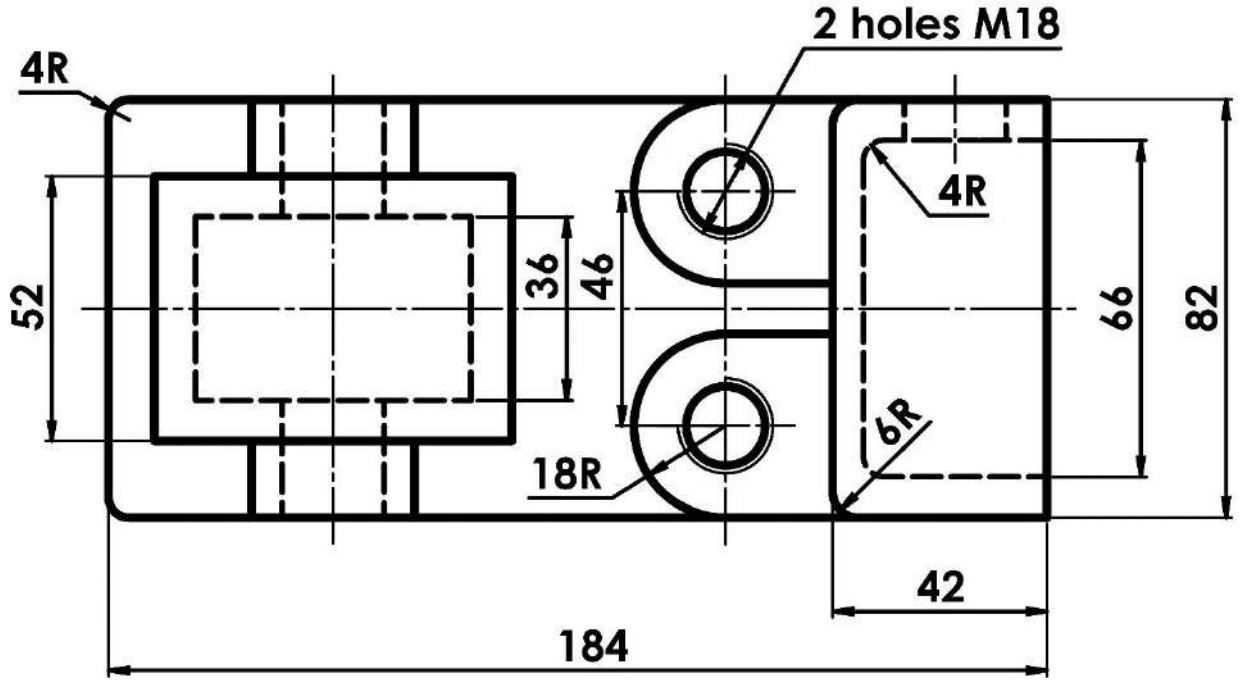

R19
10
R10
∅14
∅10
44
22
6
M12
54
8
R3
54
12
20
40
∅10
R12
28 Dia
74
116

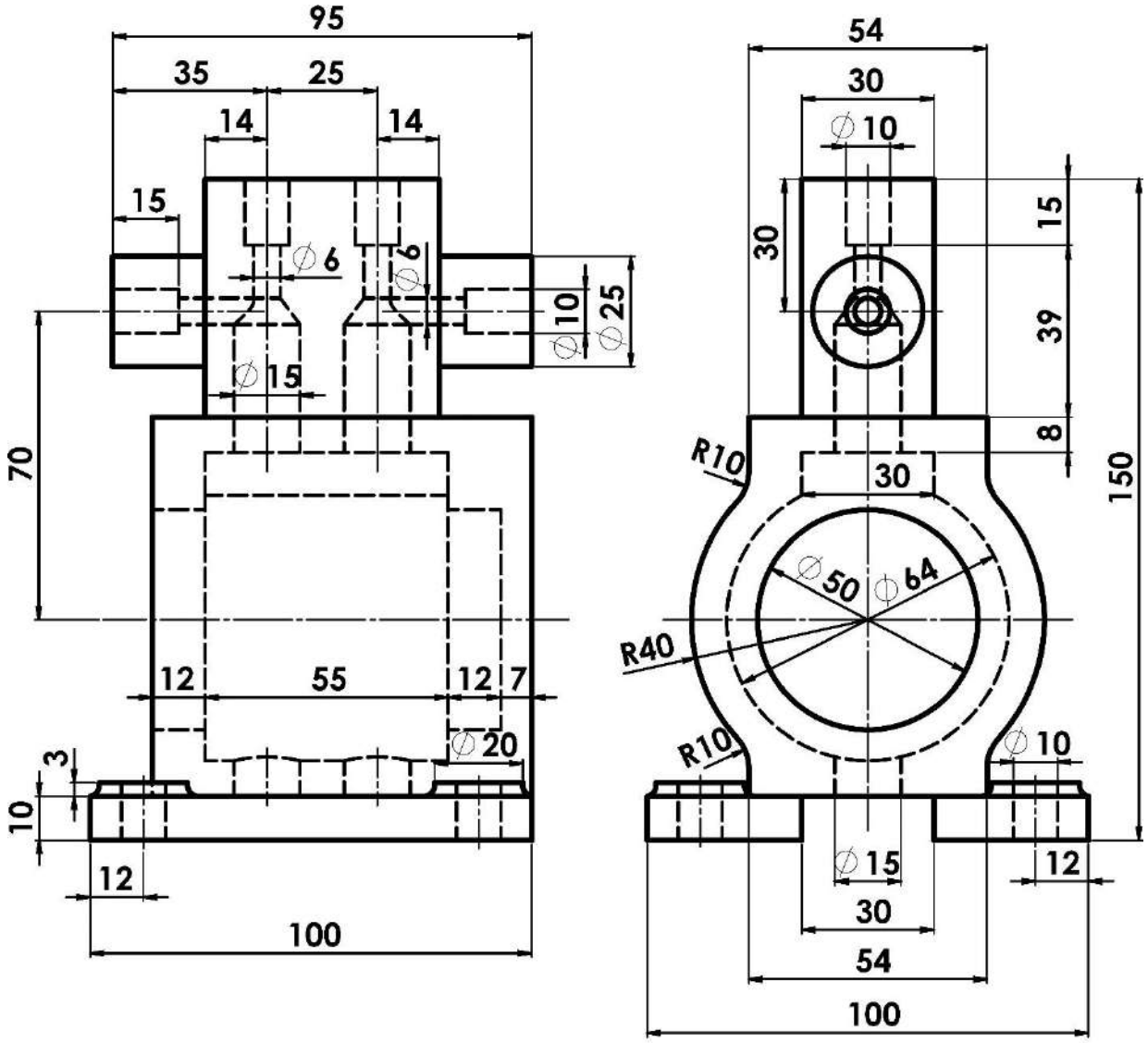

20
R2
∅20
36 Dia
22
40
60
90
100
∅50
8
20
∅24
7
∅36
30
∅93
R38
R58
R2
M18
54 Dia
∅62
75
82
94
350


18R
23R
∅16
2R
56
4R
56 Dia
68 Dia
2R
41R
12
10R
3R
∅20
40
32
32
6
46
66
4R
8 Dia
26 Dia
100


∅12
20 Dia
12 Dia
View A
12
38
A
8
40 Dia
62 Dia
46 Dia
58 Dia
5
18
42
14
22R
12R
6 Dia
4 holes
10 Dia
2 holes
8
22
23
66
54
∅8
∅20
∅6
44
5
40
44
70
5
20
46
20
132

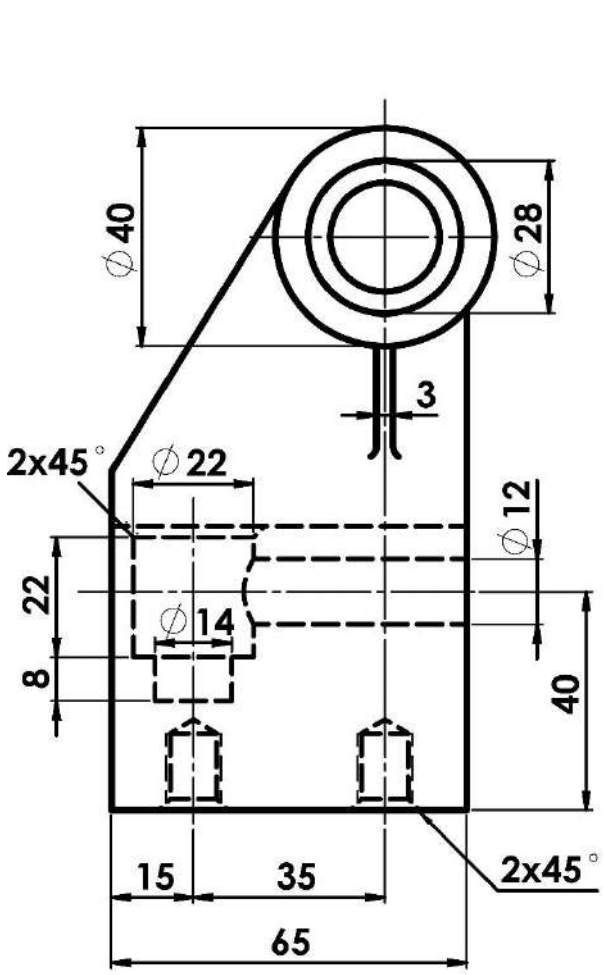

77
45
18
27R
35R
16R
10R
39
27
24
∅20
43
50
62
17
36


2 holes M18
4R
4R
52
36
46
66
82
6R
18R
42
184

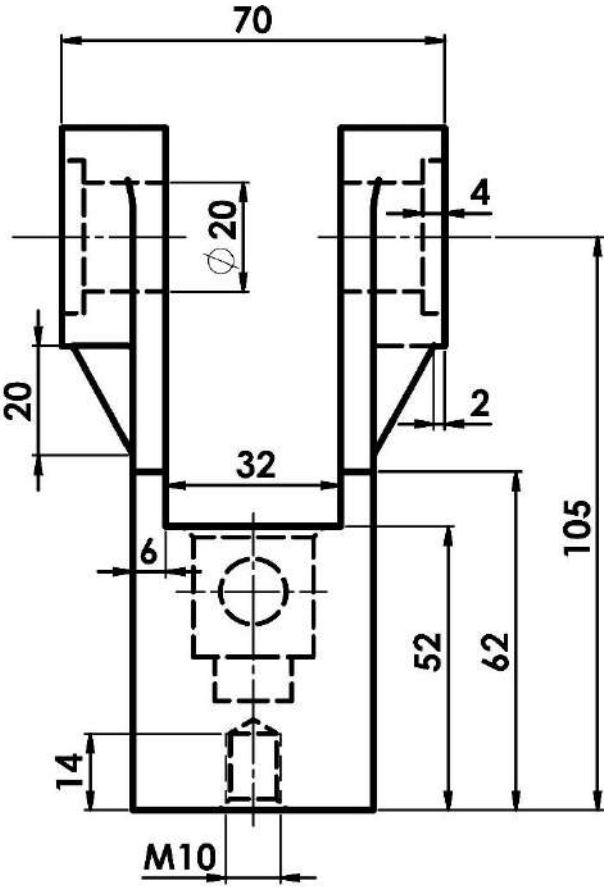


ELEVATION

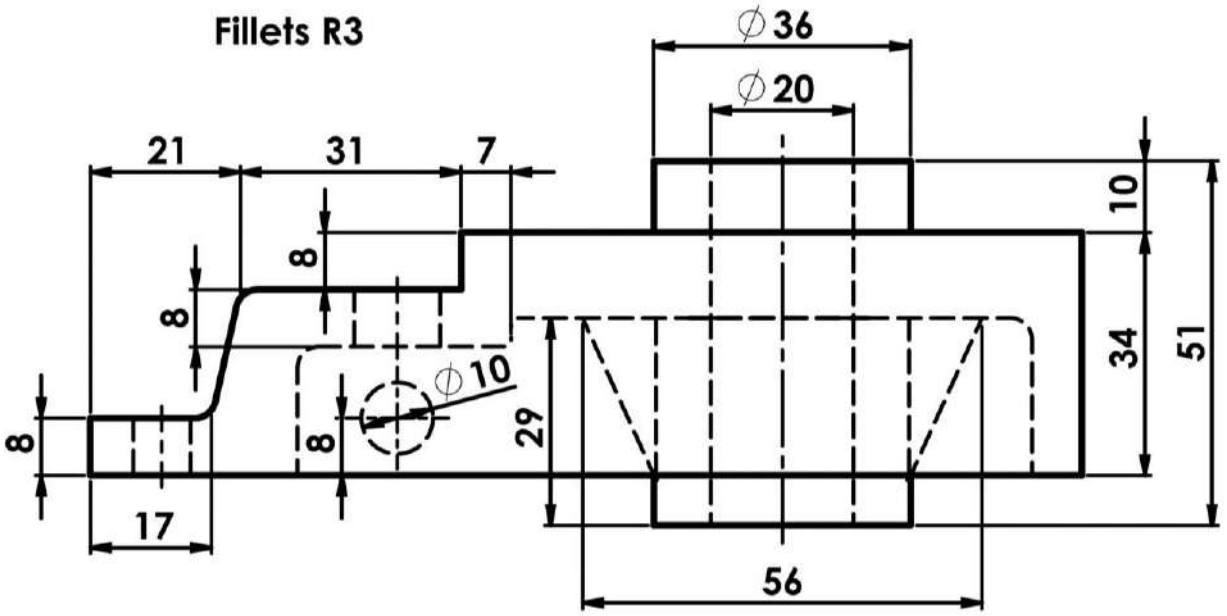
SIDE VIEW



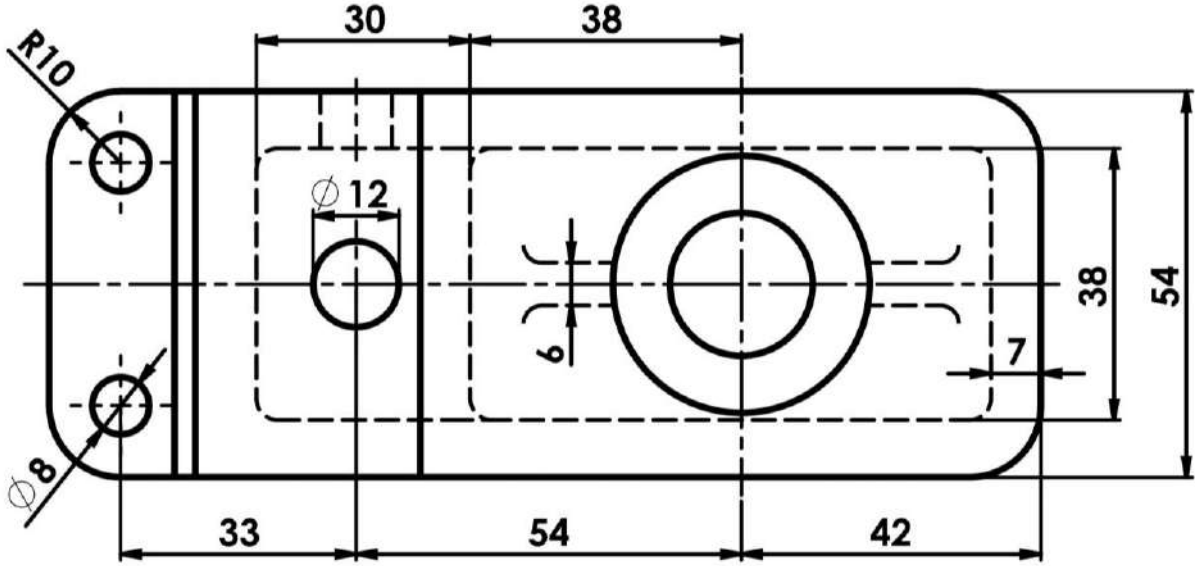
SIDE VIEW



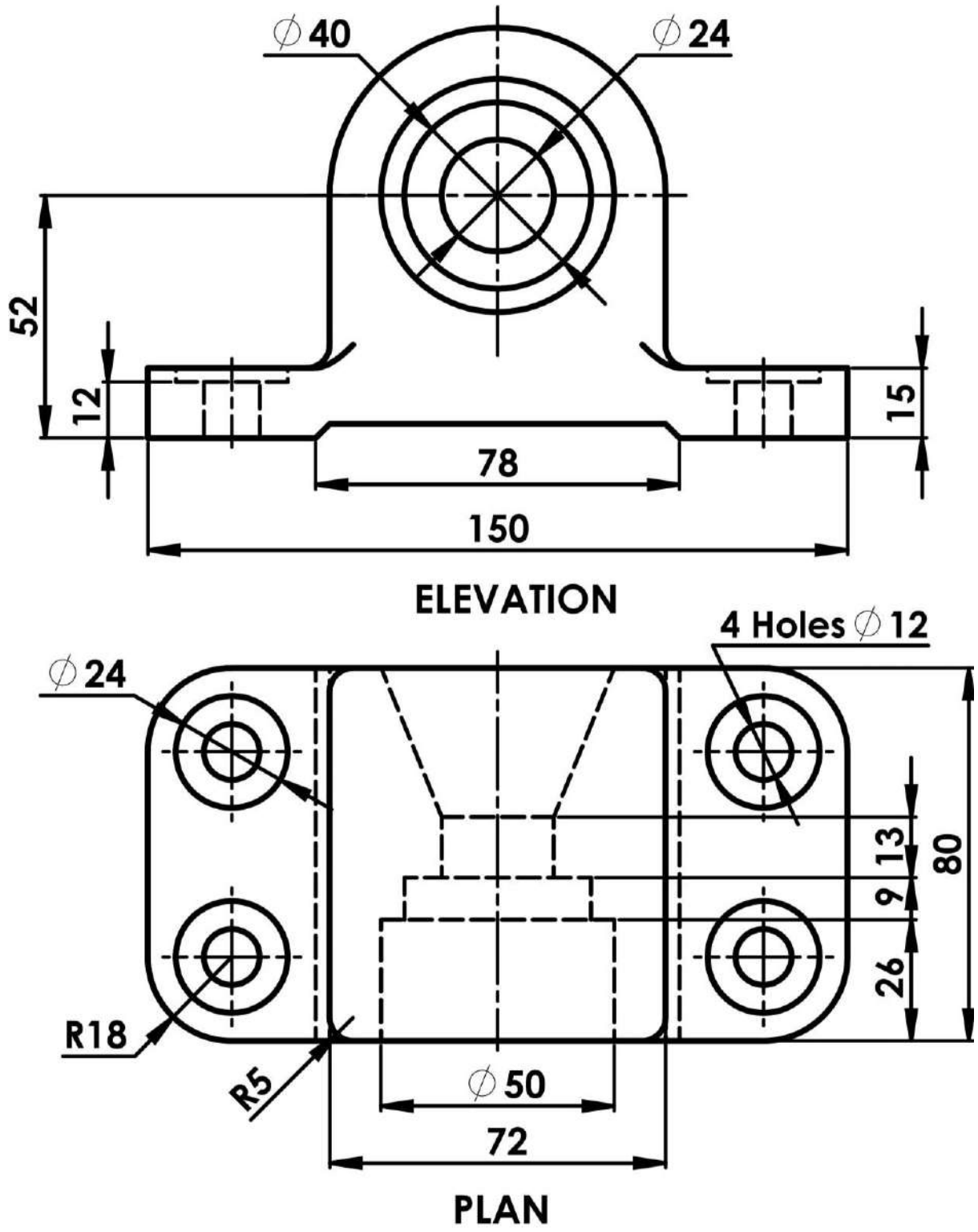
ELEVATION

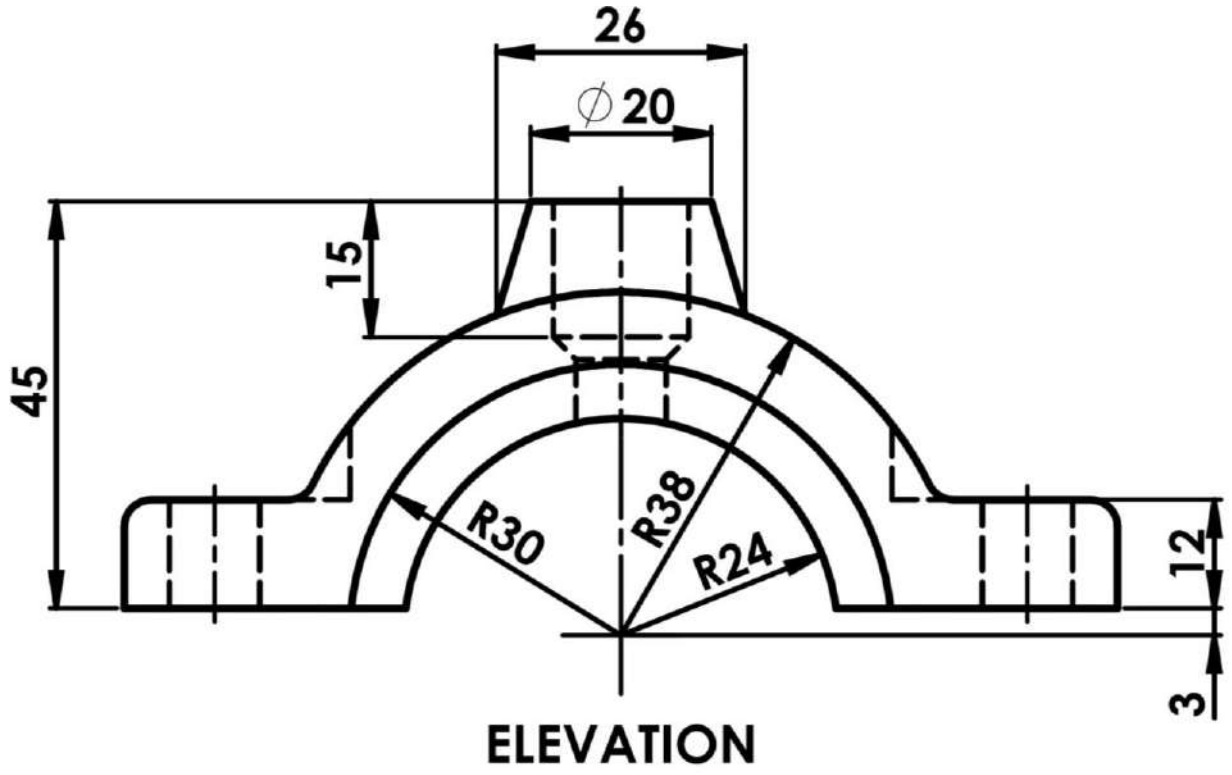


ELEVATION

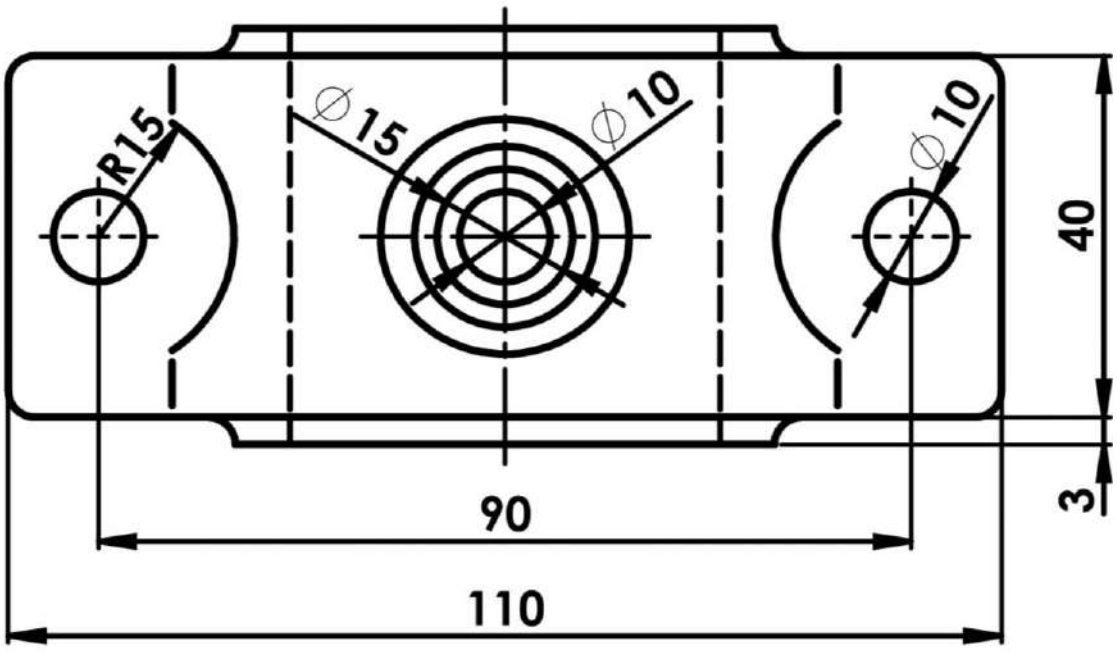


PLAN

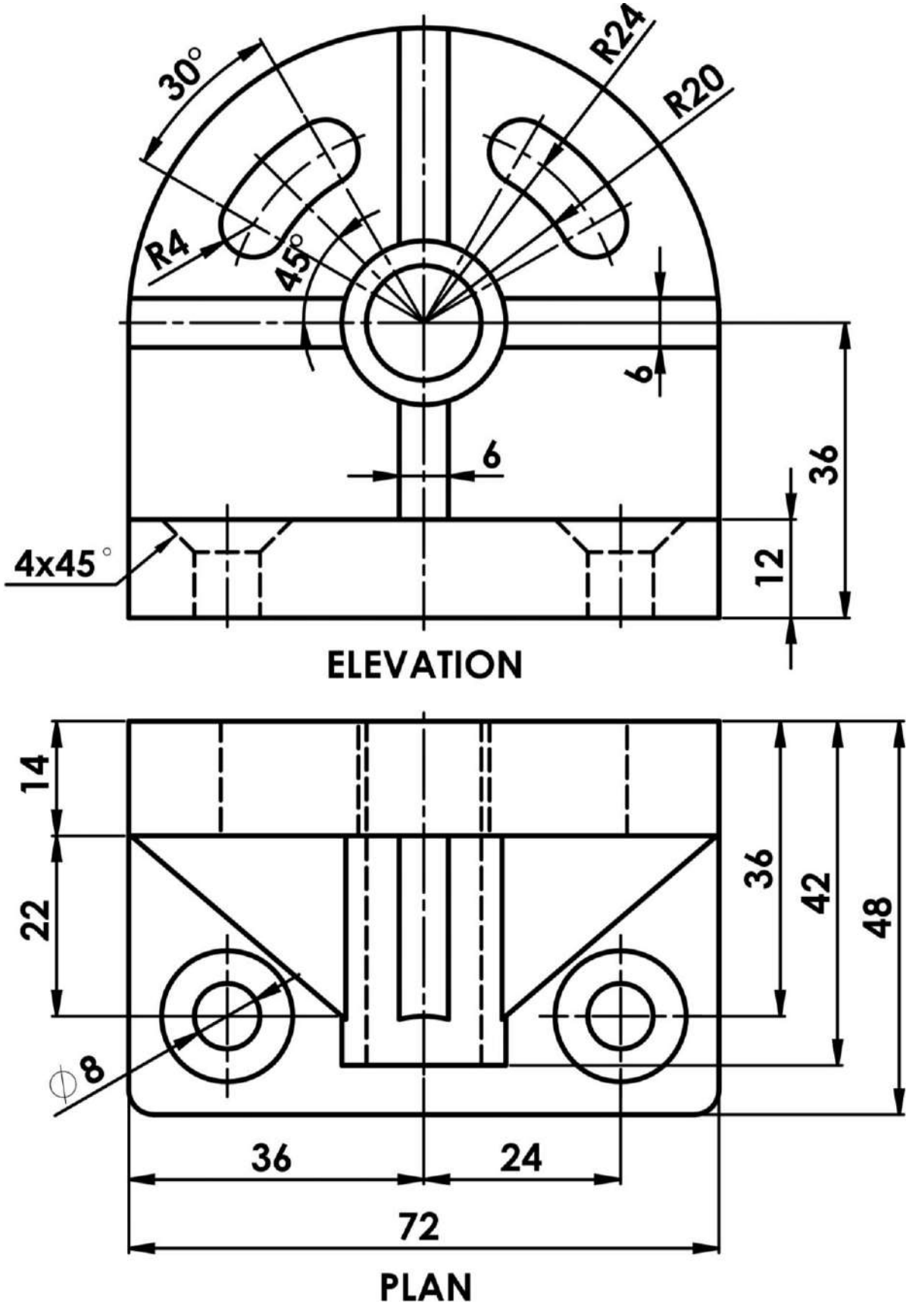

∅40
∅24
52
12
15
78
150
ELEVATION
4 Holes ∅12
∅24
13
9
26
80
R18
R5
∅50
72
PLAN

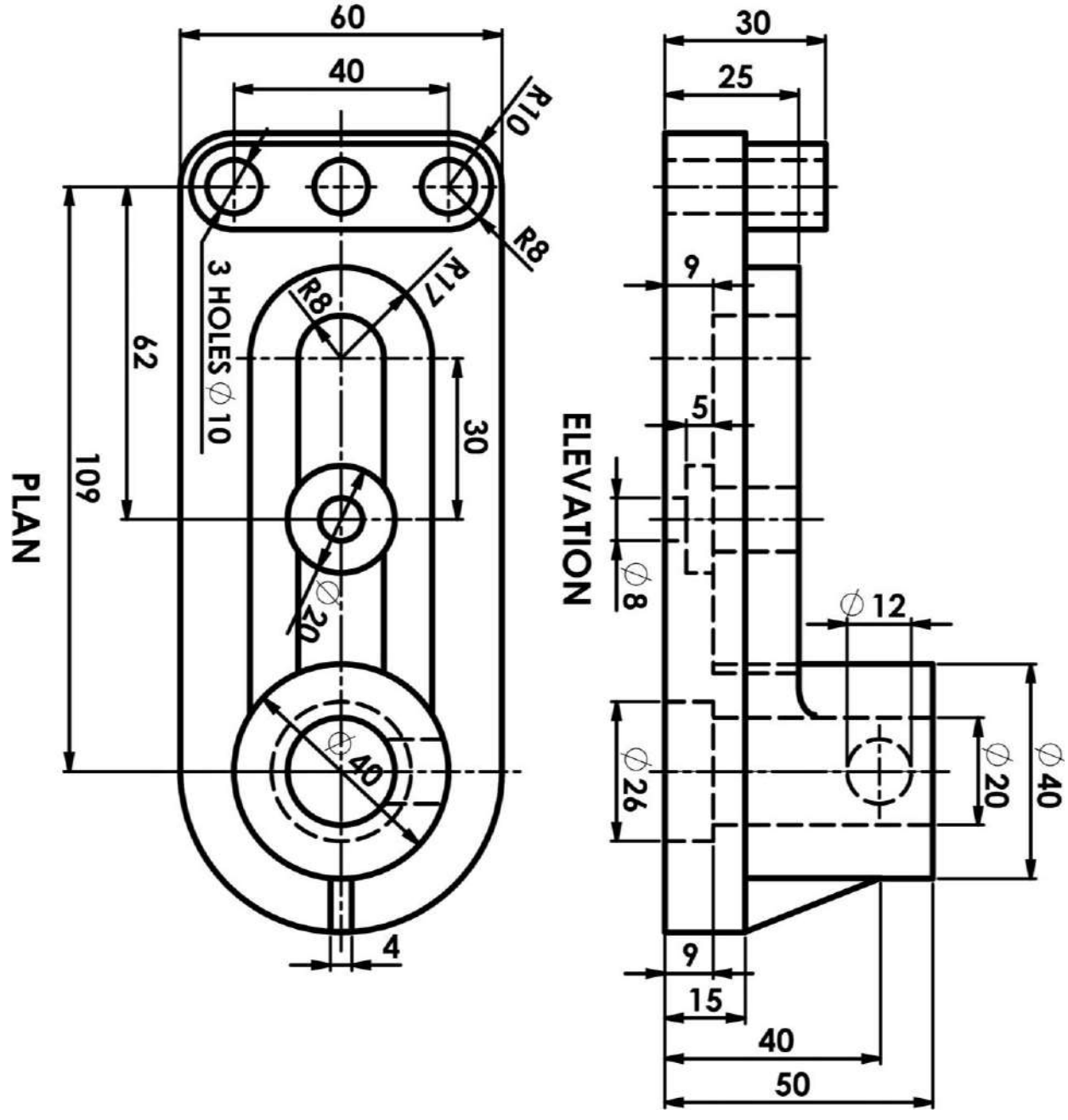


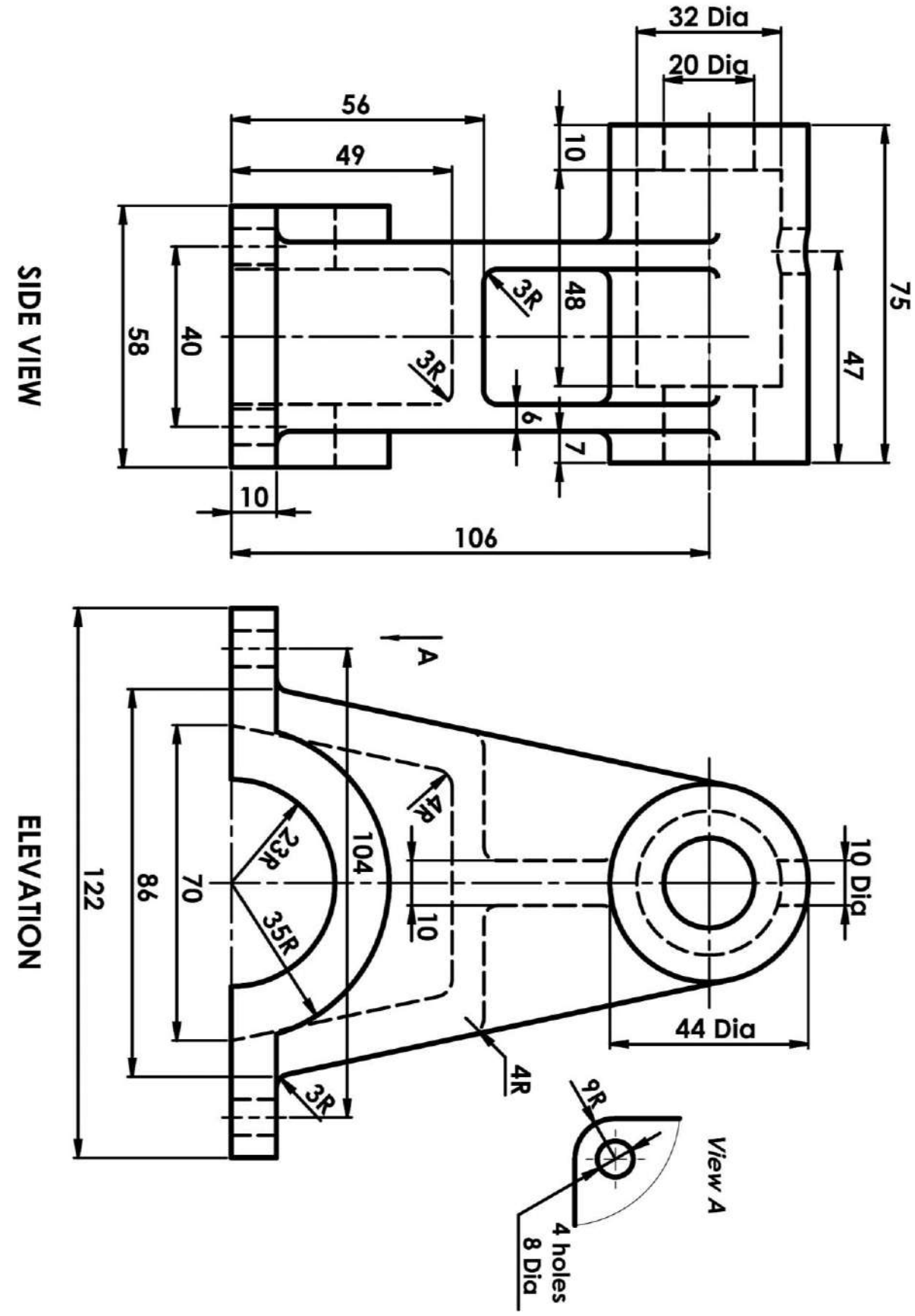
ELEVATION

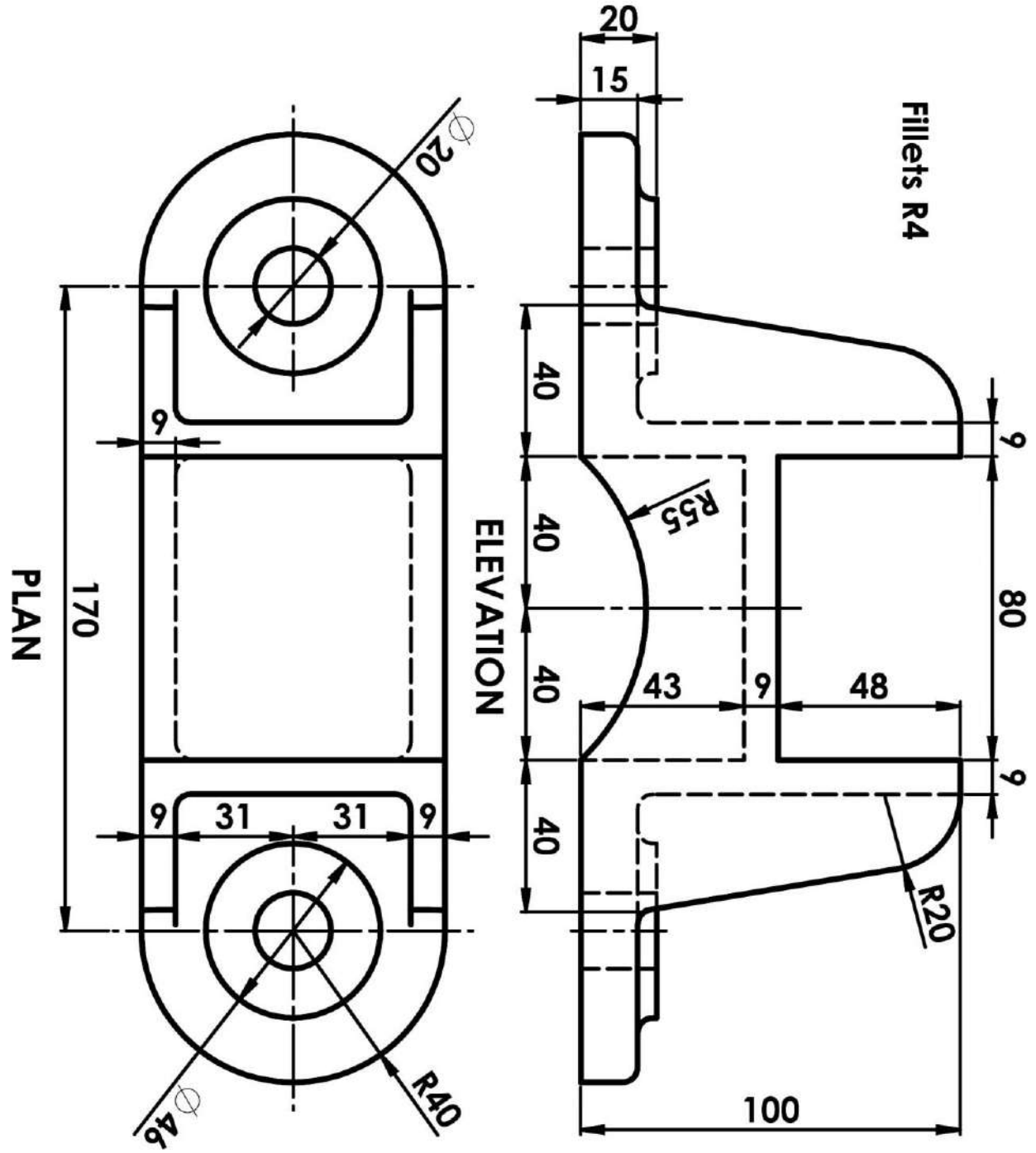


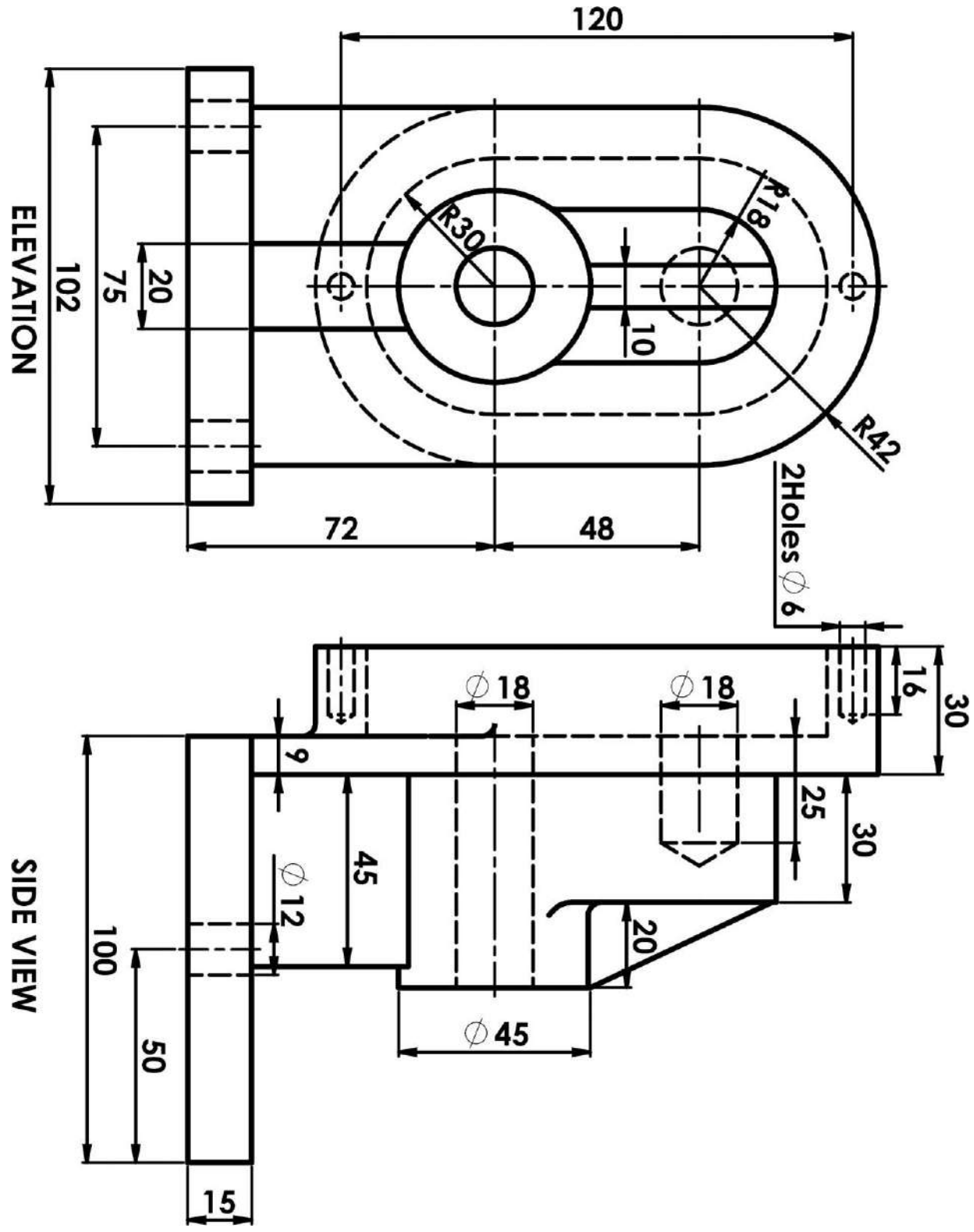
PLAN

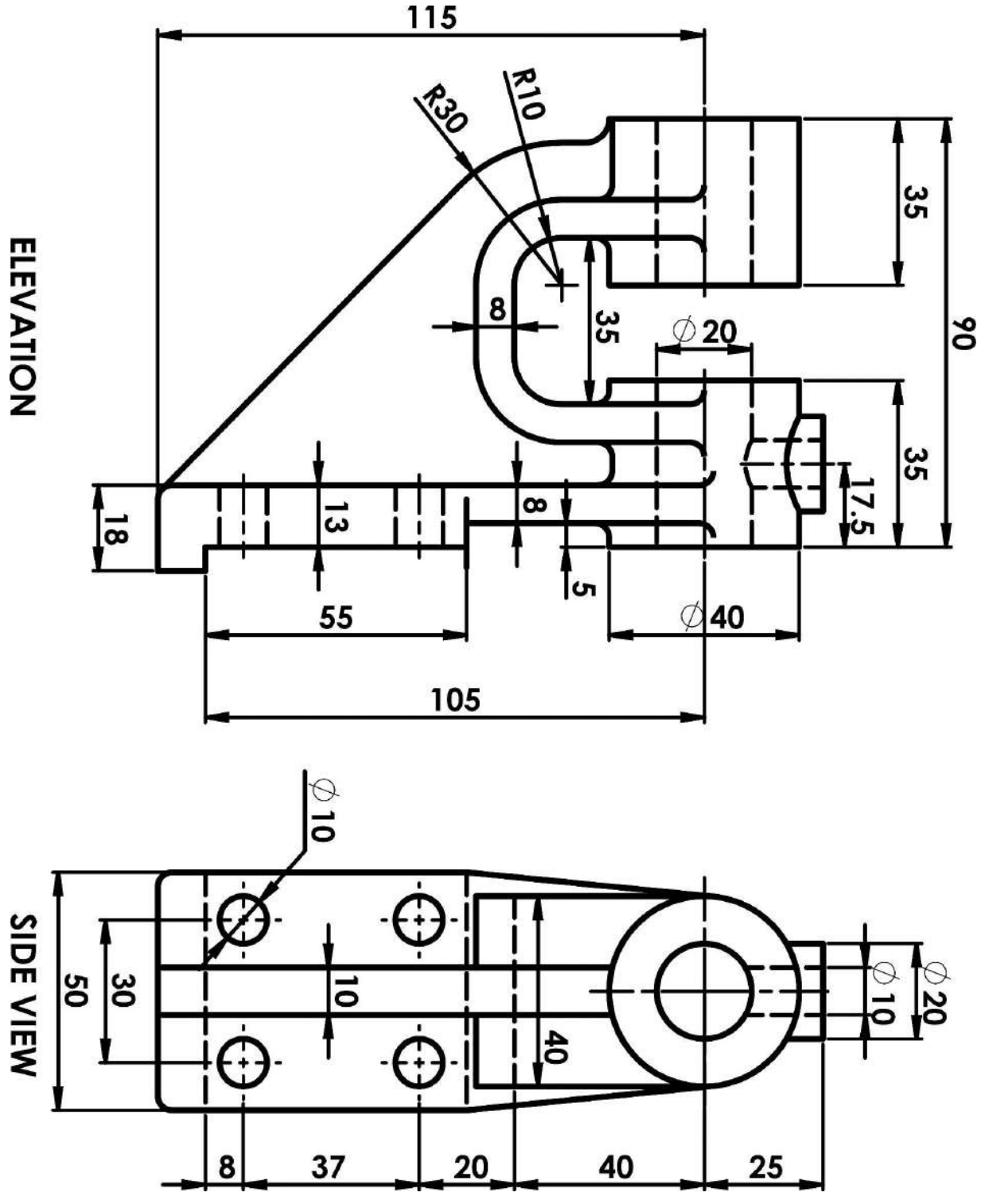

30°
R24
R20
R4
45°
6
6
36
4x45°
12
ELEVATION
14
22
36
42
48
ϕ8
36
24
72
PLAN


PLAN
60
40
R10
R8
3 HOLES ∅10
R8
R17
62
109
30
∅20
∅40
4
ELEVATION
30
25
9
5
∅8
∅12
∅26
∅20
∅40
9
15
40
50


SIDE VIEW
32 Dia
20 Dia
56
49
10
75
47
48
3R
3R
58
40
6
7
10
106
ELEVATION
A
122
86
70
104
23R
35R
4R
10
10 Dia
44 Dia
4R
3R
9R
View A
4 holes
8 Dia


PLAN
ELEVATION
Fillets R4
20
15
Ø20
9
170
9
31
31
9
Ø46
R40
40
40
40
40
R55
43
9
48
80
9
9
R20
100


ELEVATION
120
102
75
20
R30
R18
10
R42
72
48
2Holes ∅6
SIDE VIEW
∅18
∅18
16
30
9
25
30
45
∅12
20
100
50
∅45
15


ELEVATION
115
R30
R10
35
90
8
35
∅20
35
17.5
18
13
8
5
55
∅40
105
SIDE VIEW
∅10
50
30
10
40
∅10
∅20
8
37
20
40
25

1.2 Sectioning

Sections and sectional views are used to show hidden details more clearly. They are created by using a cutting plane to cut the object. A sectional view displays the outline of the cutting planeand all visible outlines which can be seen beyond the cutting plane to improve visualization ofinterior features. Section views are used when important hidden details are in the interior of anobject. These details appear as hidden lines in one of the orthographic principal views; therefore, their shapes are not very well described by pure orthographic projection.

There are a variety of sectioning methods for different applications discussed throughout thischapter.

1.2.1 Cutting Plane

The sectional view is created by placing an imaginary cutting plane through the object that cuts away the area to be exposed. The adjacent view becomes the sectional view by removing theportion of the object between the viewer and the cutting plane, fig. 1.11.

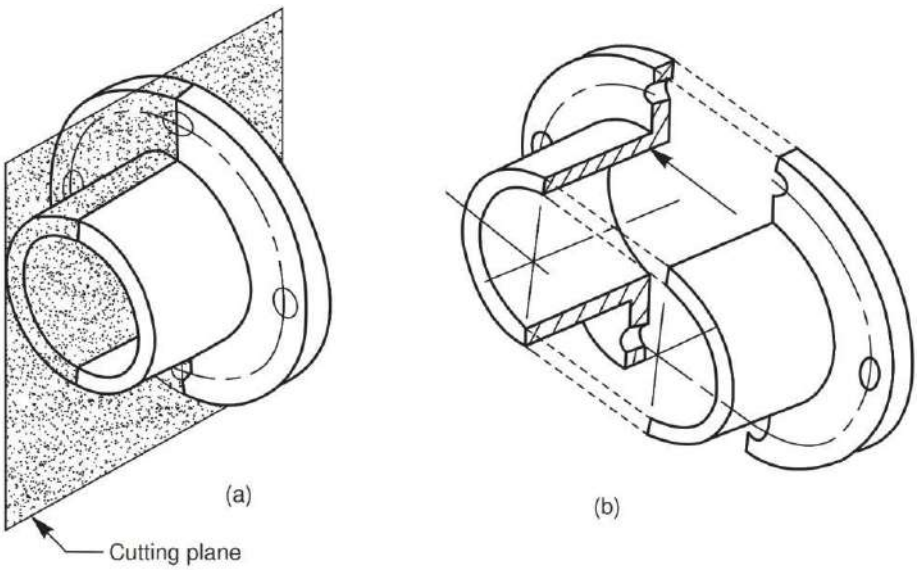


Fig. 1.11 (a): Cutting plane

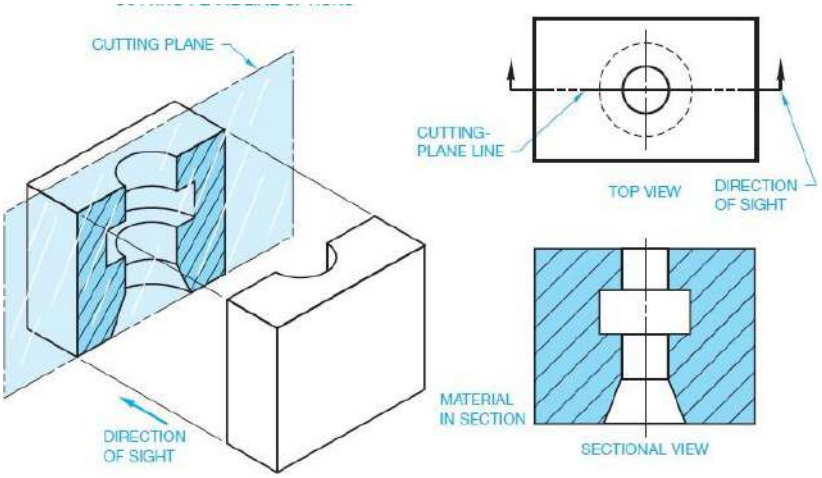


Fig. 1.11 (b): Cutting plane and sectional view

The sectional view should project from the view that has the cutting plane as you normallyproject a view in multi view.

1.2.1.1 Cutting Plane Lines

It is a thick line representing the cutting plane as shown in fig. 1.12. The cutting-plane line can be drawn using alternating long and two short dashes, or evenly spaced dashes. The long dashes can vary in length depending on the size of the drawing, but the short dashes are generally .25 in.(6 mm) in length. The cutting-plane line is capped on the ends, with arrow heads showing the direction of sight of the sectional view. The cutting-plane line arrow heads maintain the same 3:1length-to-width ratio as dimension line arrow heads. Cutting plane line arrow heads are generally twice the size of dimension line arrow heads, so they show up better on the drawing. If the dimension line arrow heads are .125 (3 mm) long on your drawing, then make the cutting-plane line arrow heads .25 in. (6 mm) long.

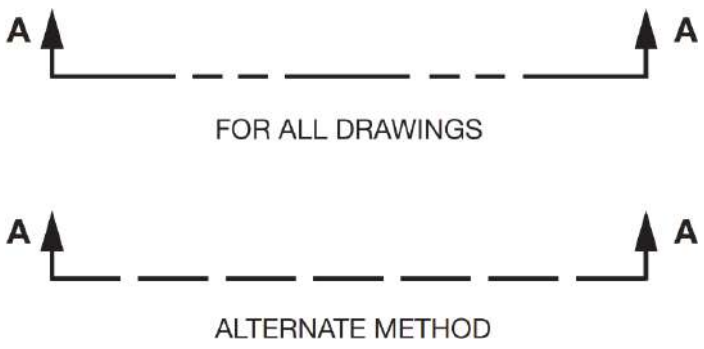


Fig. 1.12: Cutting plane lines

This depends on the size of the drawing. When the extent of the cutting plane is obvious, only the ends of the cutting-plane line can be used. Such treatment of the cutting plane also helps keepthe view clear of excess lines. The sectional view should be projected from and perpendicular to the cutting-plane line and placed as one of the standard principal multi-views.

The cutting planes and related sectional views should be labeled with letters beginning with AAas shown in fig. 1.13.

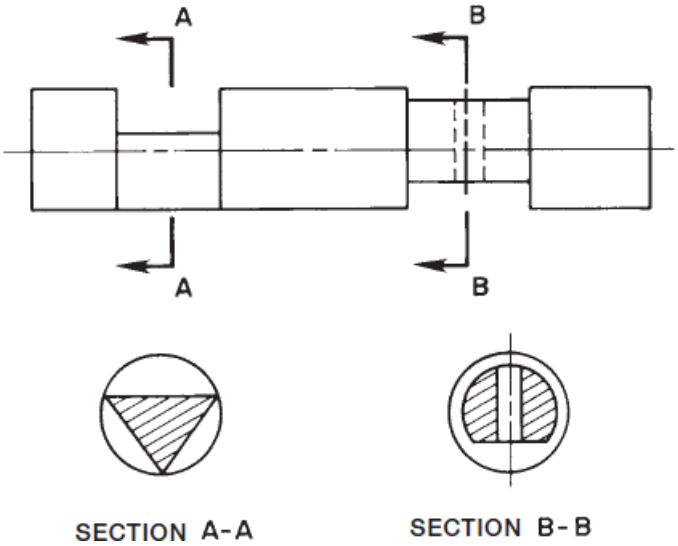


Fig. 1.13: Labeled cutting plane lines and related sectional view.

The cutting-plane line labels should be placed near the arrow heads. An option is to place only one identification letter at one arrow head when a continuous cutting-plane line is used and the application is clear. The text height for cutting-plane line labels and the correlated view identification is generally the same text height used for drawing titles. When the cutting plane line has labels A on each end, then the sectional view has the related title SECTION A-A placedbelow the sectional view. When there is more than one sectional view on a drawing, the additional cutting-plane lines and views are labeled BB, CC, and so on.

1.2.1.2 Section Lines (Hatching Lines)

Section lines are thin lines used in the view of the section to show where the cutting-plane linehas cut through material, fig. 1.14. Section lines are usually drawn equally spaced at 45° but cannot be parallel or perpendicular to any line of the object and must never be drawn horizontally or vertically.

The space between section lines can vary depending on the size of the object, but the minimum space recommended is .06 in. (1.5 mm), fig. 1.15.

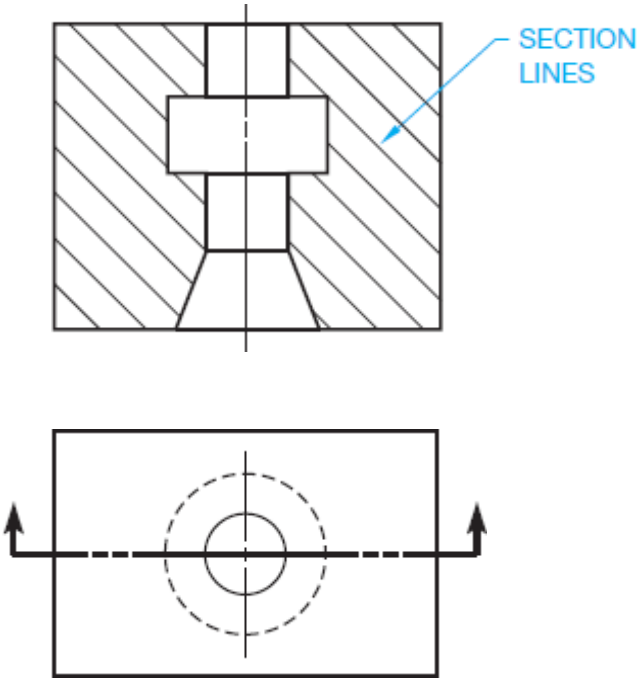


Fig. 1.14: Section lines represent the material being cut by the cutting plane

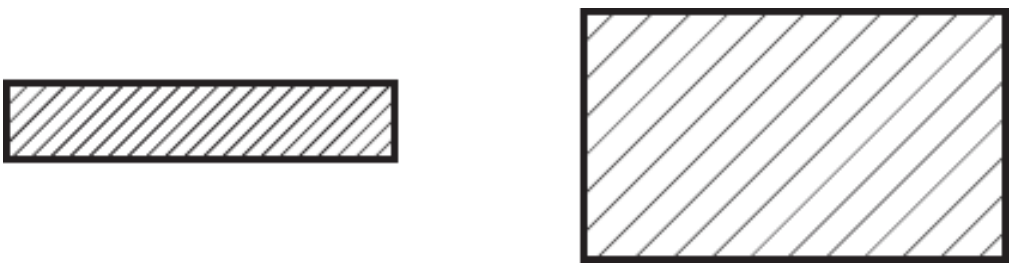


Fig. 1.15: The space between section lines according to the part size

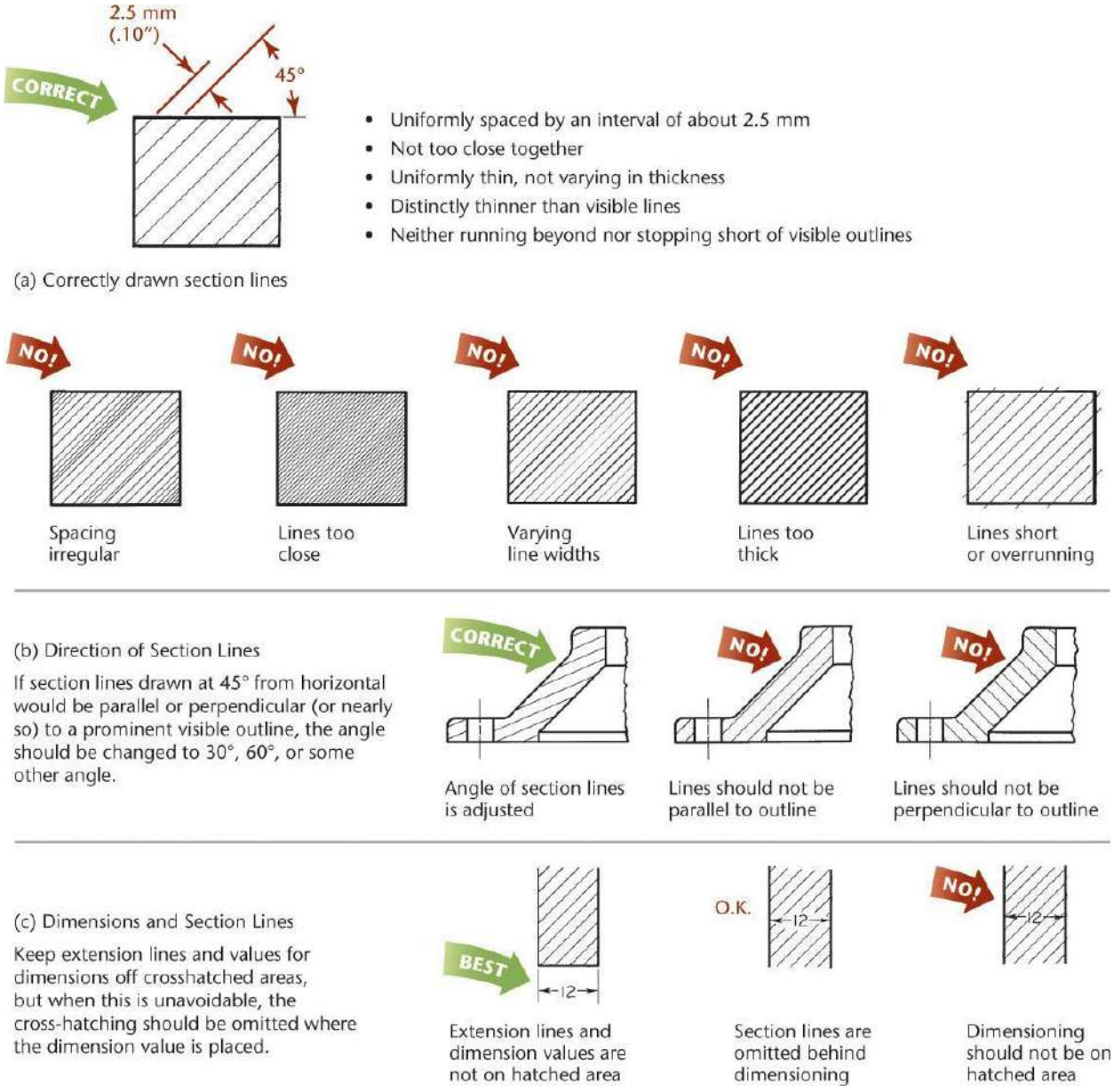


Fig. 1.16: Symbols for Section Lining

1.3 Types of Sections

1.3.1 Full Sections

A full section is drawn when the cutting plane extends completely through the object, usually along a center plane as shown in fig. 1.17.

The object shown in fig. 1.18 could have used two full perpendicular sections to further clarify hidden features. In such a case, the cutting planes and related views are labeled. The cutting- plane line can be omitted when the relationship between views is

obvious. It is normally best to show the cutting-plane line for clarity.

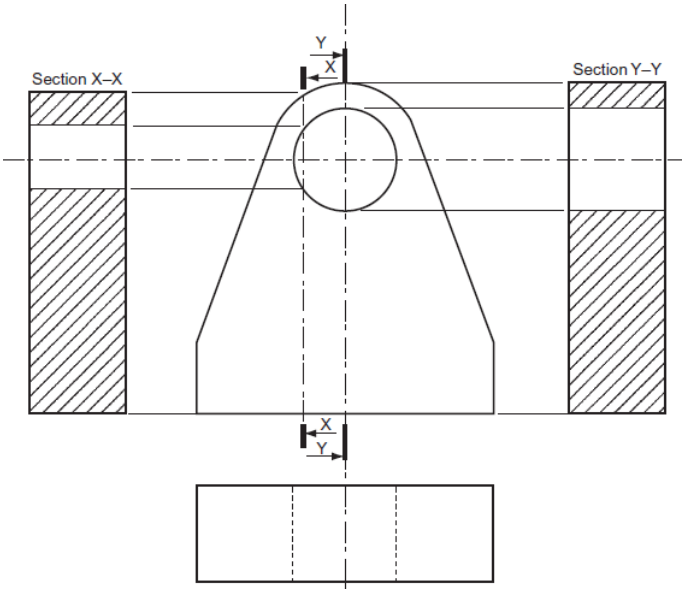


Fig. 1.17: Two parallel full sections object

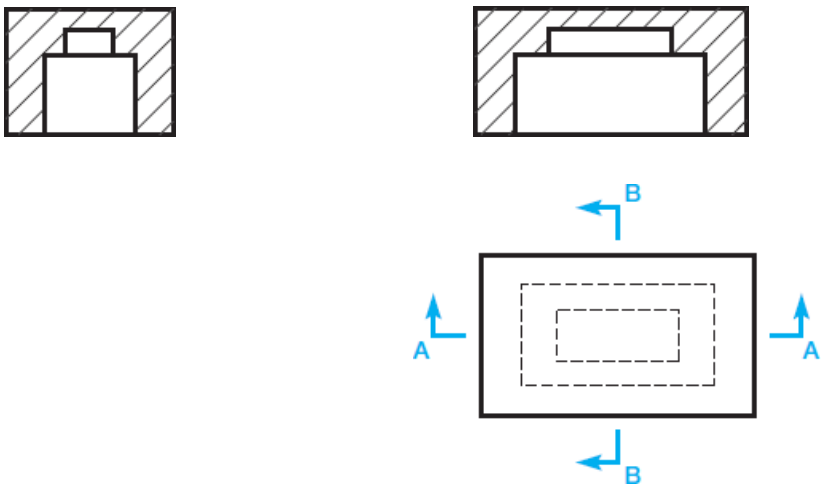


Fig.1.18: Two perpendicular full sections object

1.3.2 Half Sections

A half section is used when a symmetrical object requires sectioning. The cutting-plane line of a half section removes one quarter of the object. The advantage of a half section is the sectional view shows half of the object in section and the other half of the object as it normally appears in multi view without section. The name half section comes from the idea that only half of the sectional view is sectioned, fig. 1.19. Notice that a center line is used in the sectional view to separate the sectioned portion from

the un-sectioned portion. Hidden lines are generallyomitted from sectional views unless their use improves clarity, fig. 1.20.

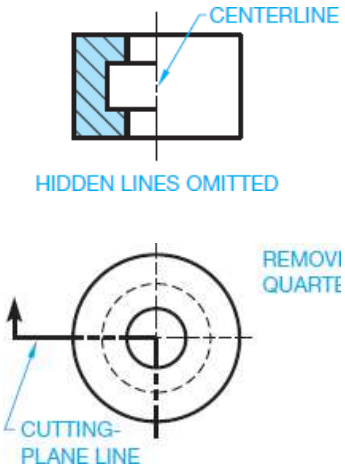


Fig. 1.19: Half section

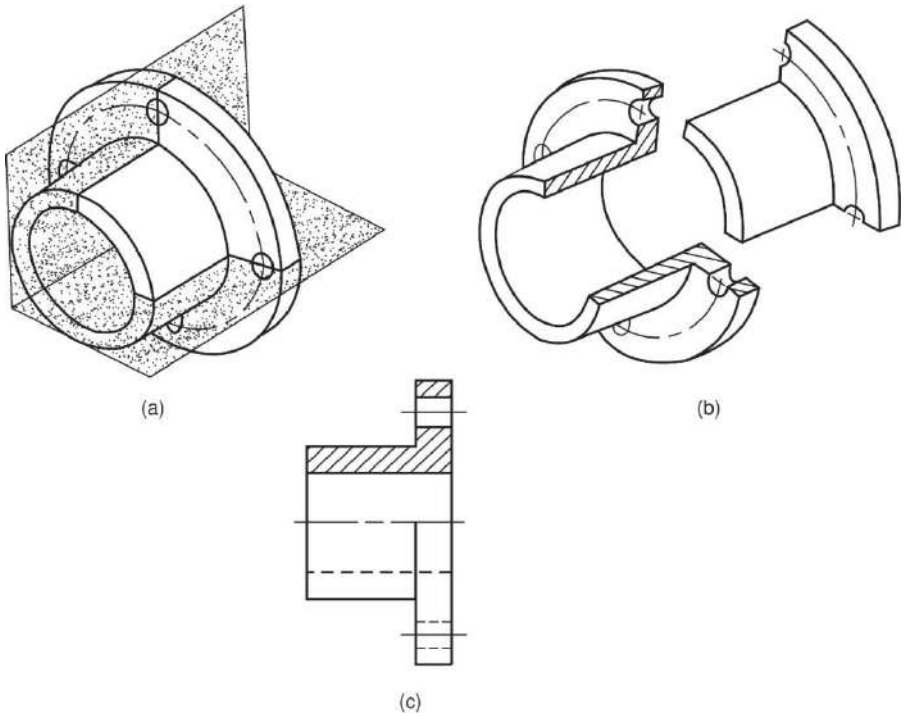


Fig. 1.20: Method of obtaining half sectional view

1.3.3 Offset Sections

Staggered interior features of an object are sectioned by allowing the cutting-plane line tooffset through the features creating an offset section as shown in fig. 1.21.

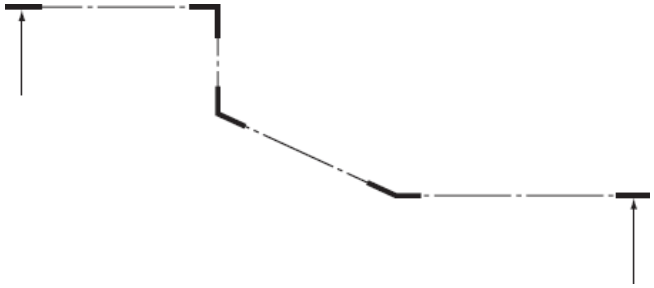


Fig. 1.21: Changes in direction of a section line

The cutting-plane line for an offset section is generally drawn using 90° turns where it offsetsthrough the staggered features as shown in fig. 1.22.

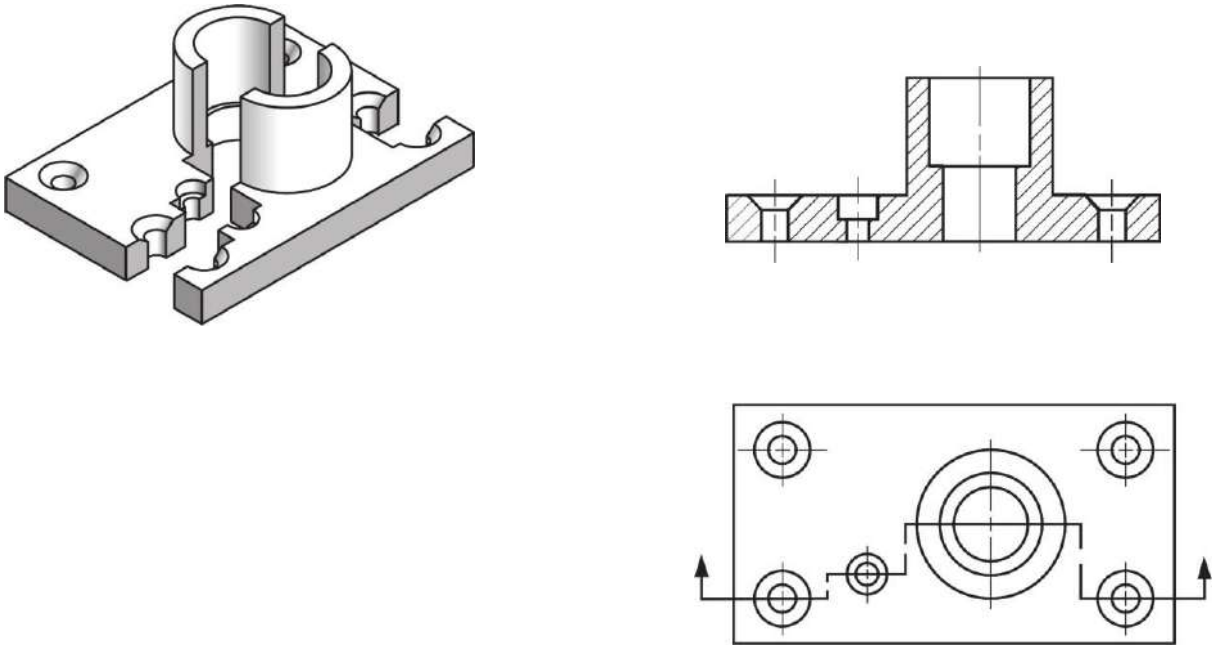


Fig. 1.22: Offset section using 90° turns

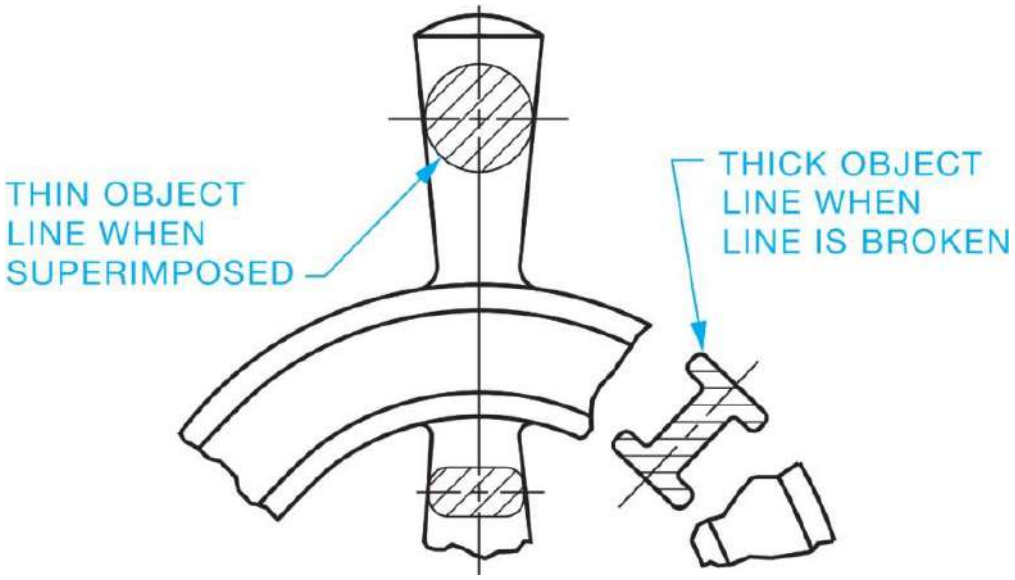
Figure 1.22, shows that there is no line in the sectional view indicating a change in direction ofthe cutting-plane line. Normally, the cutting-plane line in an offset section extends completely through the object to display the location of the section clearly. A cutting plane line is always used when the cutting plane is bent or offset or when the sectional view is nonsymmetrical.

1.3.4 Revolved Sections

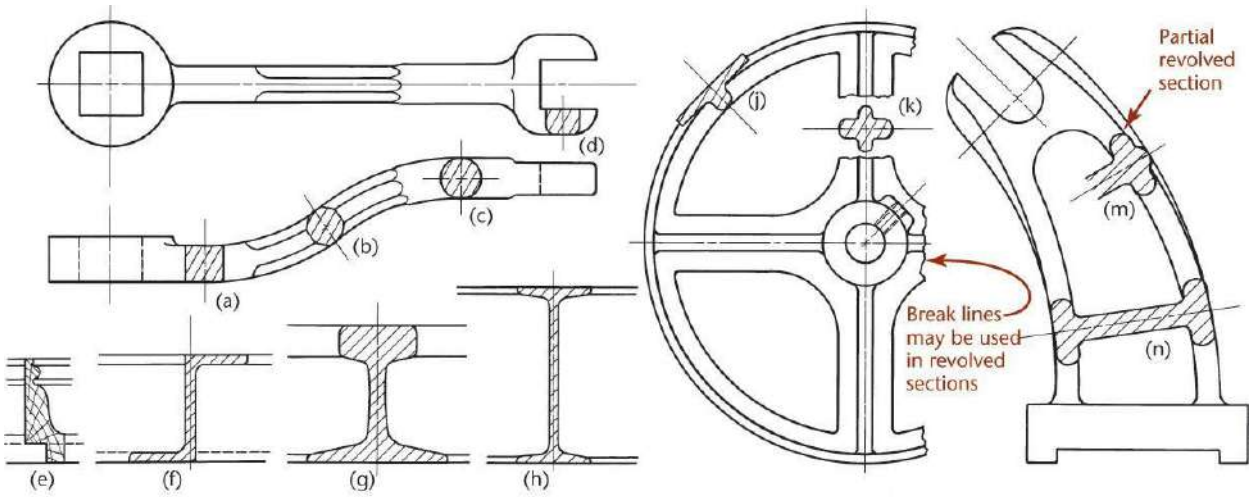
For many drawings only a portion of a complete view needs to be shown in a section to improve the clarity of the drawing.

Two additional types of sectional views are introduced. Revolved and removed sections are used to show the cross-sectional shape of ribs, spokes, or arms, when the shape is not obvious in the regular views. End views are often not needed when a revolved section is used.

For a revolved section a center line is drawn through the shape on the plane to be described. The part is imagined to be rotated 90°, and the view that would be seen when rotated issuperimposed on the view. If the revolved section does not interfere with the view on which it is revolved, then the view is not broken unless it would facilitate clearer dimensioning. When the revolved section interferes with or passes through lines on the view on which it is revolved, the view is usually broken. Often the break is used to shorten the length of the object. When superimposed on the view, the outline of the revolved section is a thin continuous line, Fig. 1.23.



(a)



(b)

Fig. 1.23: Revolved Sections

1.3.5 Removed Sections

The removed section differs from the revolved section in that the section is removed to an openarea on the drawing instead of being drawn directly on the view. Whenever practical, sectional views should be projected perpendicular to the cutting plane and be placed in the normal position for first-angle projection, Figure 1.24, the removed section is drawn to an enlarged scale for clarification and easier dimensioning. Removed sections of symmetrical parts are placed on the extension of the center line where possible.

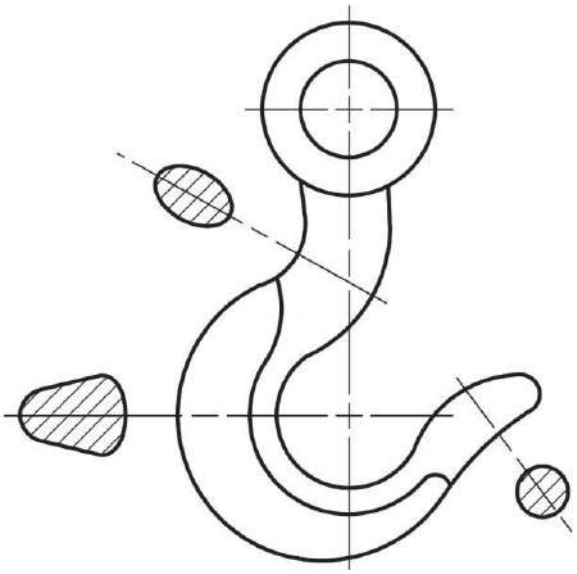


Fig.1.24: Placement of removed sectional views

1.3.6 Aligned Section

Similar to the offset section, the aligned section cutting plane line staggers to pass through offset features of an object. Normally the change in direction of the cutting-plane line is less than90° in an aligned section. When this section is taken, the sectional view is drawn as if the cuttingplane is rotated to a plane perpendicular to the line of sight as shown in fig. 1.25.

A cutting-plane line is always used when the cutting plane is bent, offset or when the sectionalview is nonsymmetrical.

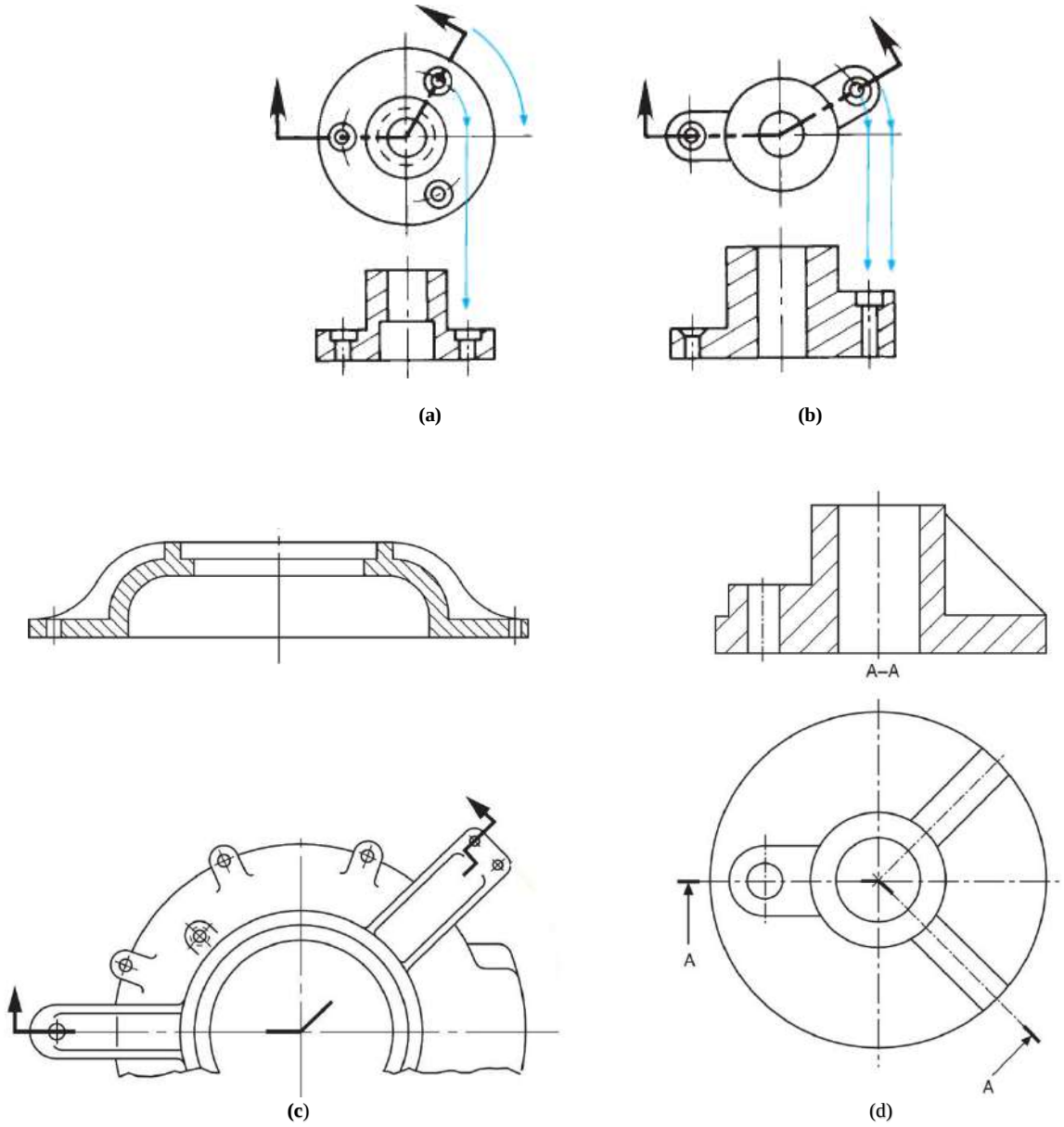


Fig. 1.25: Aligned Sections

1.3.7 Auxiliary Sections

Auxiliary sections may be used to supplement the principal views used in orthographicprojections. A sectional view projected on an auxiliary plane, inclined to the principal planes of projection, shows the cross-sectional shapes of features such as arms, ribs and so on.

In Fig. 2.16, auxiliary cutting plane X-X is used to obtain the auxiliary section X-X.

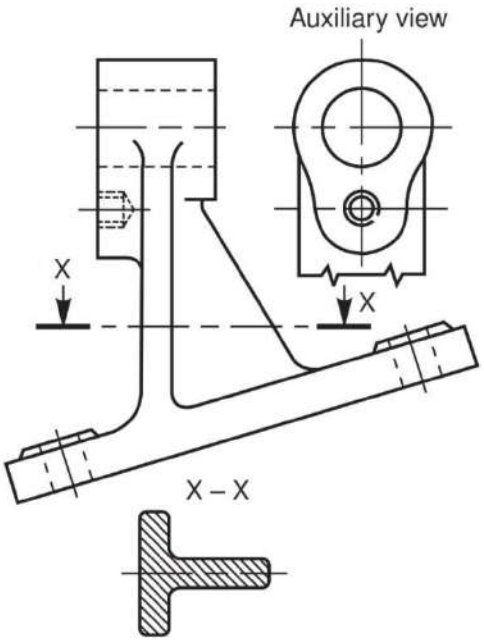


Fig. 2.16: Auxiliary section

1.3.8 Local Sections

It is not always necessary to draw a complete section through a component if a small amount of detail only needs to be illustrated. A typical example is shown in fig. 1.27 where a keyway is drawn in a section. The irregular line defines the boundary of the section. It is not required to adda section plane to this type of view.

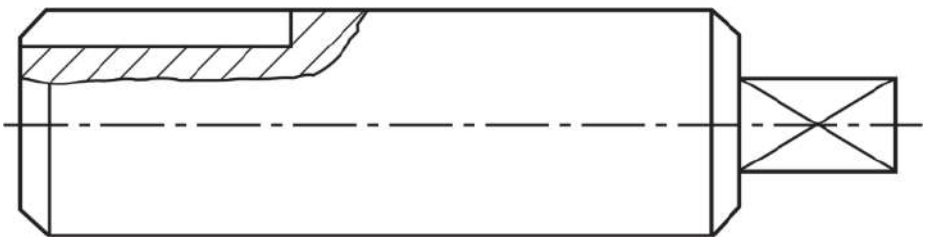


Fig. 1.27: Local Section

1.3.9 Successive Sections

Successive sections may be placed separately, with designations for both cutting planes and sections or may be arranged below the cutting planes. Note that where successive sections are drawn, each view only gives the detail at that section plane and not additional background information. Fig. 1.28 gives the details at each of the section planes in a much closer and less remote arrangement.

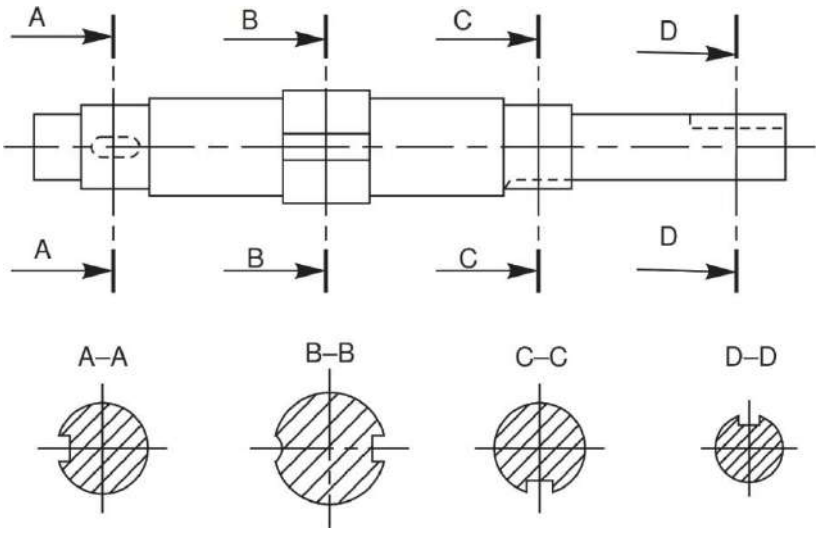


Fig. 1.28: Successive Sections

1.4 Sections through thin material

Many products are manufactured from very thin materials which would be virtually impossible to cross hatch in a sectional view and in these cases it is usual to make them entirely black. Where however two or more thin sections are adjacent to each other, a gap is left so that the profile of the separate components is clearly defined. A compound stanchion used in structural steelwork and drawn to reduced scale is shown in fig. 1.29. The same situation applies with sections through sheet-metal fabrications, gaskets, seals and packings.

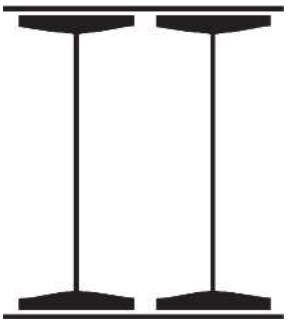


Fig. 1.29: Sections through thin material

1.5 Ribs in section

To avoid giving a false impression of thickness and solidity, ribs, webs, gear teeth, and other similar flat features are not hatched with section lining even though the cutting plane slices them.For example, in Figure 1.28, the cutting plane A–A slices through the center of the vertical web, or rib, and the web is not sectioned. Thin features are not hatched even though the cutting plane passes lengthwise through them, section A-A. If the cutting plane passes crosswise through a rib,the cut area should be hatched, section B-B, fig. 1.30.

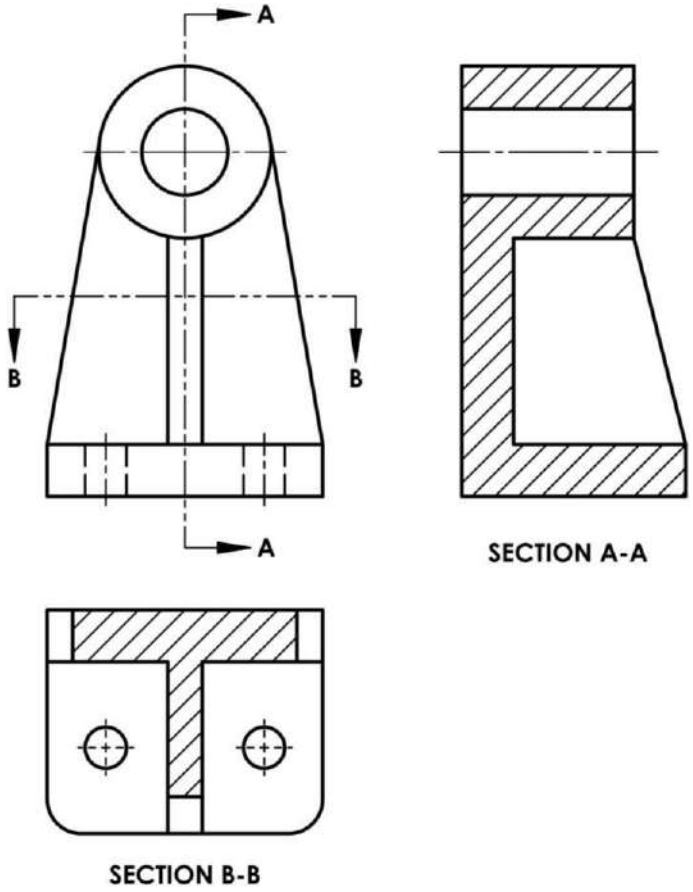


Fig. 1.30: Ribs in sections

1.6 Un-sectioned Features

Specific features of an object are commonly left un-sectioned in a sectional view if the cutting-plane line passes through and parallel to the feature. The types of features that are left un-sectioned for clarity are bolts, nuts, rivets, screws, rods, shafts, ribs, webs, spokes, bearings, gear teeth, pins, and keys, fig. 1.31.

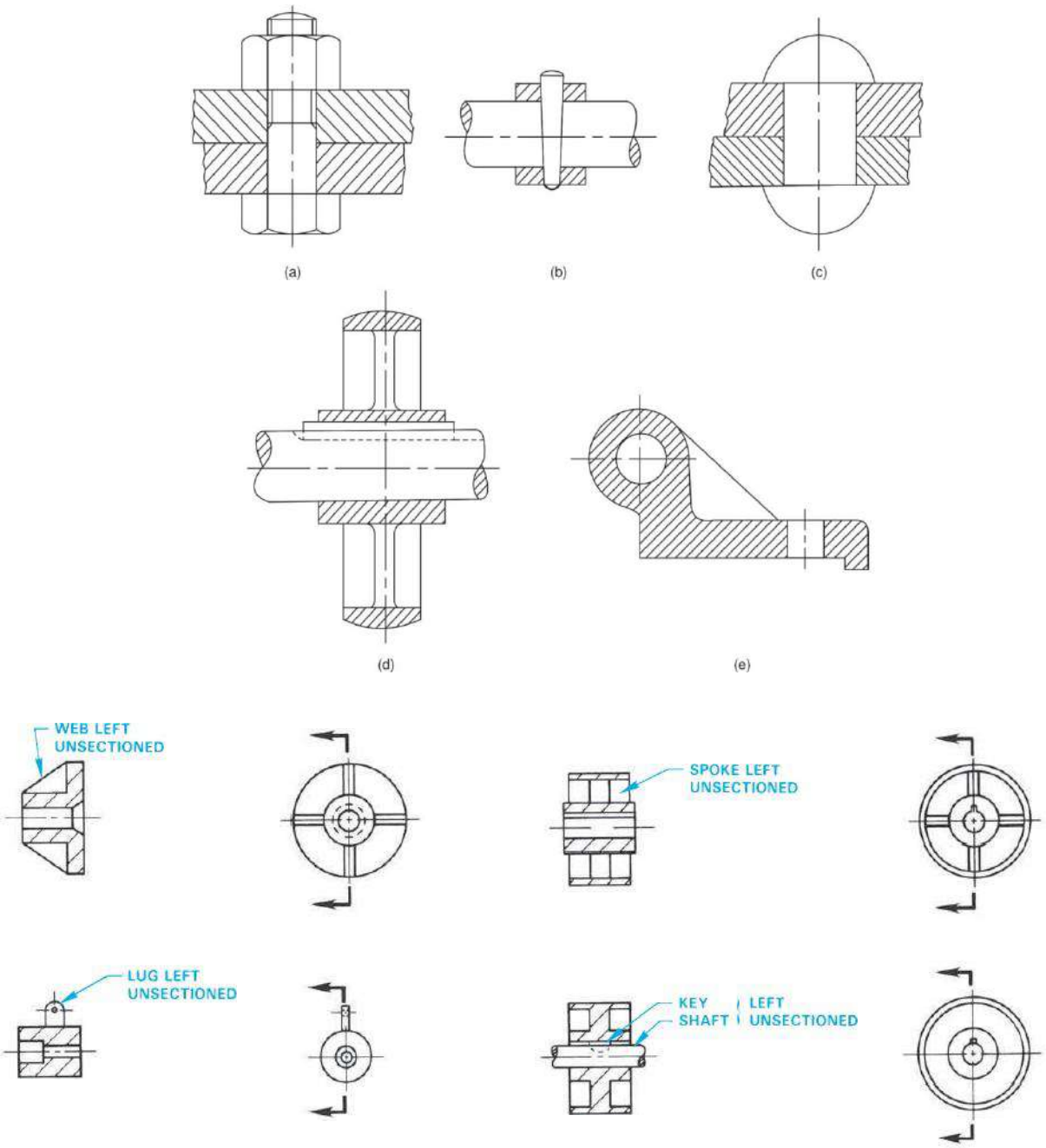


Fig.1.31: Examples for un-sectioned Features (not to be hatched)

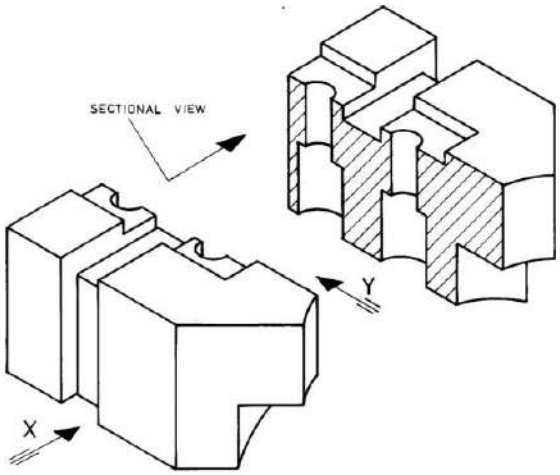
1.7 Rules to be Considered in Sectioning

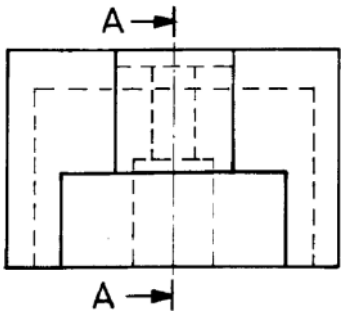
1. A sectional view shows the part of the component in front of the sectioning plane arrows. In the third-angle projection the sectional view is placed on the side behind the sectioning viewing plane, while in first-angle projection it is placed on the side in front of the sectional viewing plane.
2. Material which has been cut by the sectioning plane is cross hatched.

3. A sectional view must not have any full lines drawn over cross-hatched areas. A full linerepresents a corner or edge which cannot exist on a face which has been cut by a plane.
4. As a general rule, dimensions are not inserted in cross-hatched areas, but where it isunavoidable, it may be done as previously mentioned.

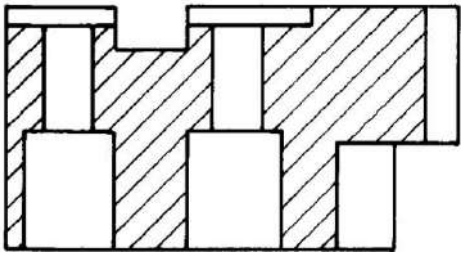
1.8 Solved Examples

(1)



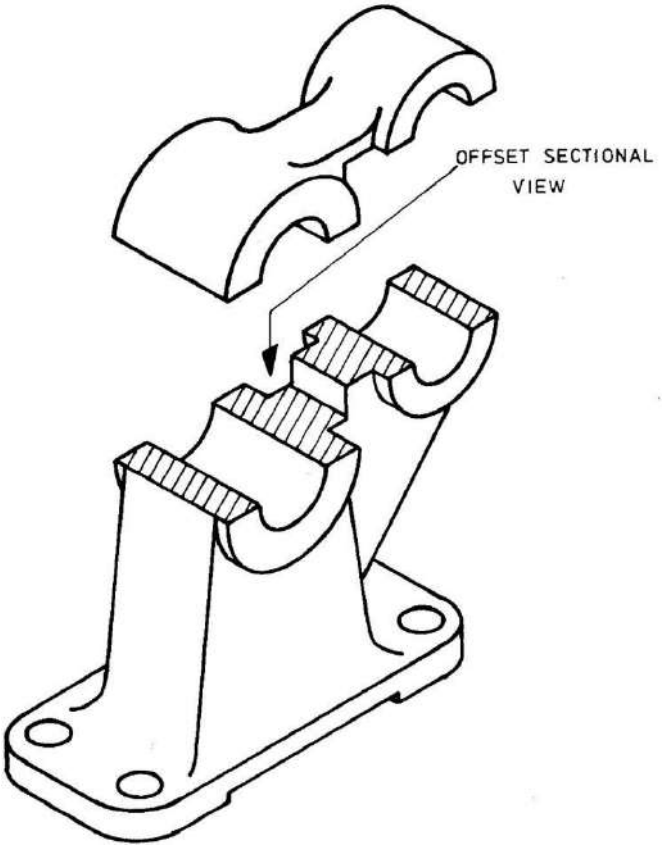


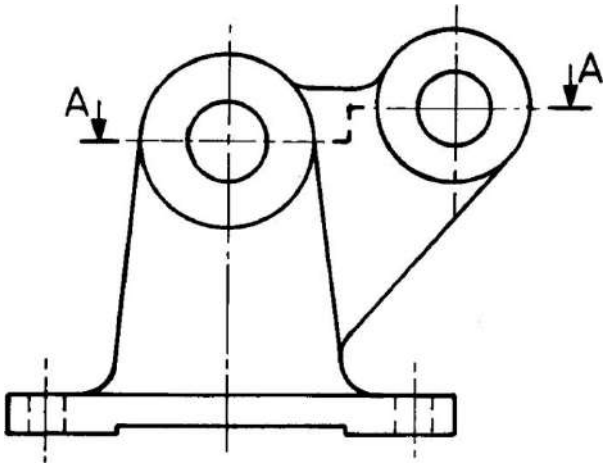
LEFT SIDE VIEW
A-A



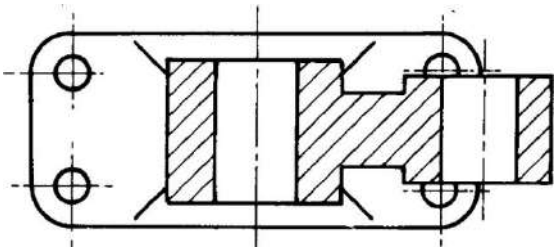
SECTIONAL ELEVATION AT

(2)



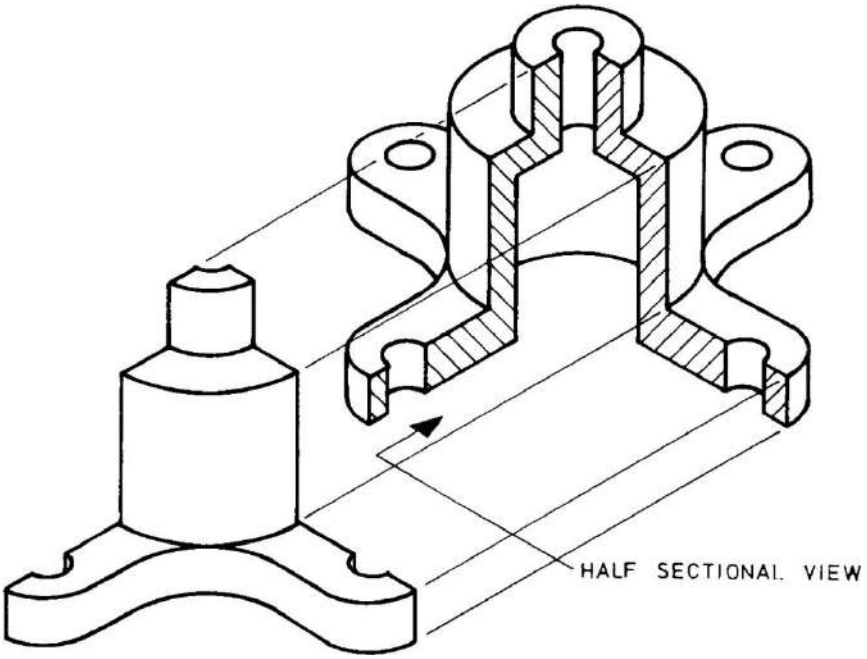


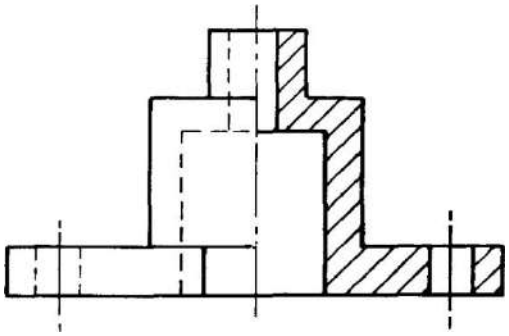
ELEVATION



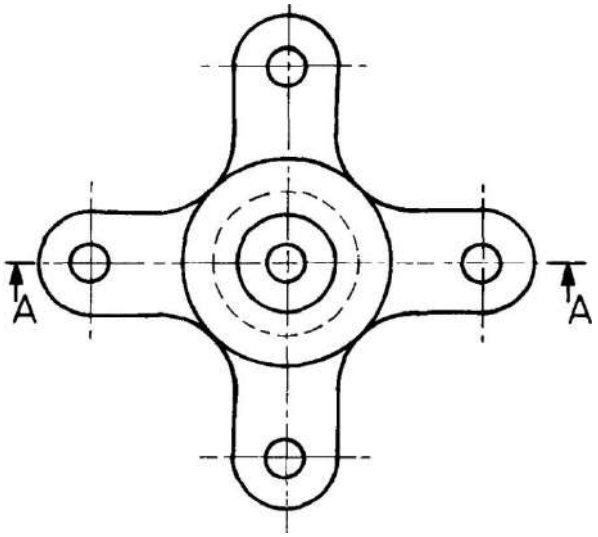
OFFSET SECTIONAL PLAN AT A-A

(3)



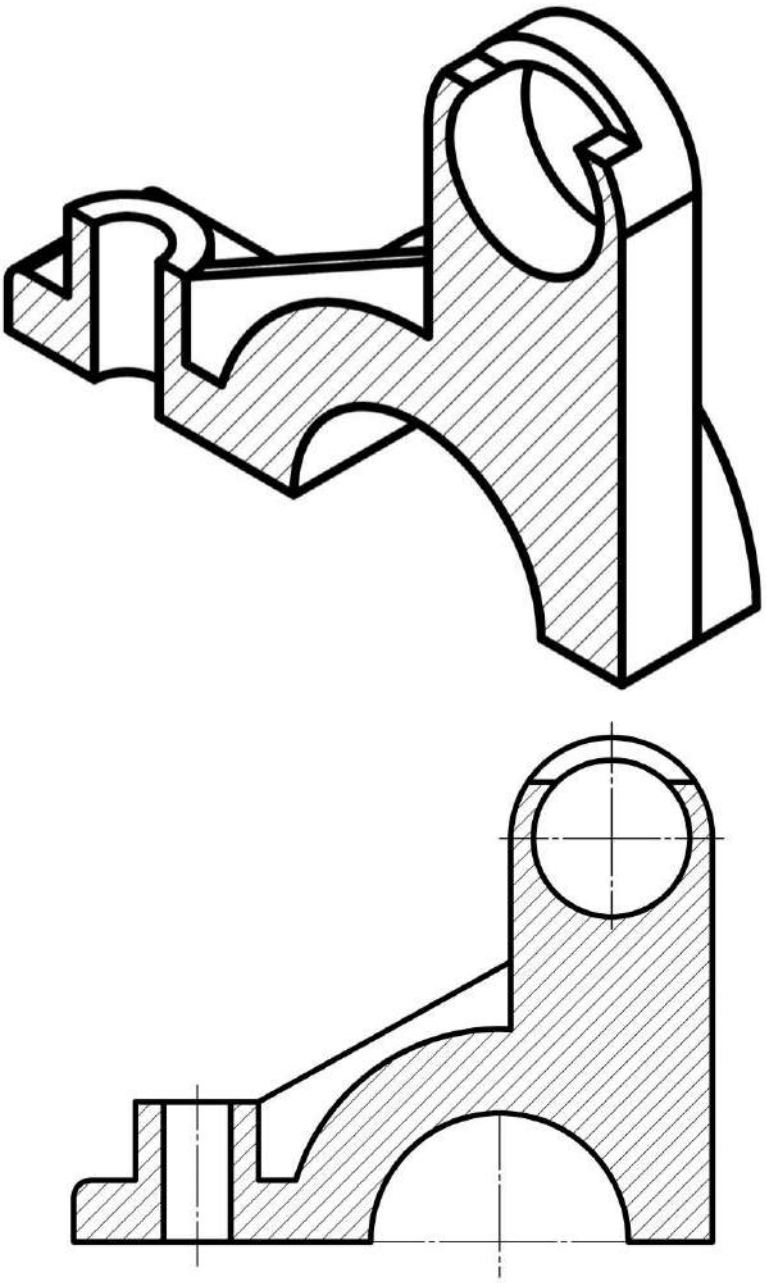


HALF SECTIONAL ELEVATION AT A-A

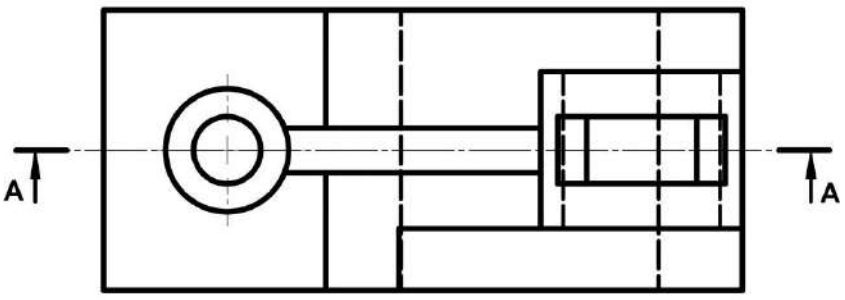


PLAN

(4)

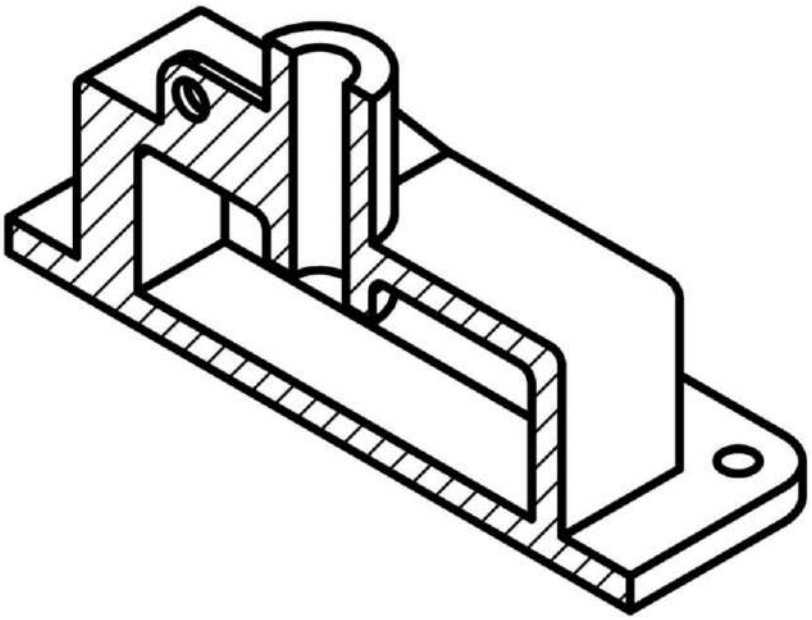


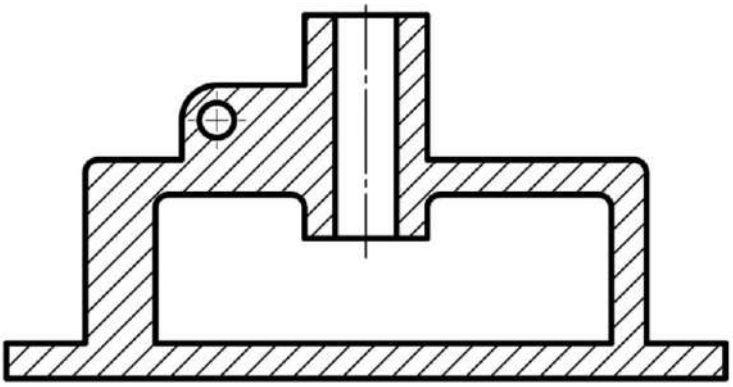
SECTIONAL ELEVATION AT A-A



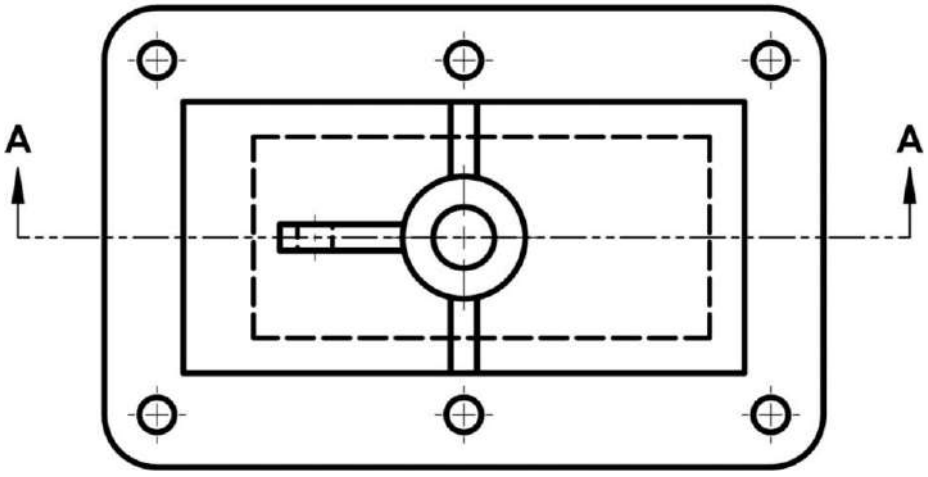
PLAN

(5)



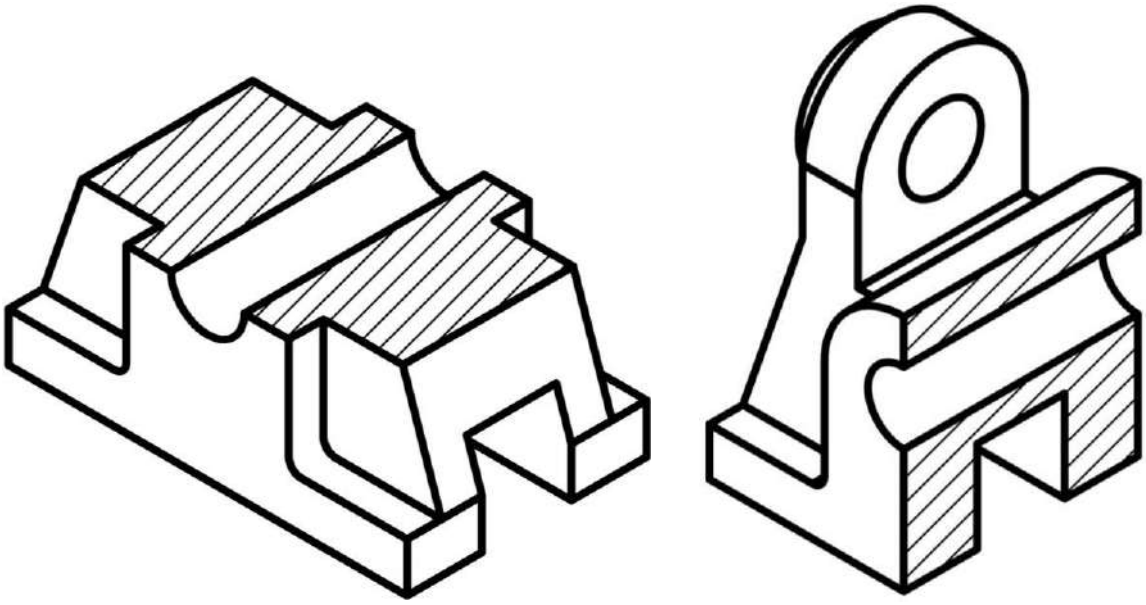


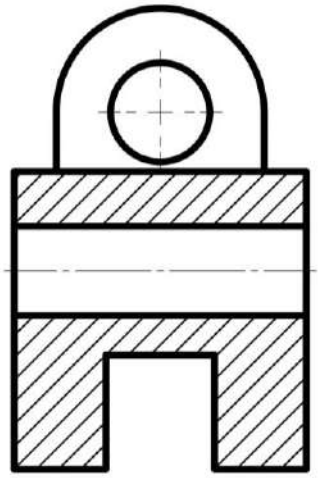
SECTIONAL ELEVATION AT A-A



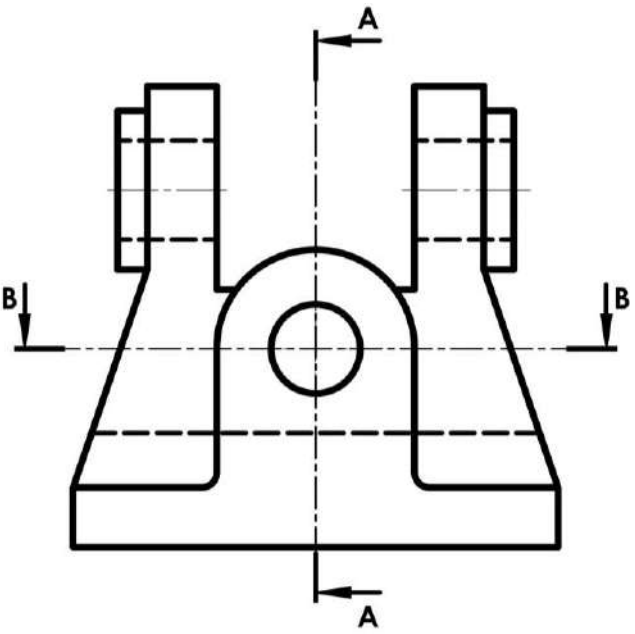
PLAN

(6)

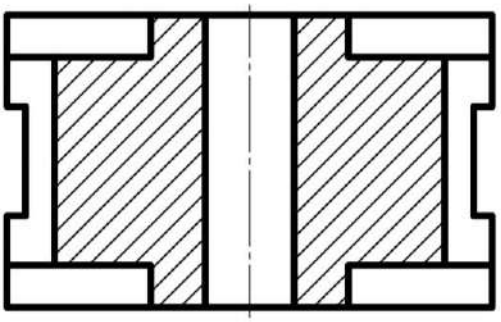




SECTIONAL SIDE VIEW AT A-A

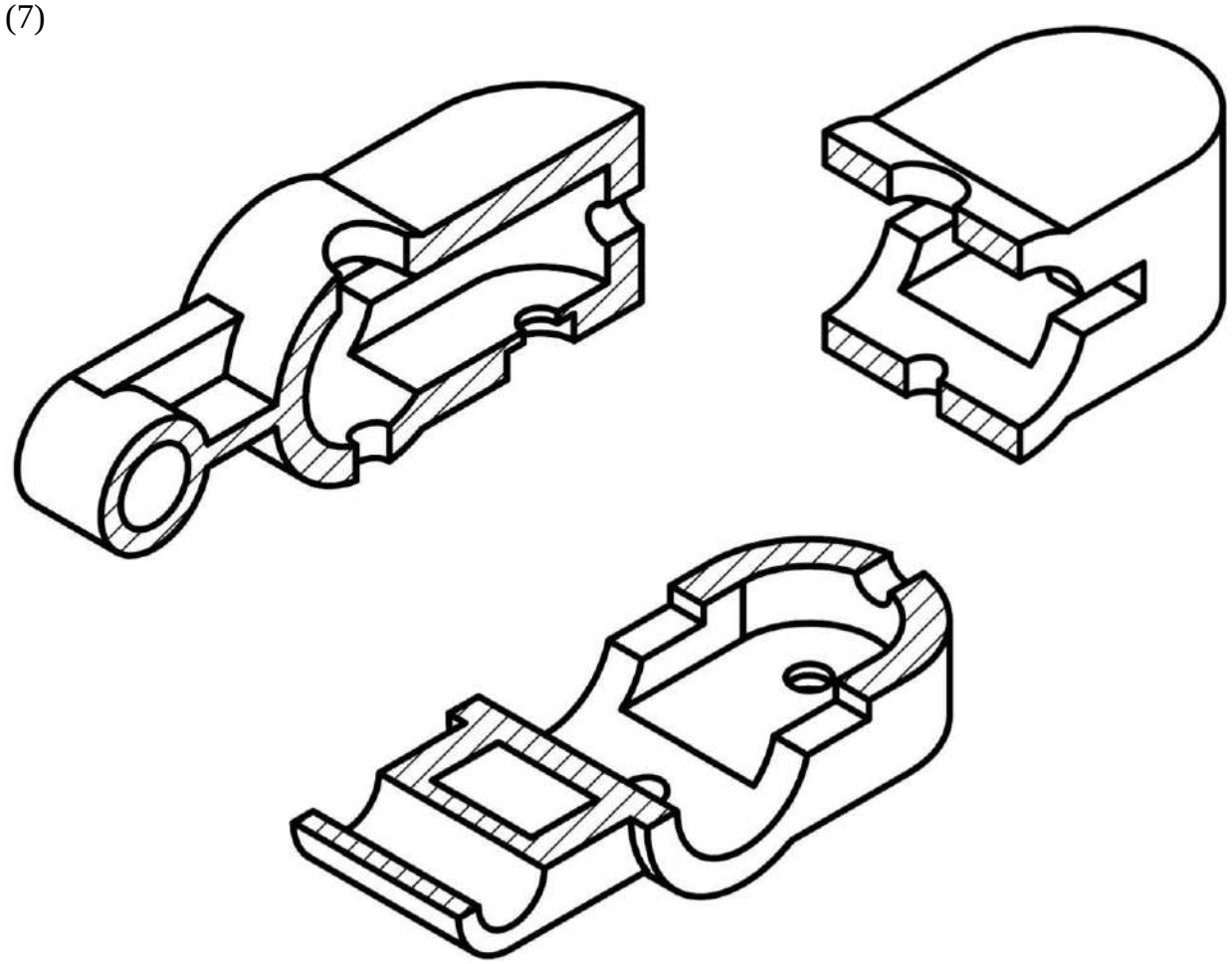


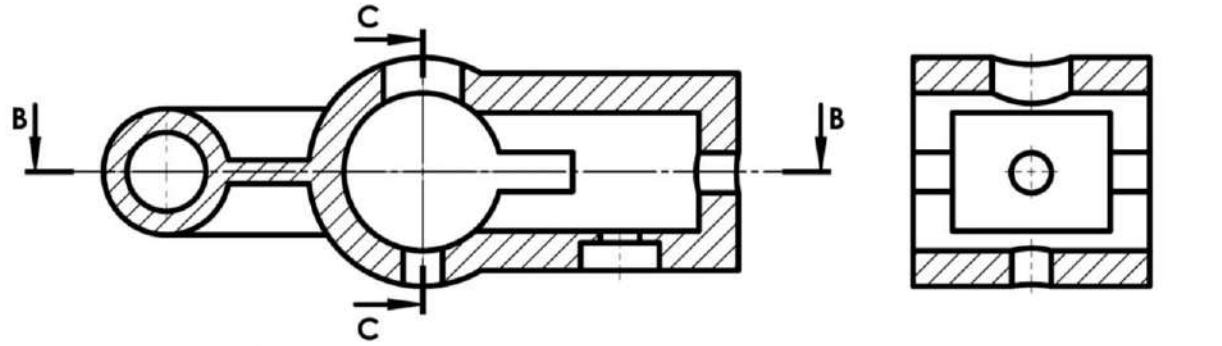
ELEVATION



SECTIONAL PLAN AT B-B

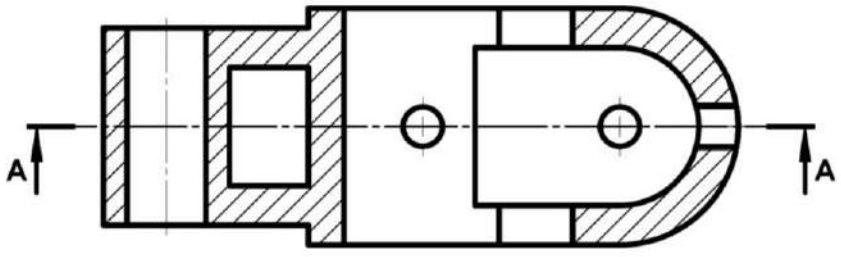
(7)





SECTIONAL ELEVATION AT A-A

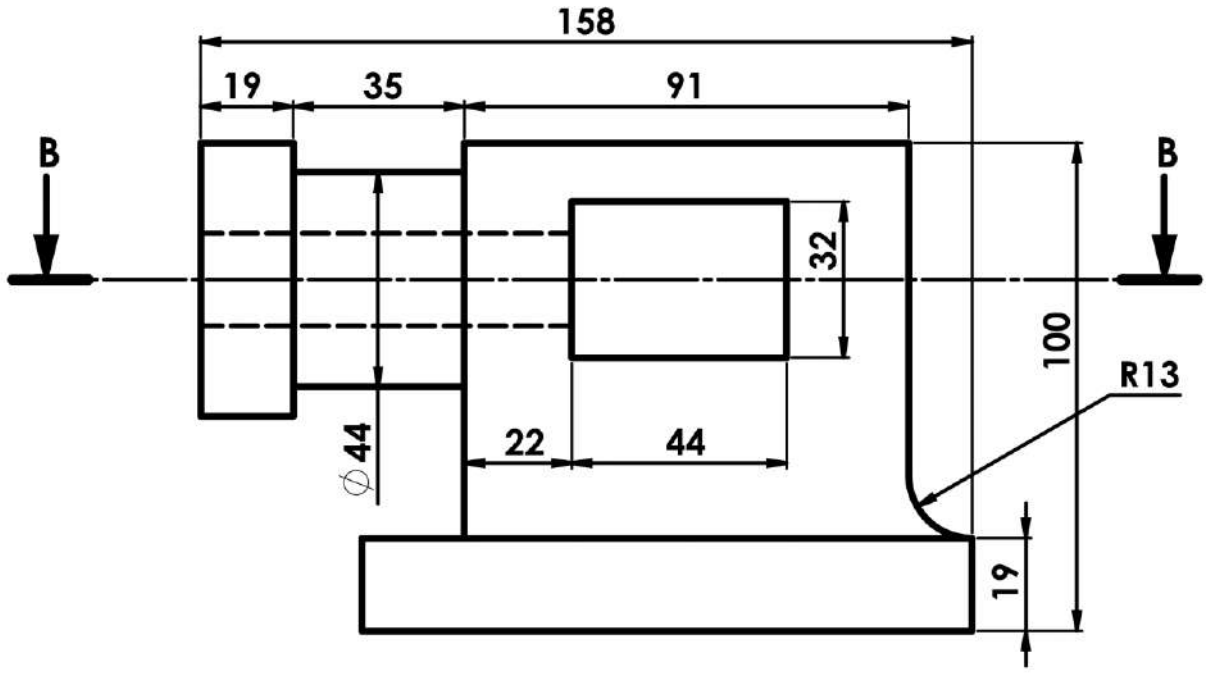
SECTIONAL SIDE VIEW AT C-C



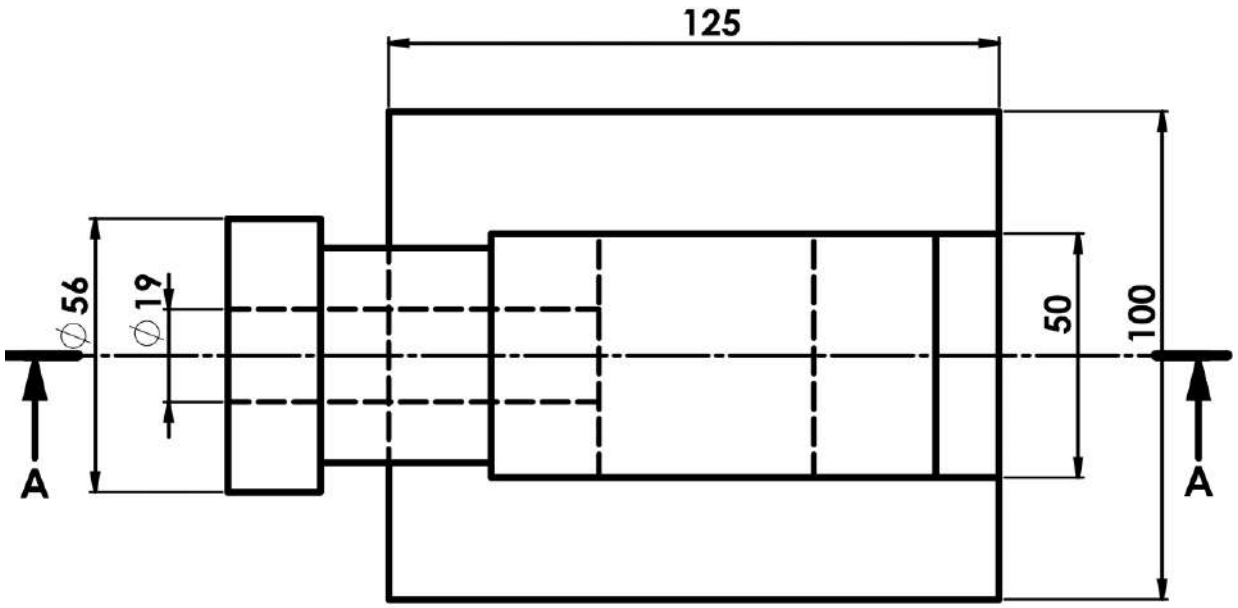
SECTIONAL PLAN AT B-B

1.9 Exercise

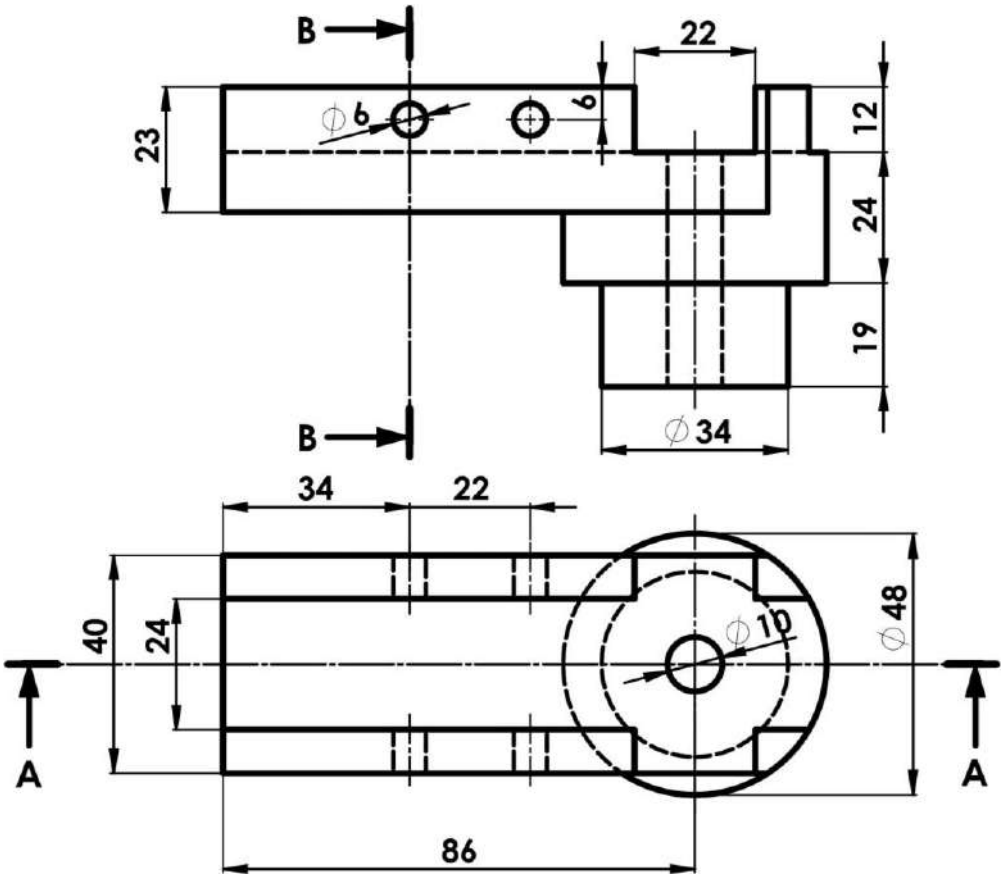
For the following mechanical parts draw the sectional views as required:

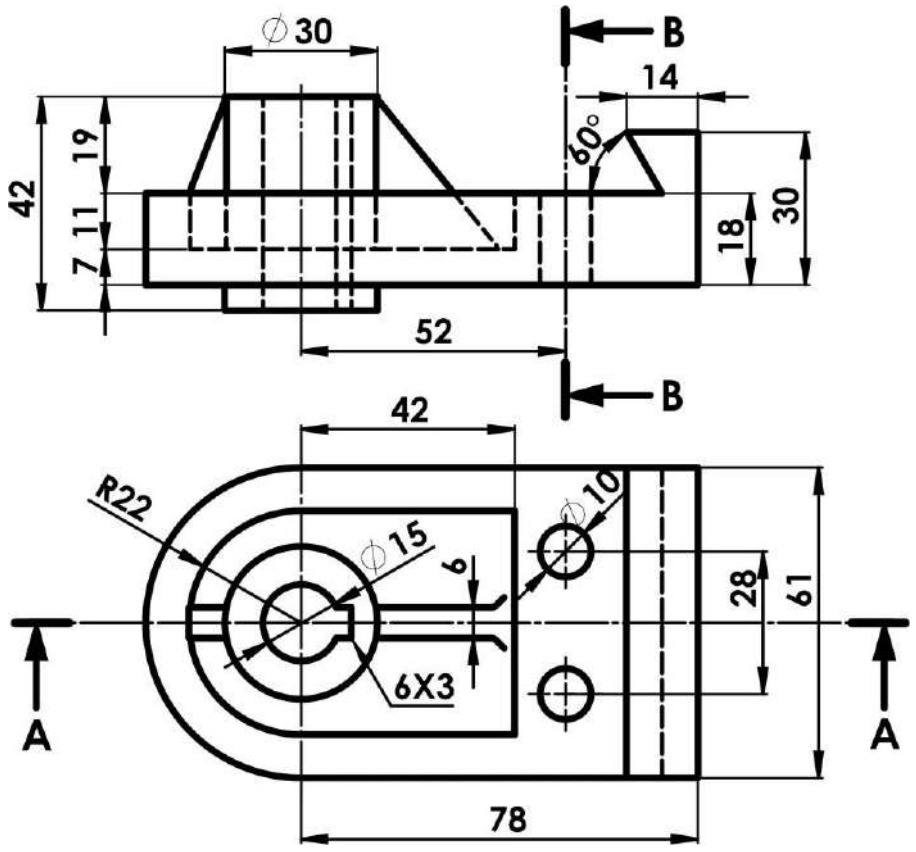


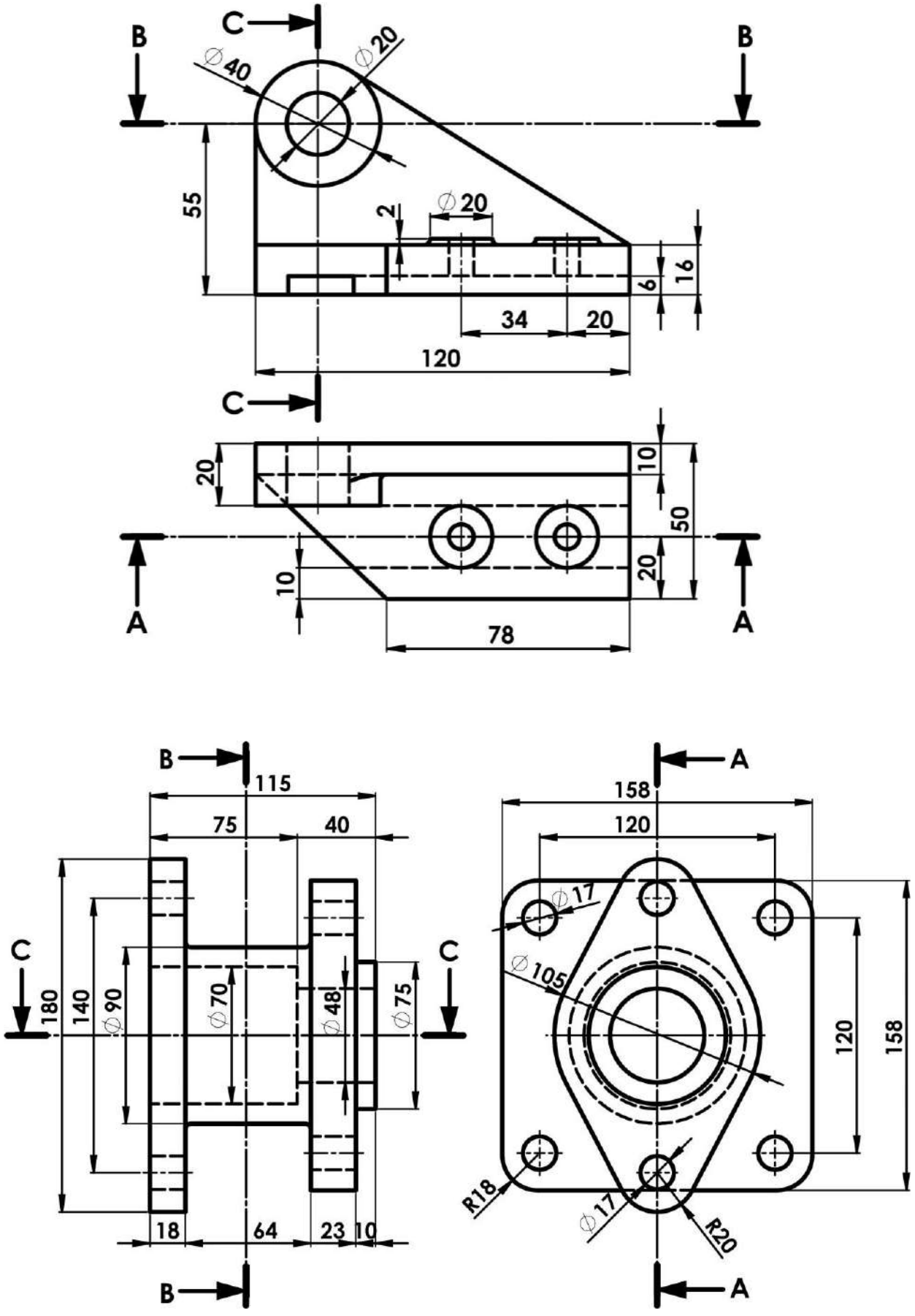
ELEVATION

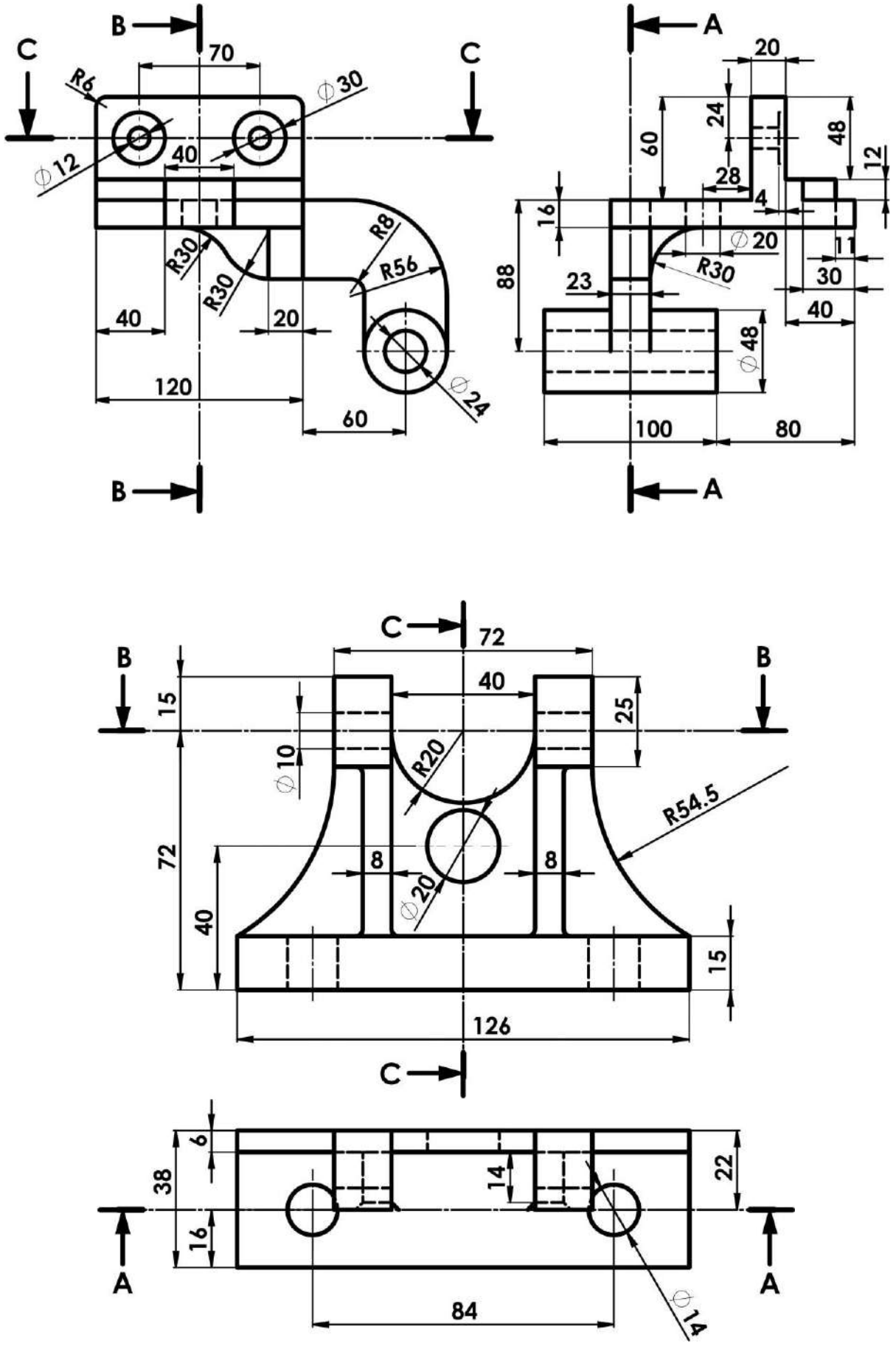


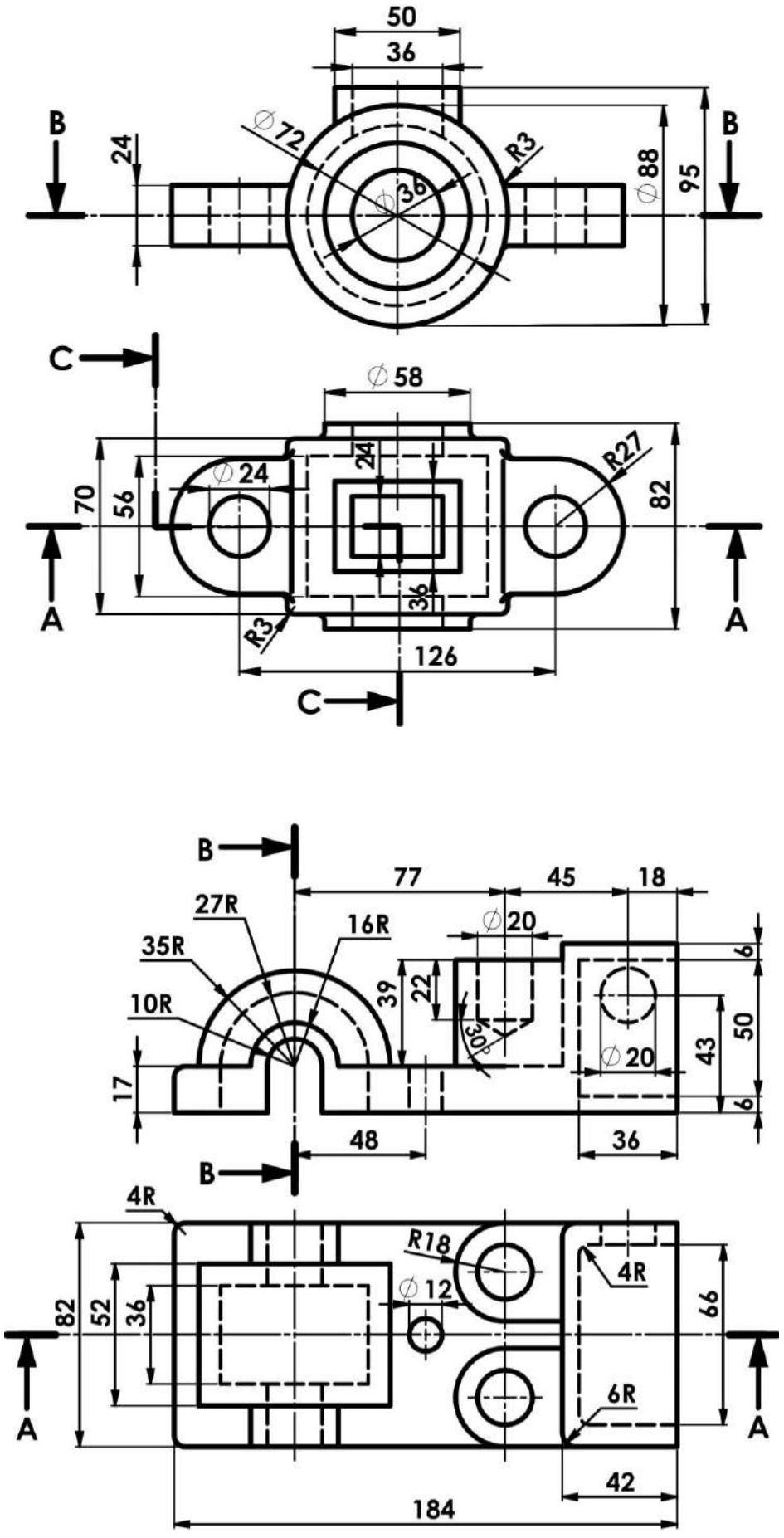
PLAN


B
22
∅6
6
23
12
24
19
B
∅34
34
22
40
24
∅10
∅48
A
A
86

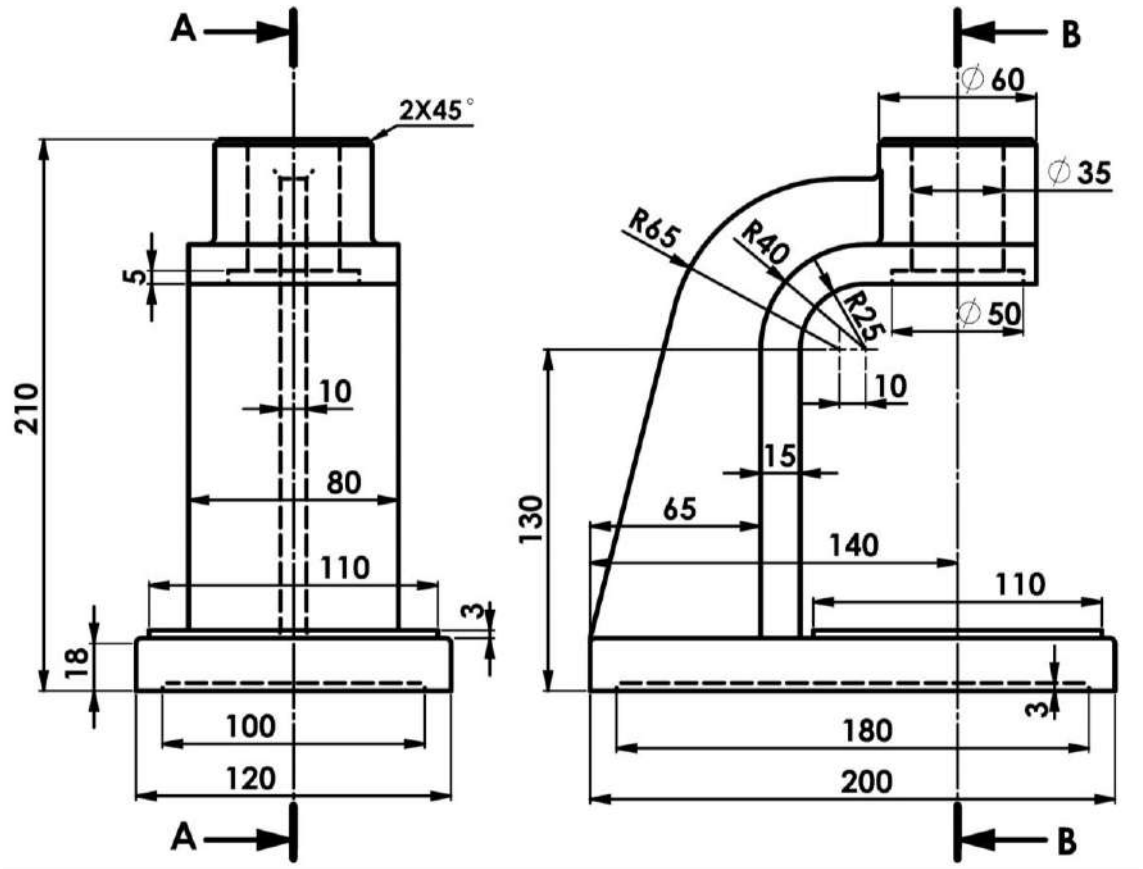

∅30
B
14
60°
42
19
7
11
18
30
52
B
42
R22
∅10
∅15
6
28
61
6X3
A
A
78

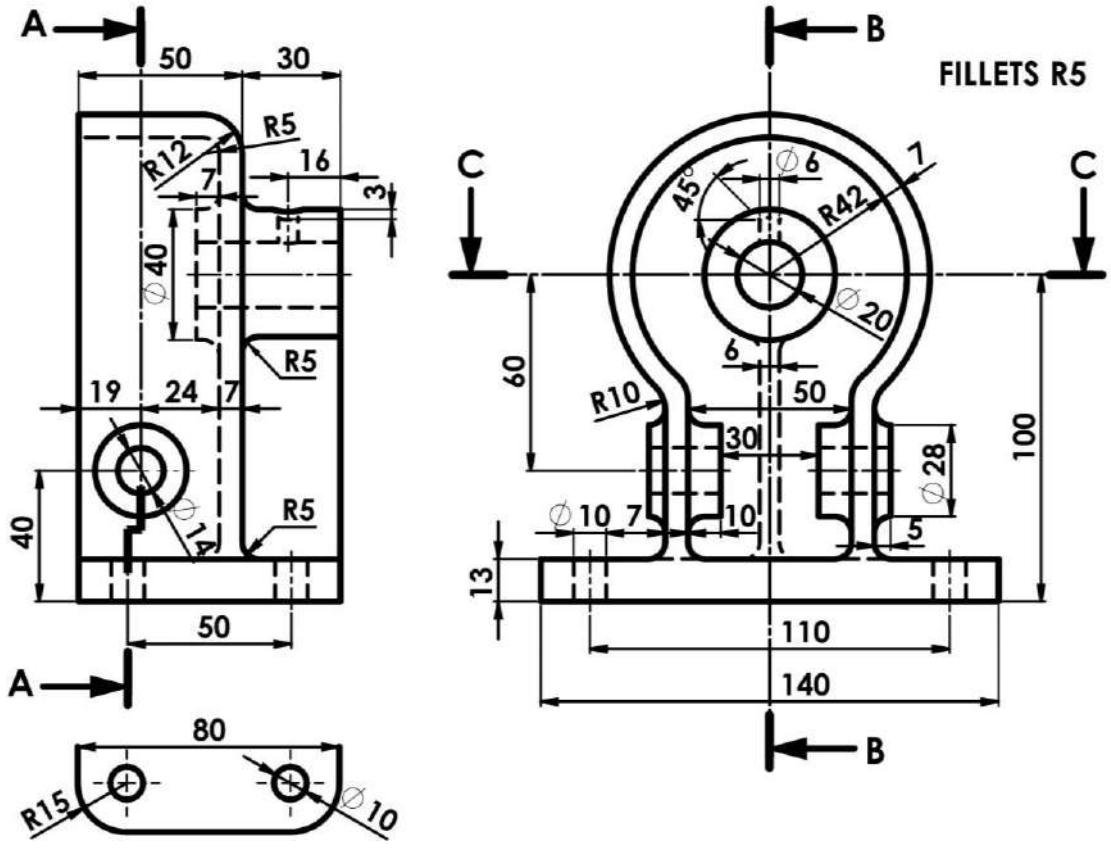

B
C
∅40
∅20
B
55
2
∅20
6
16
34
20
120
C
20
10
50
20
10
78
A
A
B
115
75
40
C
180
140
∅90
∅70
∅48
∅75
C
18
64
23
10
B
A
158
120
∅17
∅105
120
158
R18
∅17
R20
A

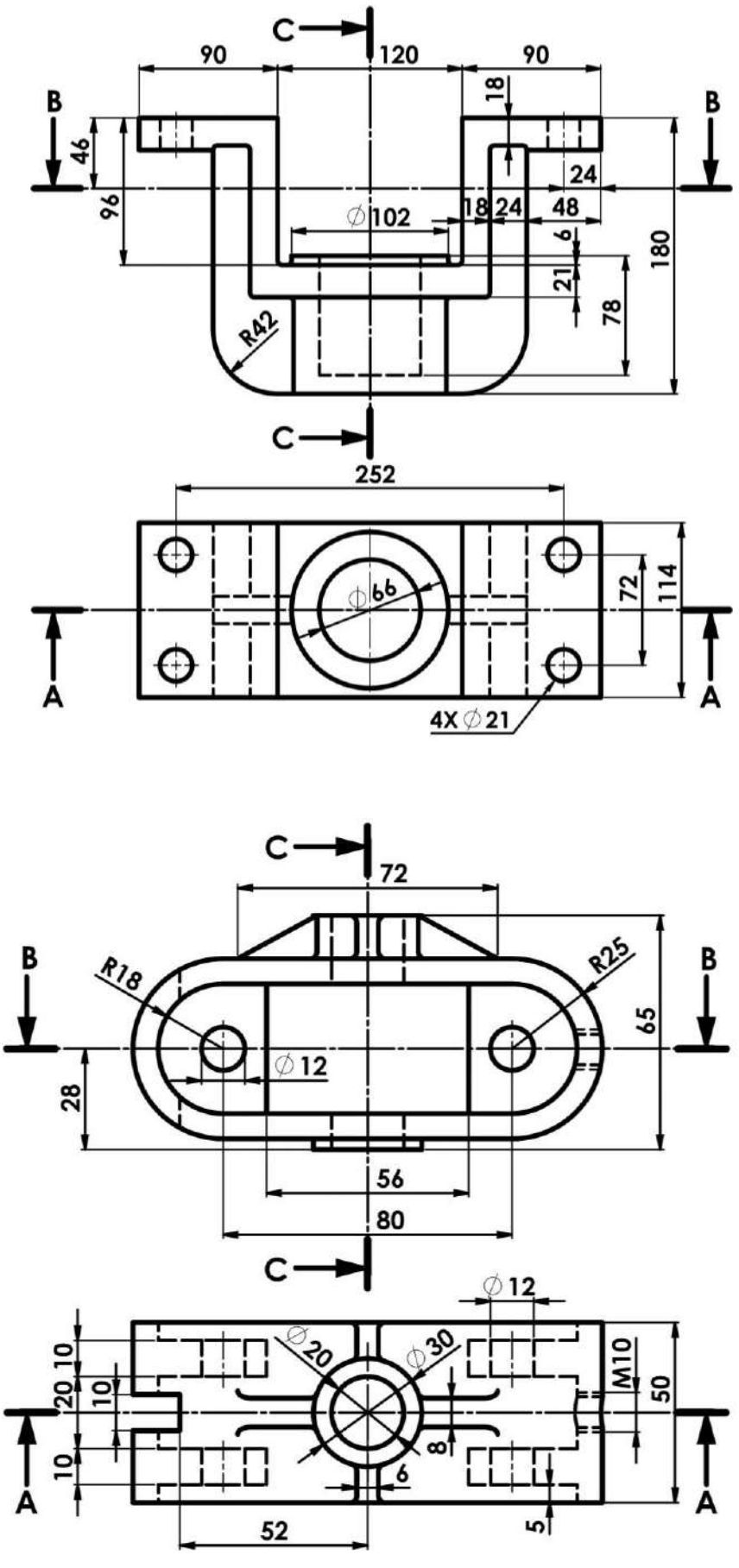

B
C
70
R6
⌀30
⌀12
40
R30
R30
R8
R56
40
20
120
60
⌀24
B
C
A
20
24
48
12
60
28
4
16
⌀20
R30
11
88
23
30
40
⌀48
100
80
A
C
72
B
B
40
15
25
⌀10
R20
R54.5
72
8
8
⌀20
40
15
126
C
6
38
14
22
16
A
A
84
⌀14

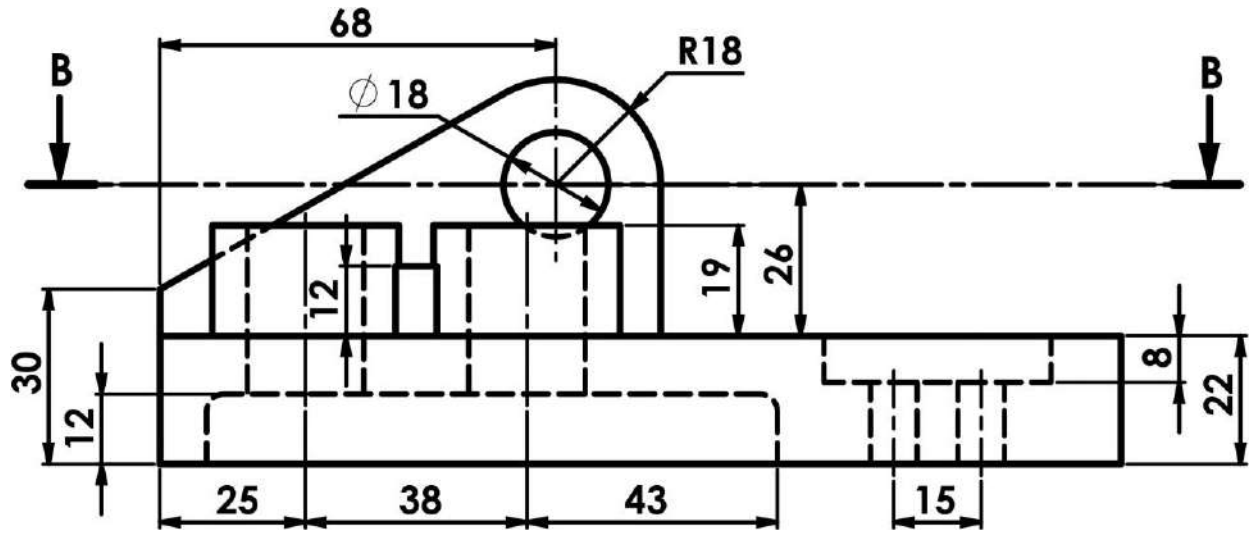

50
36
B
24
∅72
R3
∅36
∅88
95
B
C
∅58
∅24
24
R27
70
56
82
A
36
A
R3
126
C
B
77
45
18
27R
16R
35R
∅20
6
39
22
10R
30°
∅20
43
50
17
6
48
36
B
4R
R18
4R
82
52
36
∅12
66
A
6R
A
42
184

[80]

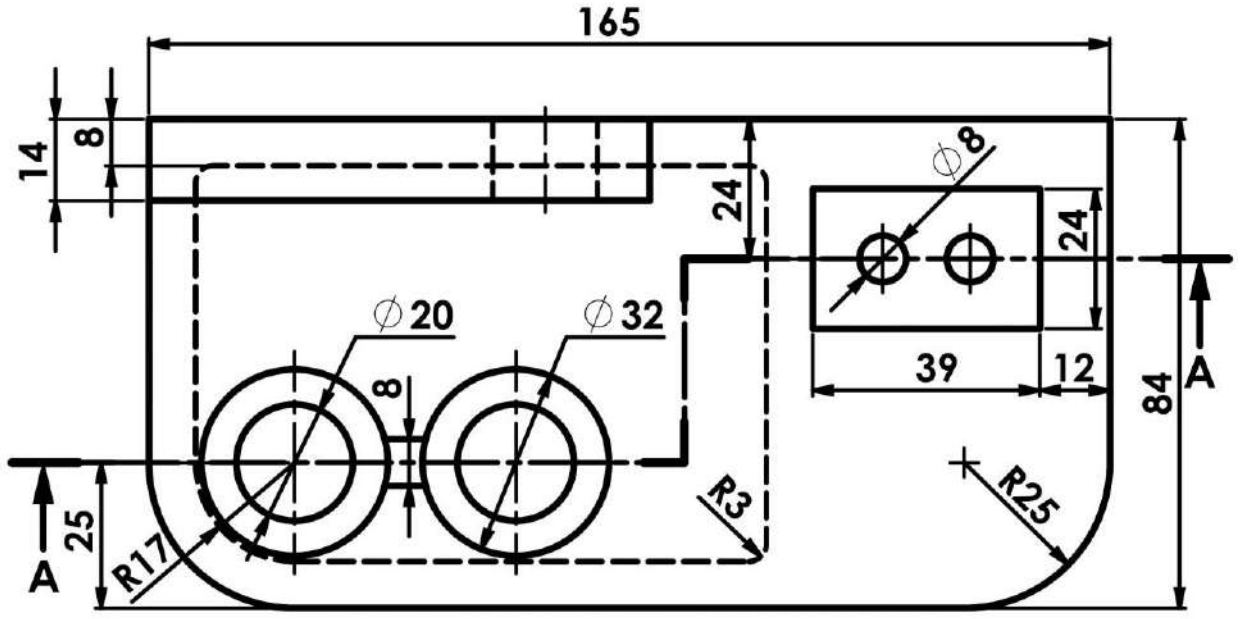

A
2X45°
5
210
10
80
110
3
18
100
120
A
B
∅60
∅35
R65
R40
R25
∅50
10
15
65
130
140
110
3
180
200
B


A
50
30
R5
R12
16
7
3
40
R5
19
24
7
40
14
R5
50
A
80
R15
∅10
B
FILLETS R5
C
C
45°
∅6
7
R42
∅20
6
60
R10
50
30
28
100
∅10
7
10
5
13
110
140
B

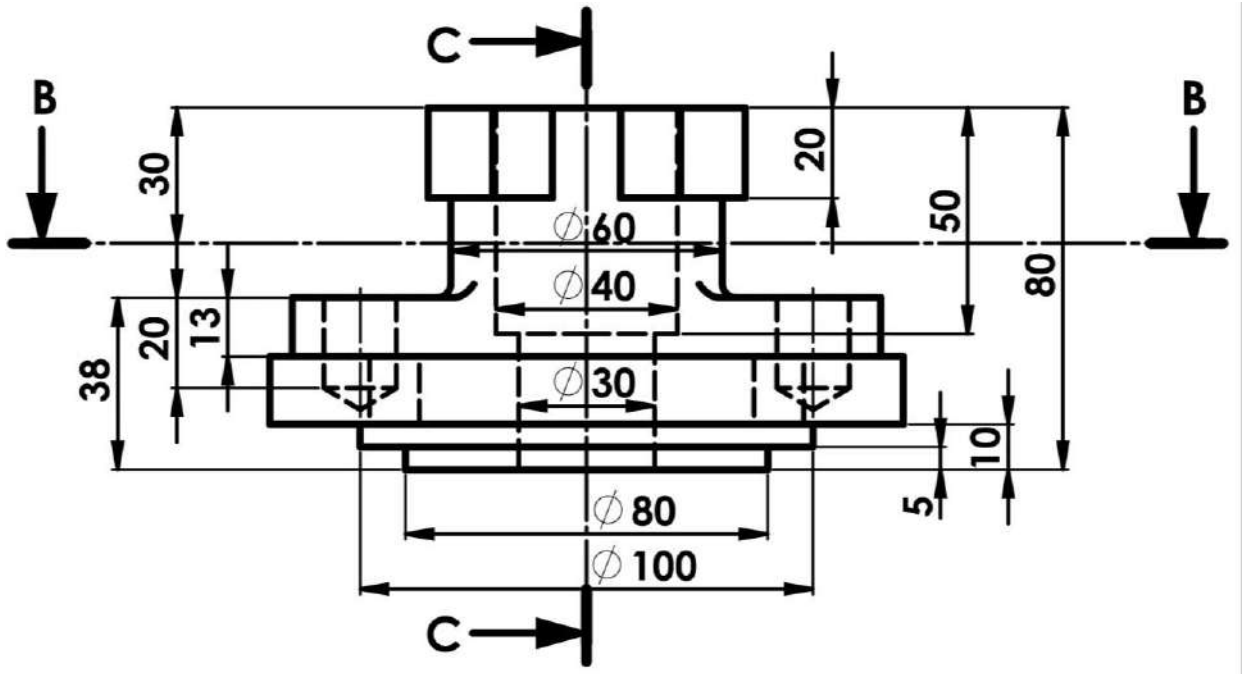

C
90
120
90
18
B
B
46
96
24
18
24
48
∅102
6
21
78
180
R42
C
252
∅66
72
114
A
A
4X ∅21
C
72
B
R18
R25
B
65
∅12
28
56
80
C
∅12
∅20
∅30
M10
50
20
10
10
10
8
6
A
A
52
5



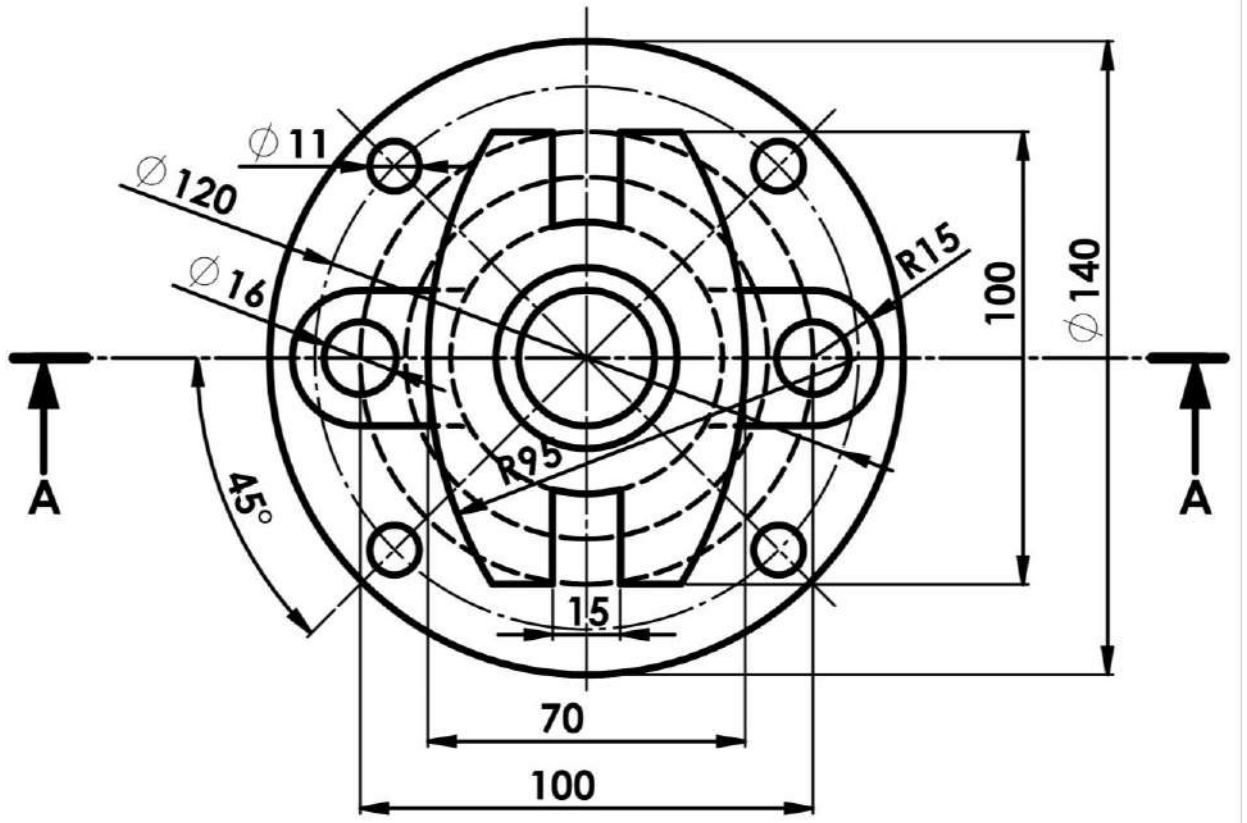
ELEVATION



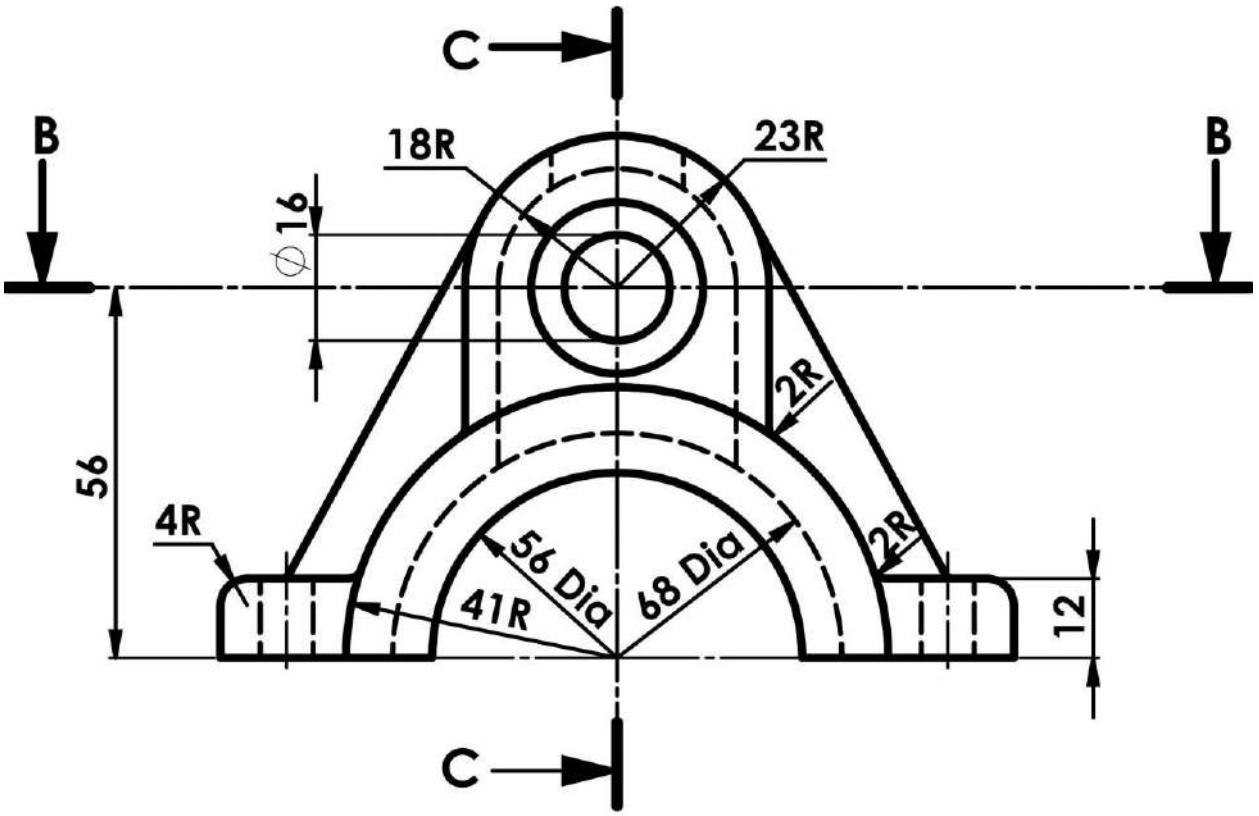
PLAN



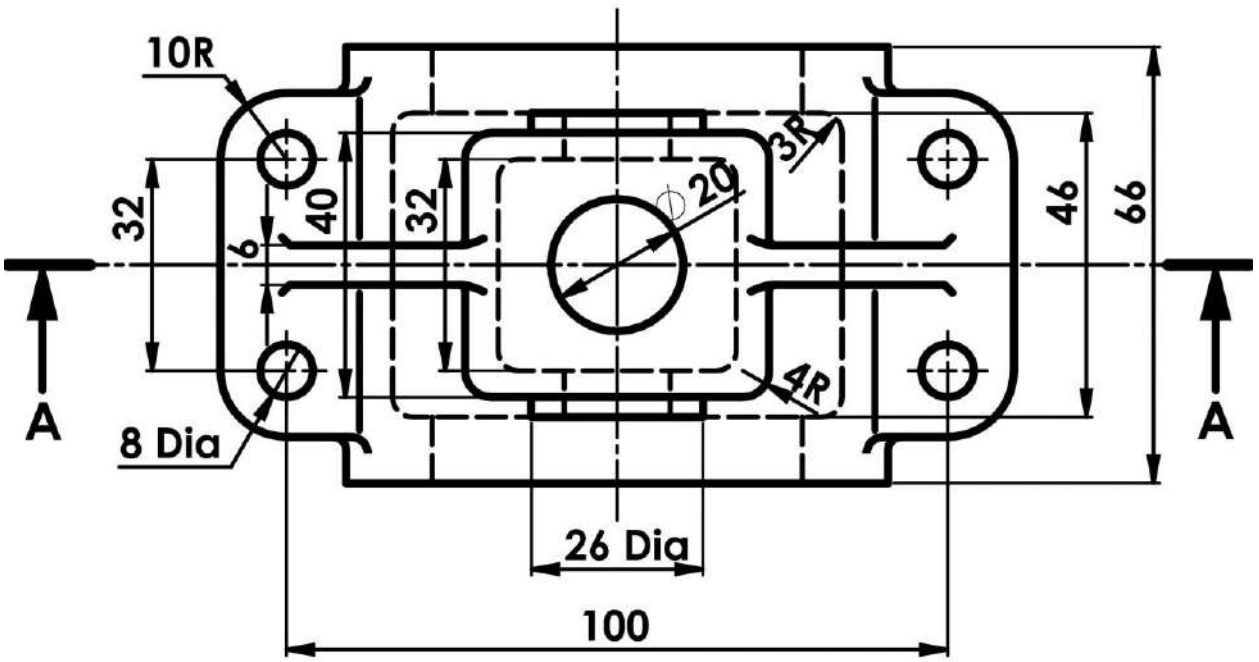
ELEVATION



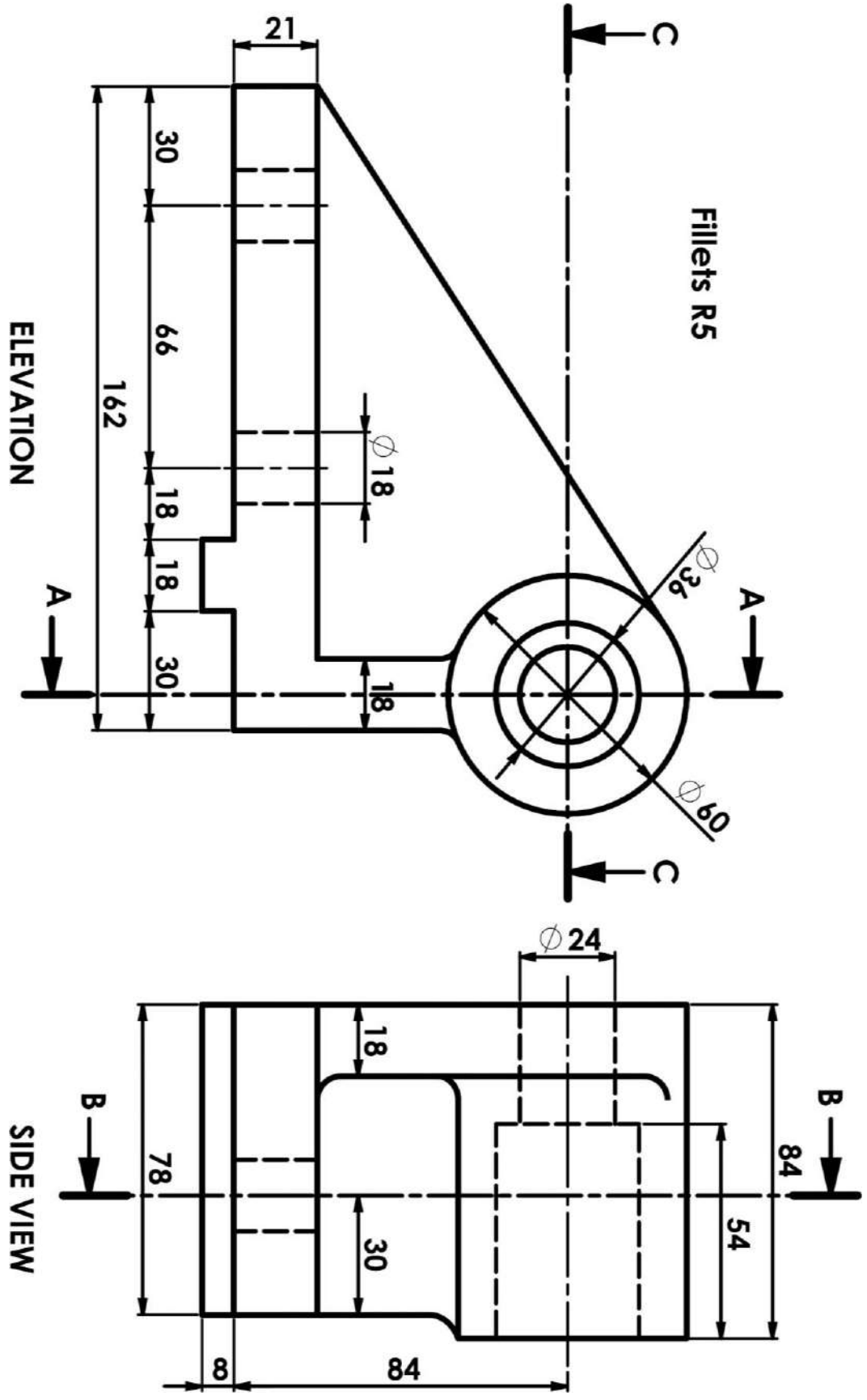
PLAN

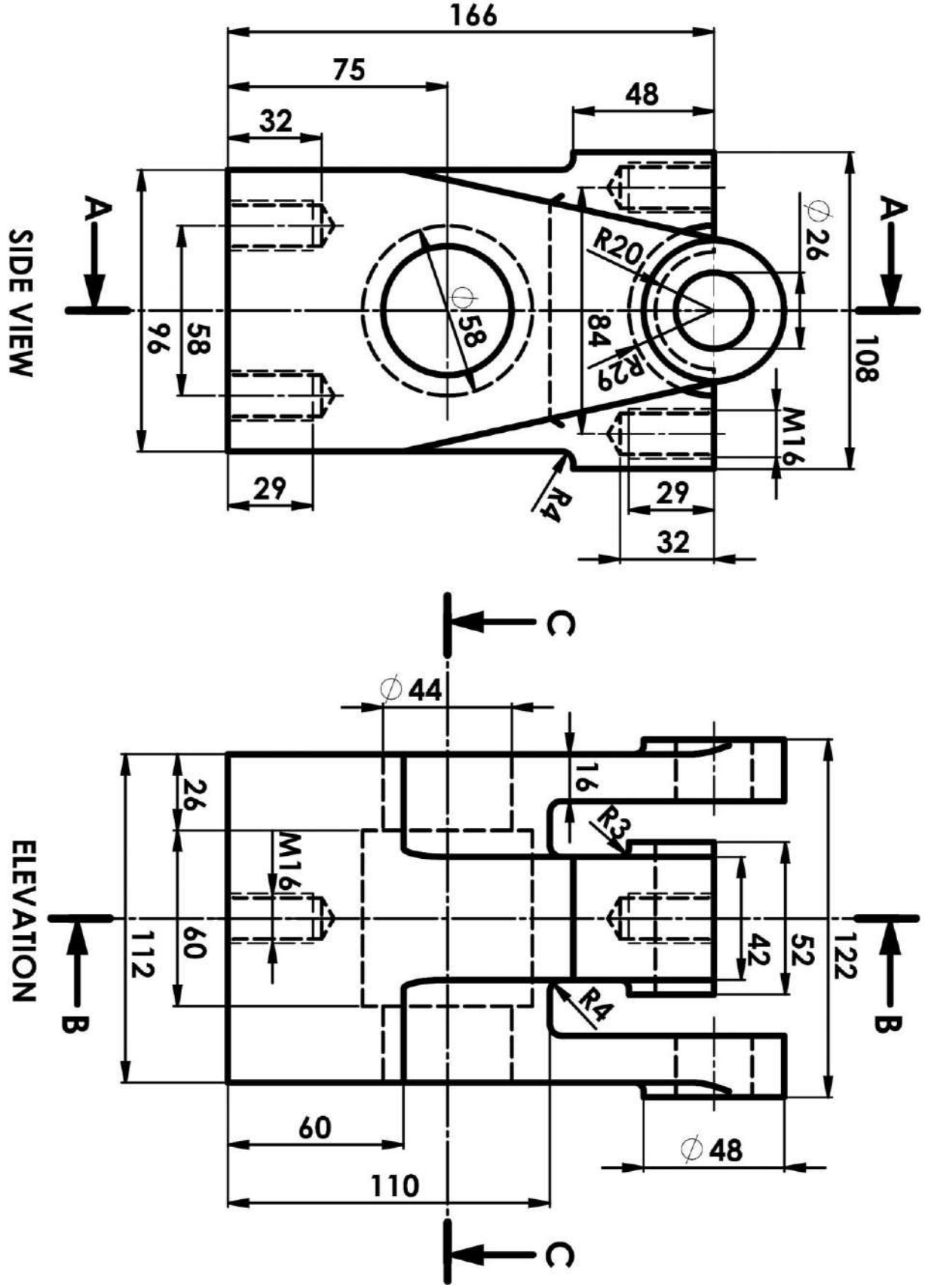


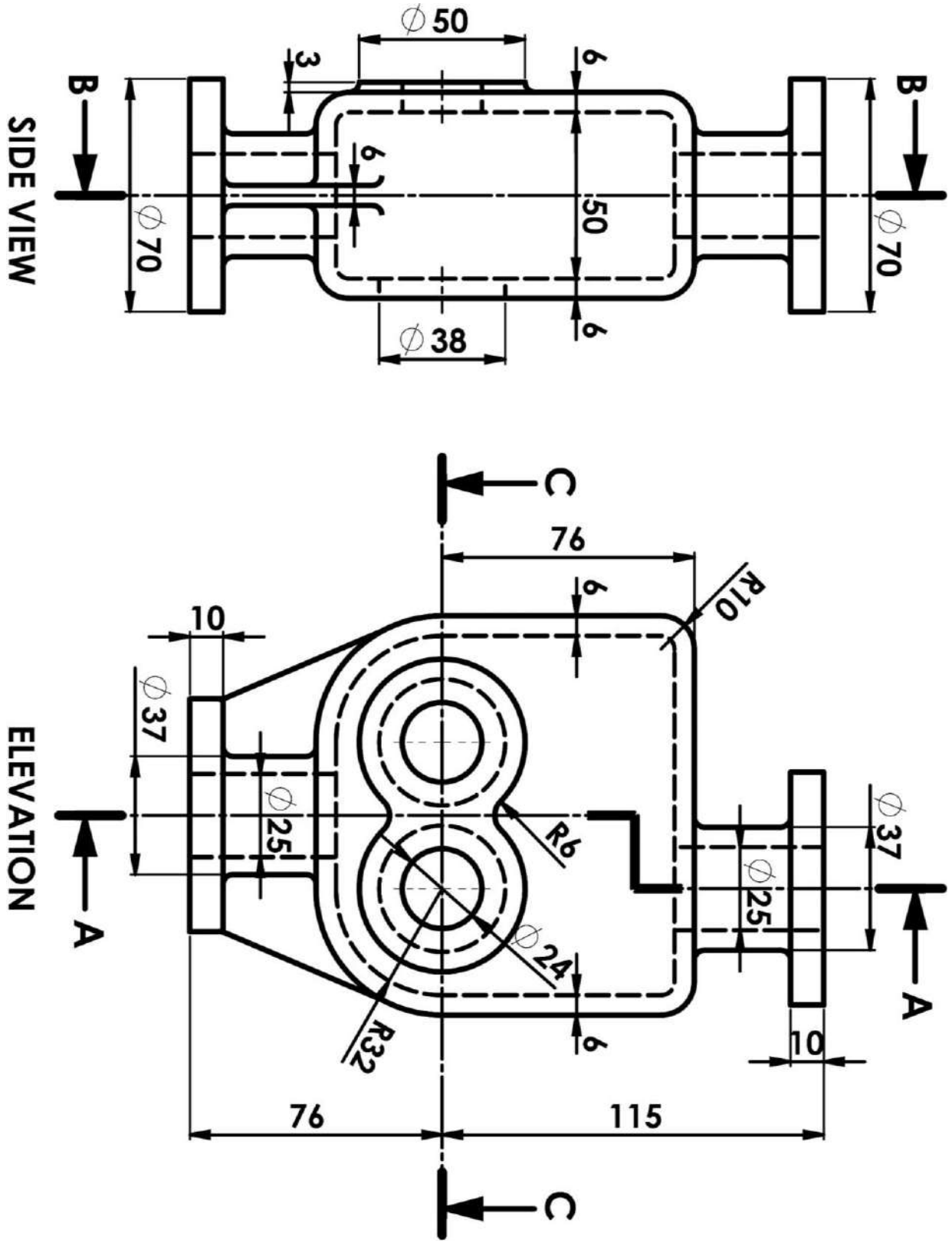
ELEVATION

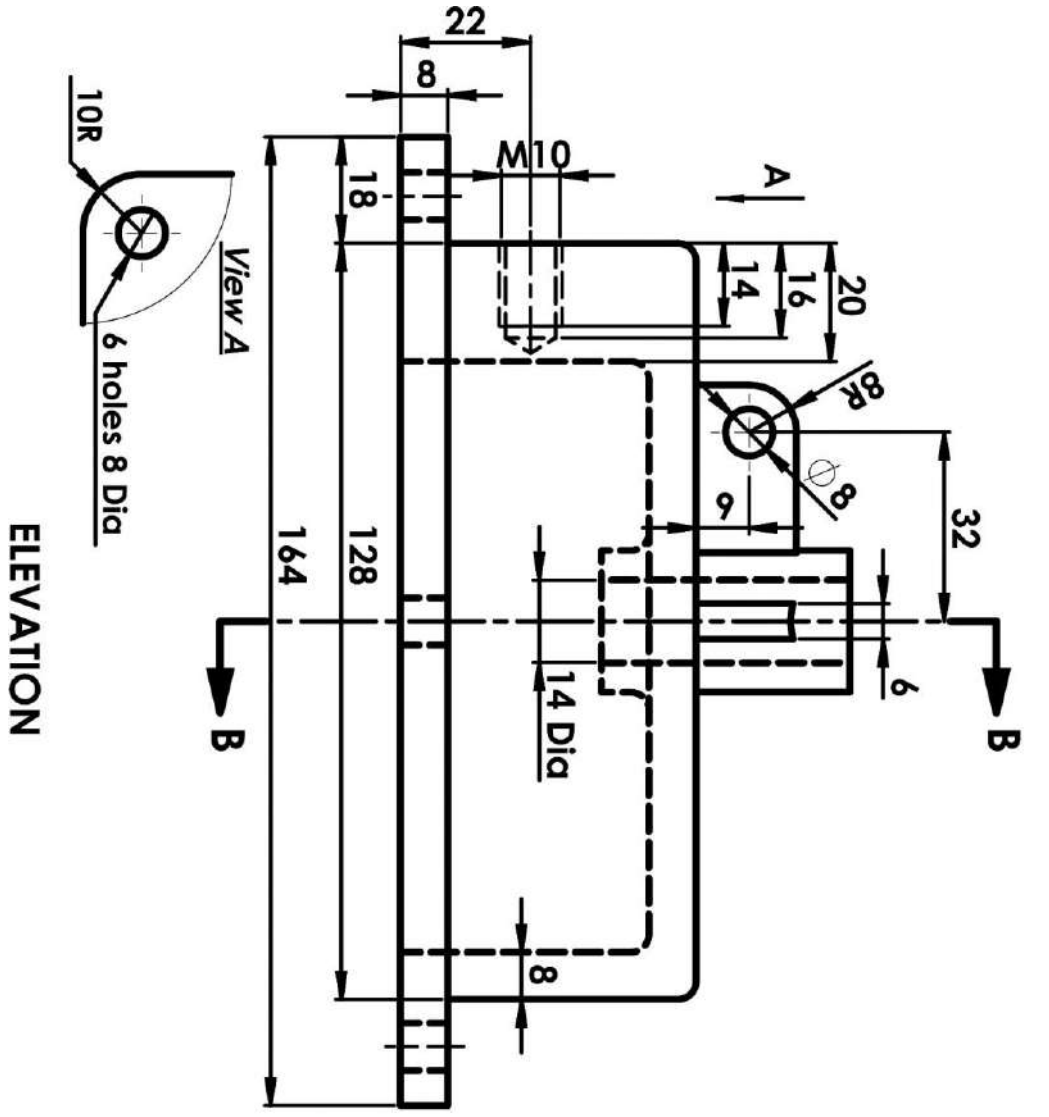


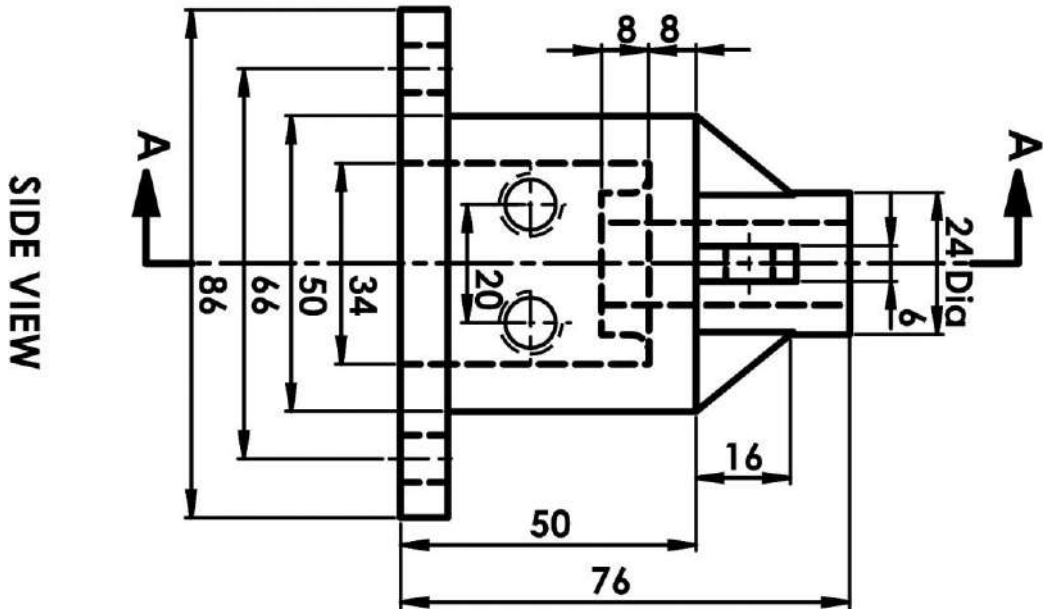
PLAN

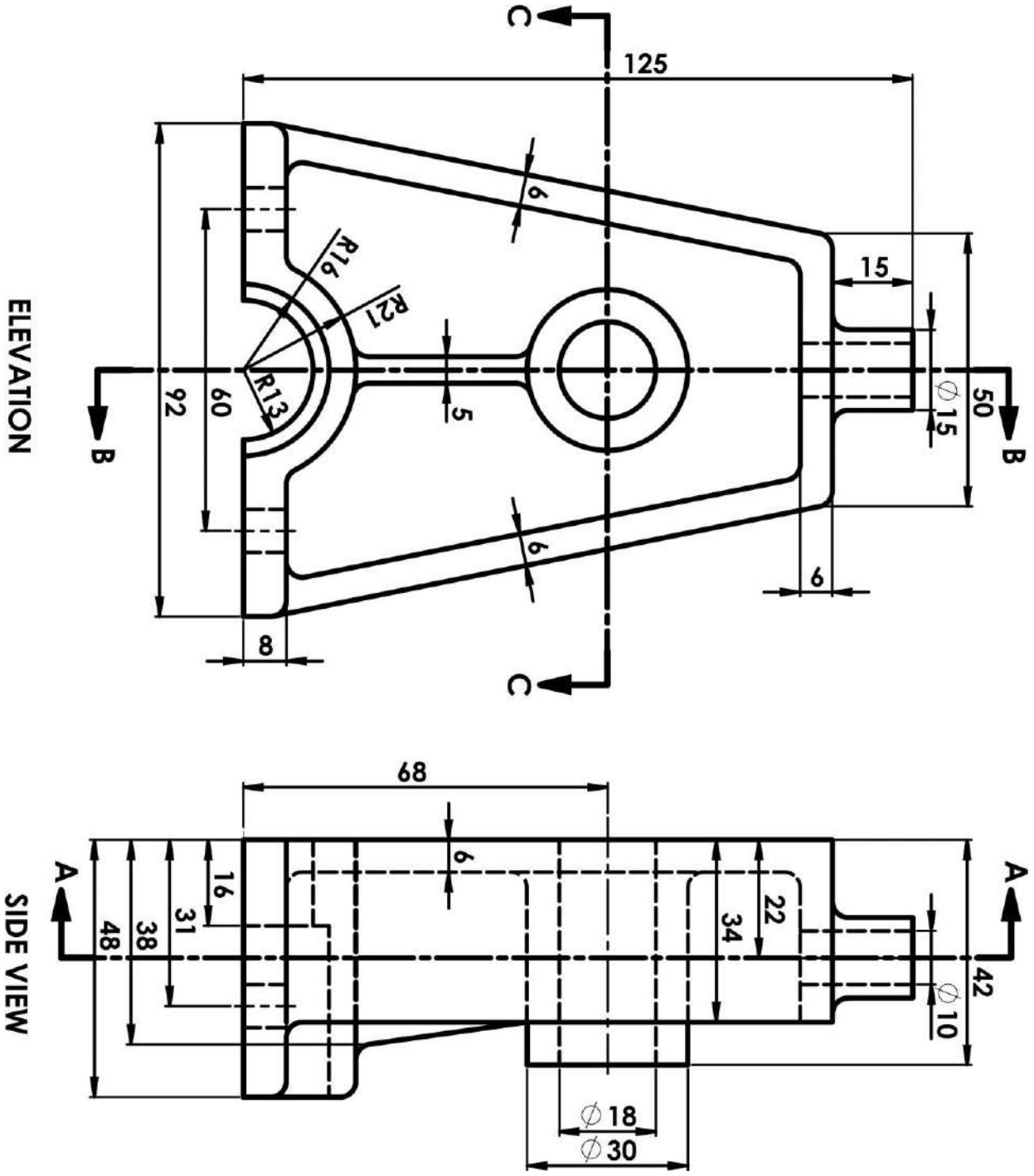

21
C
30
66
162
Fillets R5
ELEVATION
∅18
18
18
A
30
18
∅36
A
∅60
C
∅24
18
B
78
84
B
SIDE VIEW
30
54
8
84

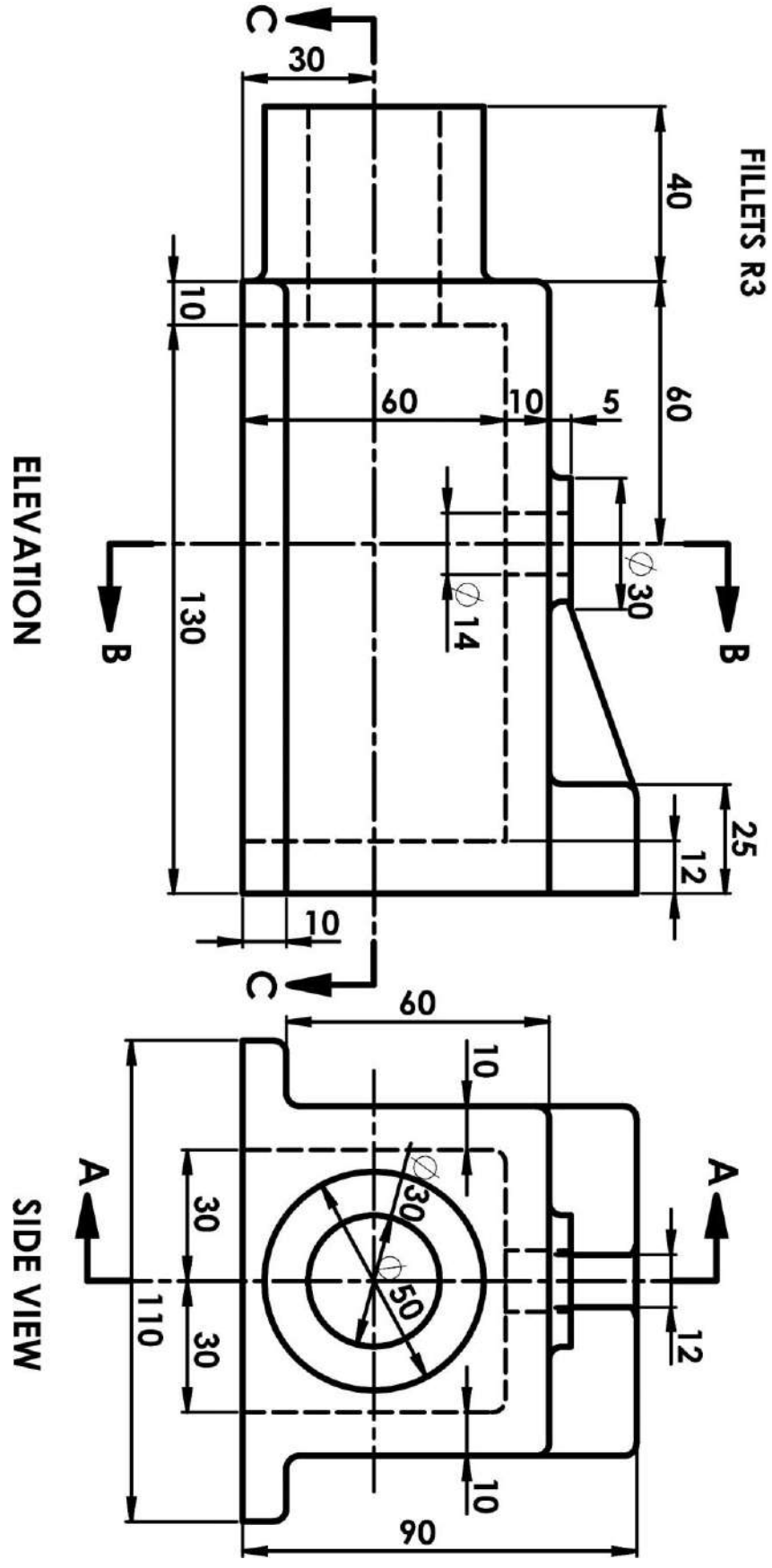

SIDE VIEW
166
75
48
32
A
A
96
58
58
84
R20
R29
26
108
M16
29
R4
29
32
C
44
ELEVATION
26
M16
16
R3
112
60
42
52
122
B
B
R4
60
110
48
C

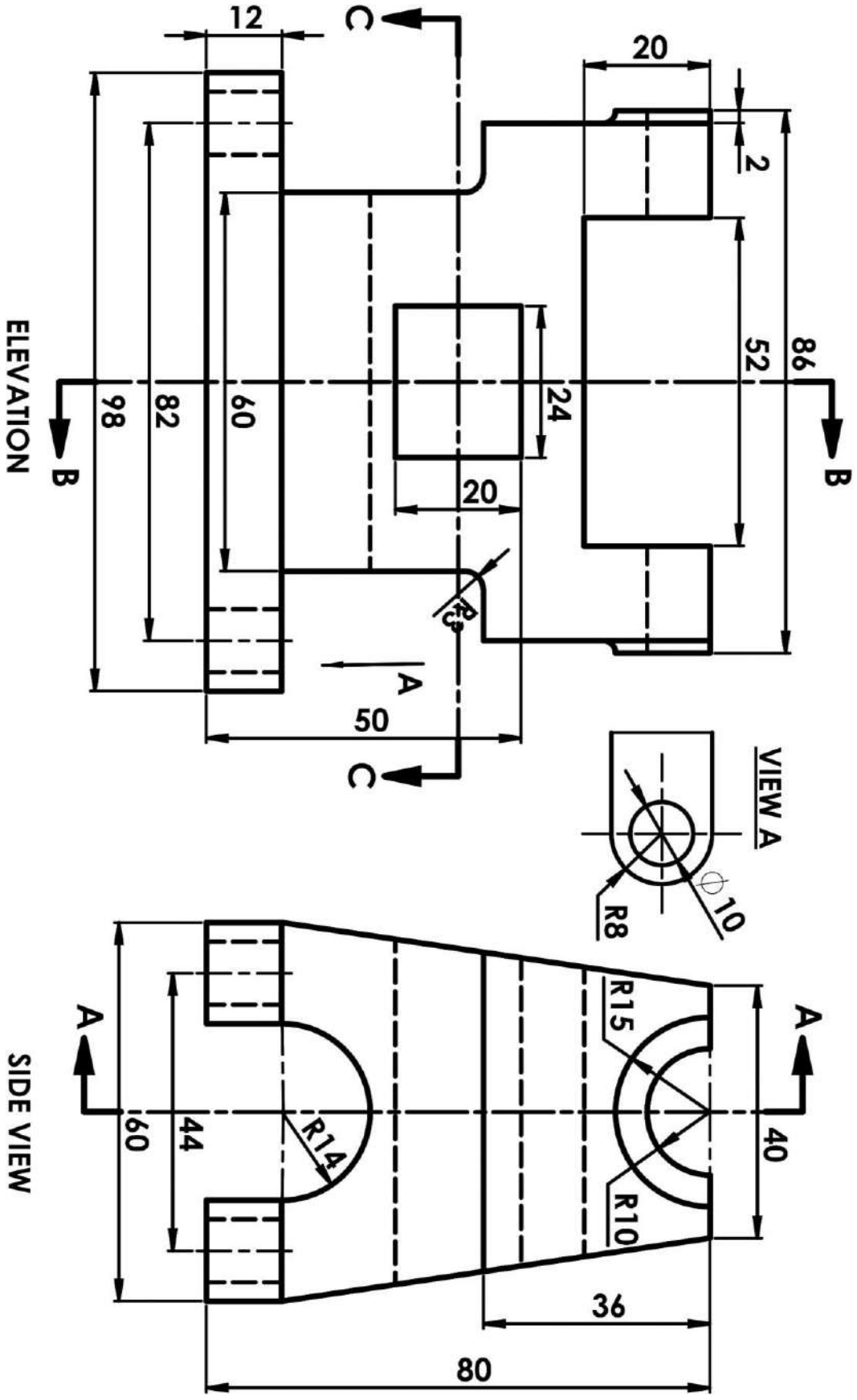

SIDE VIEW
B
B
∅ 50
3
6
6
50
6
∅ 38
∅ 70
∅ 70
ELEVATION
A
A
C
C
76
10
6
R10
∅ 37
∅ 25
R6
∅ 24
R32
6
∅ 37
∅ 25
10
76
115

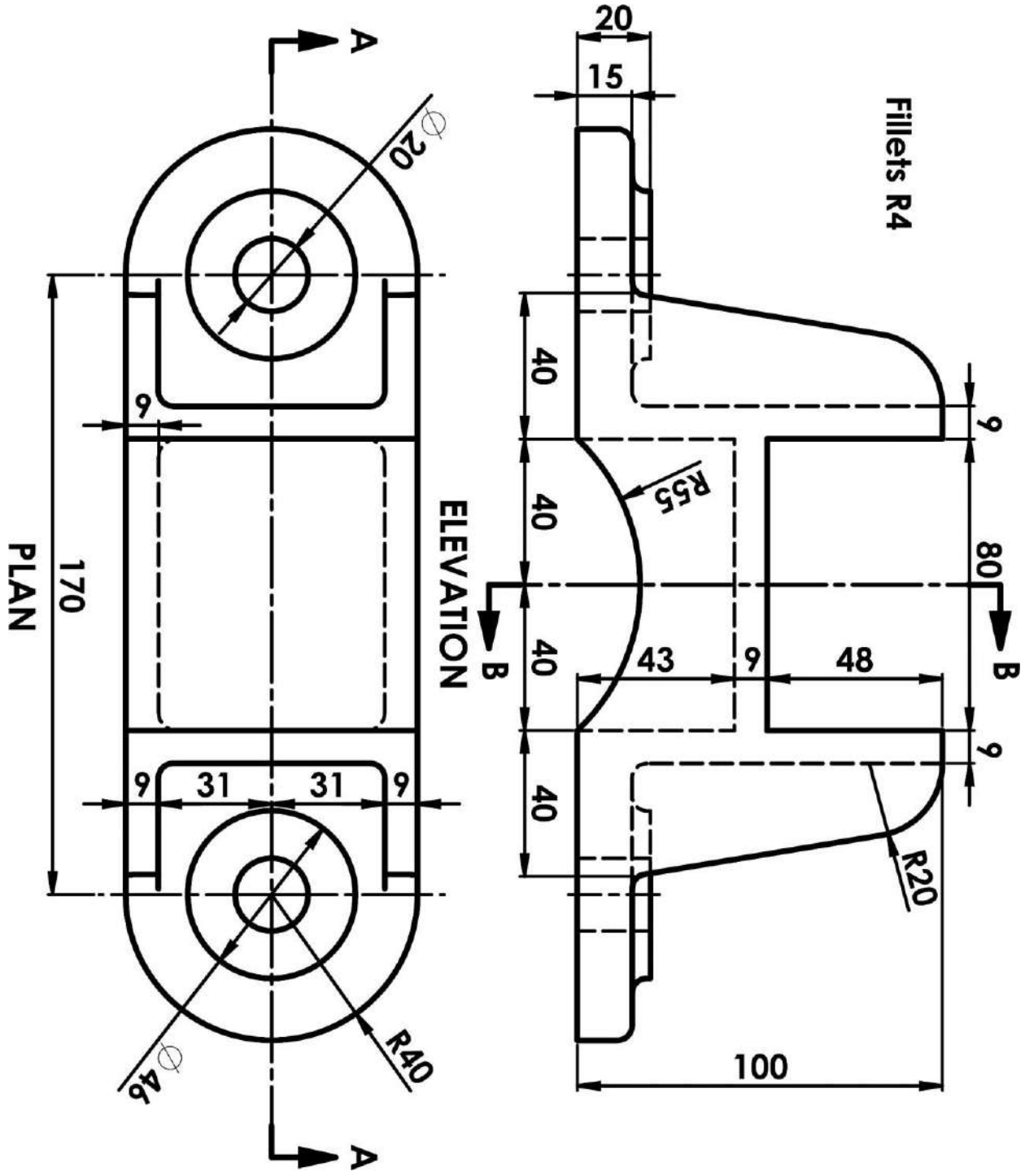

22
8
10R
M10
A
18
14
16
20
View A
6 holes 8 Dia
8
8
9
32
164
128
B
B
14 Dia
6
8
ELEVATION

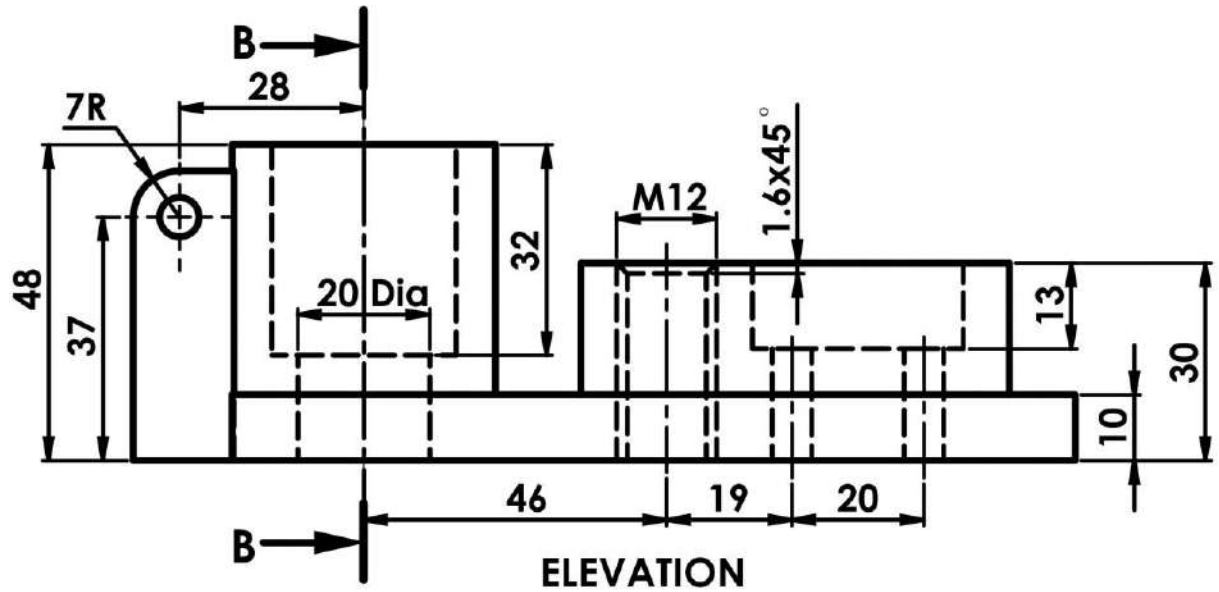

8
8
A
A
86
66
50
34
20
24 Dia
6
16
50
76
SIDE VIEW


ELEVATION
SIDE VIEW
C
C
B
B
A
A
125
6
R16
R27
R13
15
92
60
5
50
∅15
6
8
68
16
31
38
48
22
34
42
∅10
∅18
∅30

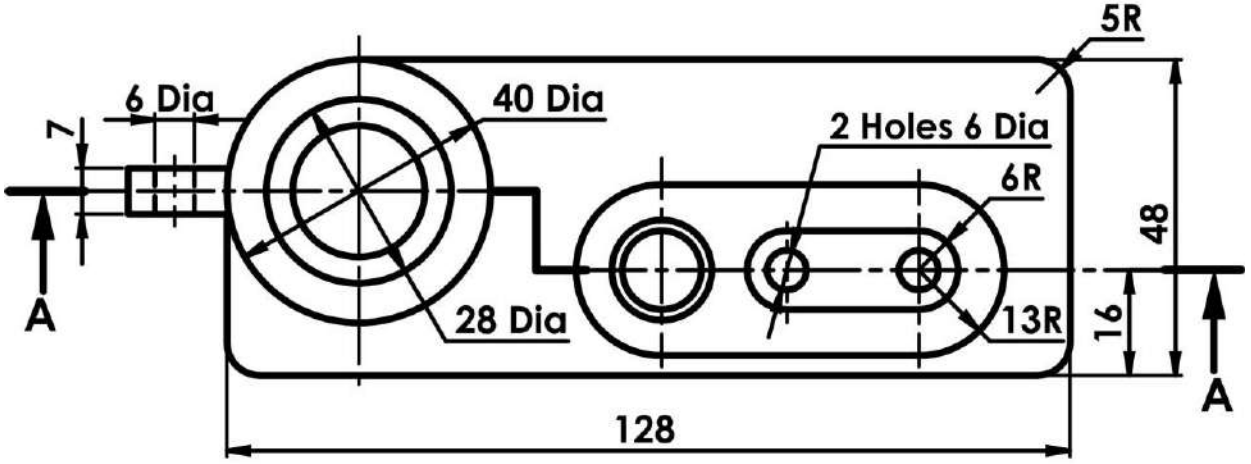

C
30
40
FILLETS R3
10
60
10
5
60
ELEVATION
B
130
∅14
∅30
B
25
12
10
C
60
10
A
30
∅30
∅50
A
SIDE VIEW
110
30
12
10
90


ELEVATION
12
C
20
2
86
52
98
82
60
24
B
B
20
R8
A
50
C
VIEW A
R8
10
SIDE VIEW
A
A
R15
60
44
R14
40
R10
36
80

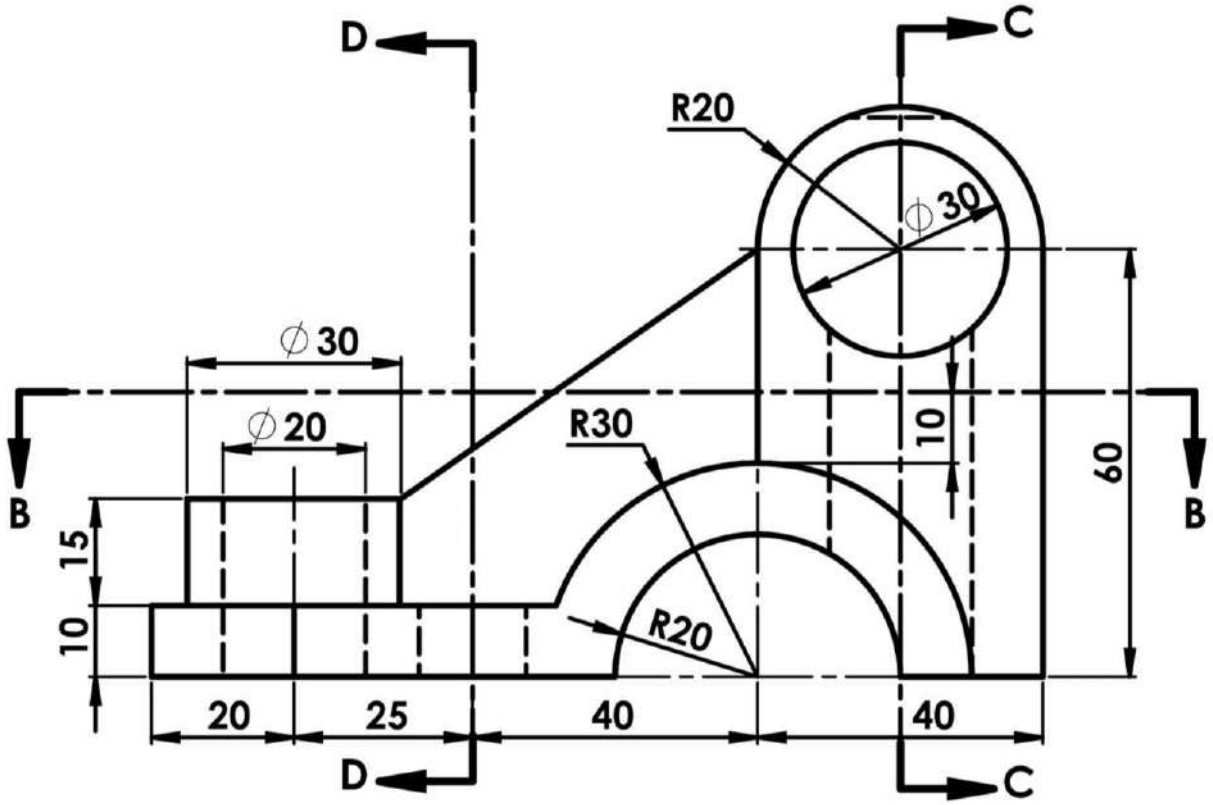

PLAN
ELEVATION
A
A
B
B
20
15
Fillets R4
40
40
40
40
9
9
9
9
31
31
170
80
R55
43
48
R20
100
20
46
R40



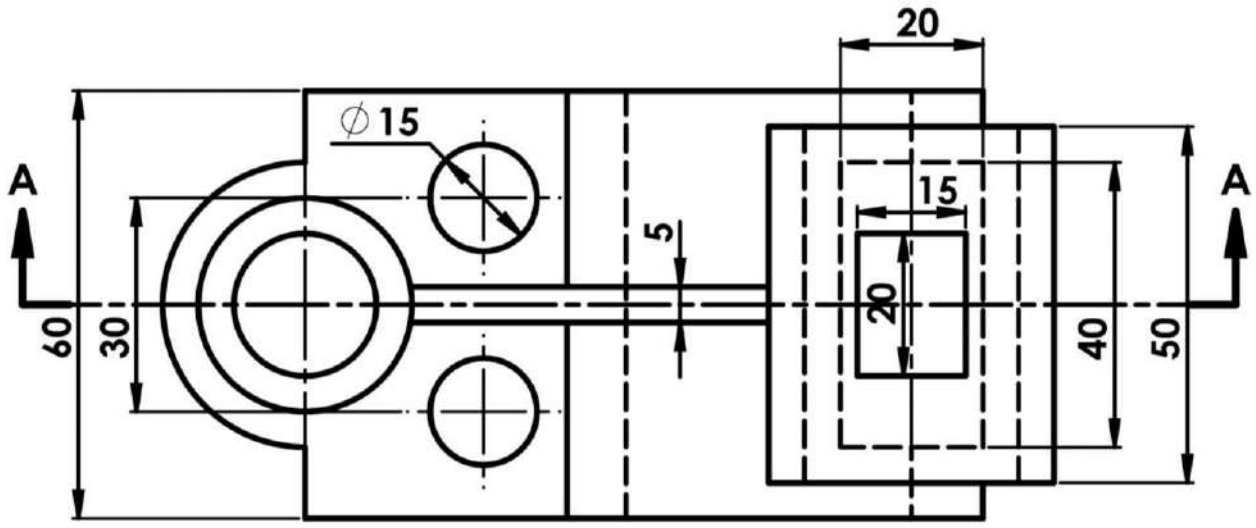
ELEVATION



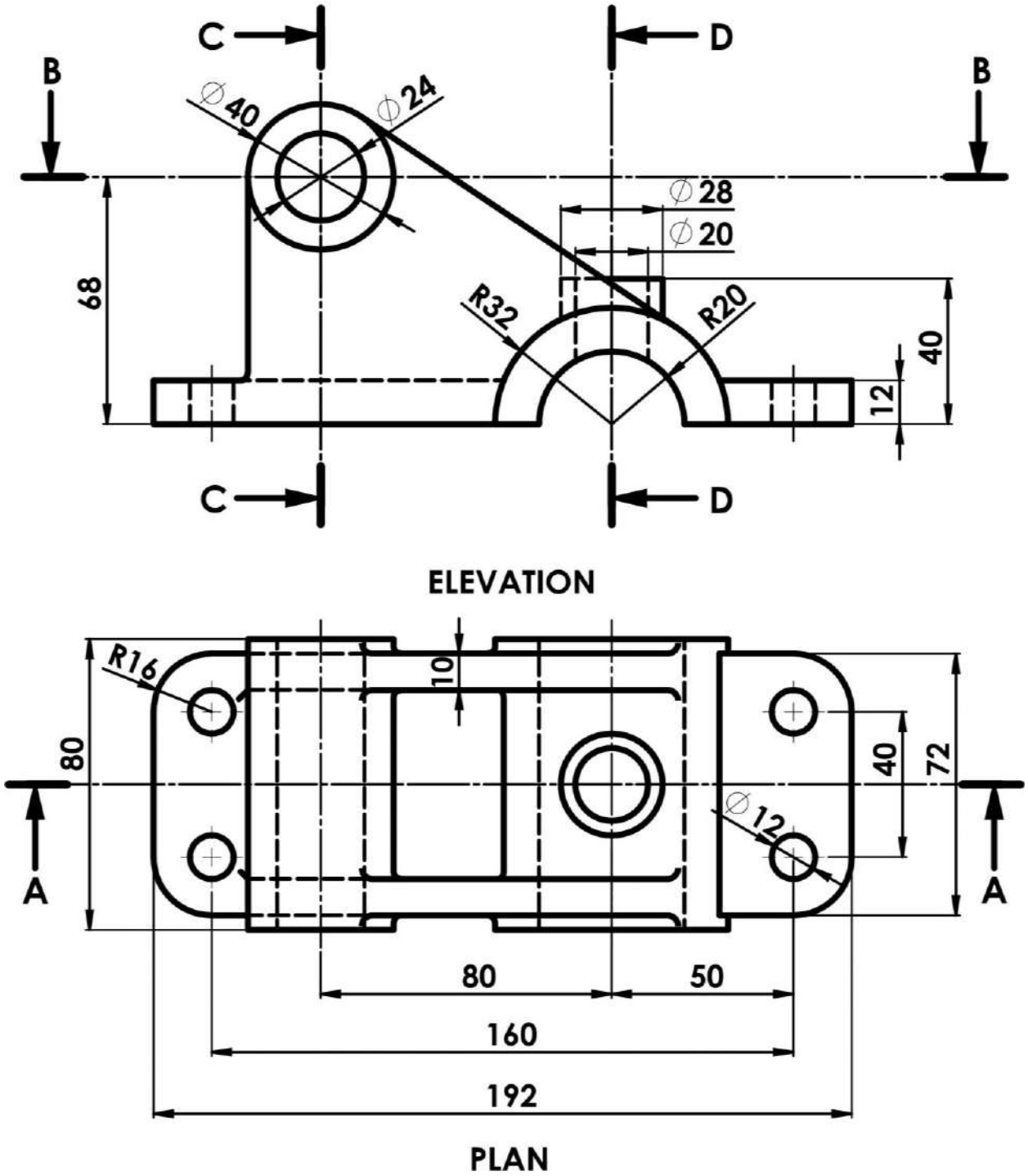
PLAN

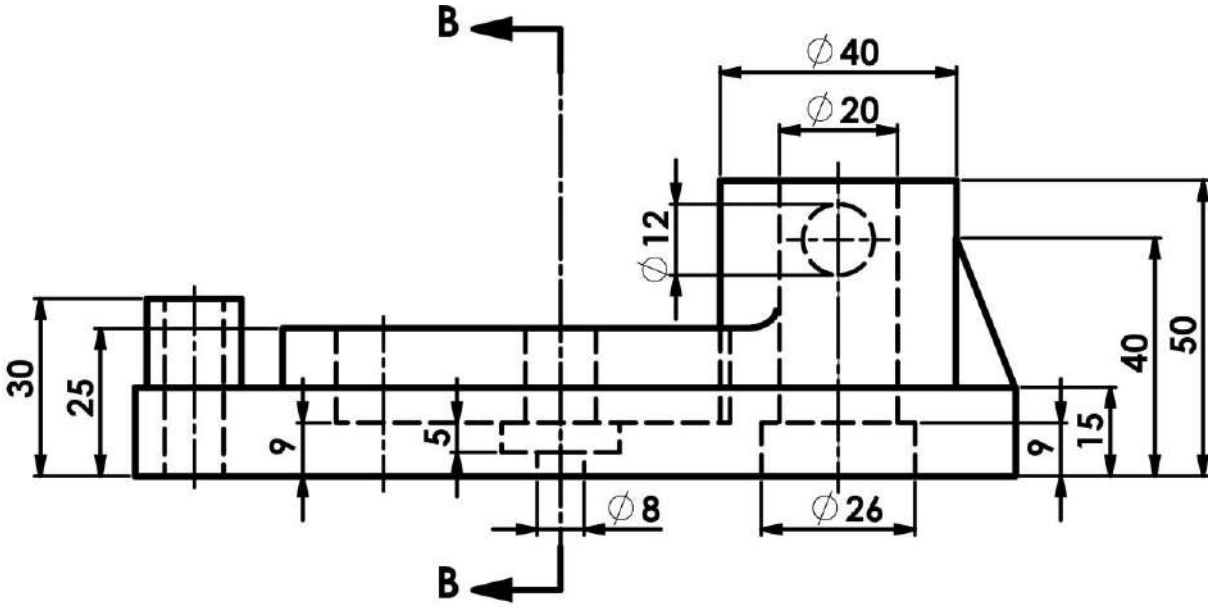


ELEVATION

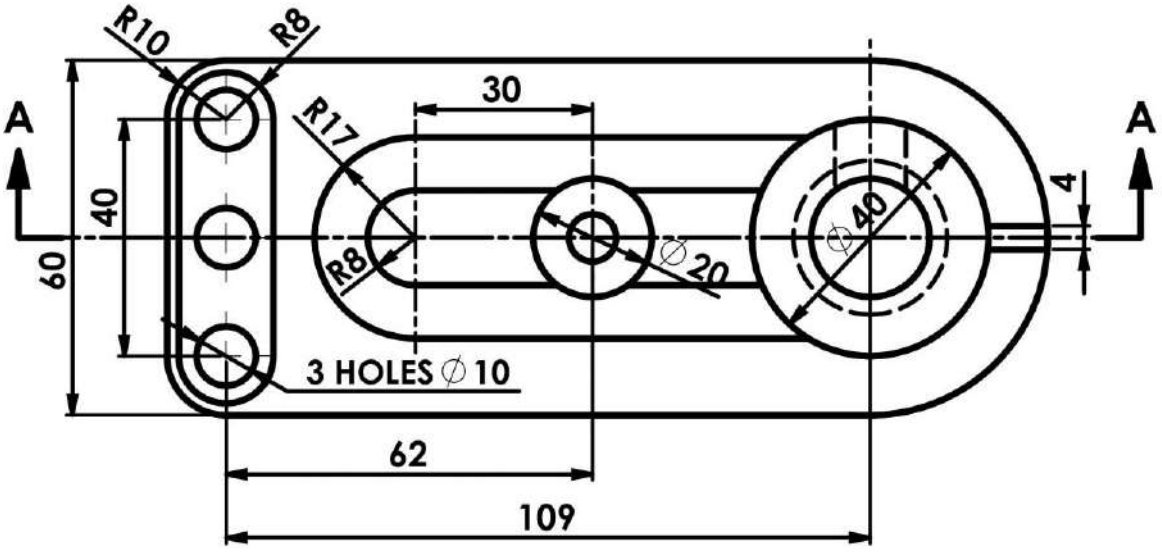


PLAN

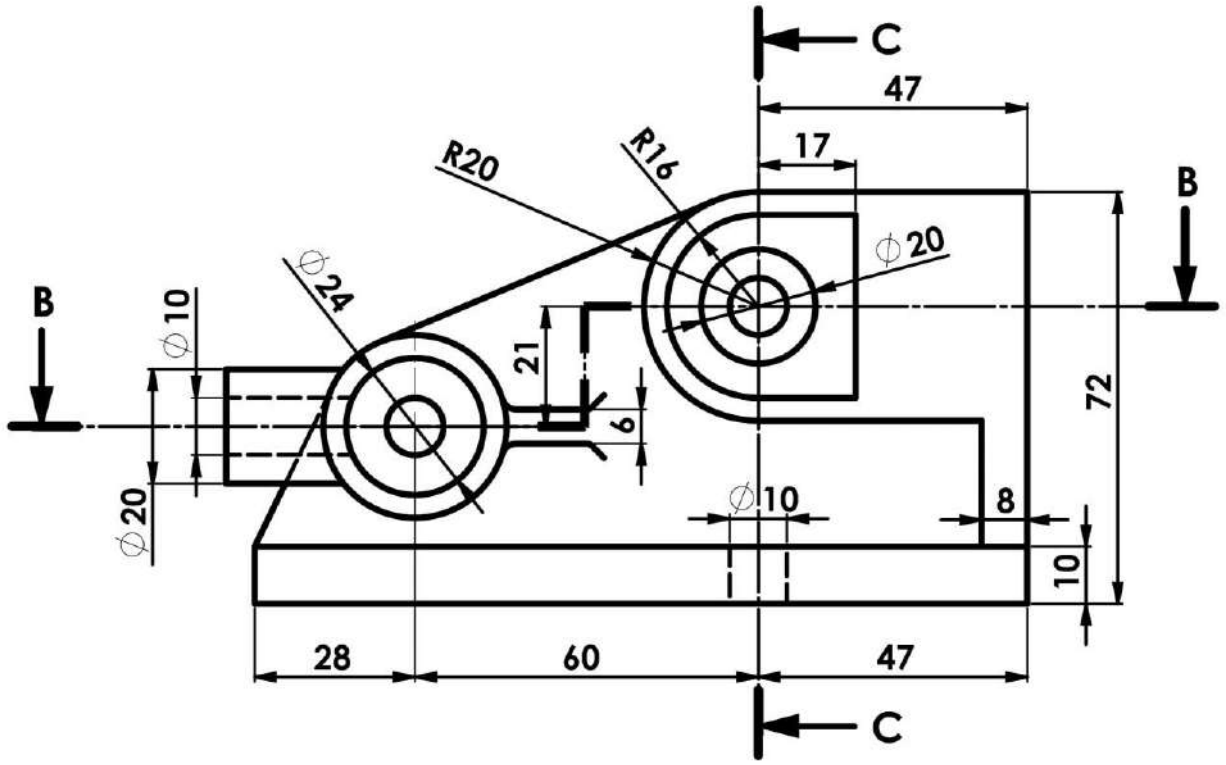

C
D
B
B
∅40
∅24
∅28
∅20
68
R32
R20
40
12
C
D
ELEVATION
R16
10
80
40
72
∅12
A
A
80
50
160
192
PLAN



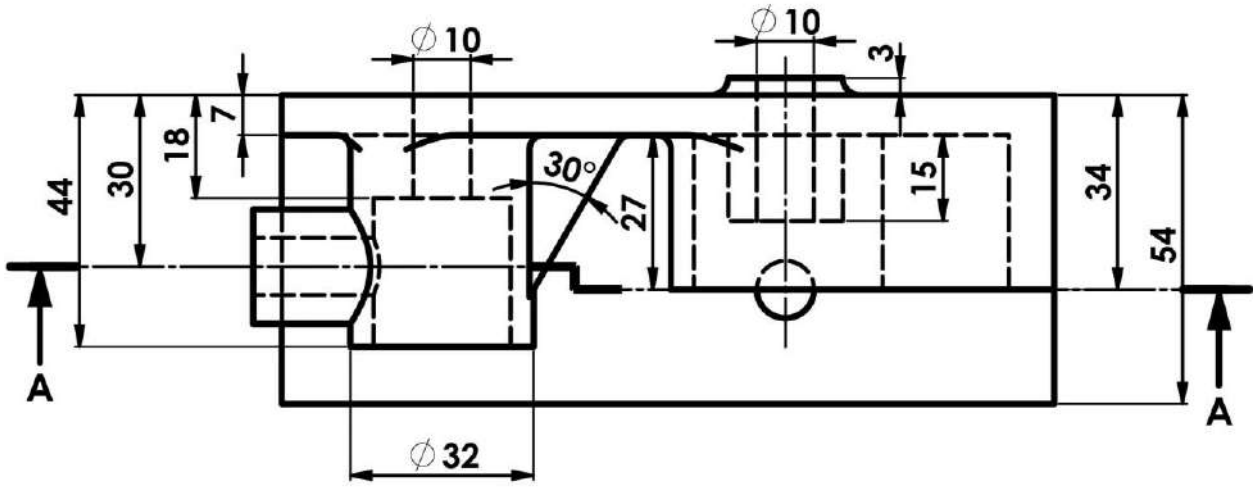
ELEVATION



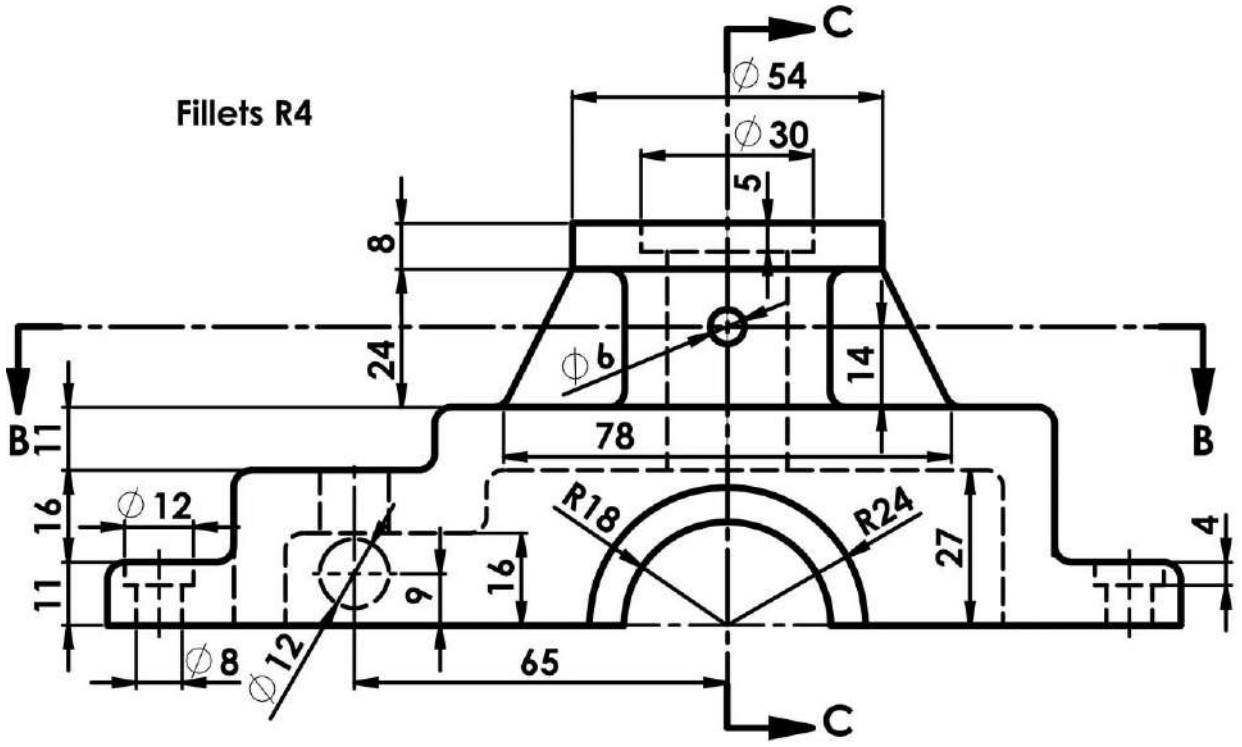
PLAN



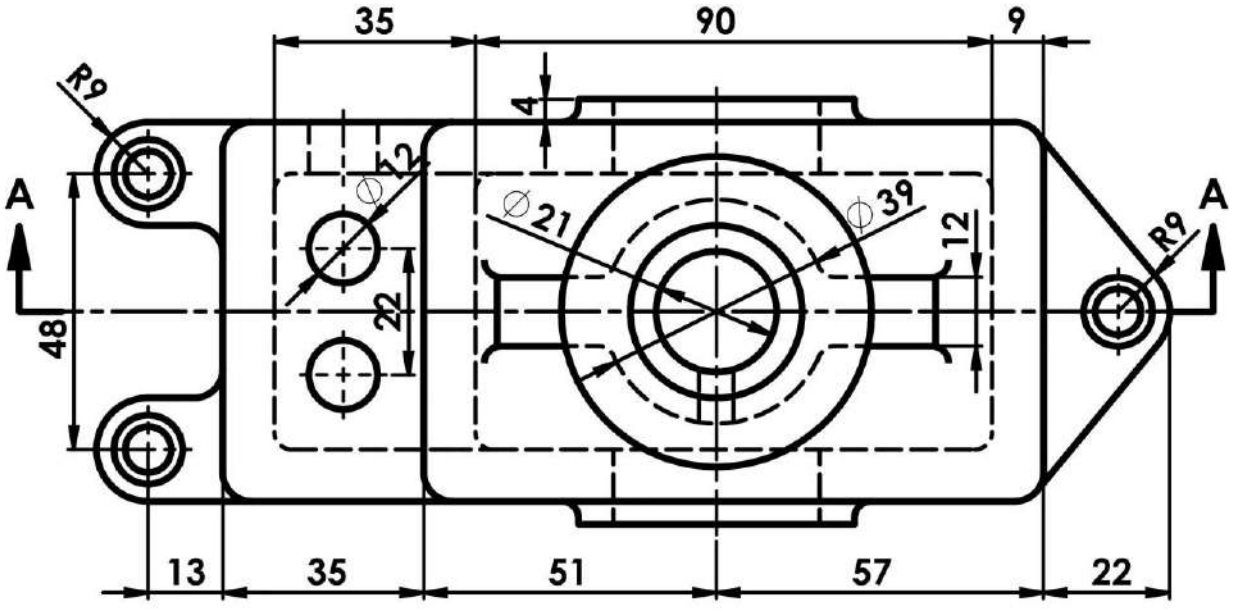
ELEVATION



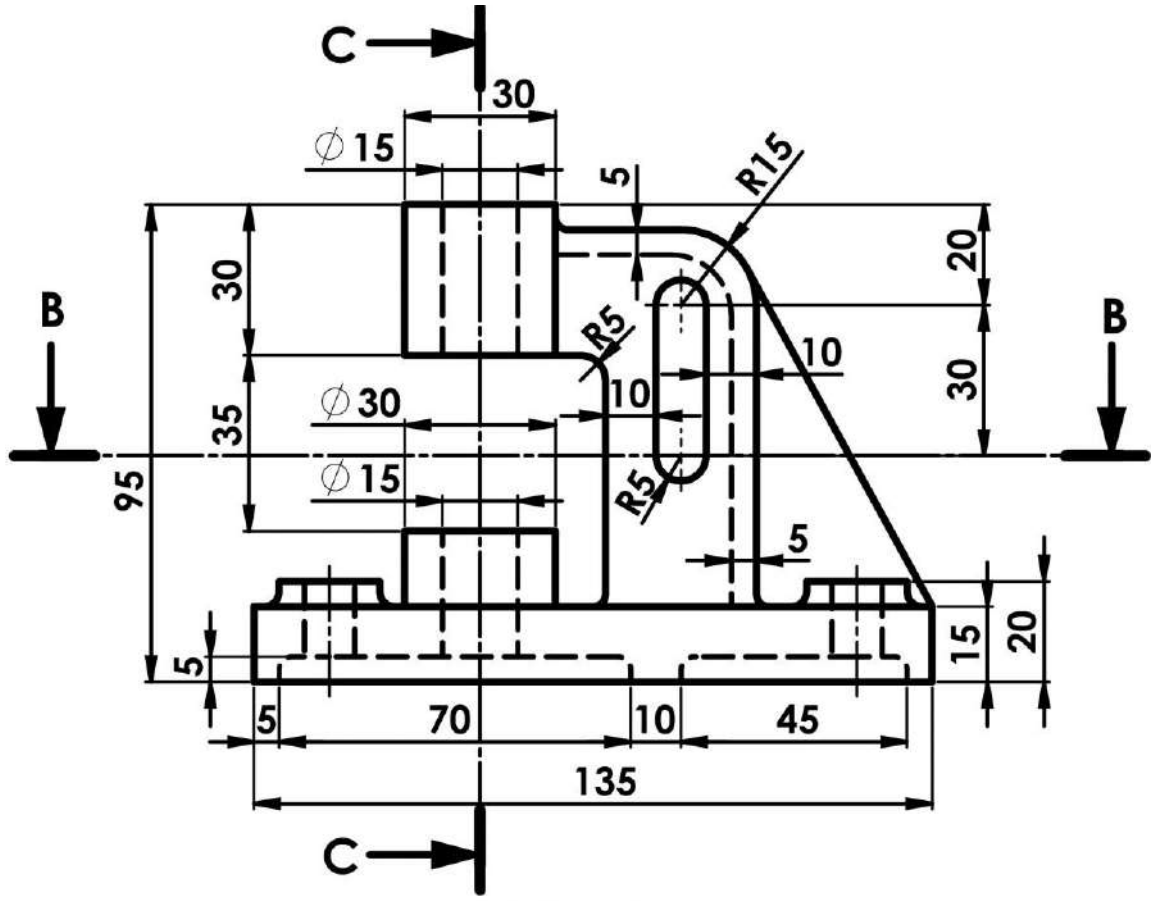
PLAN



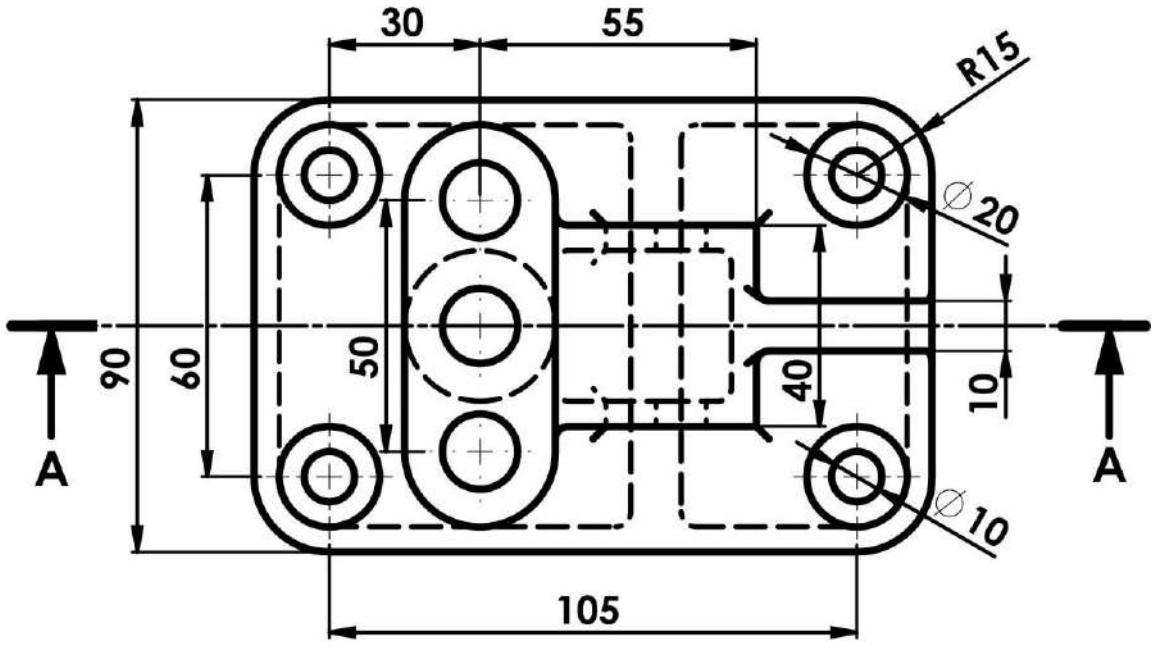
ELEVATION



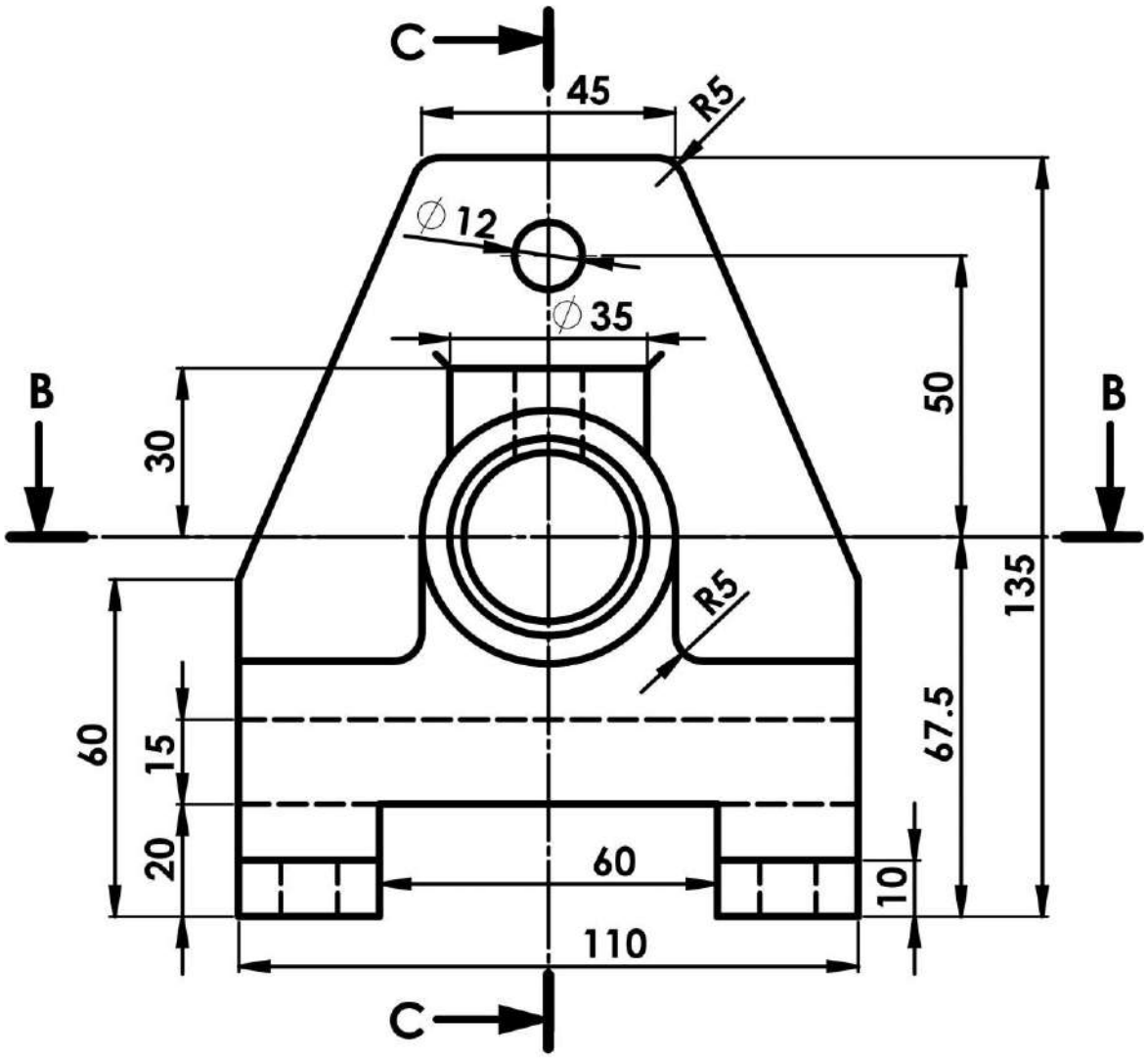
PLAN



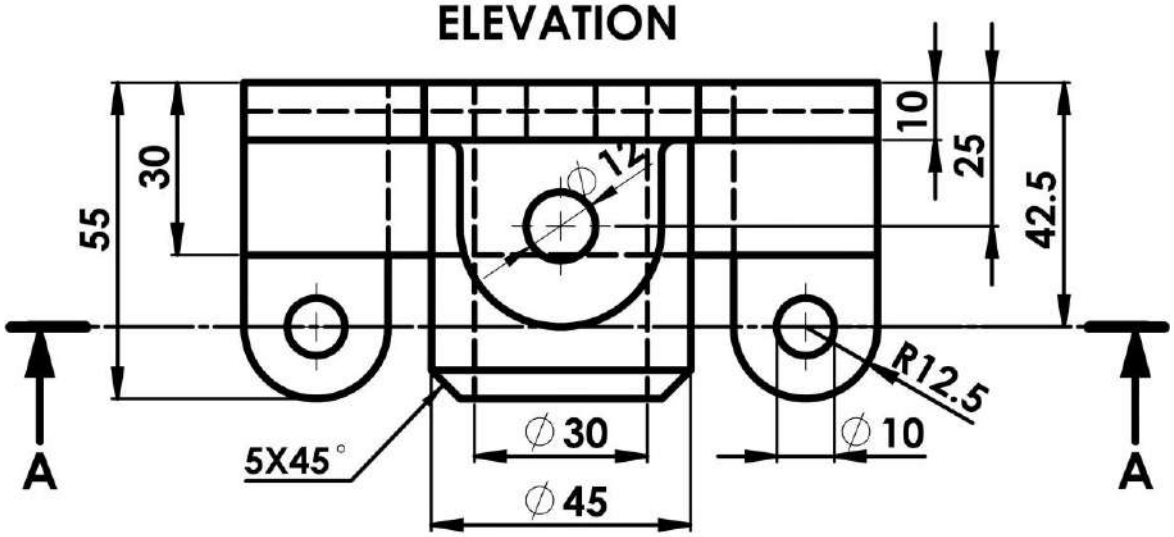
ELEVATION



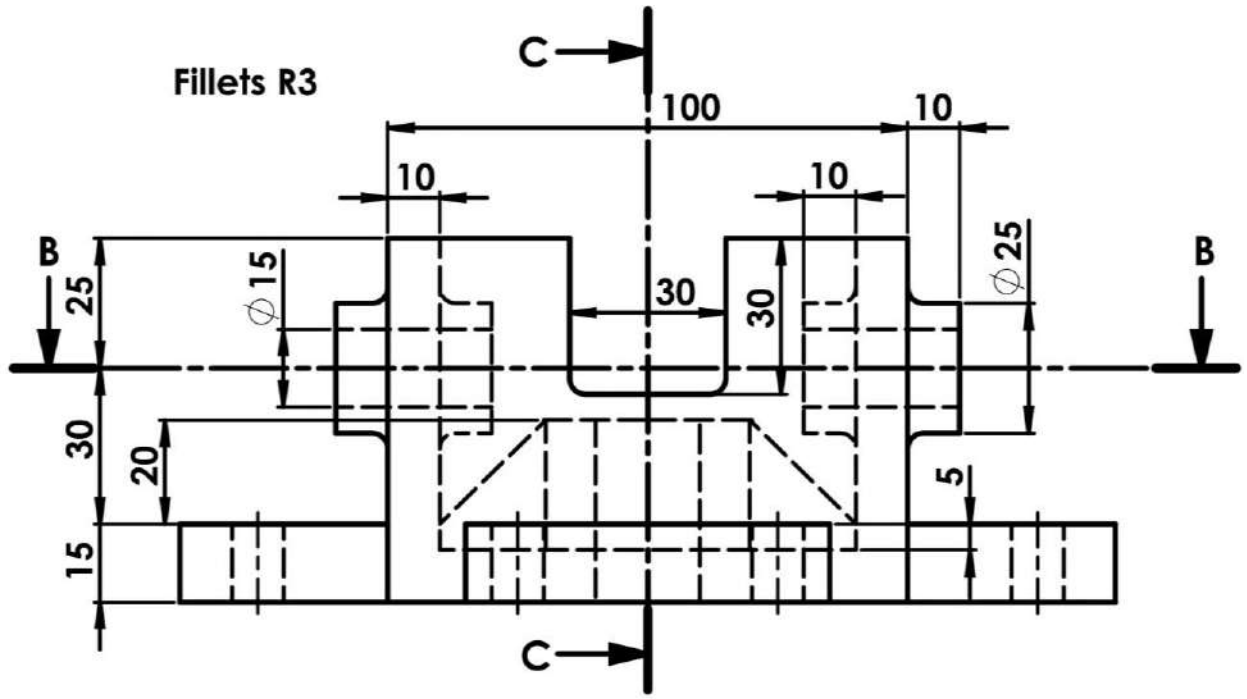
PLAN



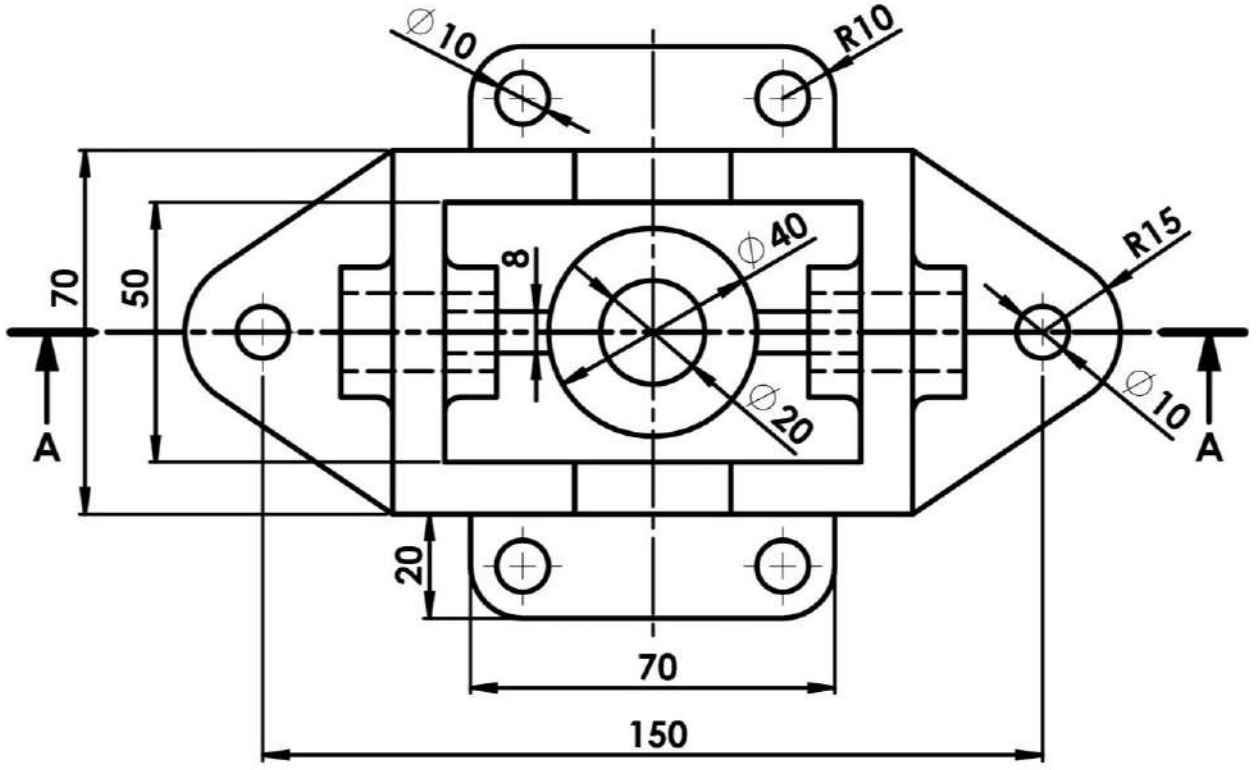
ELEVATION



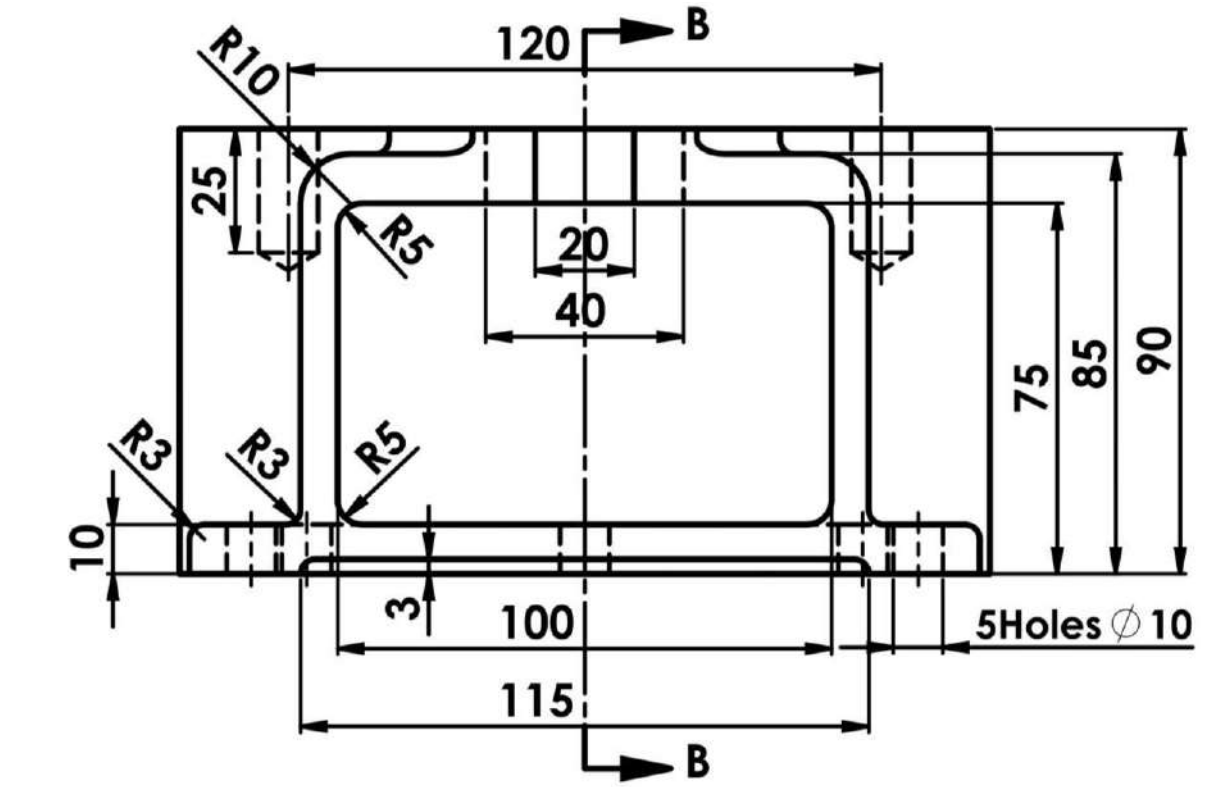
PLAN



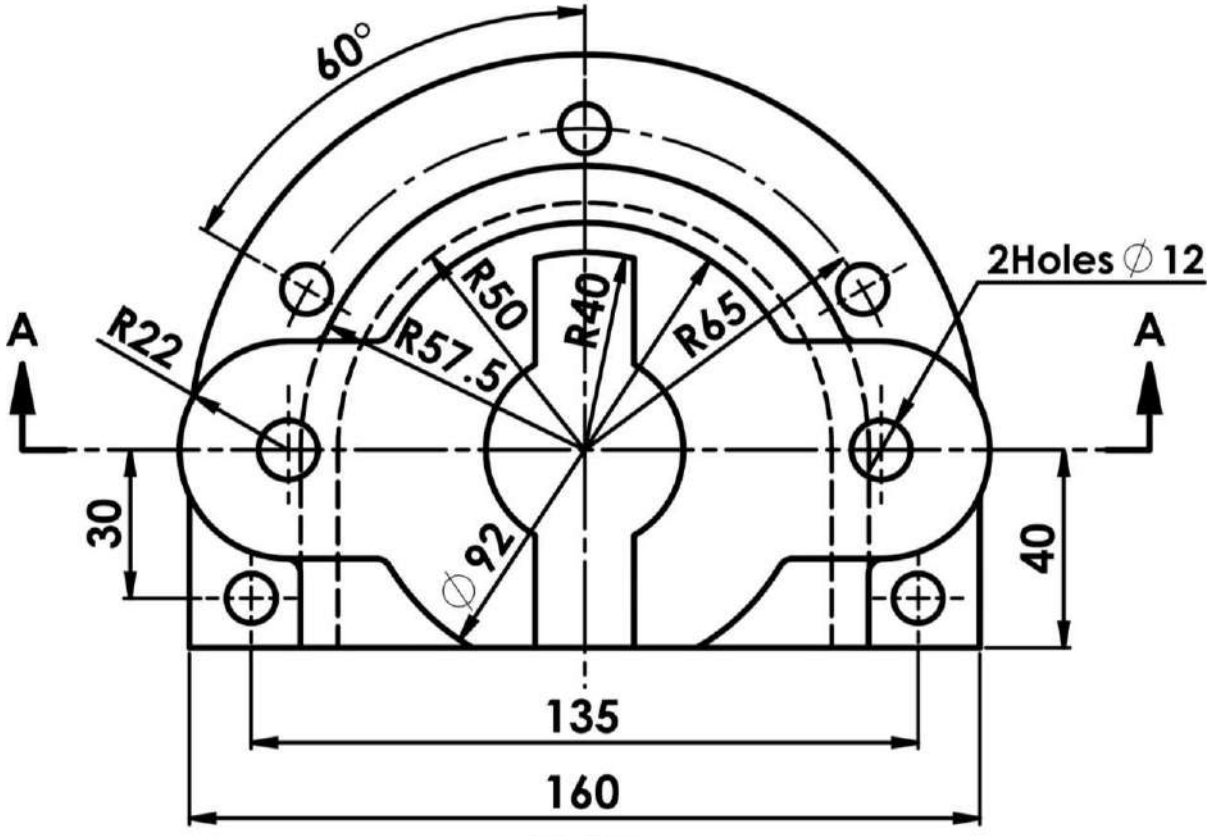
ELEVATION



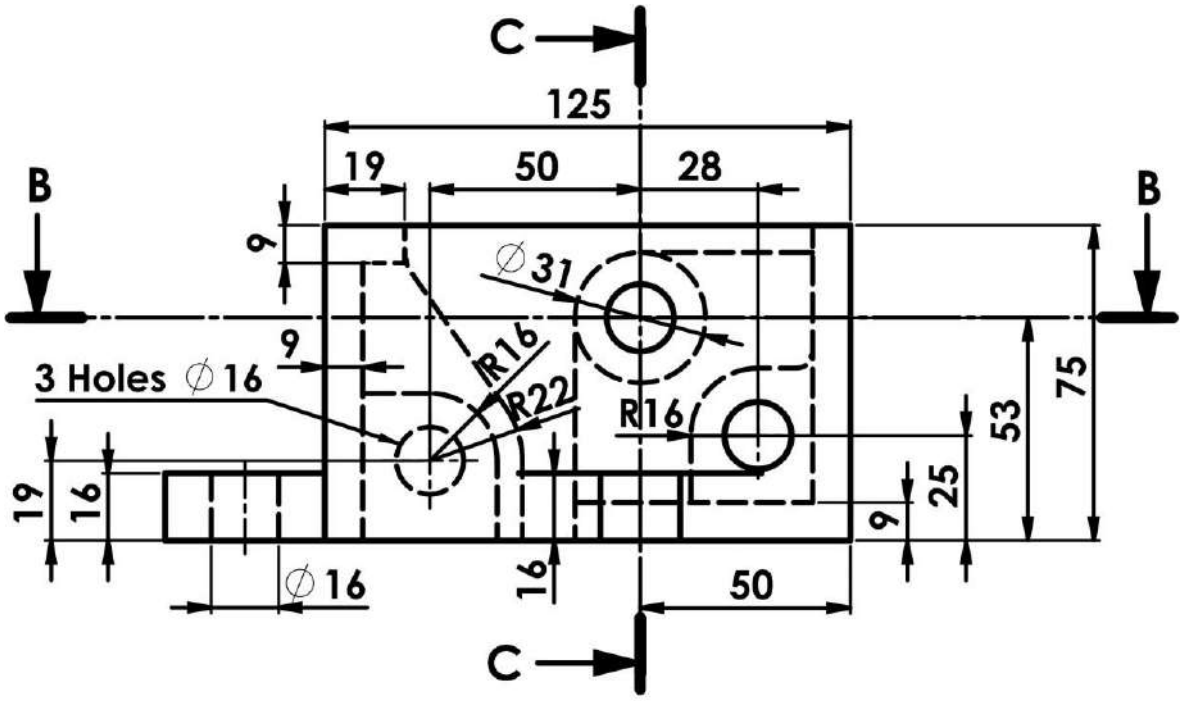
PLAN



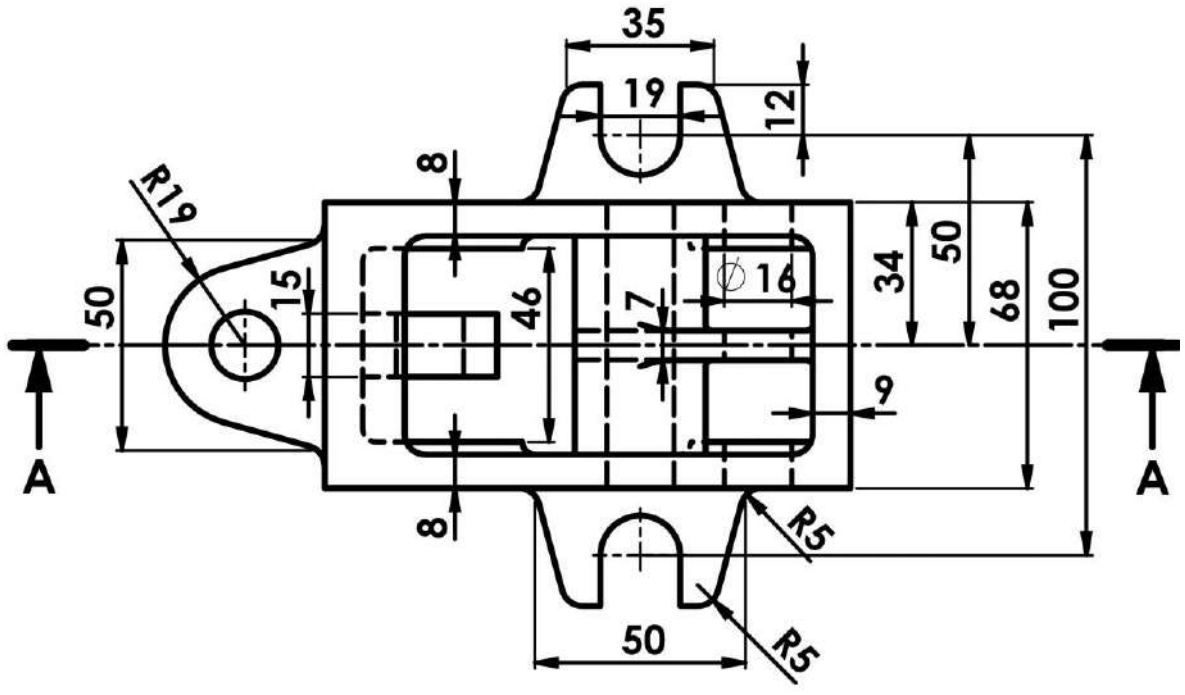
ELEVATION



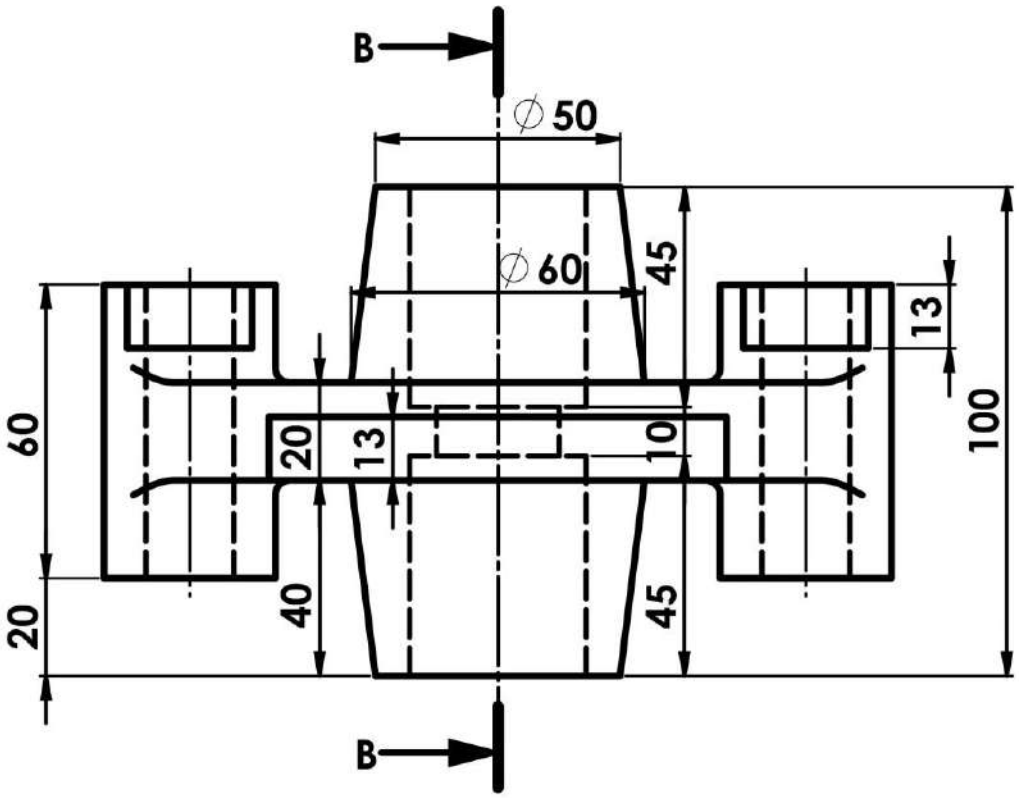
PLAN



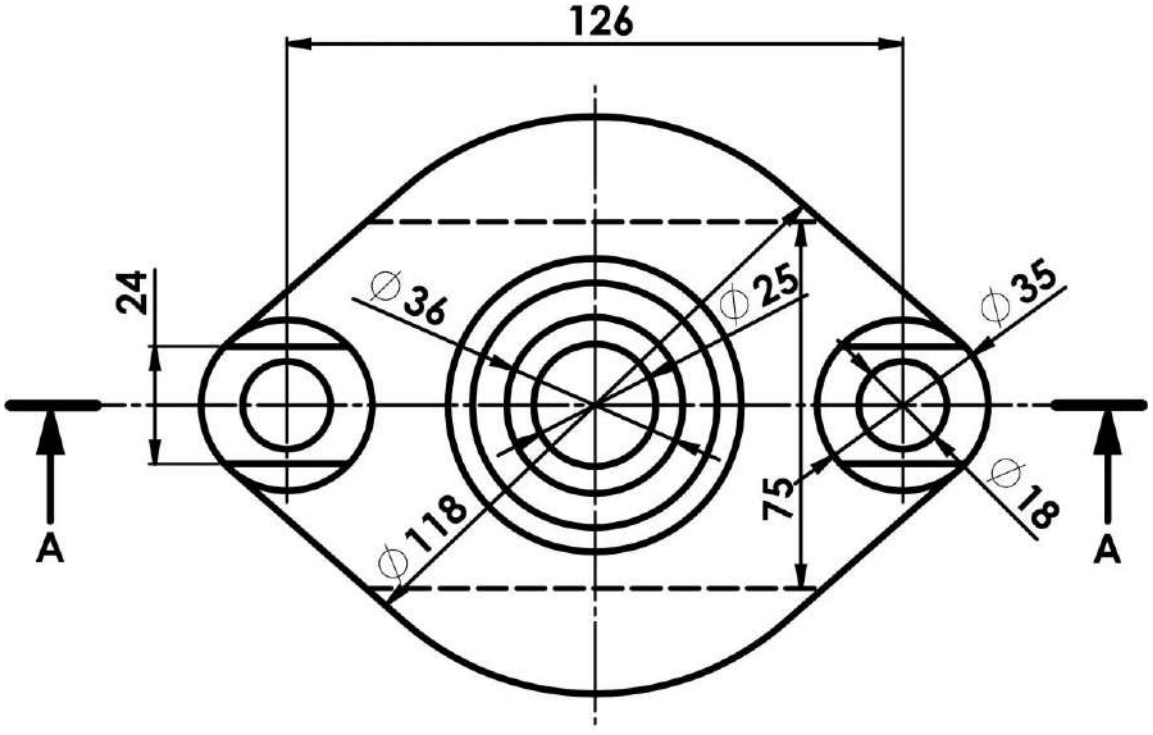
ELEVATION



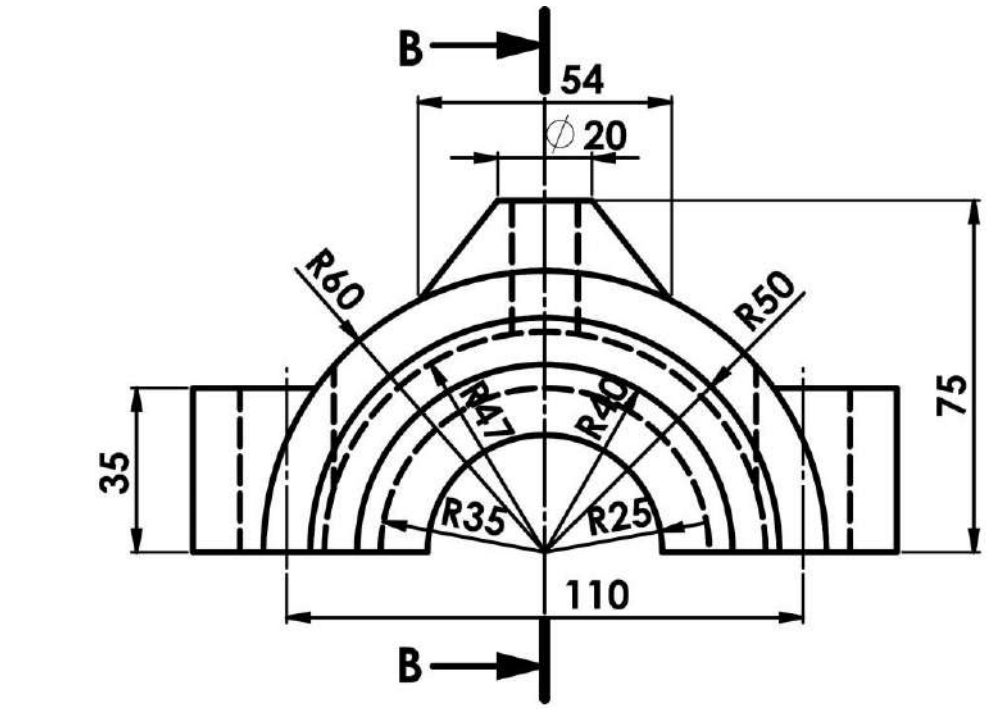
PLAN



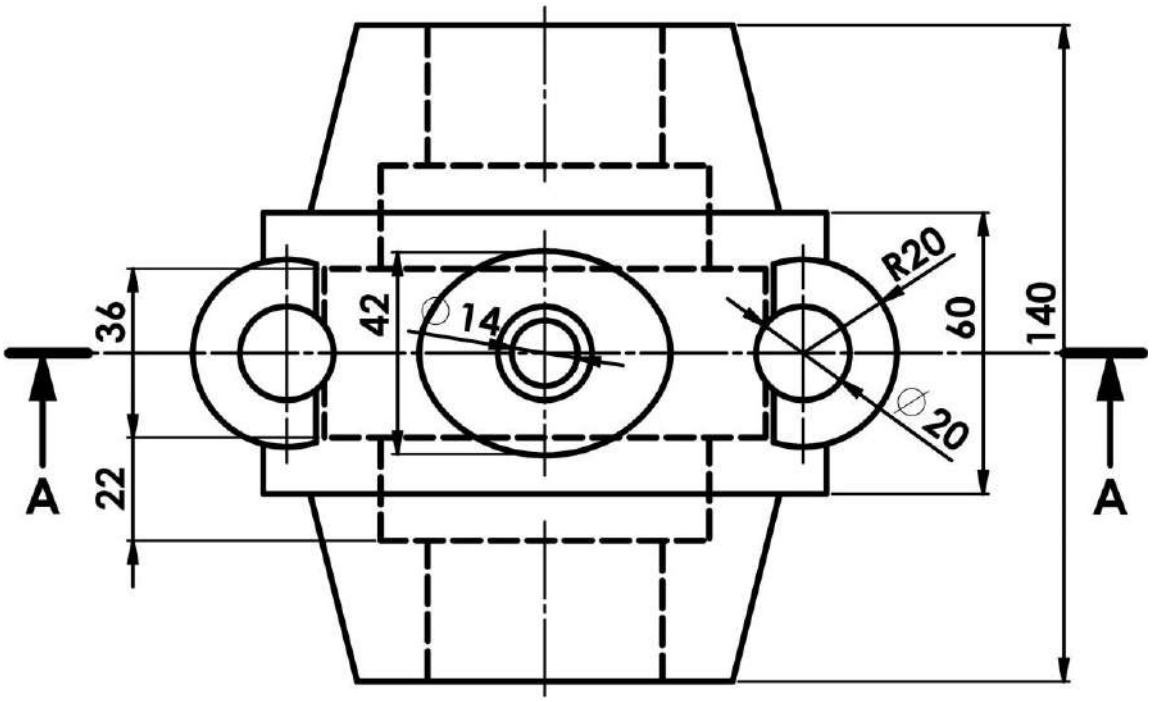
ELEVATION



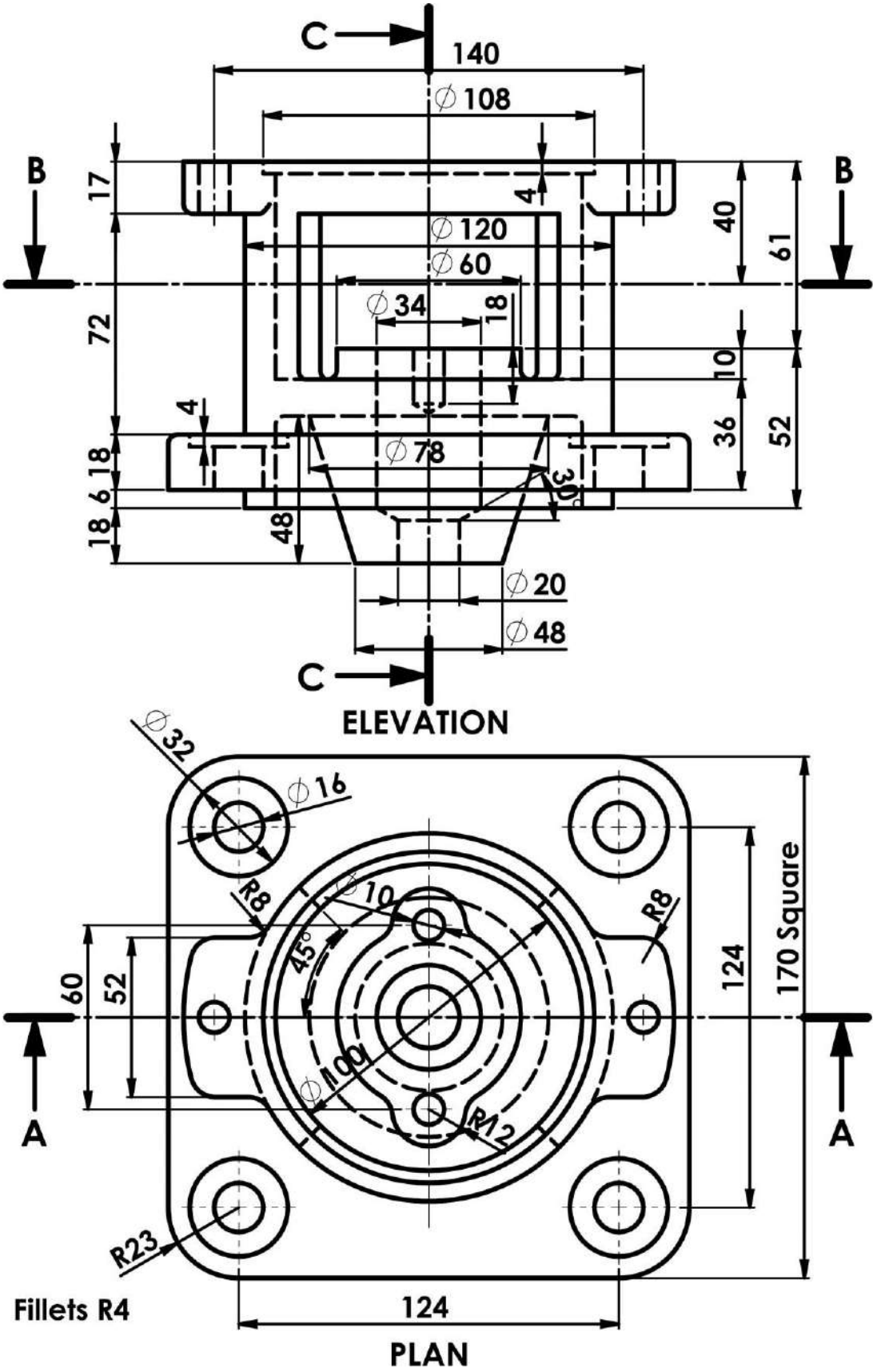
PLAN

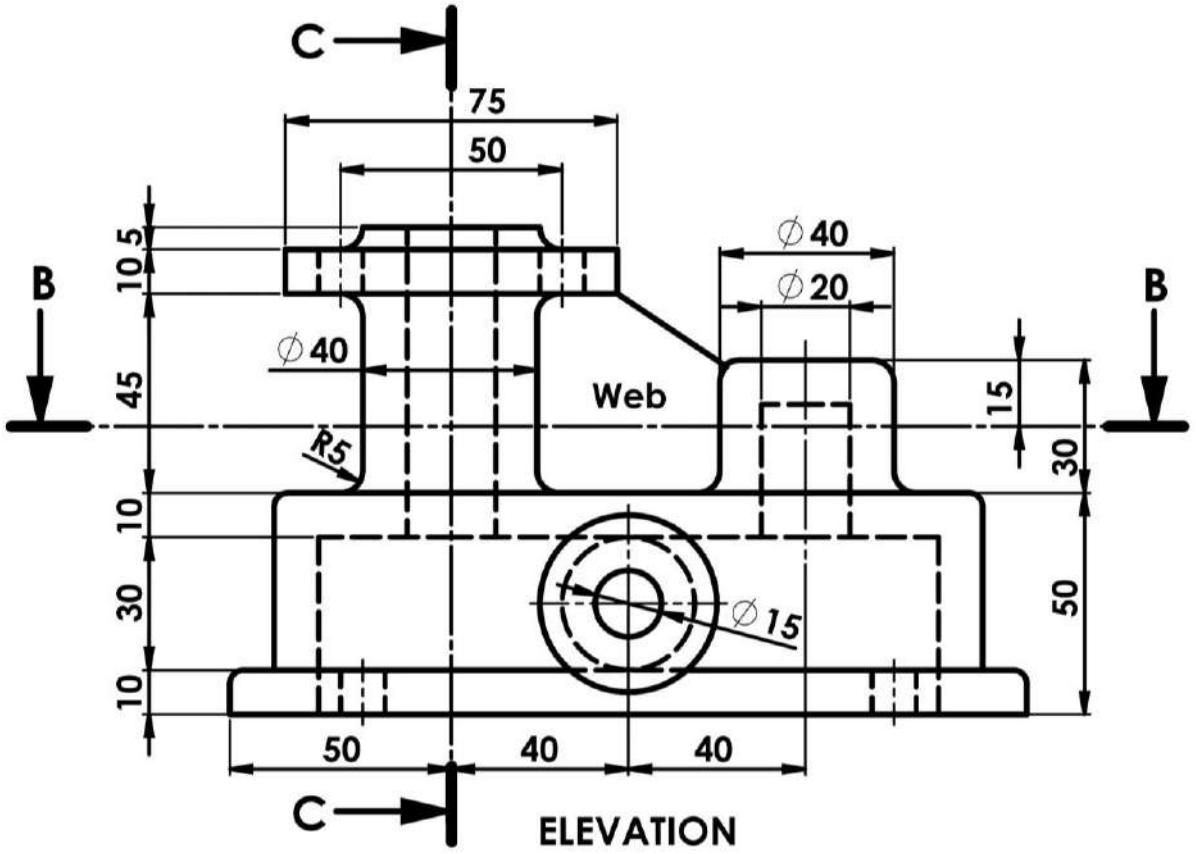


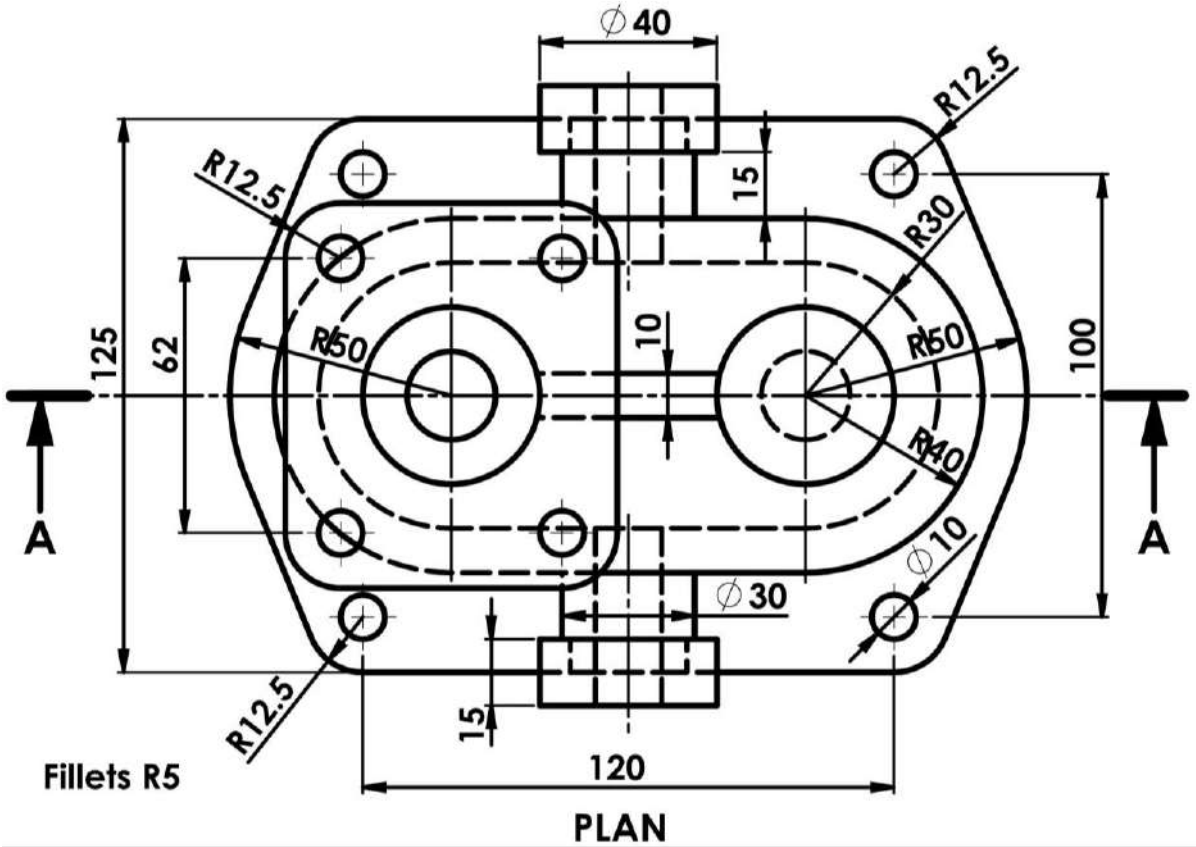
ELEVATION

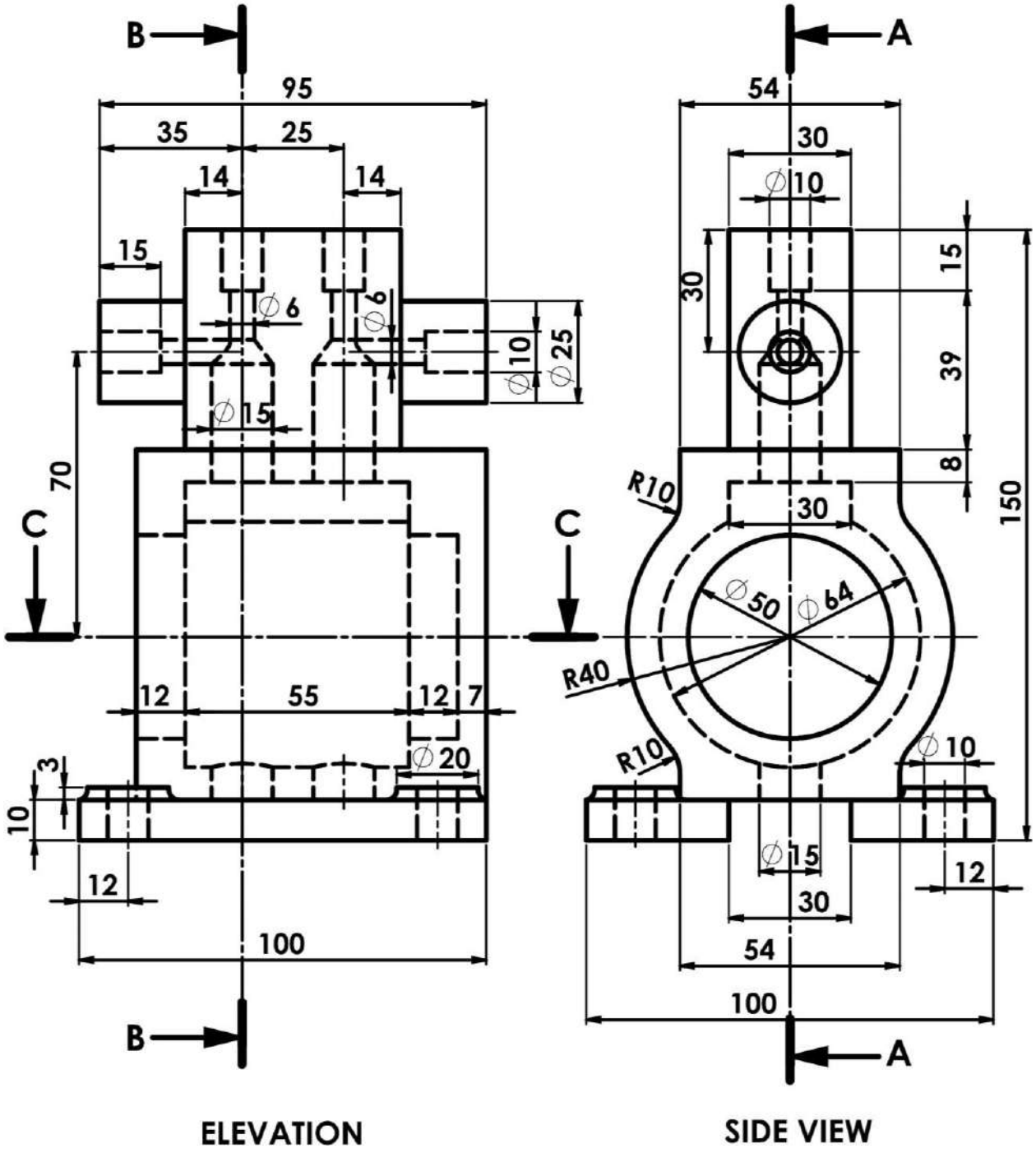


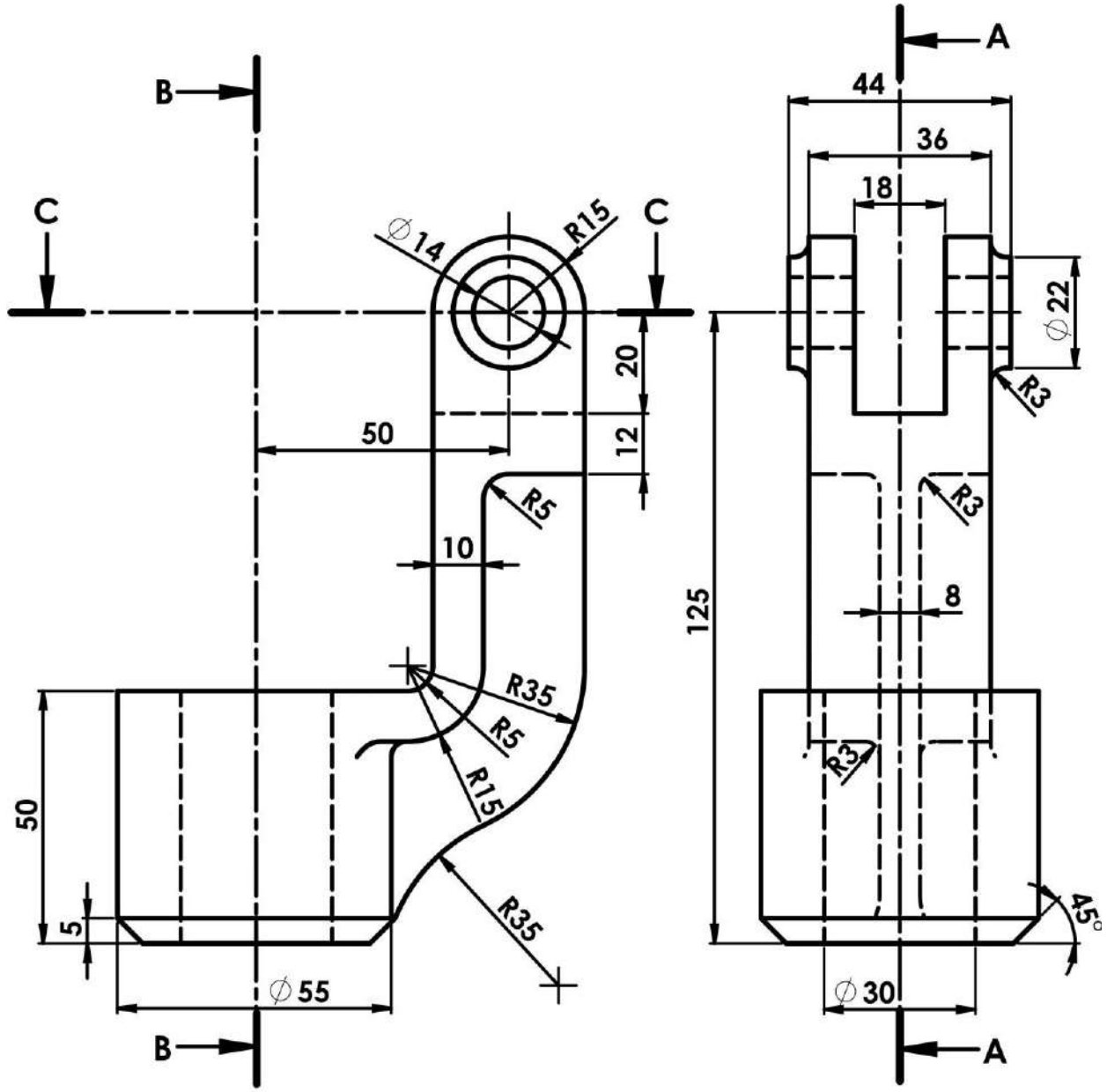
PLAN

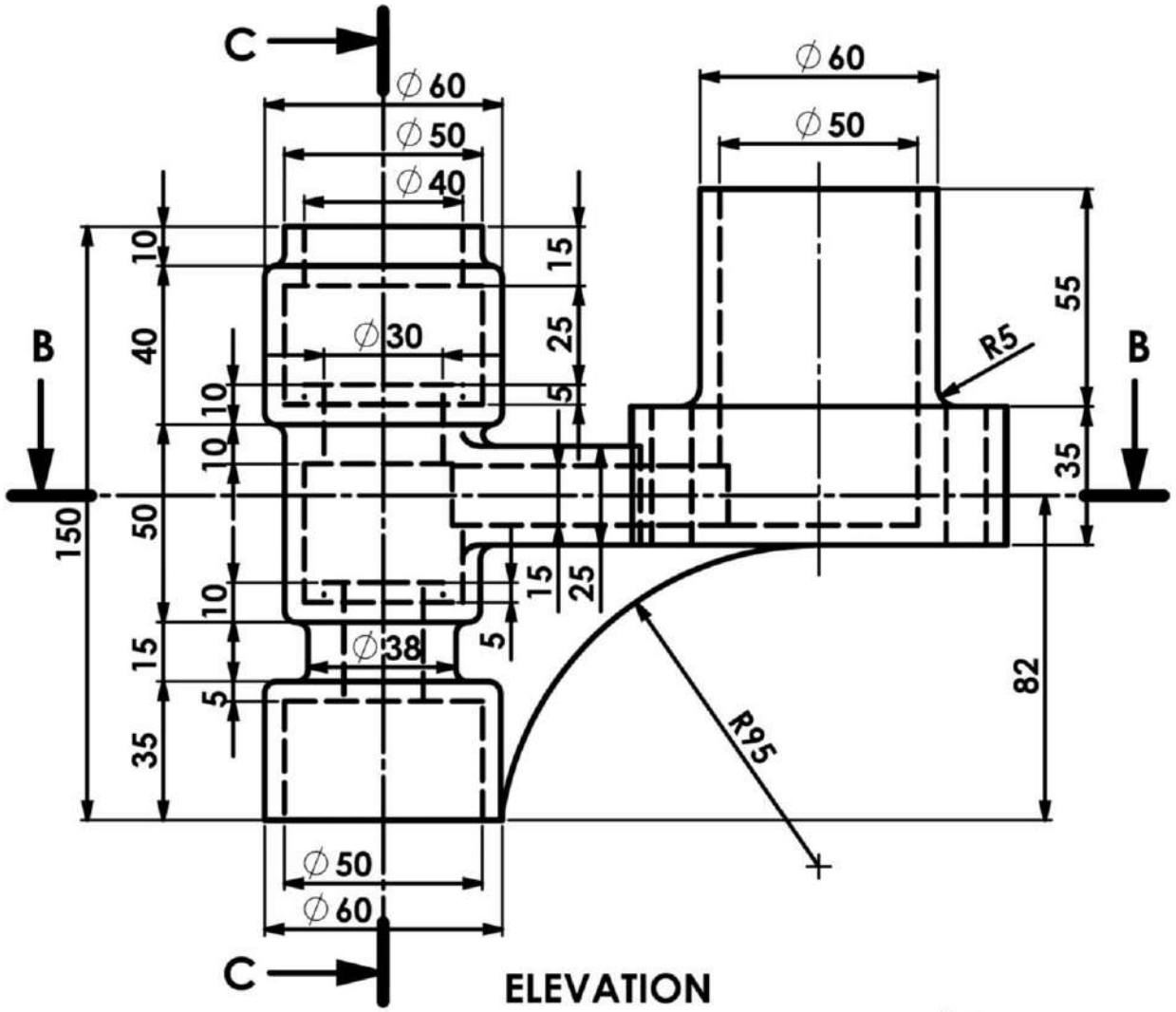

C
140
∅108
B
17
4
40
61
B
∅120
∅60
∅34
18
72
10
4
36
52
∅78
30°
18
6
18
48
∅20
∅48
C
ELEVATION
∅32
∅16
R8
∅10
R8
45°
60
52
124
170 Square
∅100
R12
A
A
R23
Fillets R4
124
PLAN


C
75
50
10.5
45
10
30
10
B
B
∅40
∅20
∅40
Web
15
30
50
R5
∅15
50
40
40
C
ELEVATION


∅40
R12.5
R12.5
15
R30
125
62
R50
10
R50
100
R40
A
A
∅10
∅30
R12.5
15
120
Fillets R5
PLAN

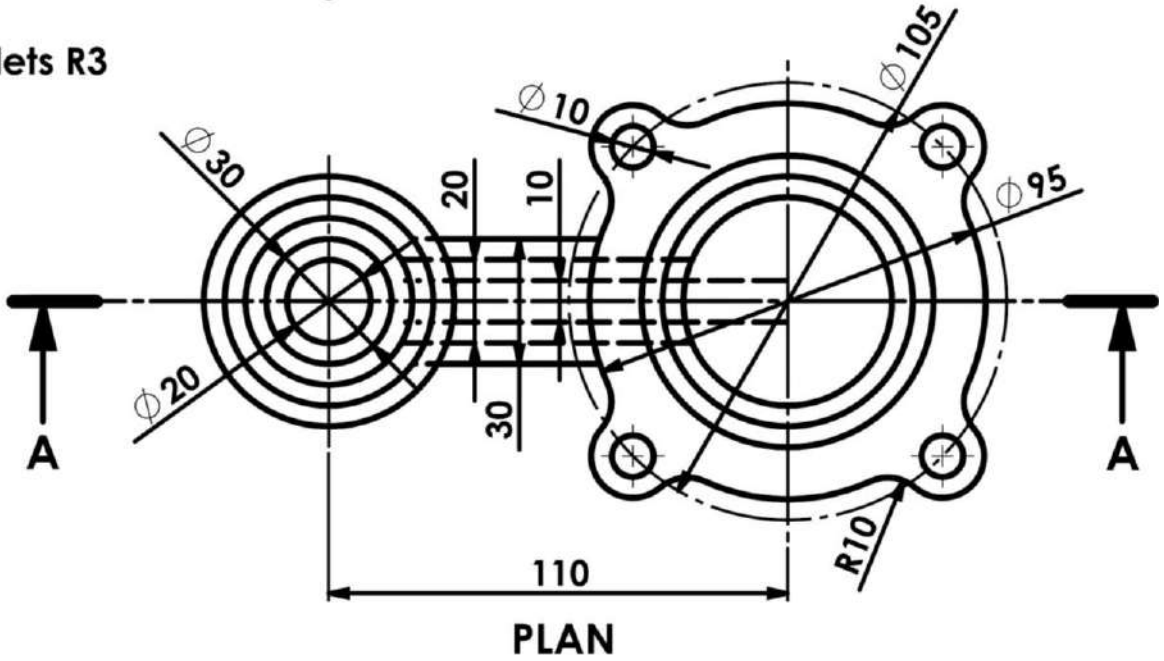

B
95
35
25
14
14
15
∅6
∅6
∅10
∅25
∅15
70
C
12
55
12
7
∅20
3
10
12
100
B
ELEVATION
A
54
30
∅10
15
30
39
8
150
R10
30
C
∅50
∅64
R40
R10
∅10
∅15
12
30
54
100
A
SIDE VIEW


A
B
C
44
36
18
∅14
R15
∅22
R3
20
50
12
R5
10
8
125
R35
R5
R15
50
5
45°
∅55
∅30
ELEVATION
SIDE VIEW

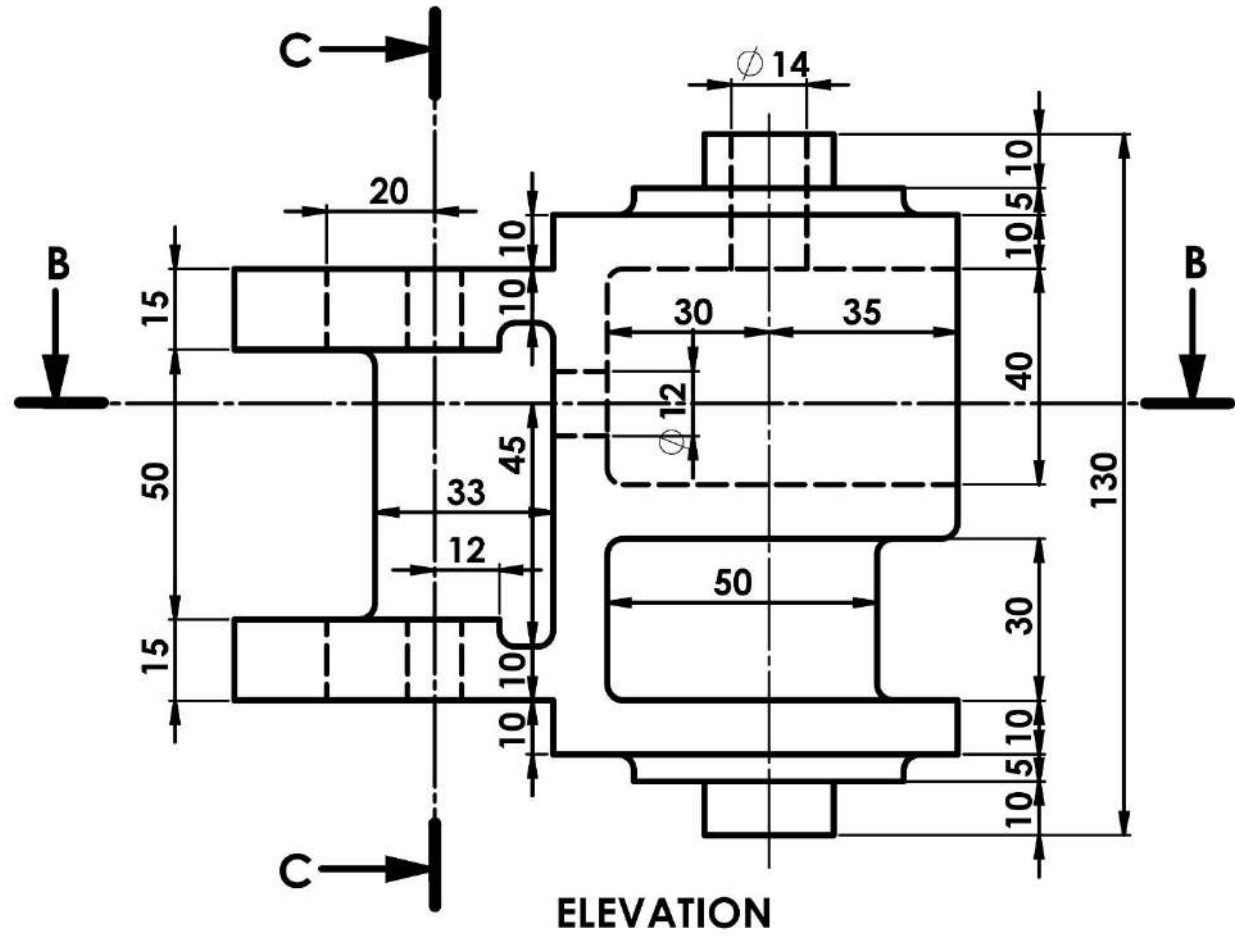


ELEVATION

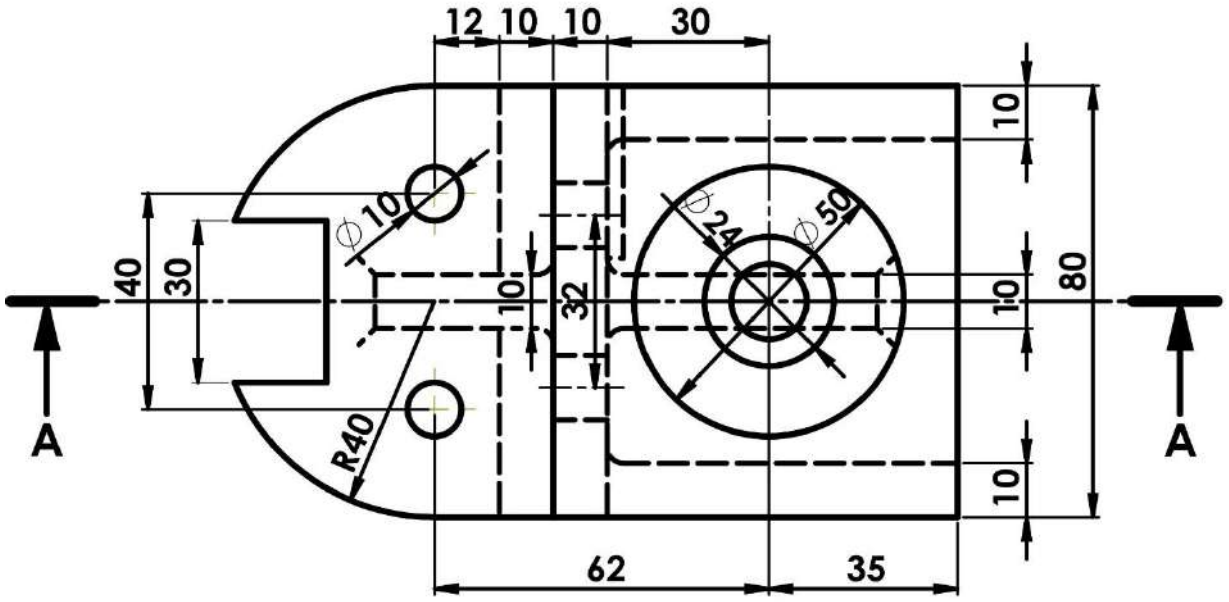
Fillets R3



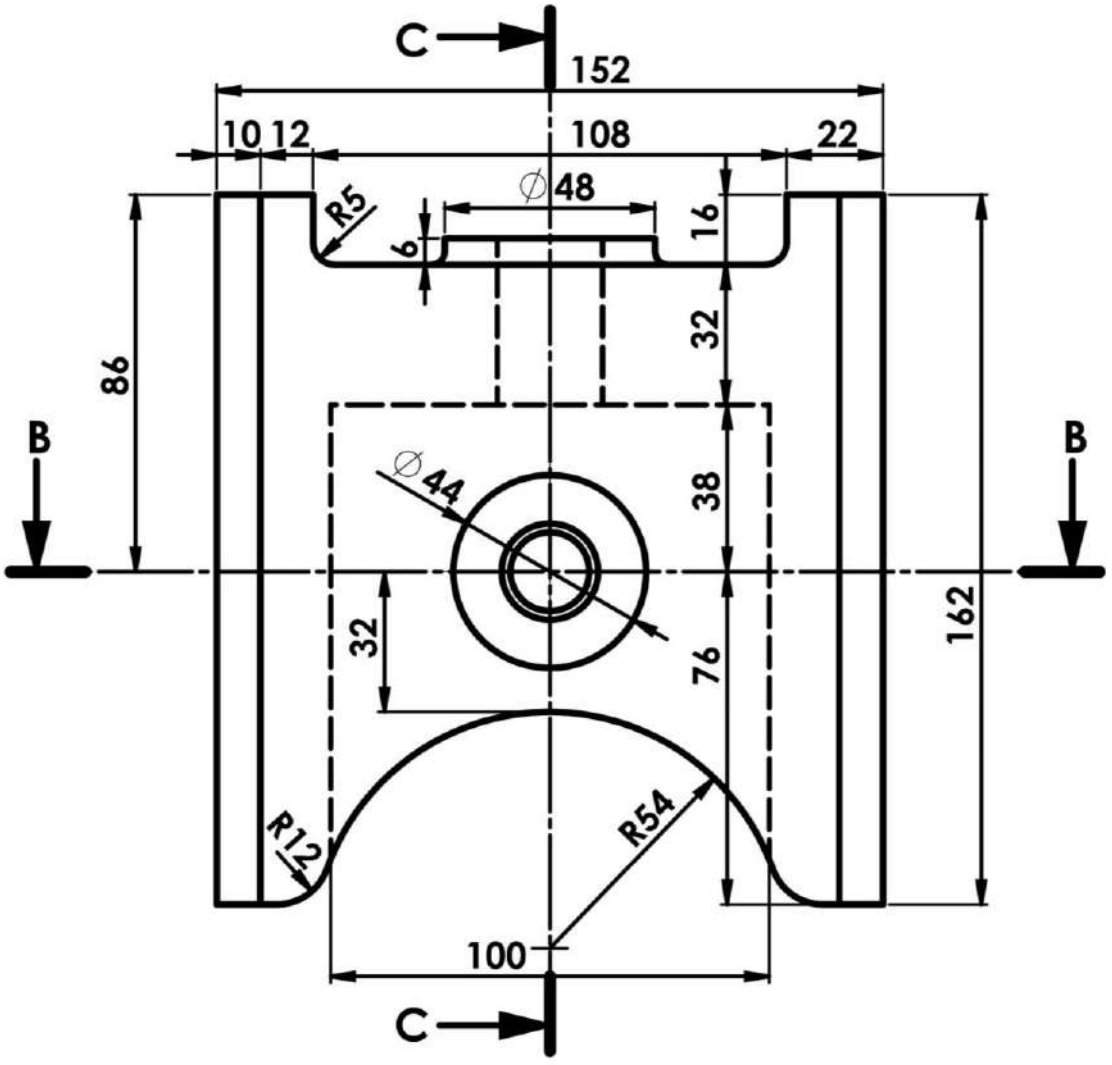
PLAN



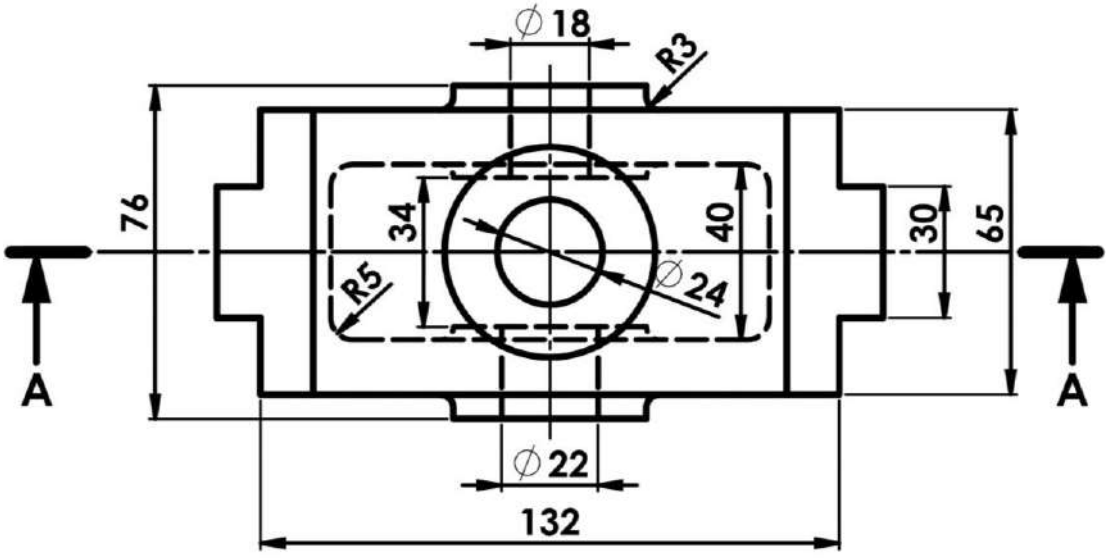
ELEVATION



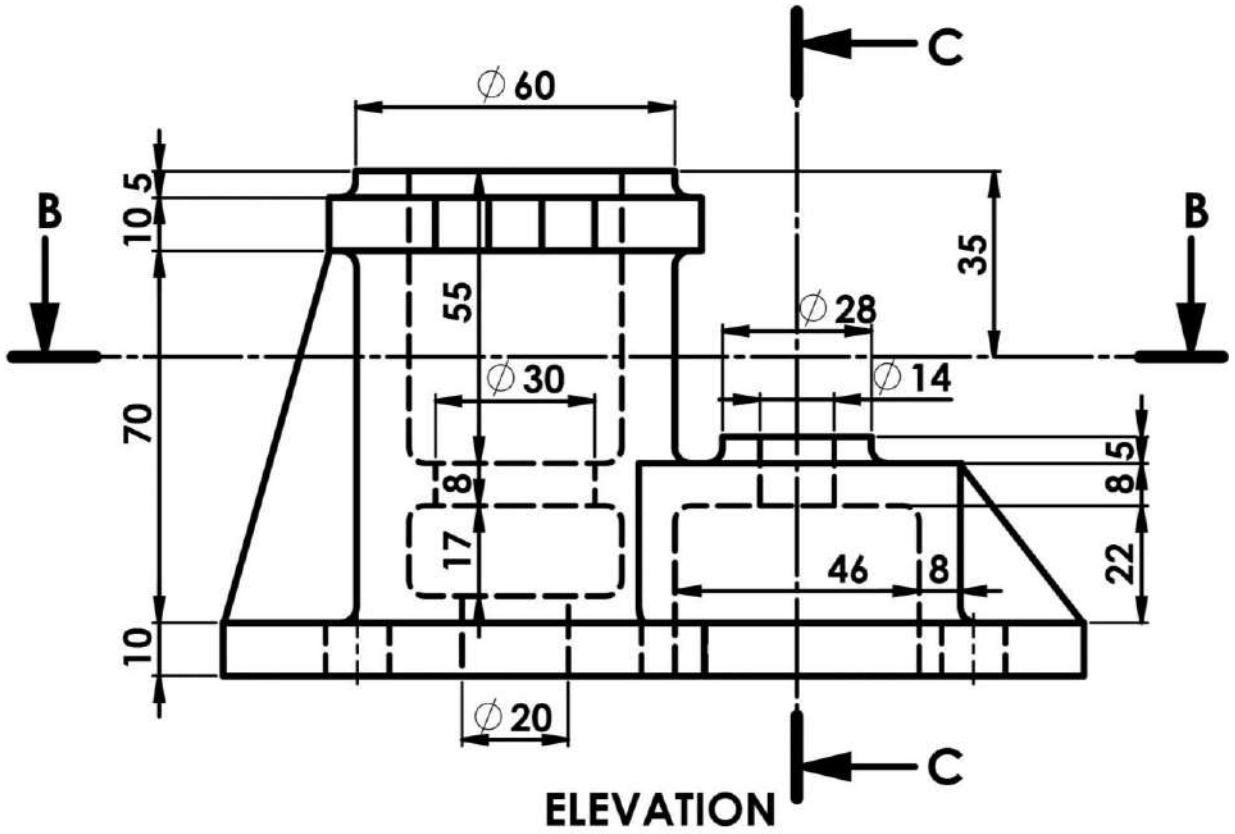
PLAN



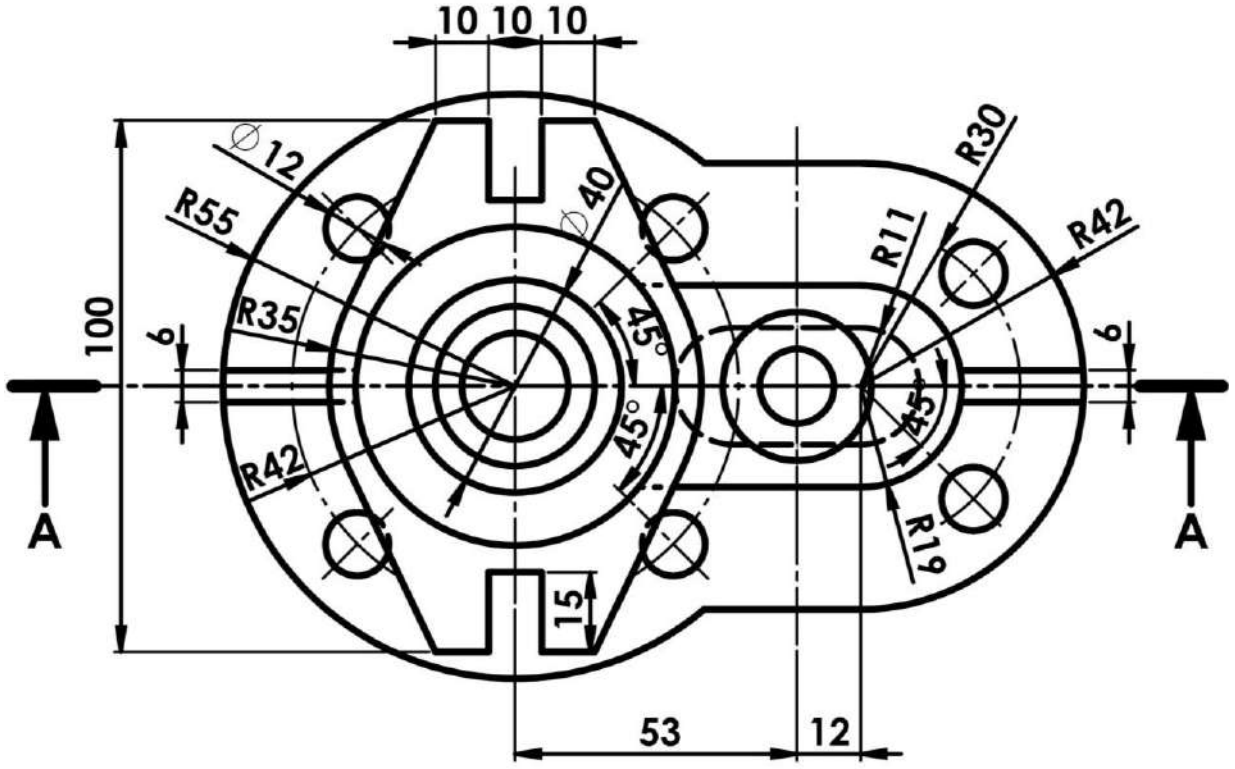
ELEVATION



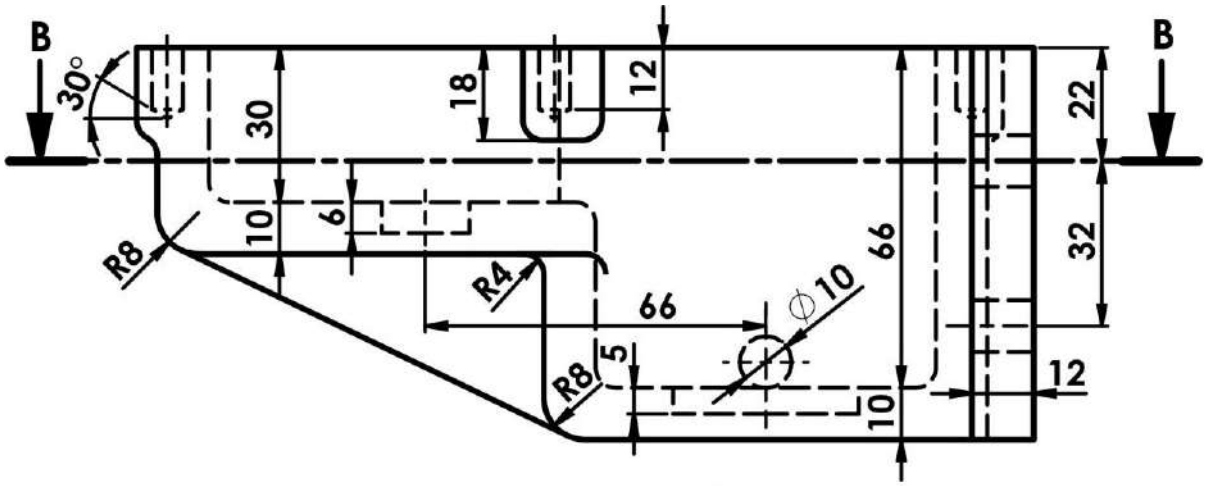
PLAN



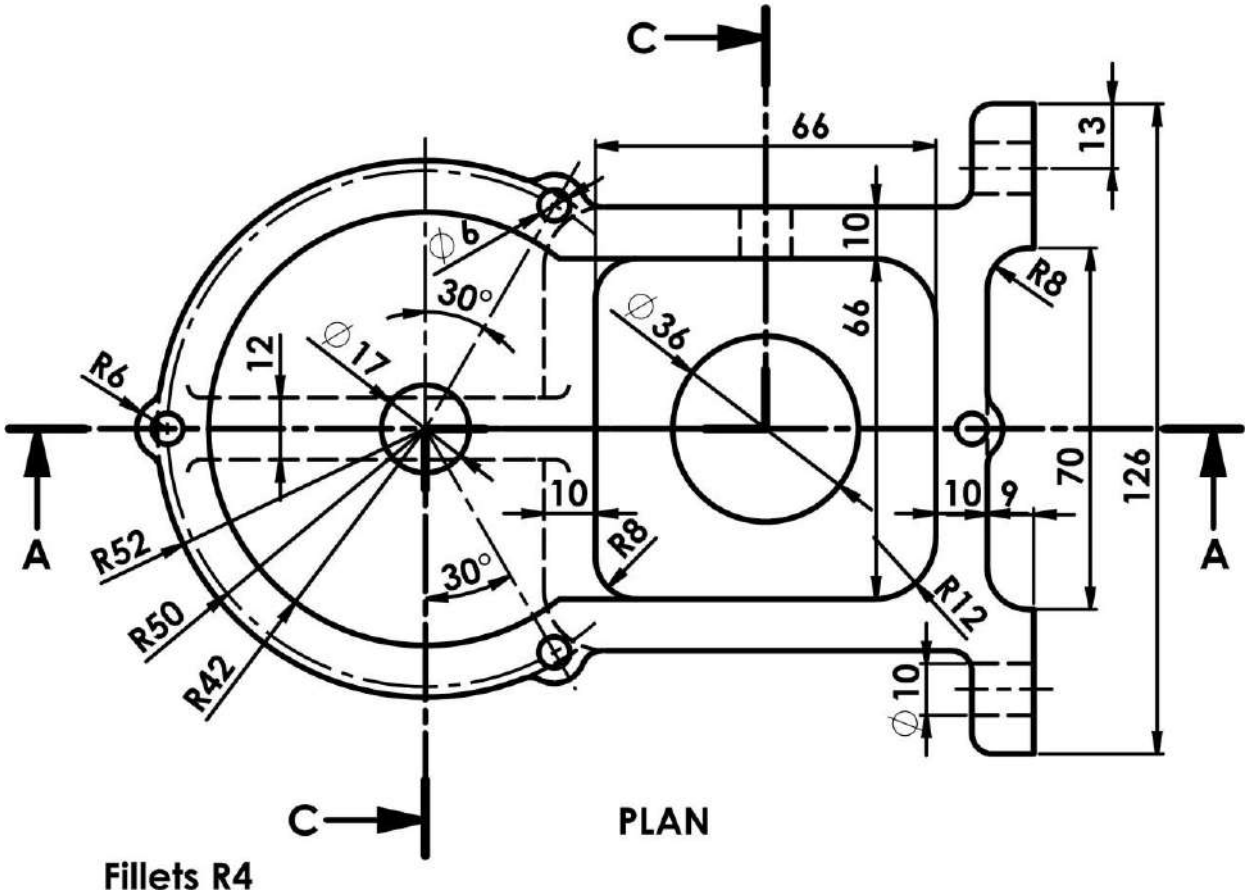
ELEVATION



PLAN

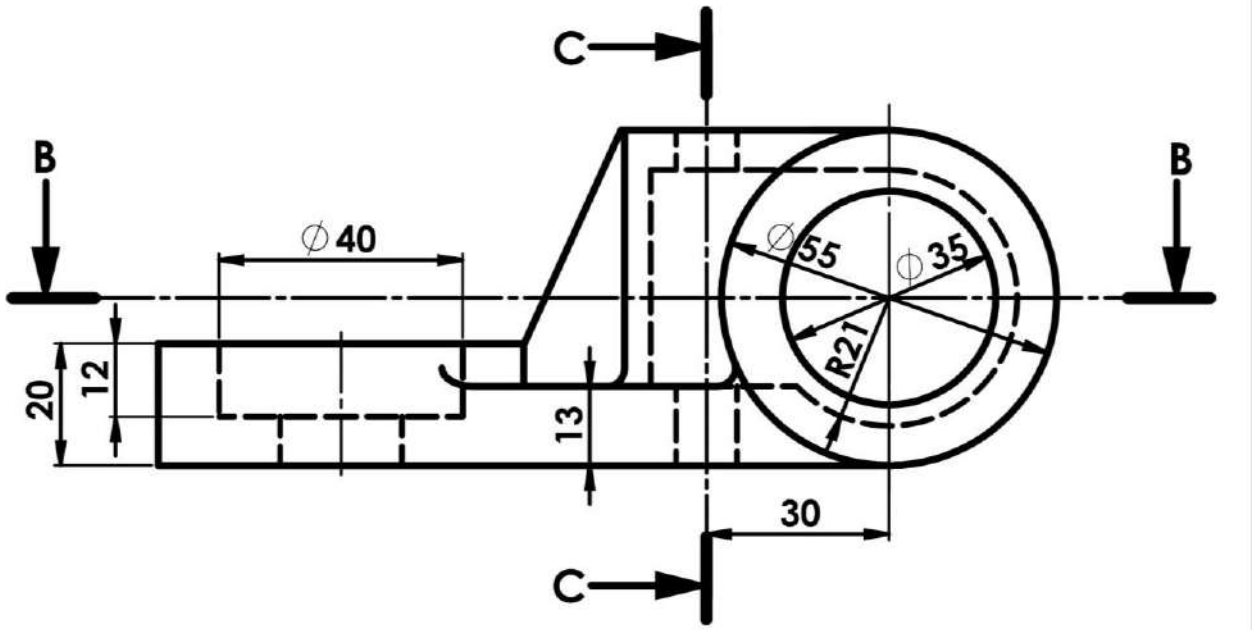


ELEVATION

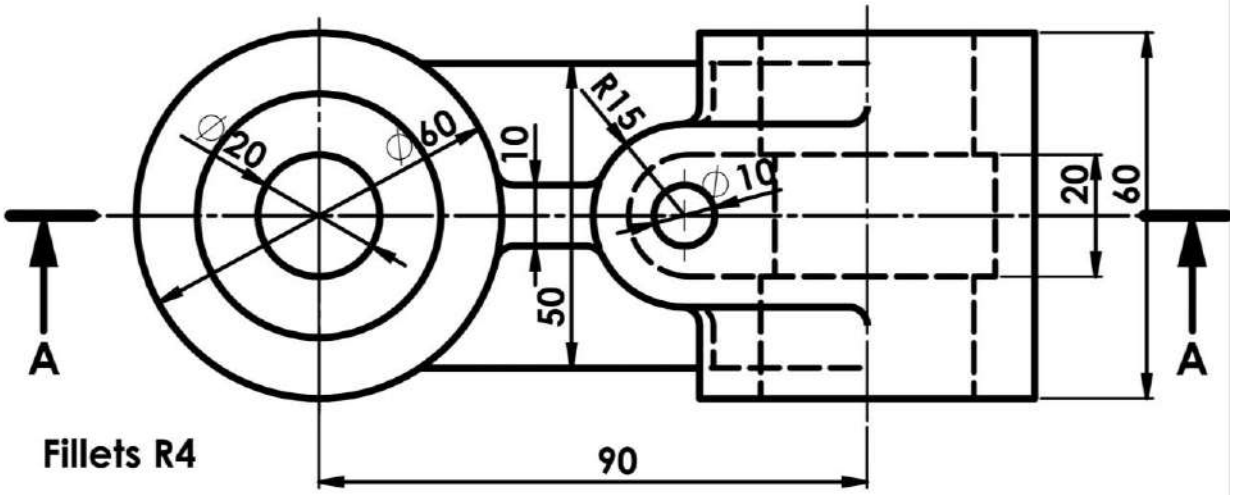


PLAN

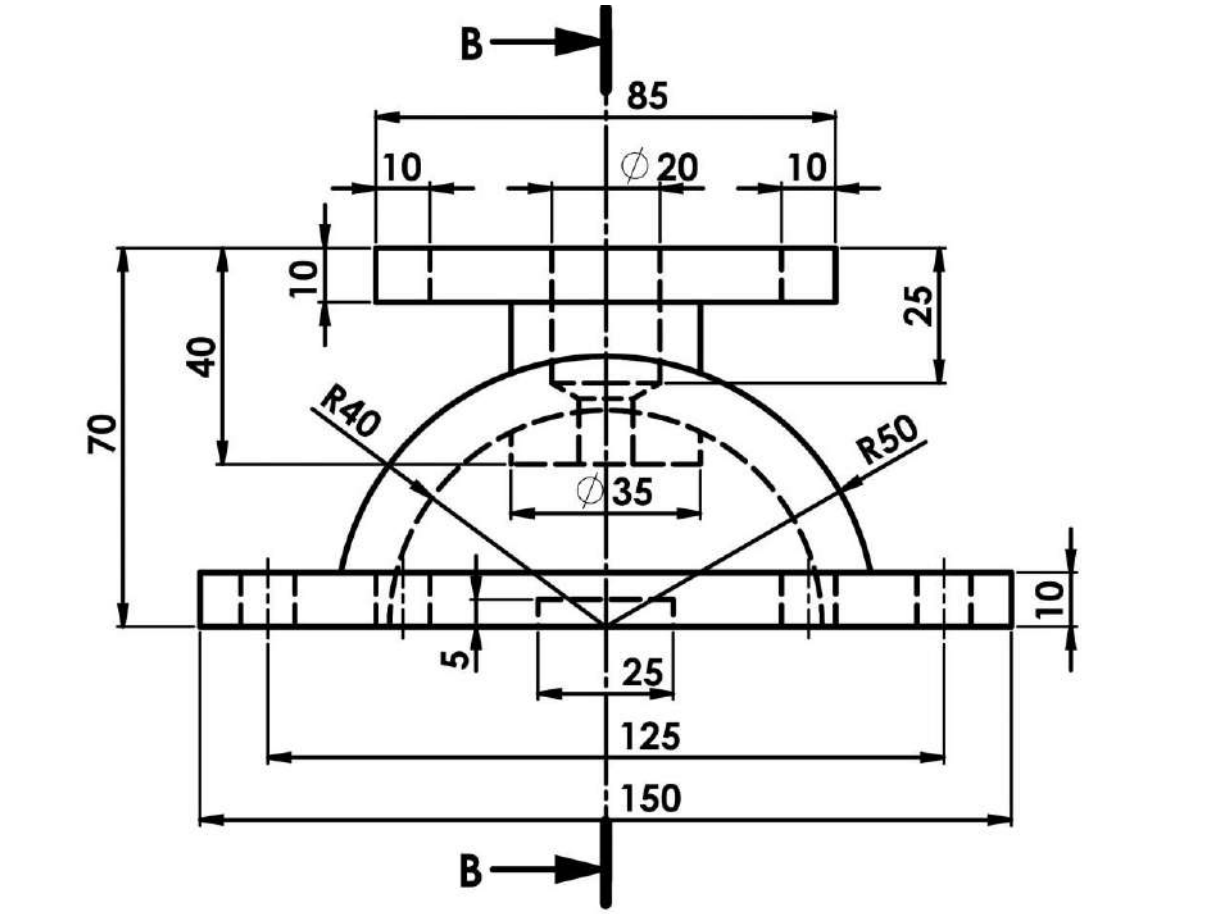
Fillets R4



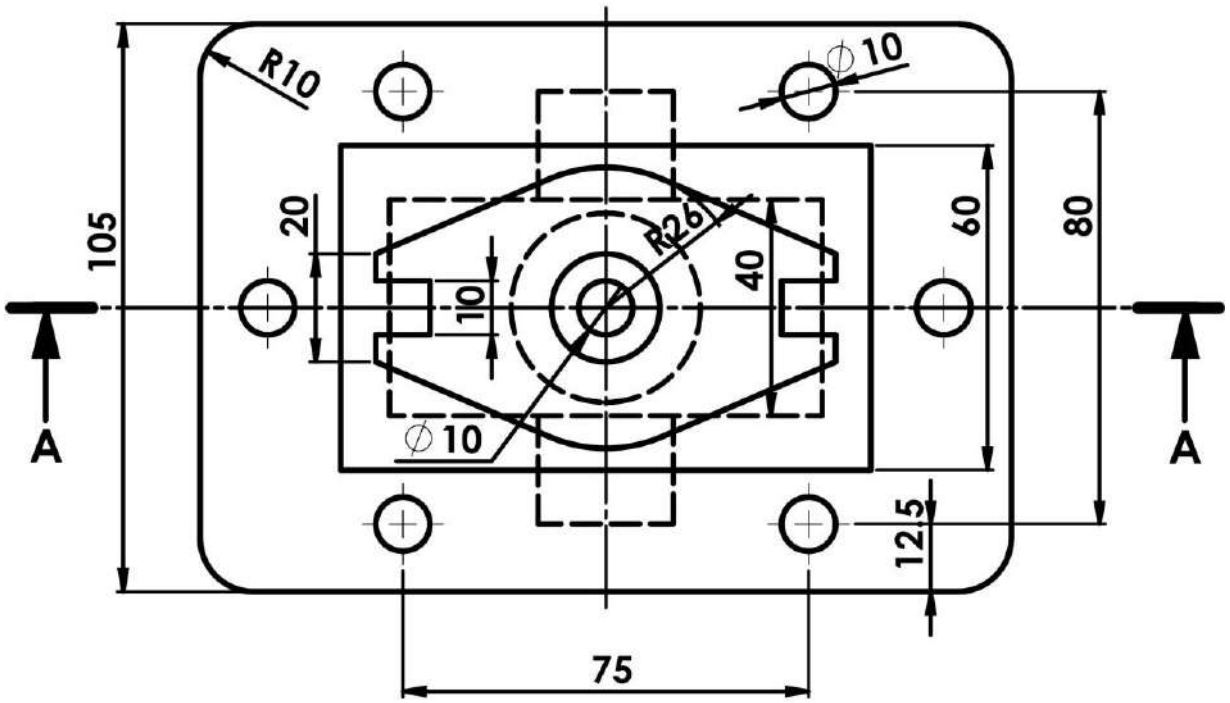
ELEVATION



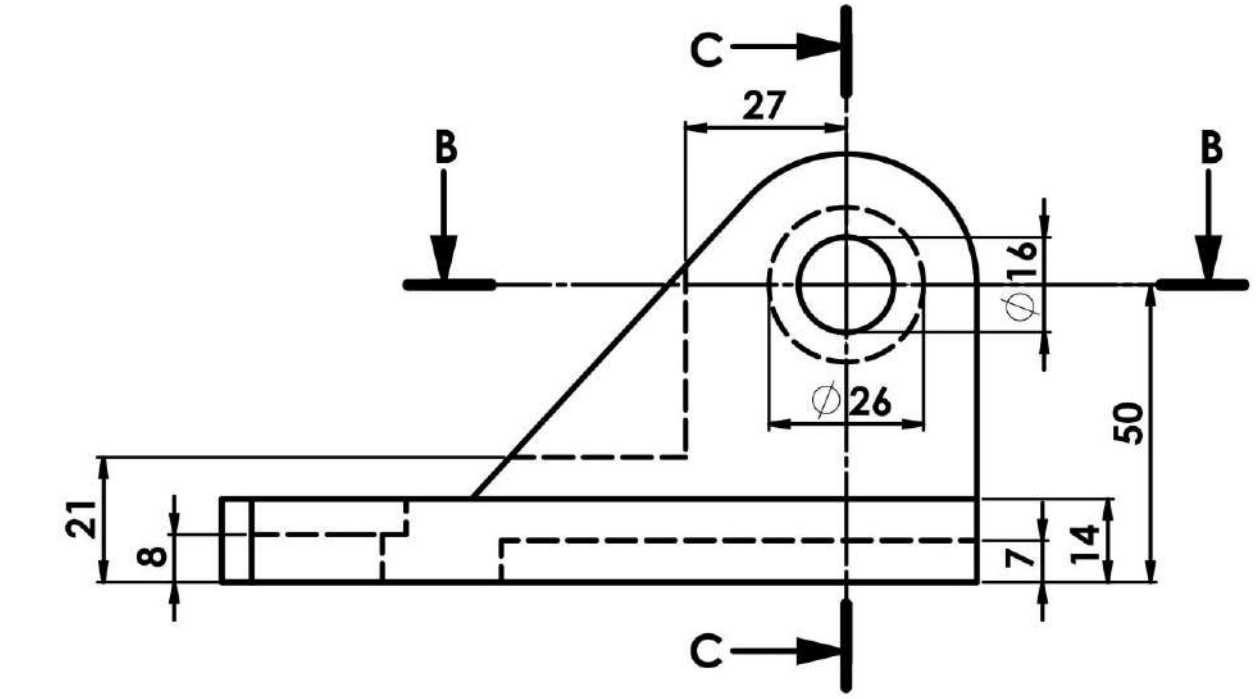
PLAN



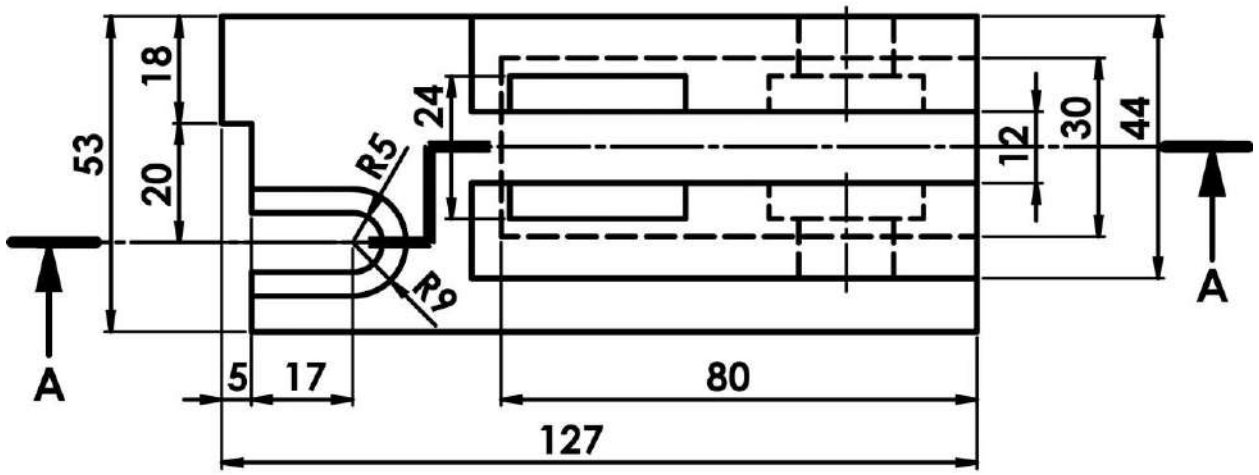
ELEVATION



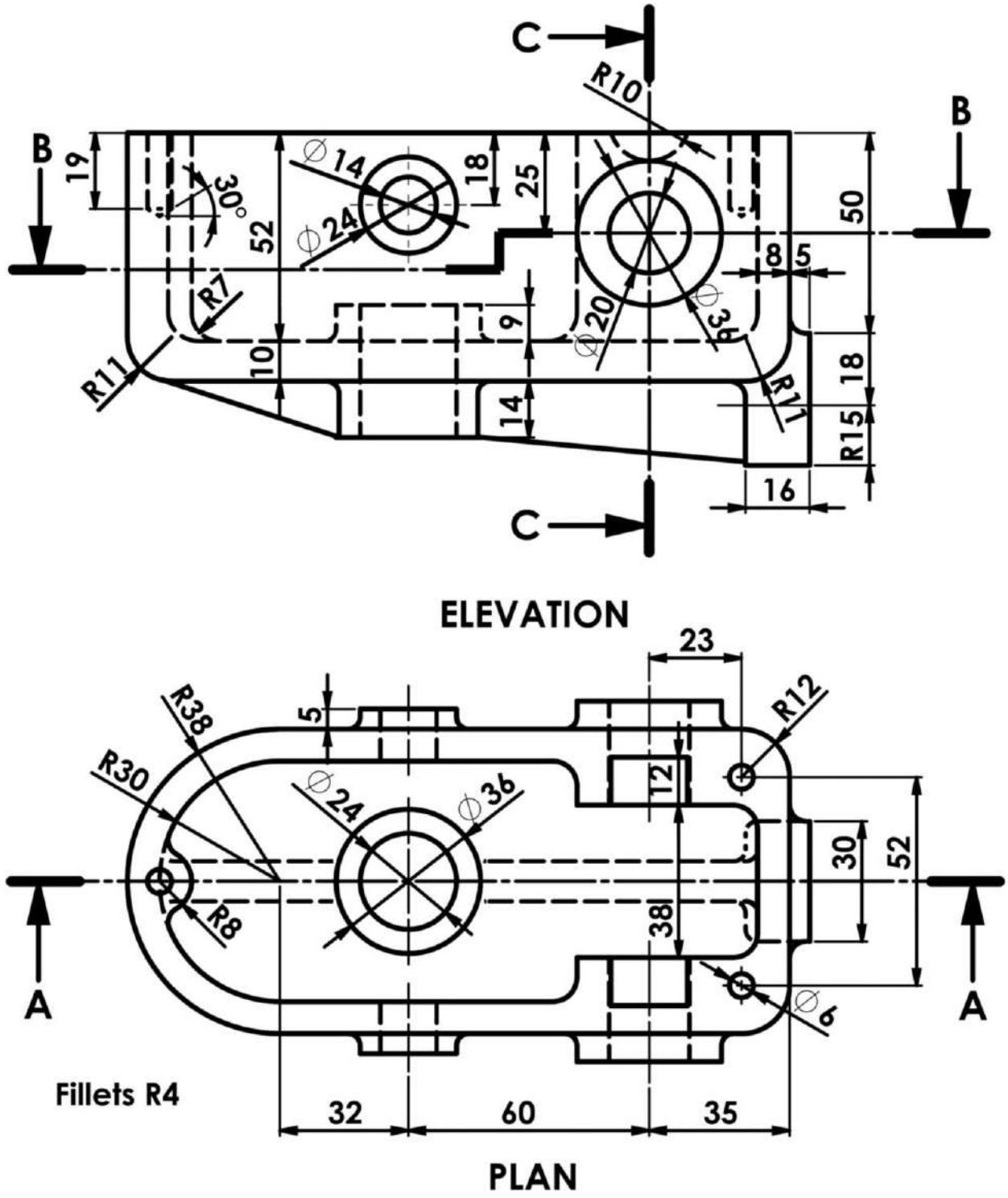
PLAN

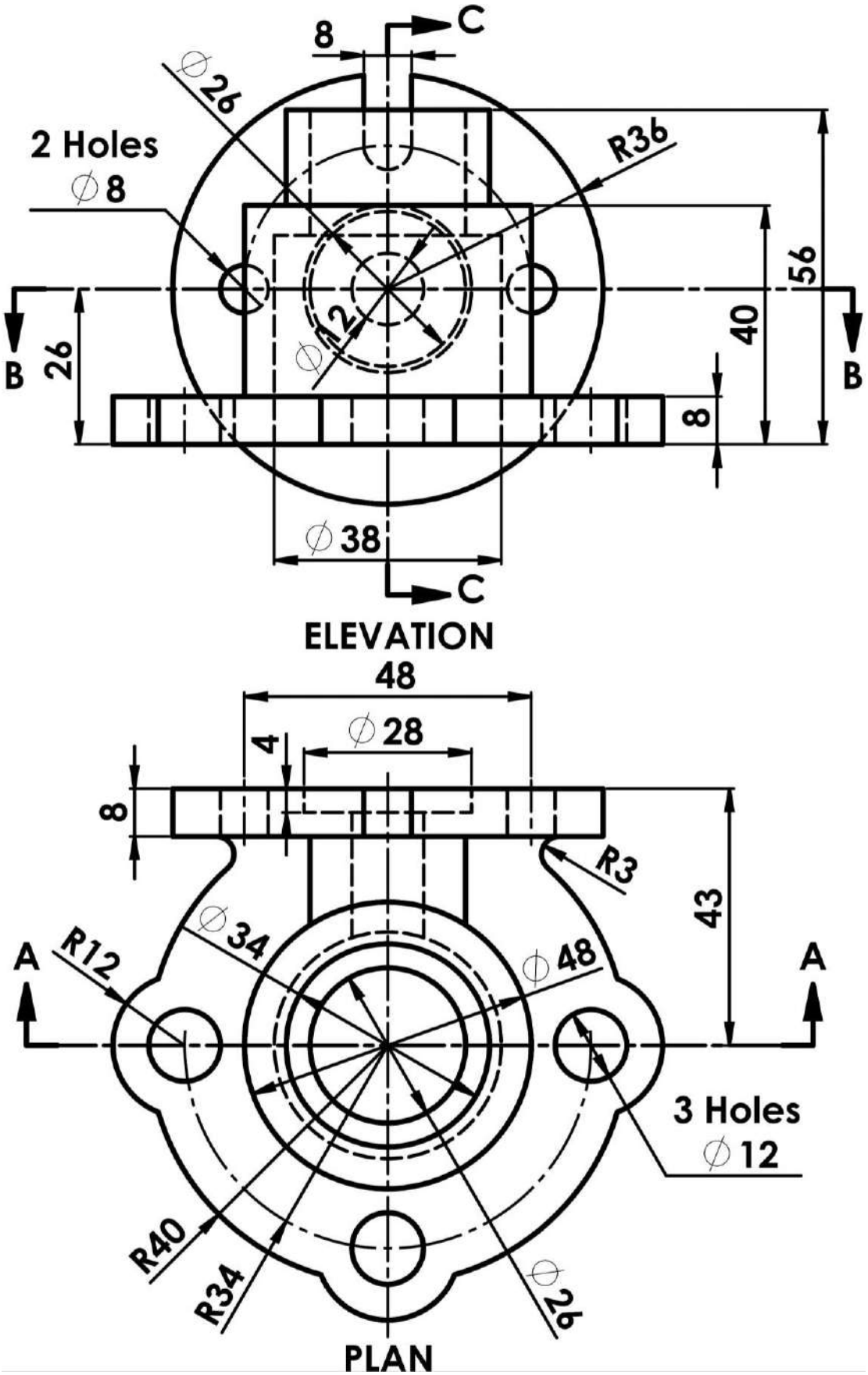


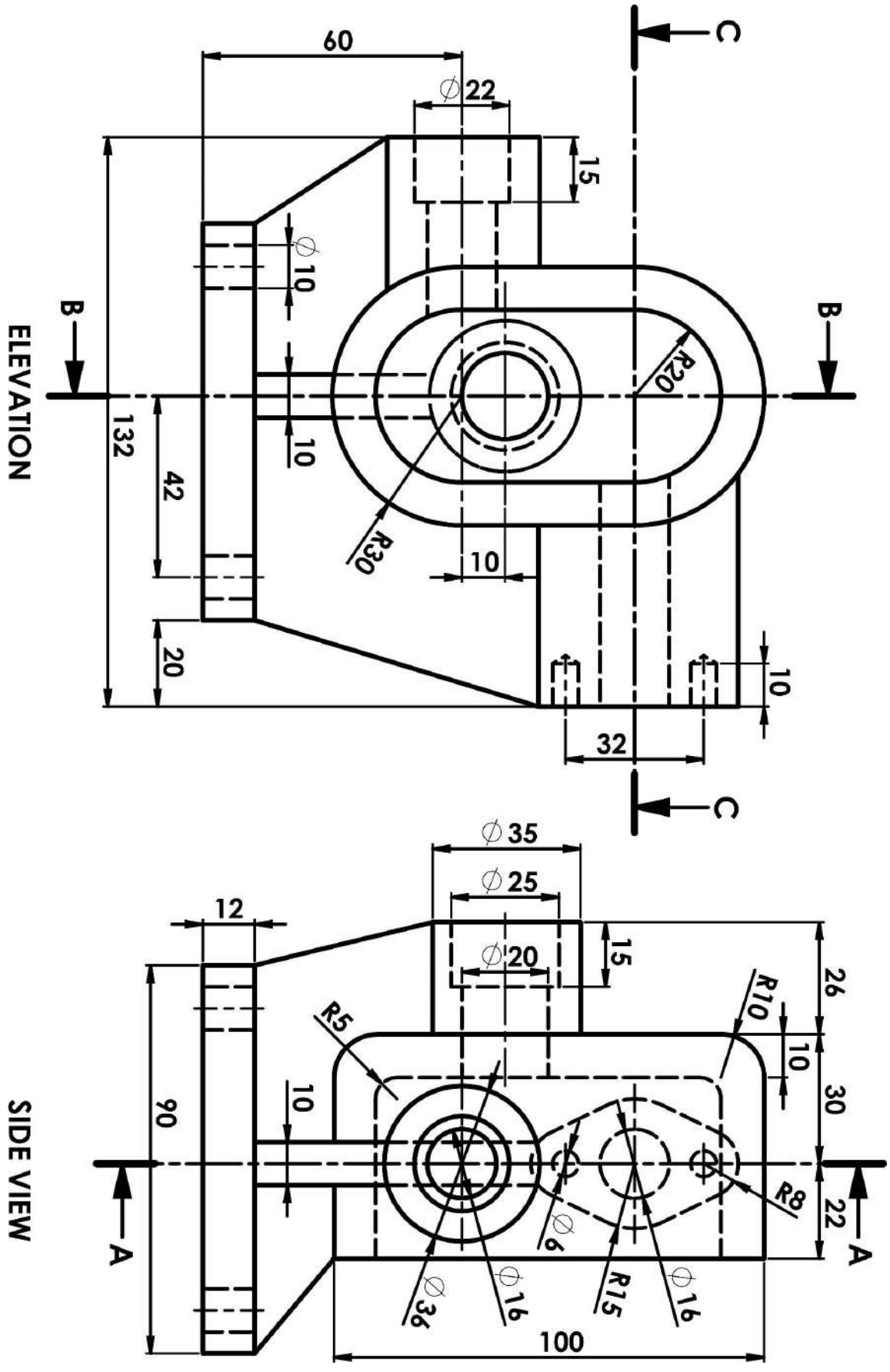
ELEVATION

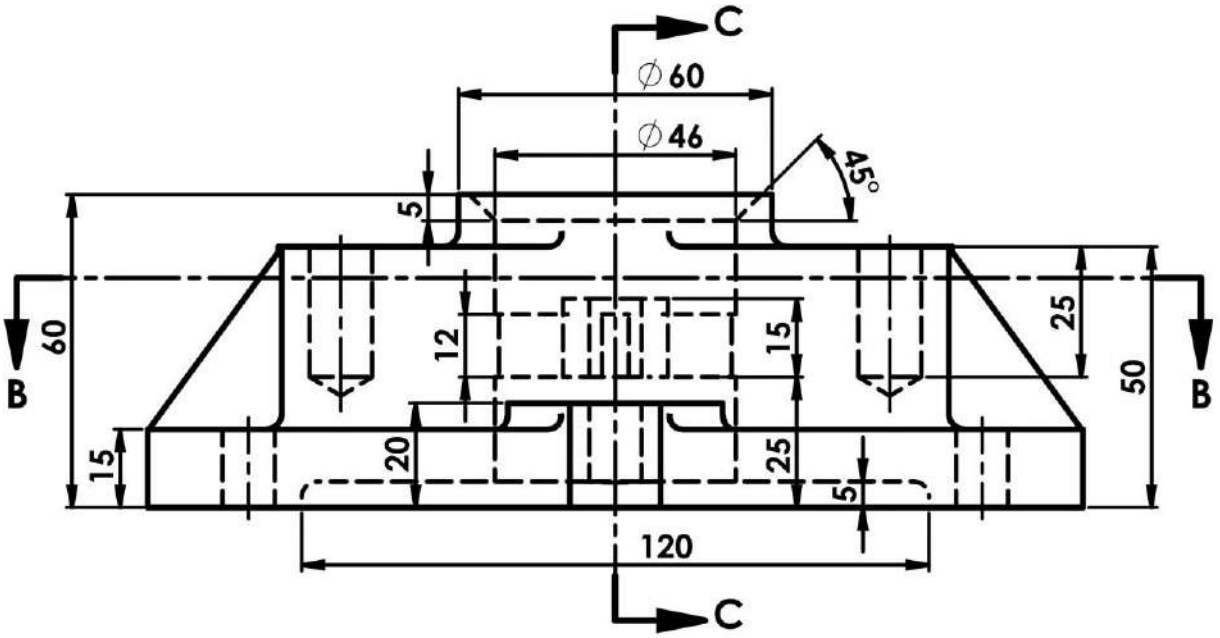


PLAN

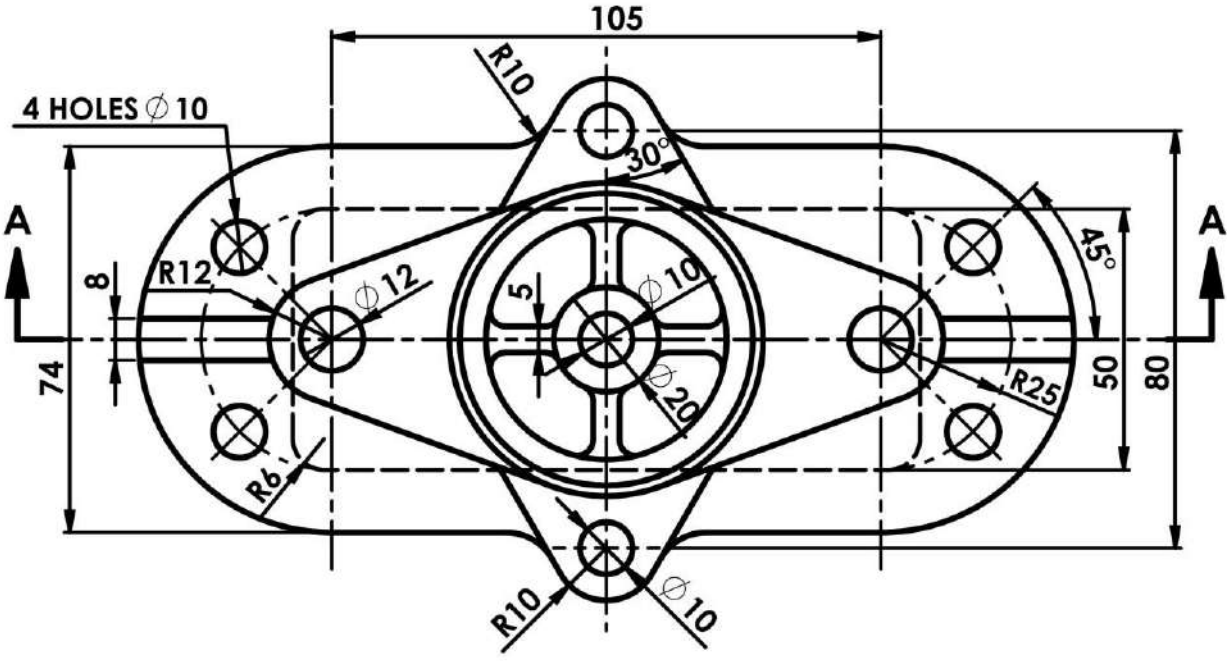

C
R10
B
B
19
30°
52
∅14
∅24
18
25
50
8
5
R7
9
∅20
∅36
R11
10
14
R11
18
R15
16
C
ELEVATION
23
R38
5
R12
R30
12
∅24
∅36
30
52
R8
38
A
A
∅6
Fillets R4
32
60
35
PLAN


8
C
∅26
2 Holes
∅8
R36
56
40
∅12
B
26
B
8
∅38
C
ELEVATION
48
∅28
4
8
R3
43
∅34
R12
A
∅48
A
3 Holes
∅12
R40
R34
∅29
PLAN

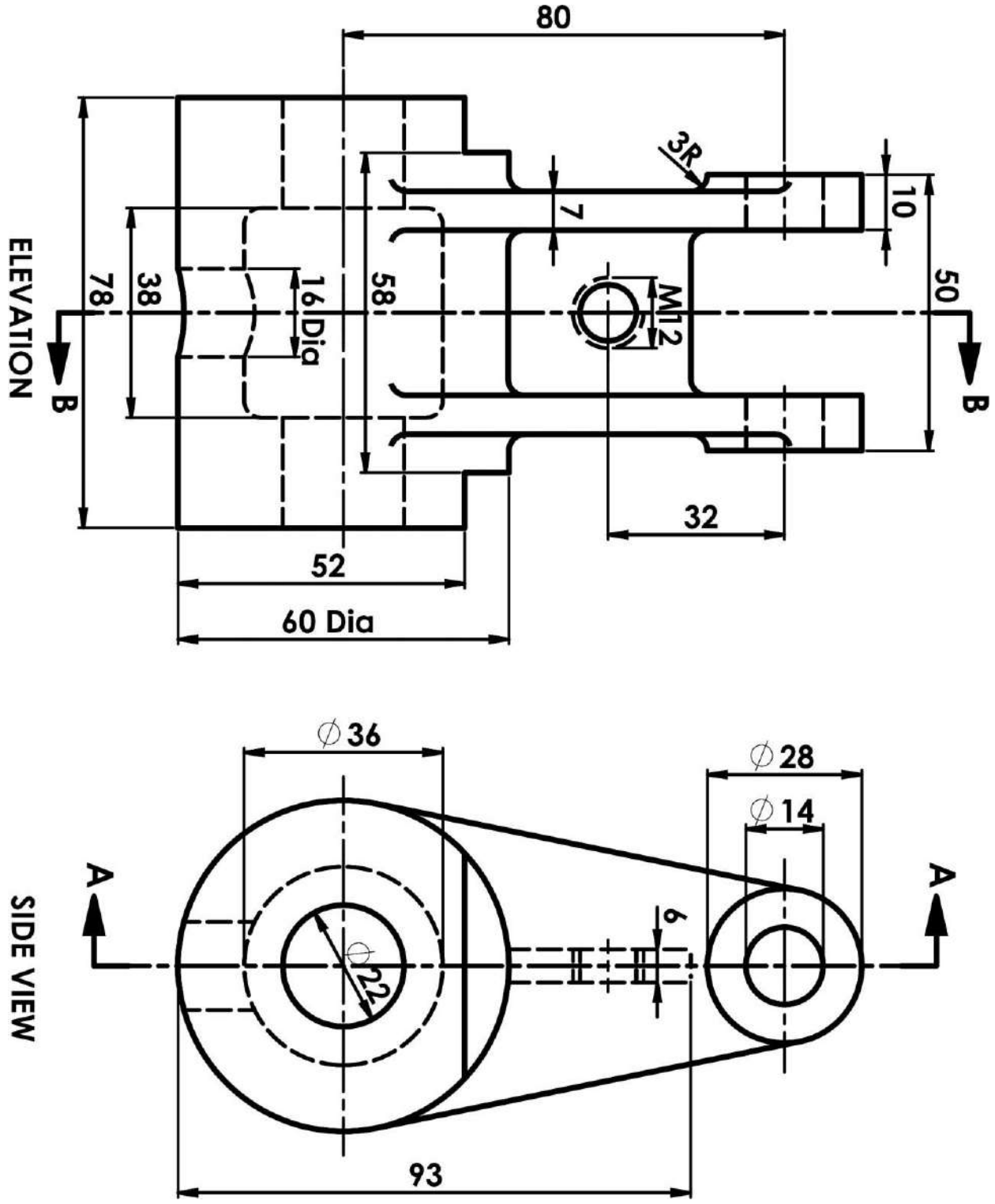

ELEVATION
SIDE VIEW
60
∅22
15
∅10
B
B
R20
132
42
10
10
R30
20
32
C
C
∅35
∅25
∅20
12
15
26
R10
10
30
R5
90
10
R8
22
A
A
∅6
∅36
∅16
R15
∅16
100

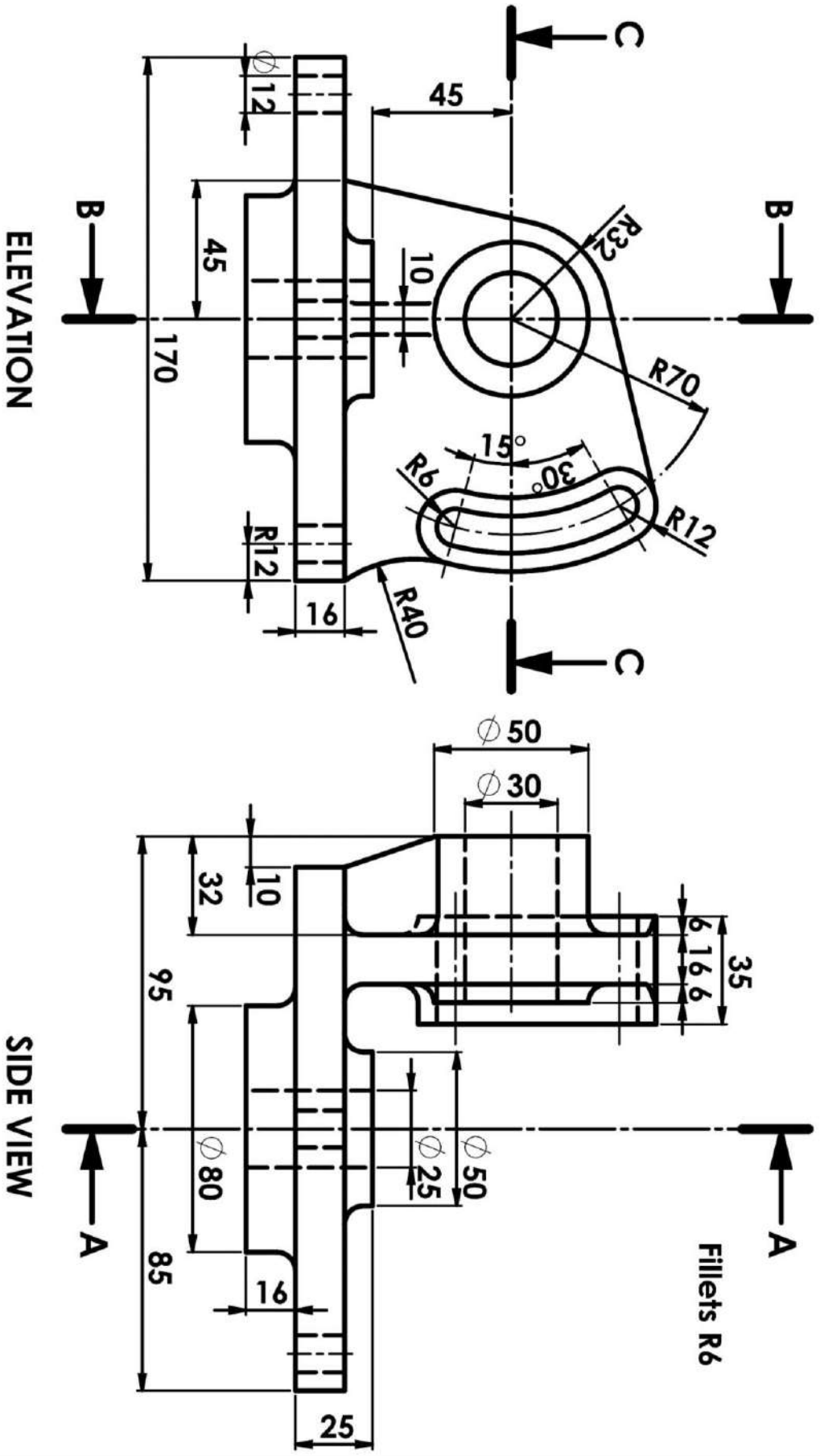


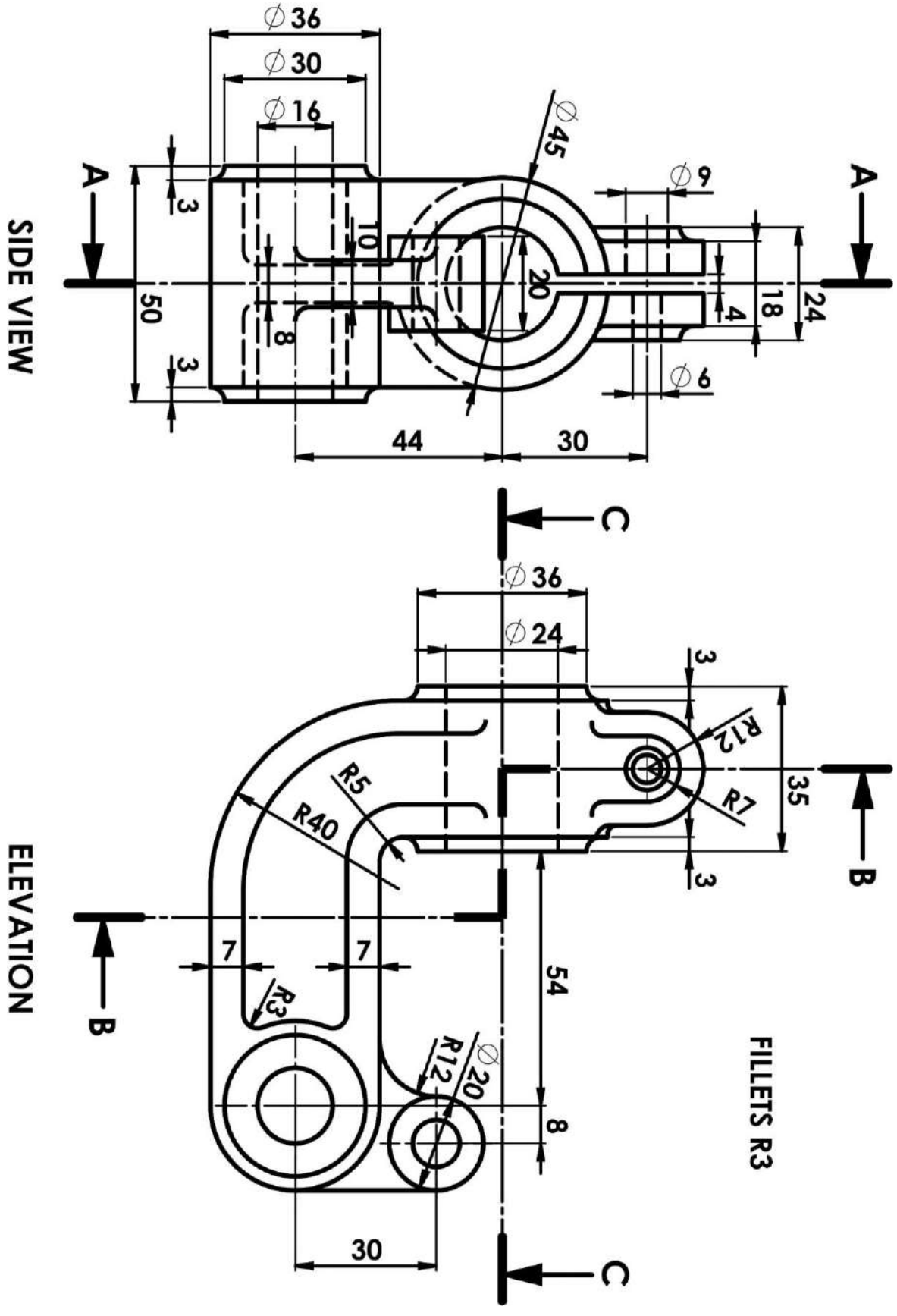
ELEVATION



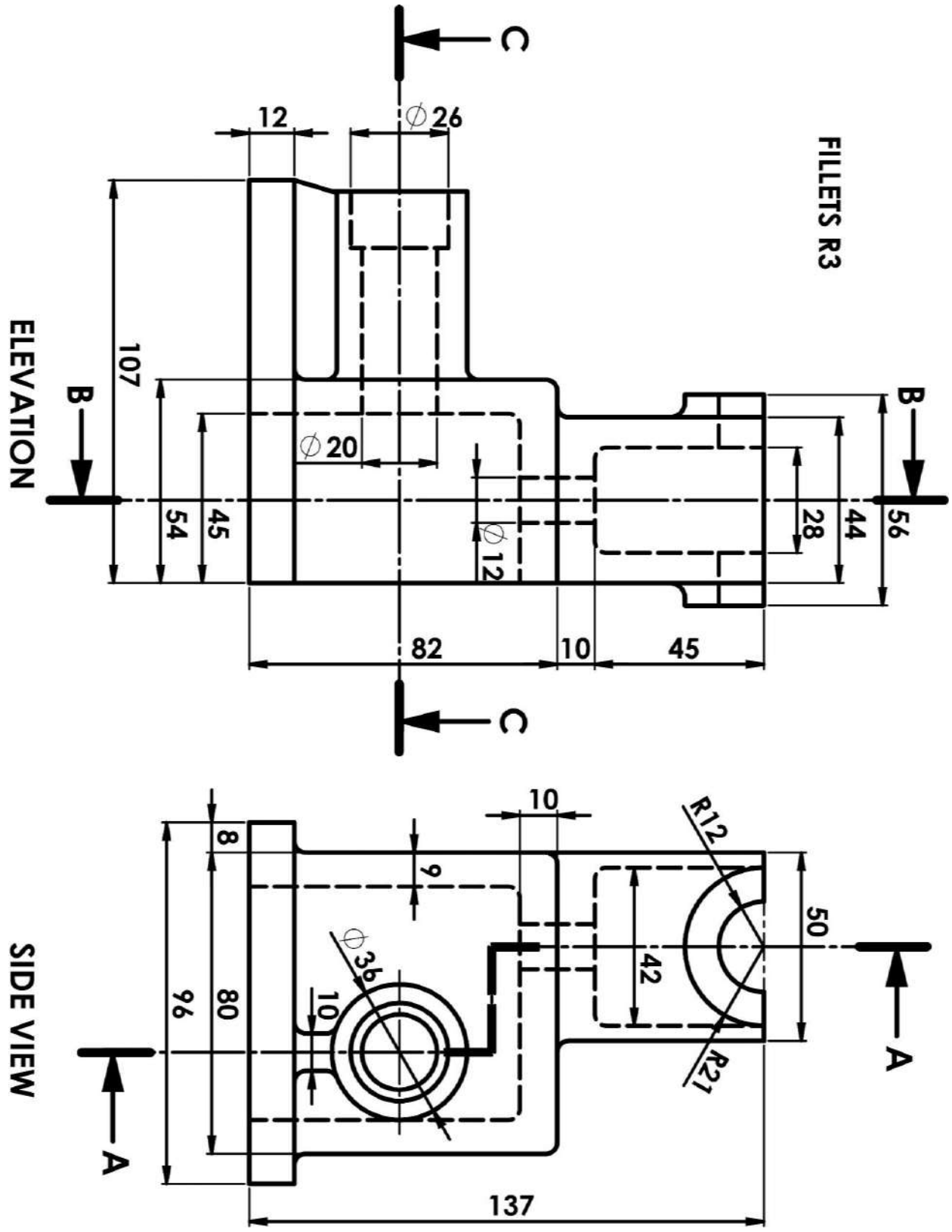
PLAN

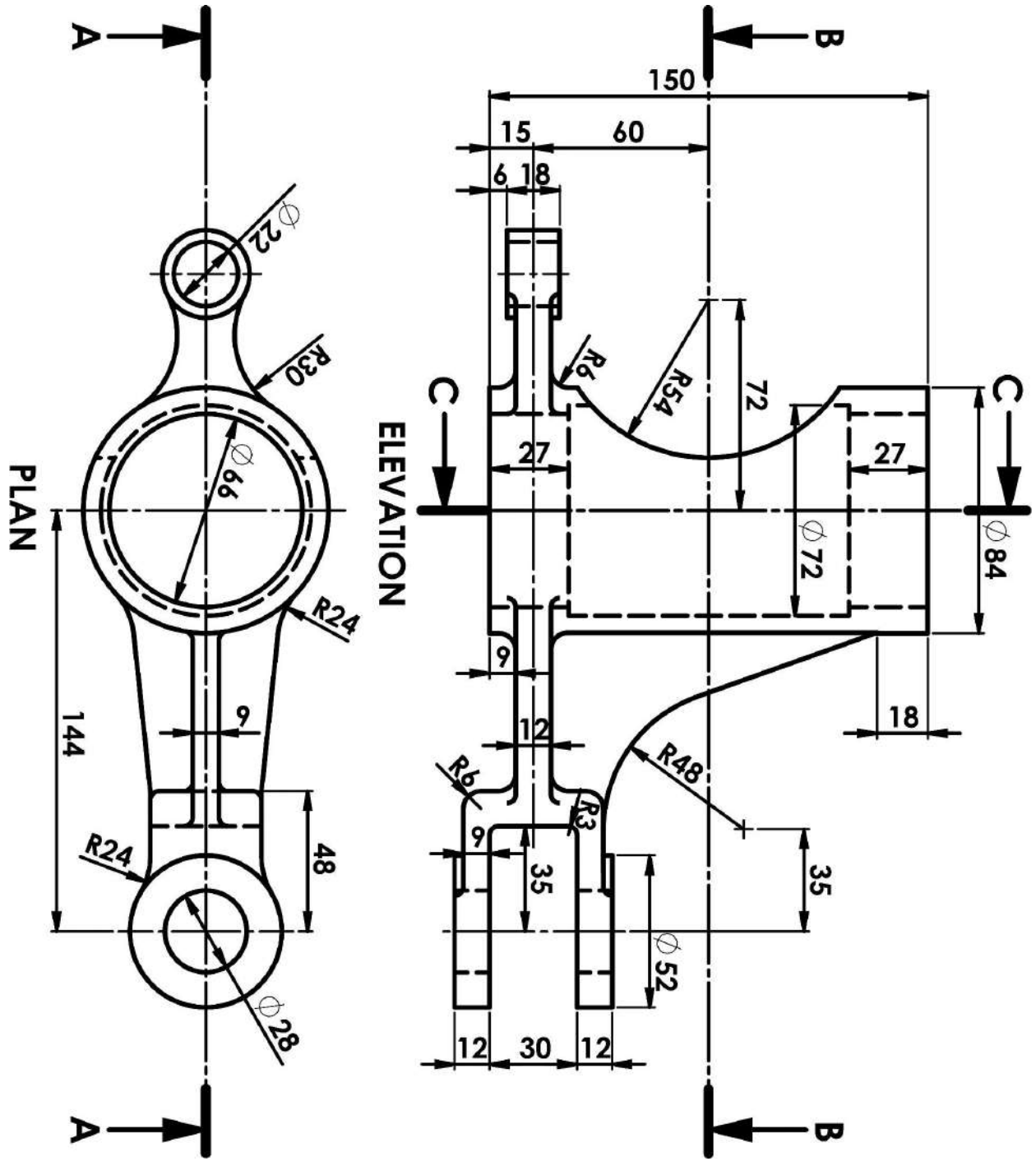

80
3R
10
7
50
78
38
16 Dia
58
M12
B
B
32
52
60 Dia
ELEVATION
∅ 36
∅ 28
∅ 14
A
A
6
∅ 22
93
SIDE VIEW

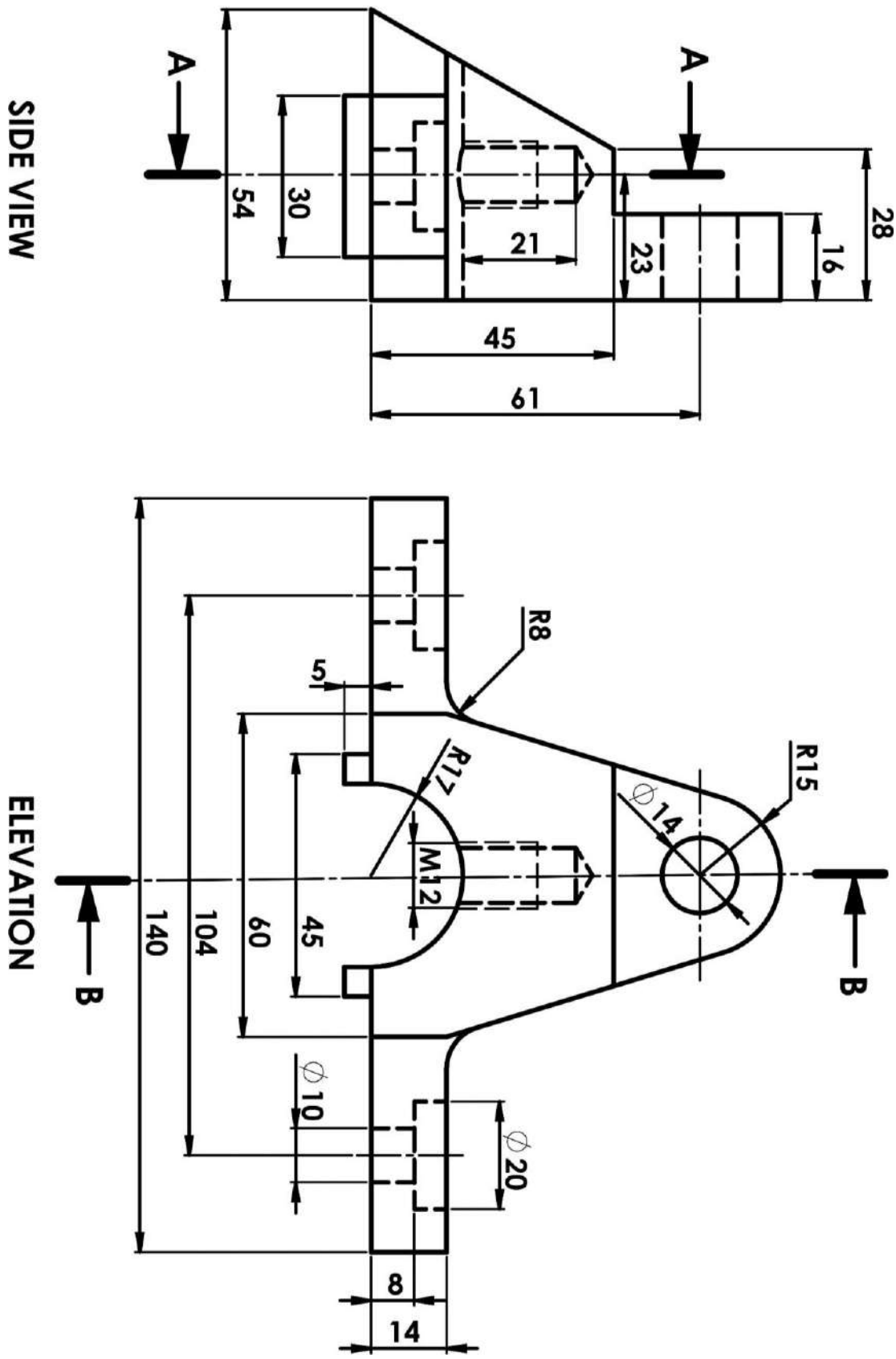

ELEVATION
SIDE VIEW
Fillets R6
A
B
C
∅12
45
45
10
170
R32
R70
15°
30°
R6
R12
R12
16
R40
∅50
∅30
32
10
95
6
16
6
35
∅80
∅25
∅50
85
16
25

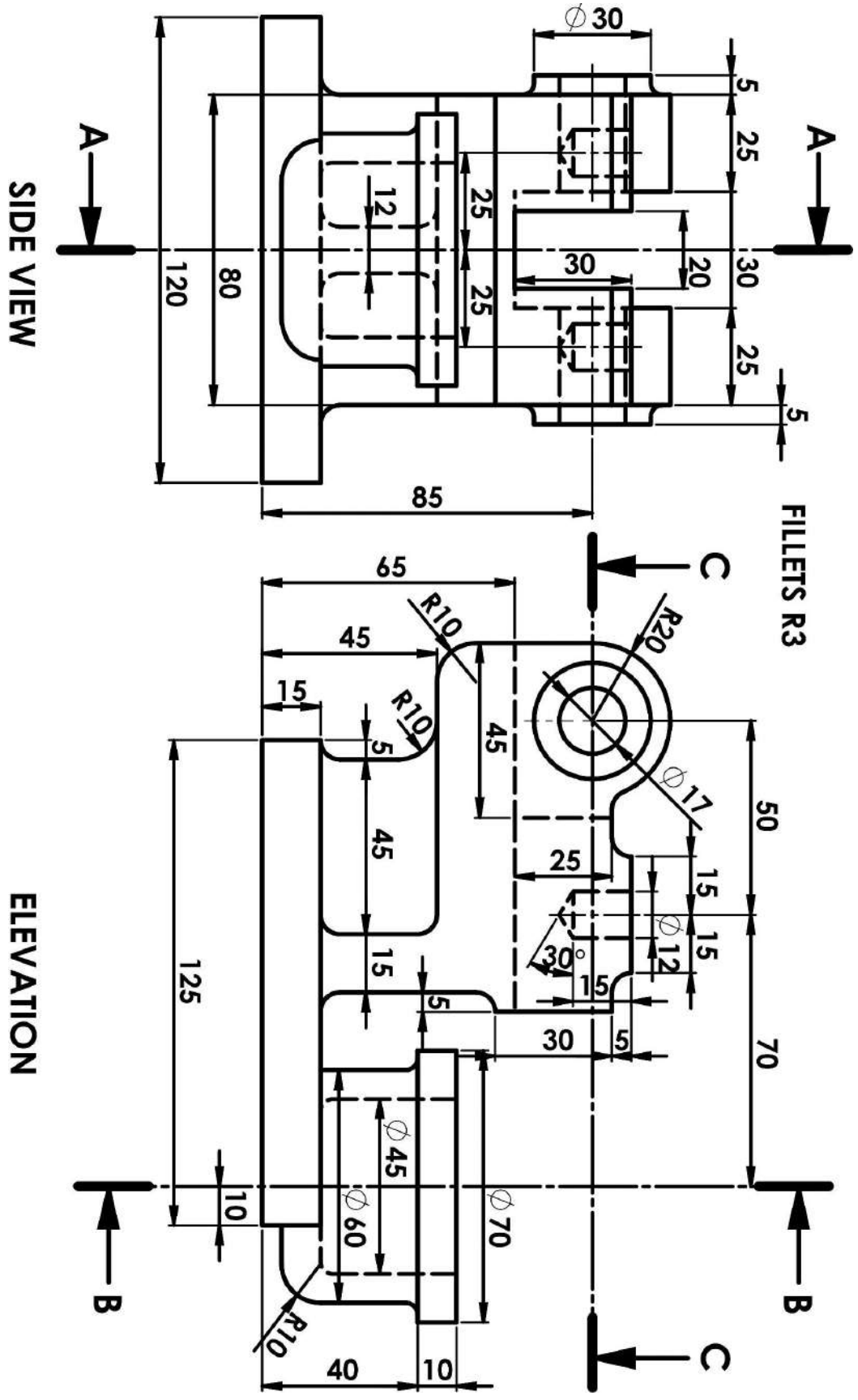

SIDE VIEW
ELEVATION
FILLETS R3
A
B
C
∅36
∅30
∅16
∅45
∅9
∅6
∅24
∅20
3
10
8
50
20
4
18
24
44
30
R12
R5
R40
R7
35
7
54
R3
30

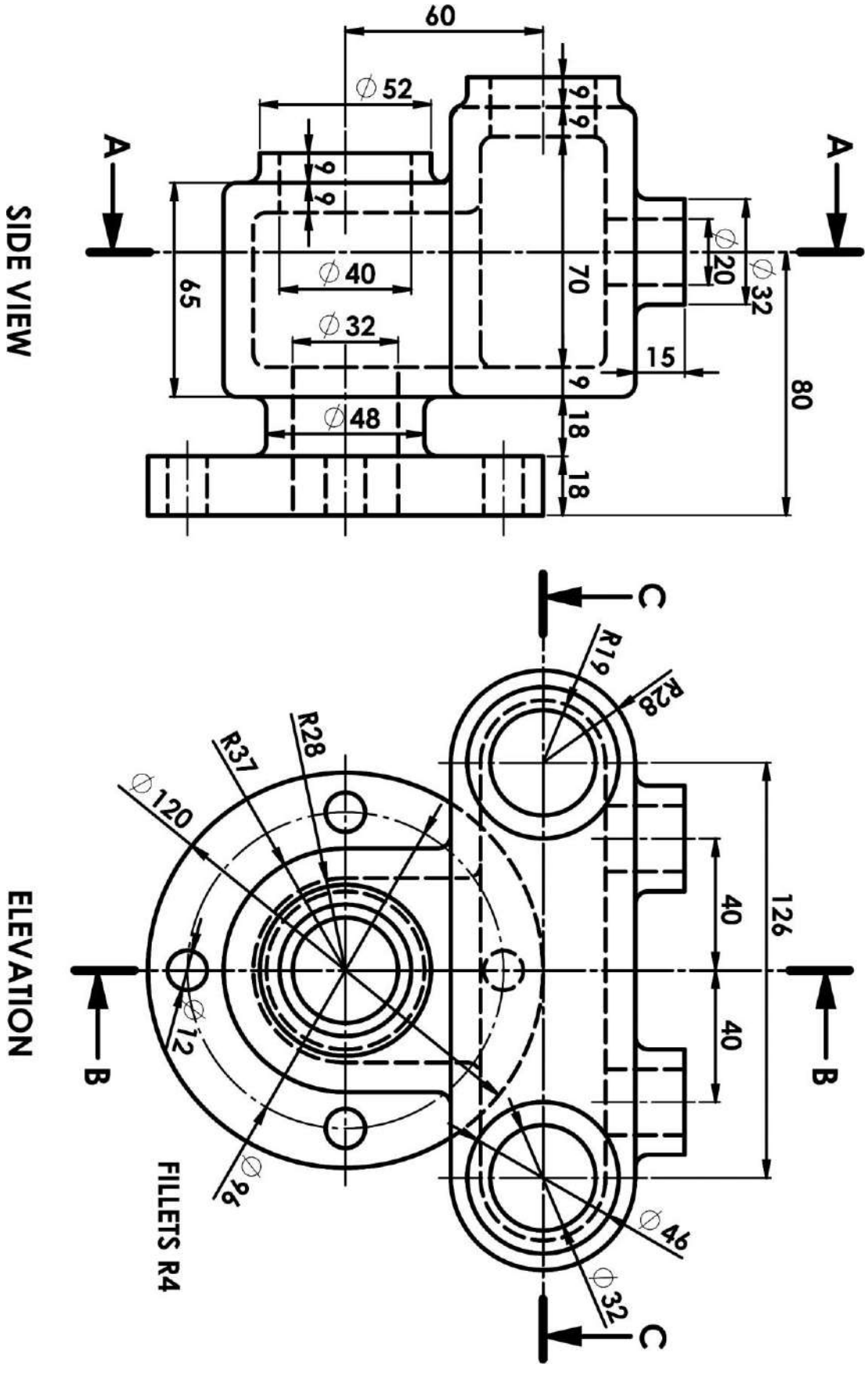
[125]

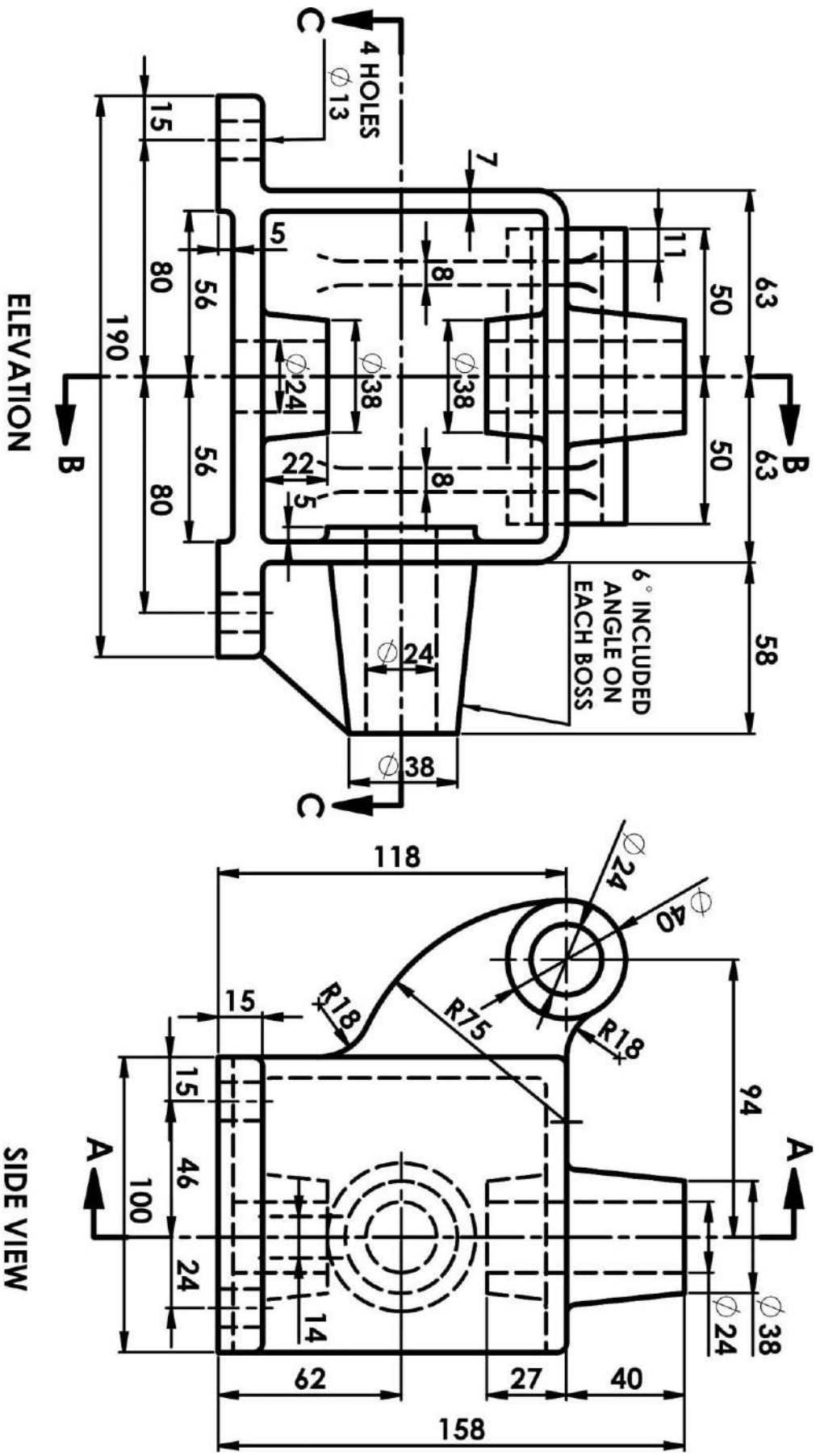

ELEVATION
FILLETS R3
C
B
12
∅26
107
∅20
54
45
∅12
28
44
56
82
10
45
SIDE VIEW
A
8
96
80
9
∅36
10
10
R12
50
42
R21
137

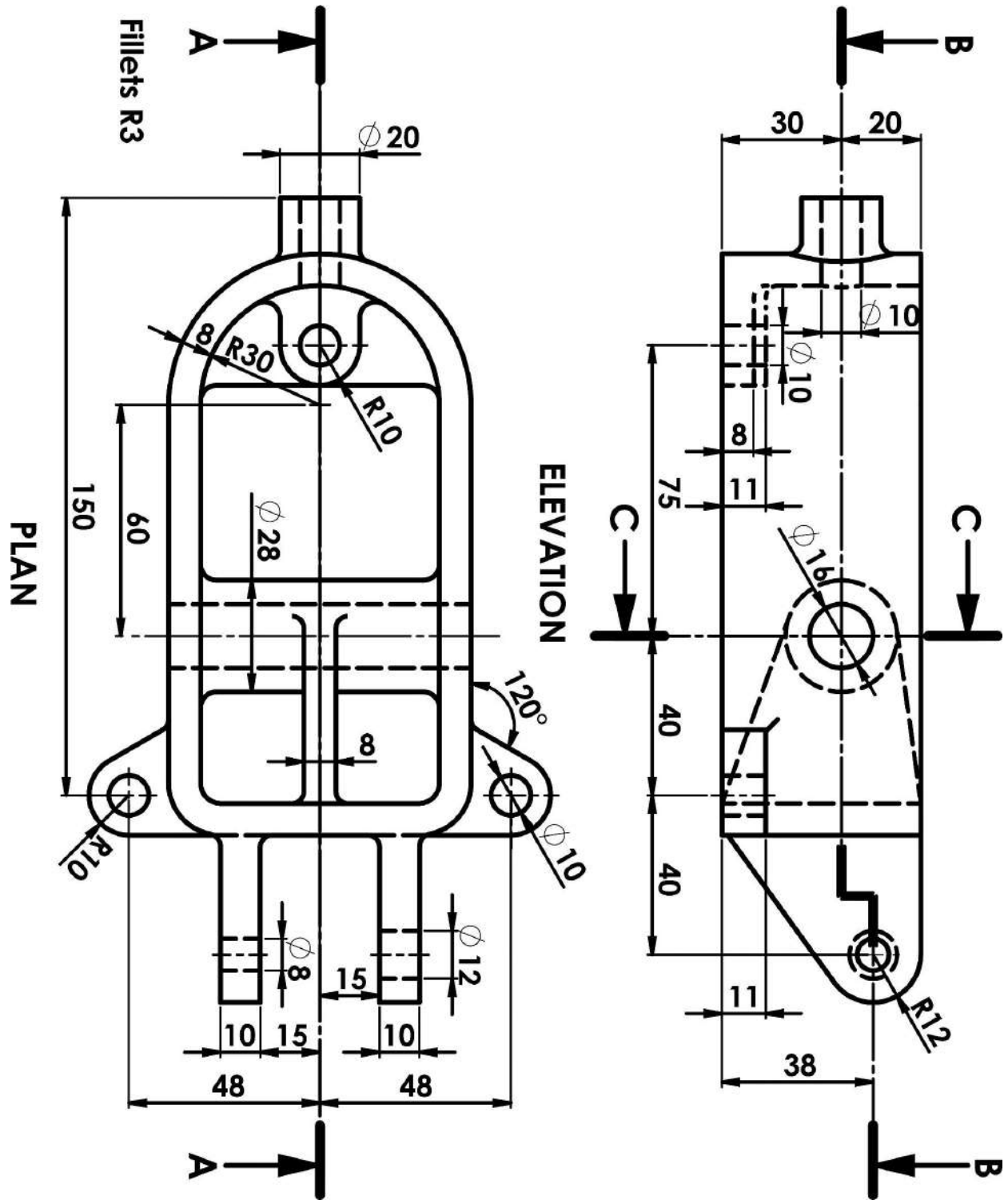

PLAN
ELEVATION
A
A
B
B
C
C
150
15
60
6
18
22
R30
66
R24
144
9
48
R24
28
R6
R54
72
27
27
72
84
9
12
18
R6
R48
R3
9
35
35
52
12
30
12

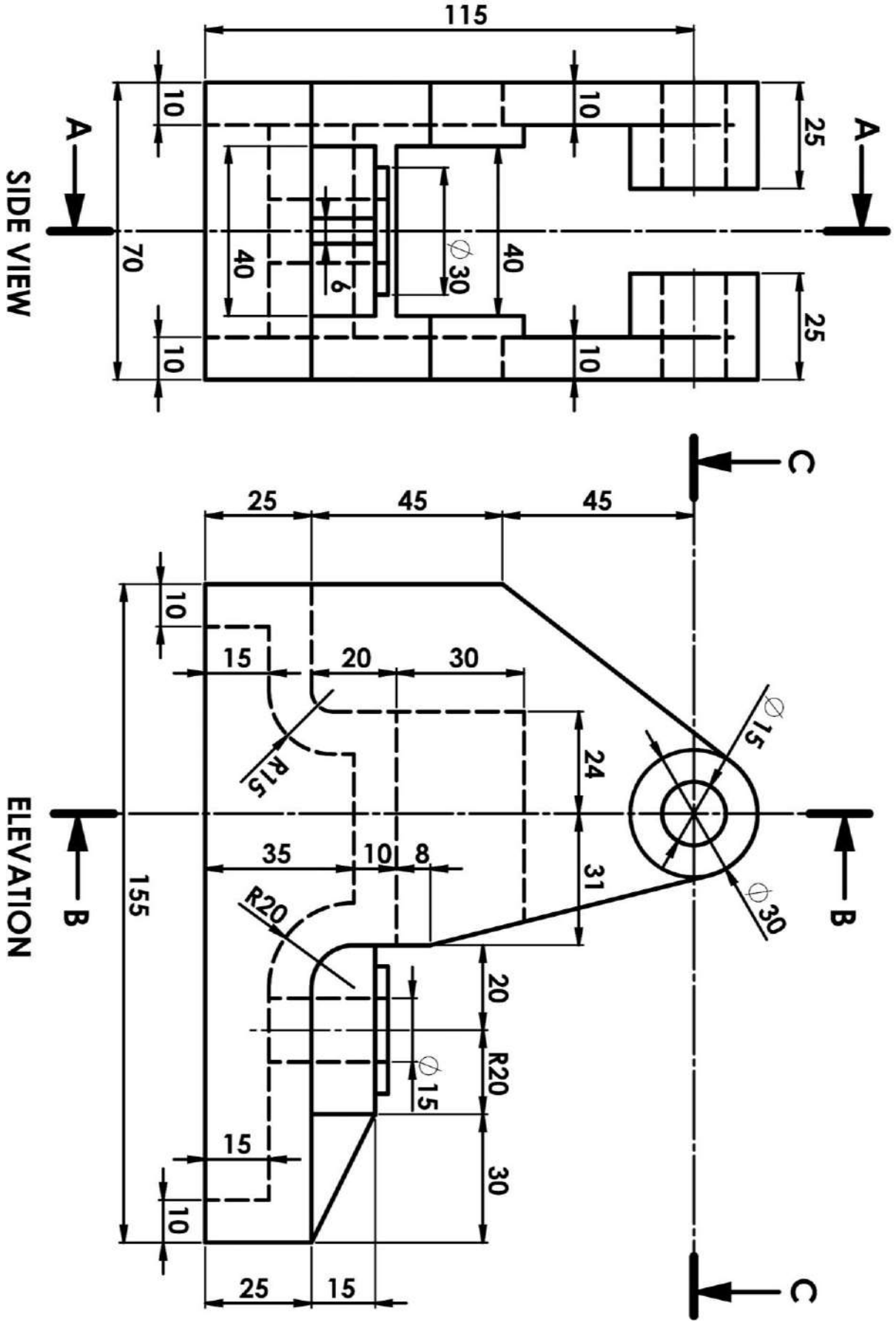

SIDE VIEW
A
A
54
30
21
23
16
28
45
61
ELEVATION
B
B
R8
5
R17
R15
∅14
M12
140
104
60
45
∅10
∅20
8
14

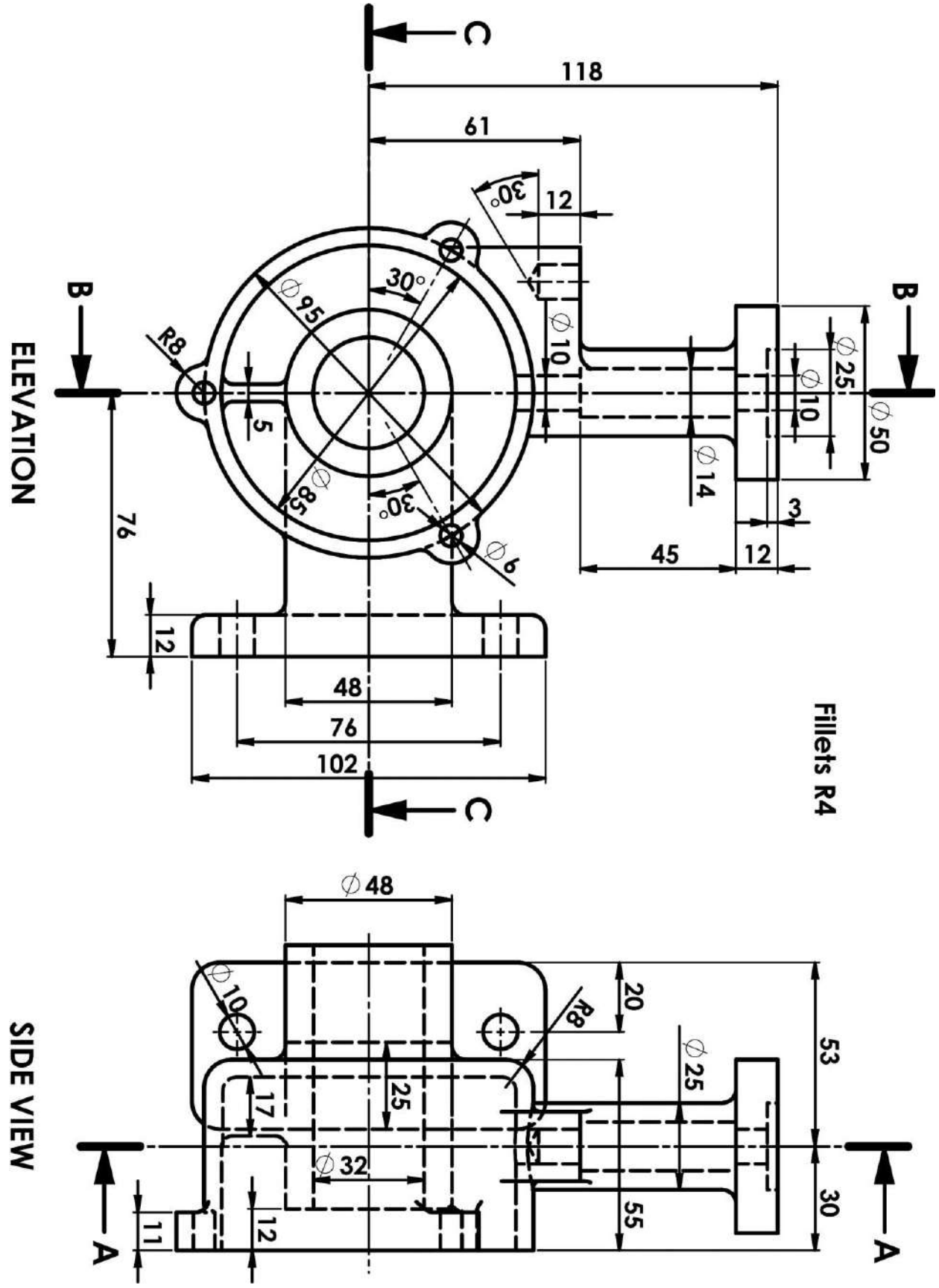

SIDE VIEW
ELEVATION
FILLETS R3
A
A
B
B
C
C
∅30
5
25
12
25
30
20
30
25
25
5
120
80
85
65
R10
45
15
R10
5
45
45
125
15
5
30
5
10
40
10
R10
R20
∅17
50
25
15
15
∅12
30°
15
5
30
5
70
∅45
∅60
∅70

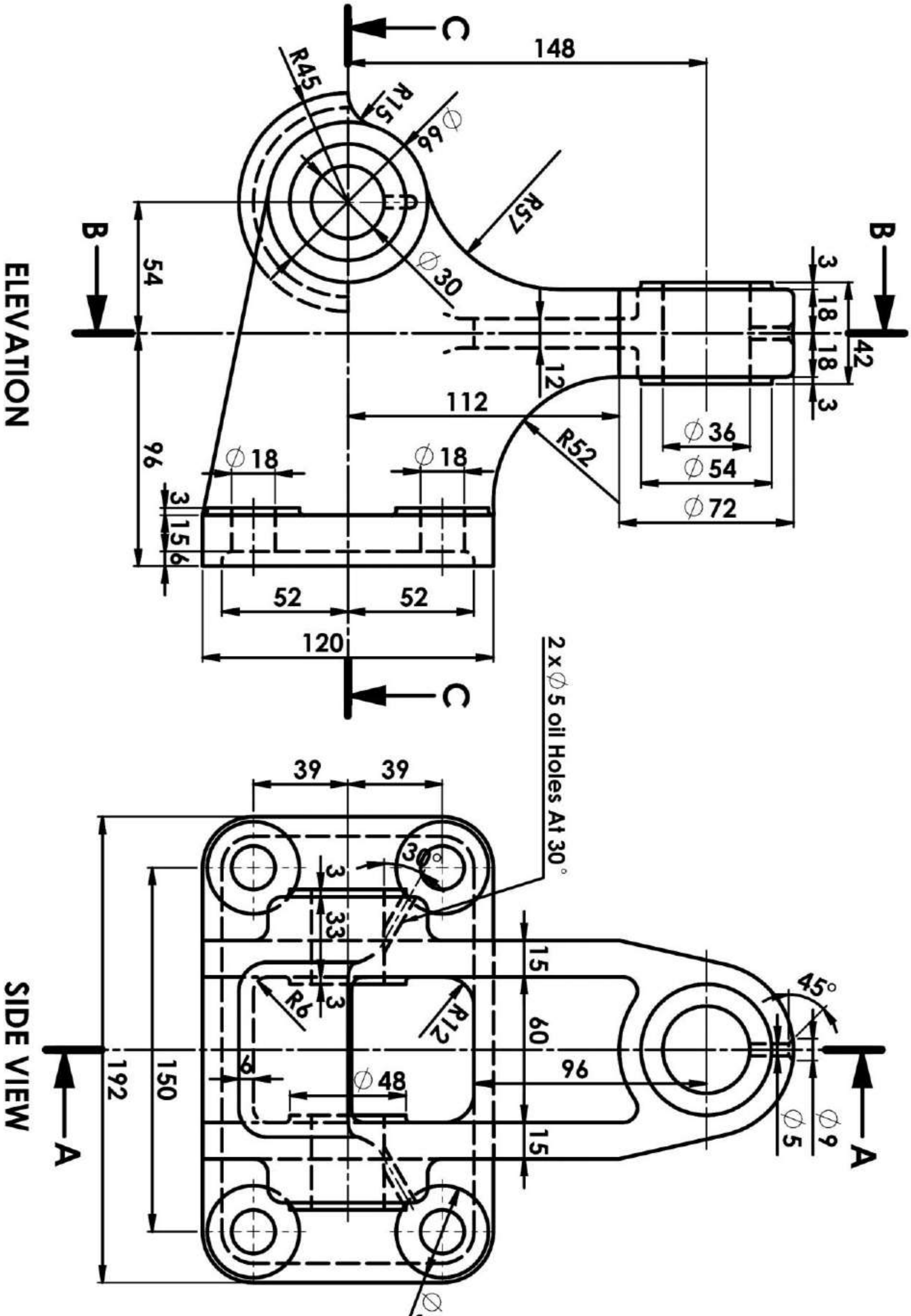

SIDE VIEW
ELEVATION
FILLETS R4
60
∅52
∅40
∅32
∅48
65
70
80
15
18
18
9
∅20
∅32
A
A
B
B
C
C
R19
R28
R28
R37
∅120
∅12
∅96
∅46
∅32
126
40
40

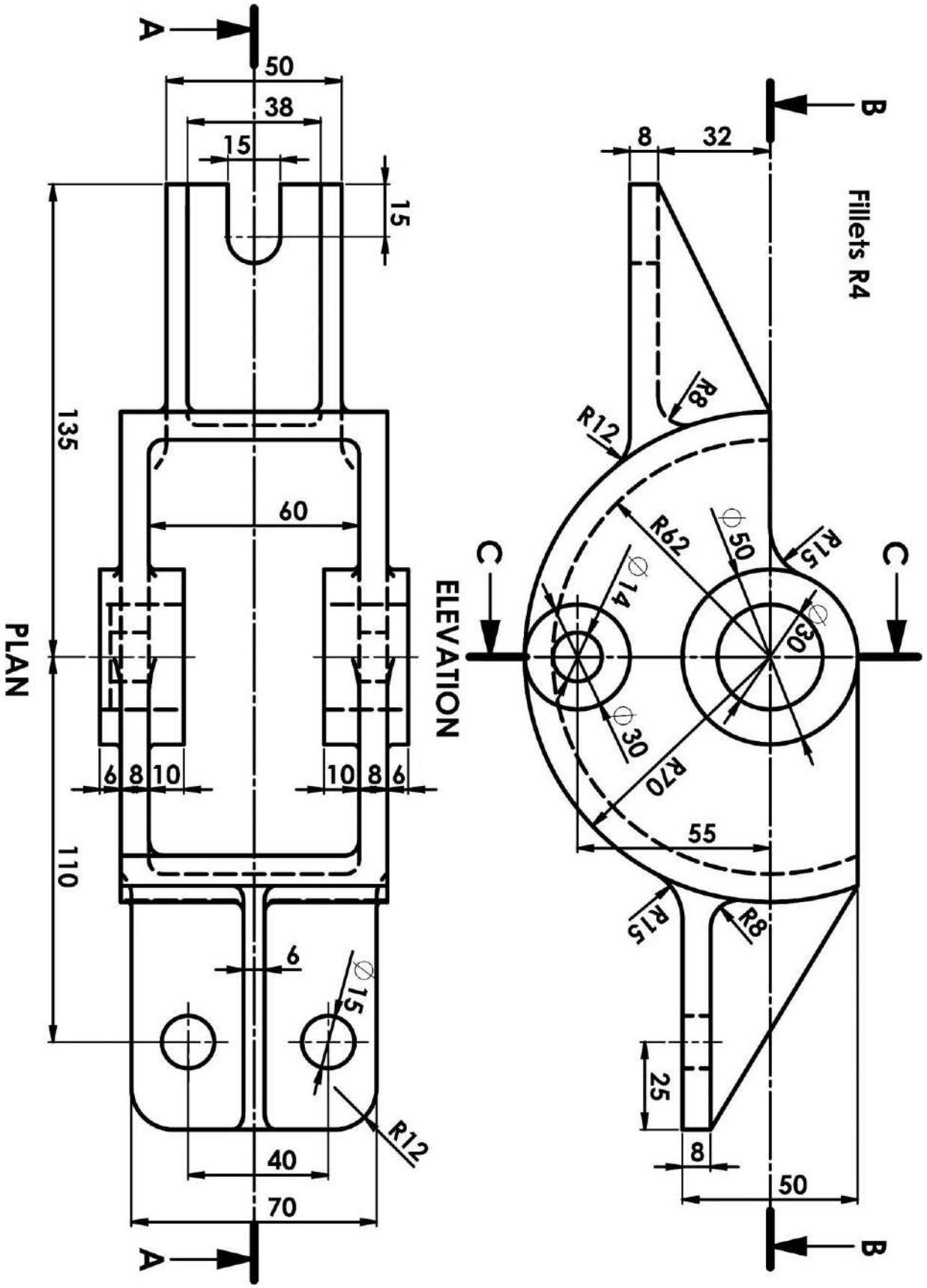

ELEVATION
SIDE VIEW
4 HOLES
∅13
C
B
A
15
80
56
190
5
7
8
11
50
63
∅24
∅38
22
6° INCLUDED
ANGLE ON
EACH BOSS
58
118
∅40
R18
R75
94
46
100
24
14
62
27
40
158

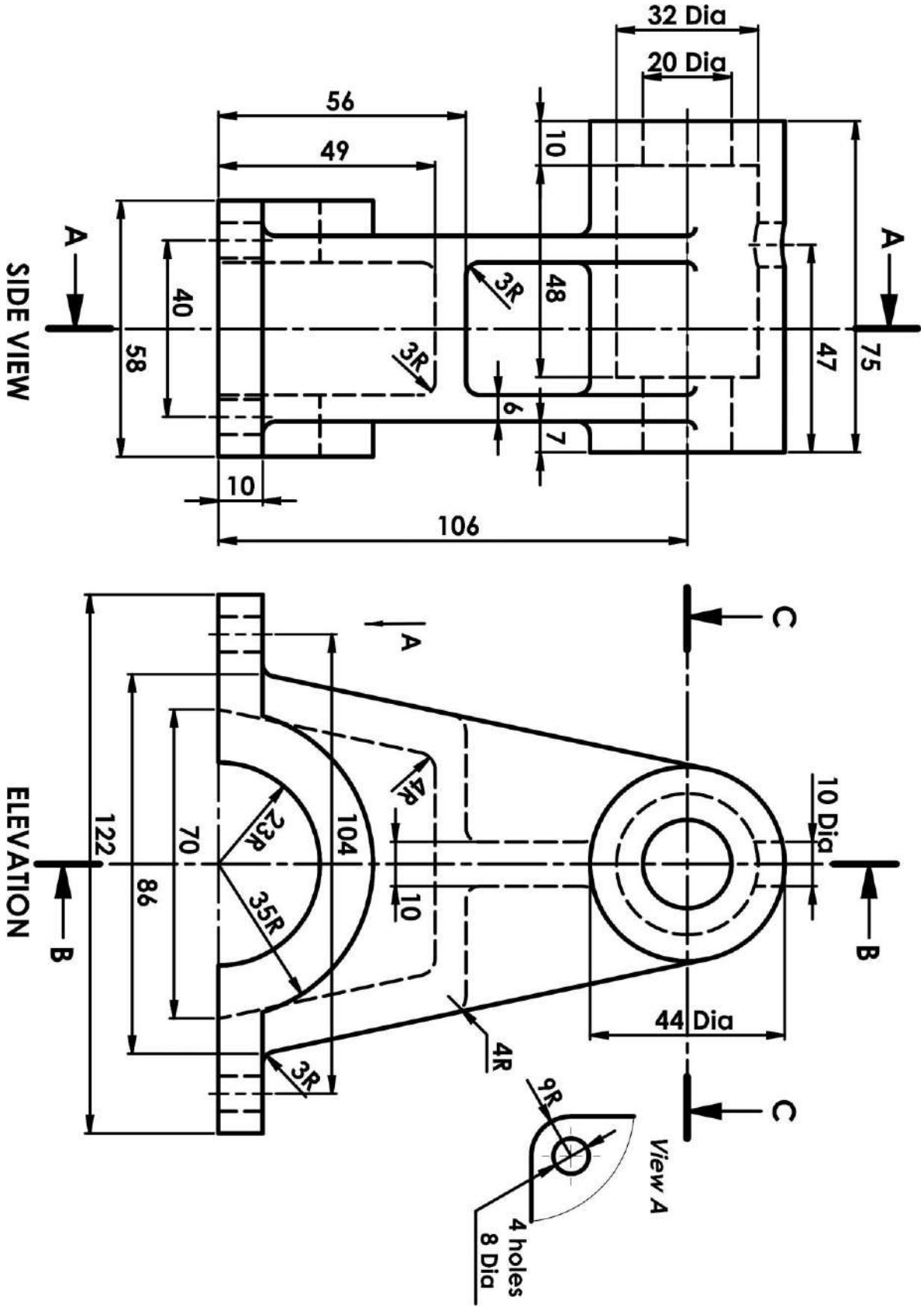

PLAN
ELEVATION
Fillets R3
A
A
B
B
C
C
∅20
∅28
∅8
∅12
∅10
∅10
∅10
∅16
8
R30
R10
R10
R12
150
60
75
8
11
40
40
11
8
15
10
15
10
48
48
38
30
20
120°

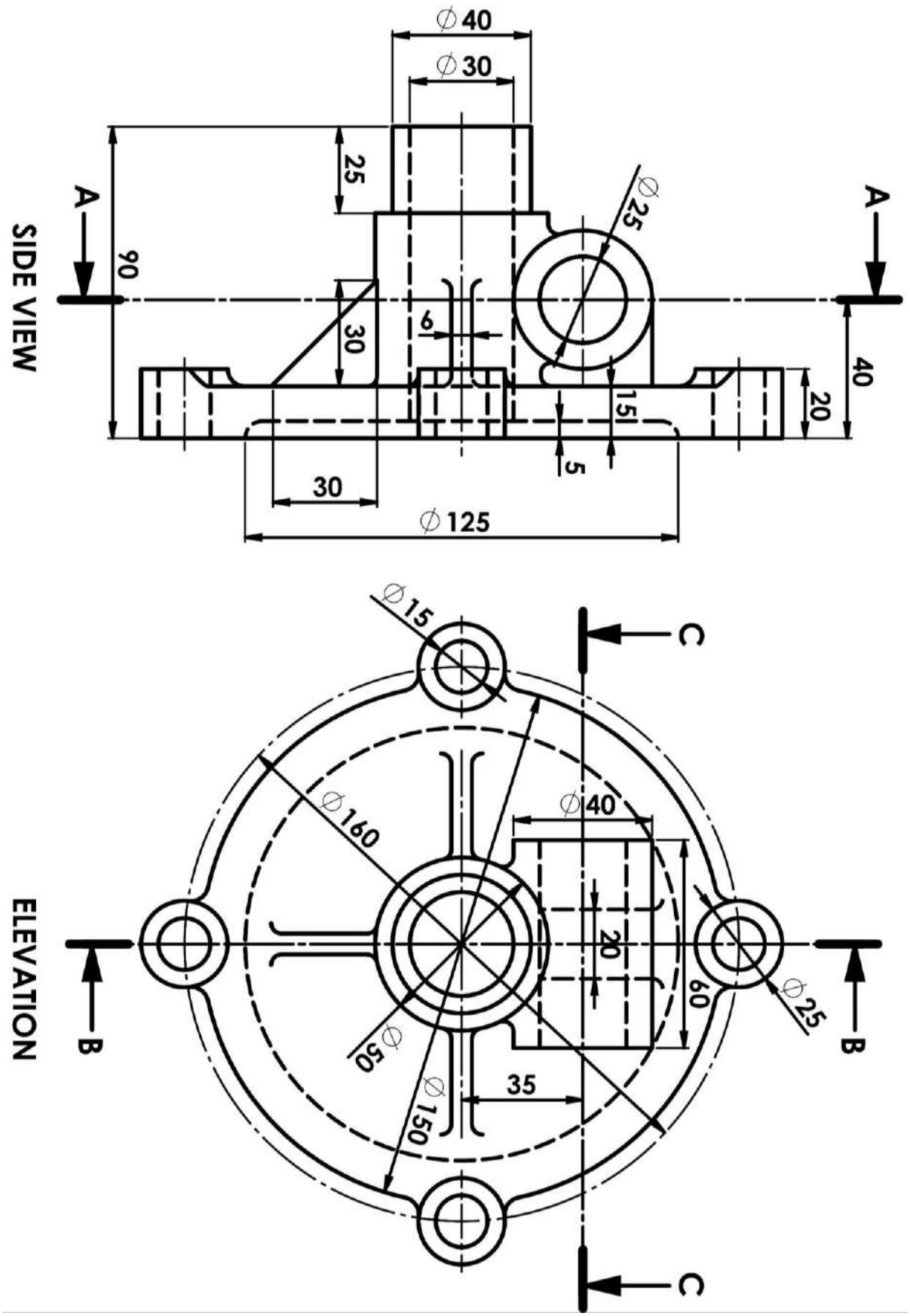

SIDE VIEW
ELEVATION
115
10
10
25
A
A
70
40
6
∅30
40
25
10
10
C
25
45
45
10
15
20
30
R15
∅15
24
B
B
35
10
8
31
155
R20
∅30
20
R20
∅15
15
30
10
25
15
C

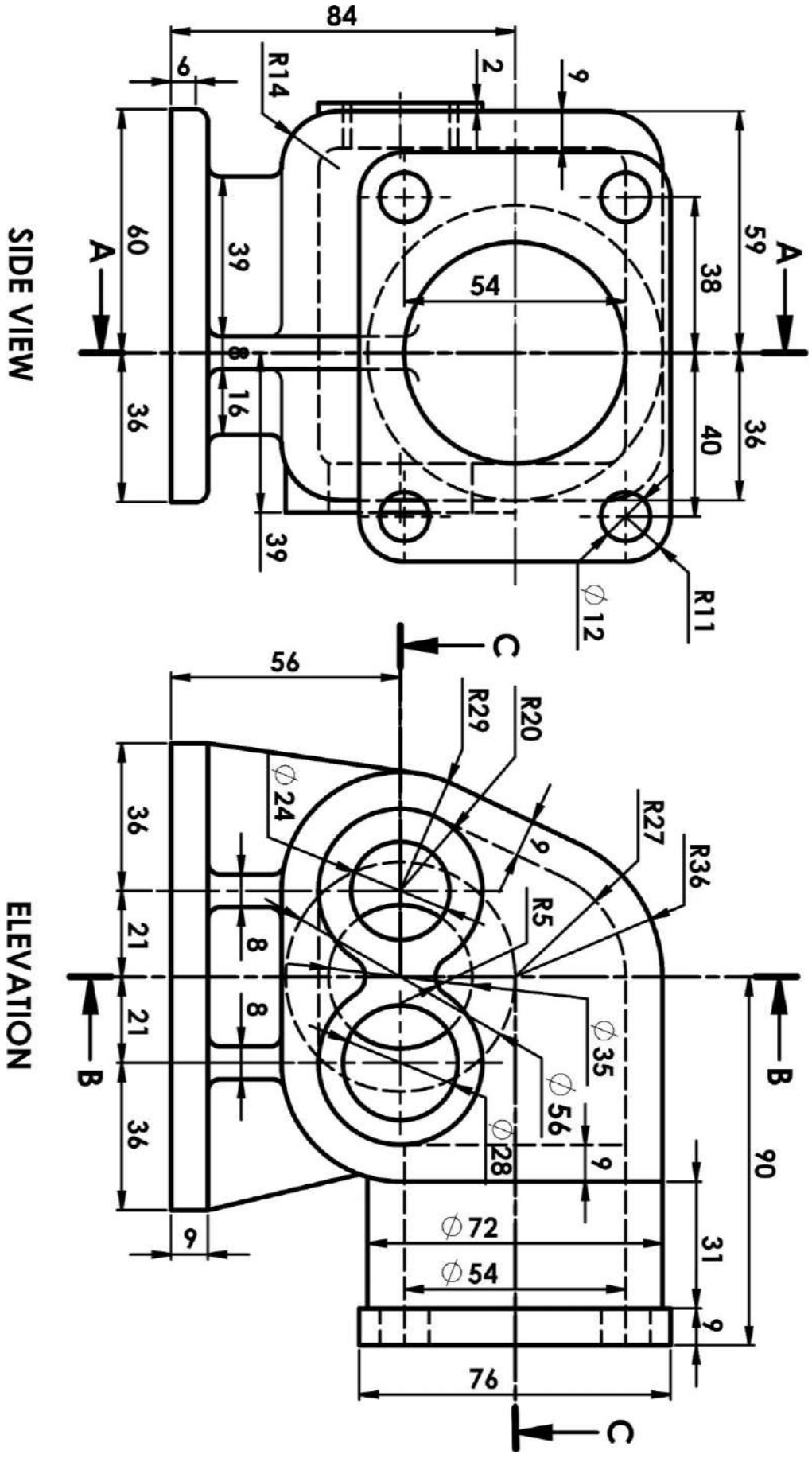

ELEVATION
SIDE VIEW
Fillets R4
118
61
12
30°
95
R8
5
85
10
25
50
14
3
45
76
48
102
6
B
C
A
20
53
55
30
11
17
32

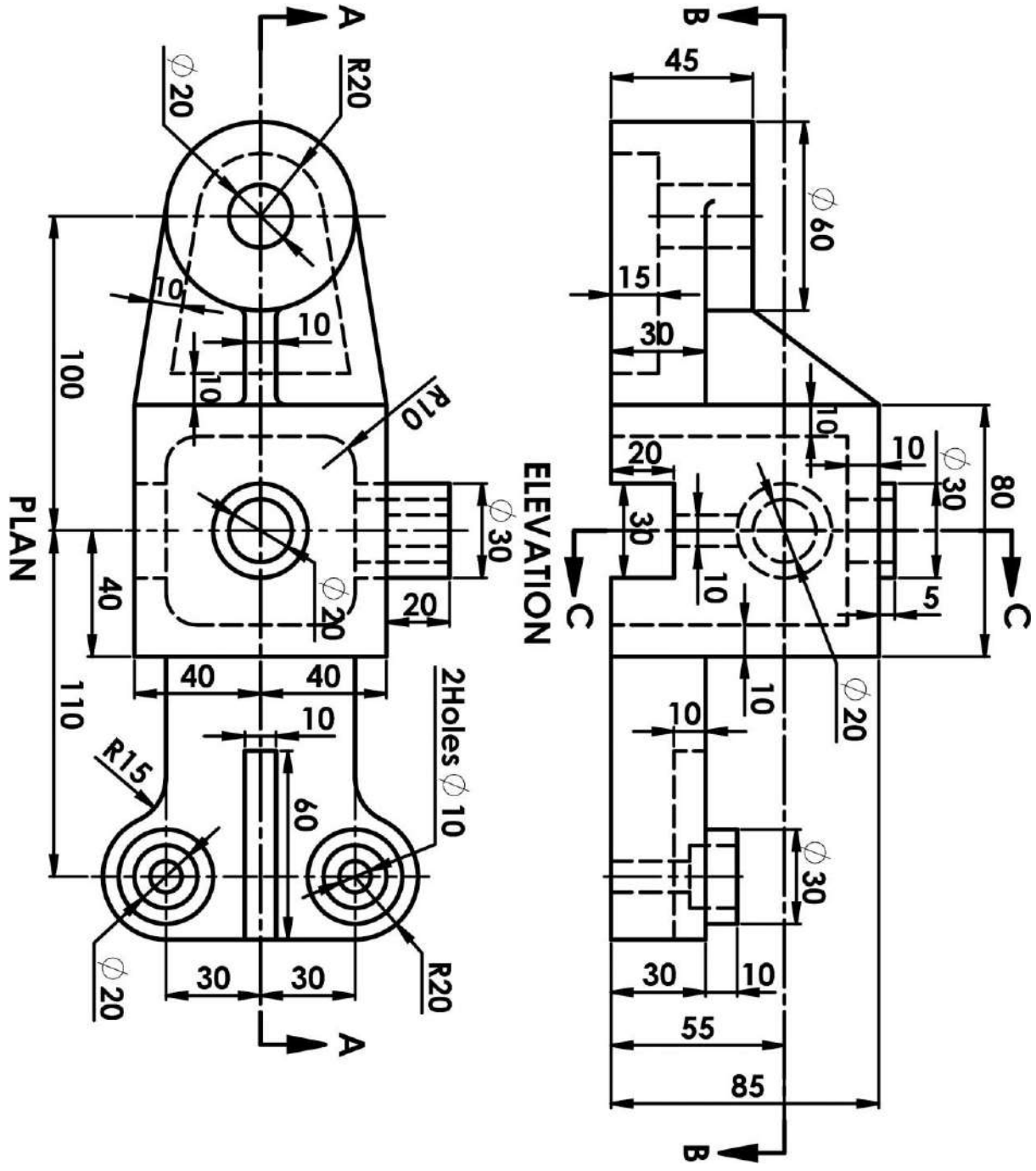

ELEVATION
SIDE VIEW
2 x ∅ 5 oil Holes At 30°
B
B
C
C
A
A
148
R45
R15
∅ 66
R57
∅ 30
54
96
112
R52
12
3
18
18
3
42
∅ 36
∅ 54
∅ 72
∅ 18
∅ 18
3
15
6
52
52
120
39
39
30°
3
33
3
R6
R12
15
60
15
96
45°
∅ 5
∅ 9
6
∅ 48
192
150
∅ 38


A
50
38
15
15
135
60
PLAN
6
8
10
10
8
6
110
6
15
R12
40
70
A
B
8
32
Fillets R4
R8
R12
R62
50
R15
C
C
14
30
30
R70
55
R15
R8
25
8
50
B
ELEVATION


SIDE VIEW
ELEVATION
32 Dia
20 Dia
56
49
10
A
A
40
58
3R
48
3R
6
7
47
75
10
106
C
A
4R
122
70
23R
104
10
86
35R
10 Dia
B
B
44 Dia
4R
3R
9R
C
View A
4 holes
8 Dia


SIDE VIEW
ELEVATION
∅40
∅30
25
90
30
6
∅25
40
20
15
5
30
∅125
A
A
∅15
C
∅160
∅40
20
60
∅25
B
B
∅50
∅150
35
C


SIDE VIEW
ELEVATION
84
6
2
9
R14
60
39
54
38
59
A
A
8
16
36
40
36
39
Ø12
R11
C
56
R29
R20
Ø24
R27
R36
9
R5
8
8
21
21
36
B
B
Ø35
Ø56
Ø28
9
90
9
Ø72
Ø54
31
9
76
C


PLAN
ELEVATION
A
B
C
R20
∅20
10
100
R10
∅30
40
110
R15
60
2Holes ∅10
30
45
∅60
15
80
5
55
85

Chapter 2

Developments

The process of unfolding the three-dimensional ‘solid’ is called ‘development’. The sheet material must be shaped so that, after it is bent, we have the correct size and shape. Then a component is to be made of sheet material, the designer must not only visualize and draw the final three-dimensional component, but also calculate and draw the shape of the component in the form that it will take when marked out on the two-dimensional sheet material.

The developments of shapes of most engineering components as whole, or parts of prisms, pyramids, cylinders, or cones are presented in this chapter which deals with the development of some of these shapes.

2.1 Development of Prisms

Figure 2.1 shows how a square prism is unfolded and its development obtained. Note that where there are corners in the undeveloped solid, these are shown as dotted lines in the development.

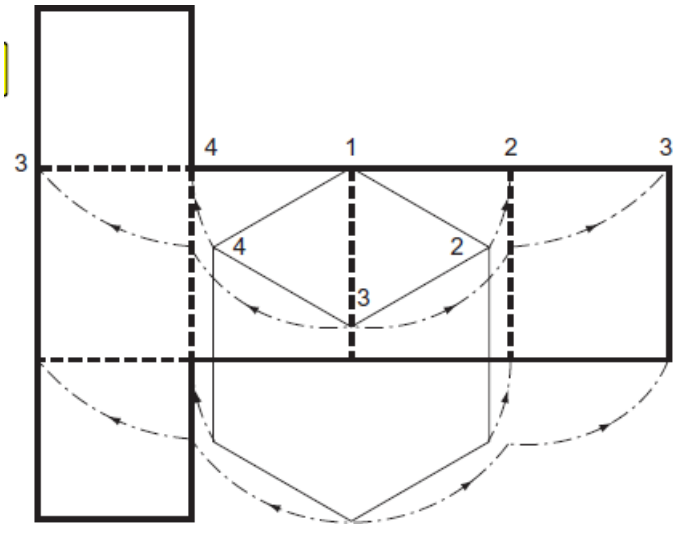


Fig.2.1: Developing a square prism.

2.2 Development of Cylinders

If you painted the curved surface of a cylinder and, while the paint was wet, placed the cylinder on a flat surface then rolled it once, the pattern that the paint left on the flat surface would be the development of the curved surface of the cylinder.

Figure 2.2, shows the shape that would evolve if the cylinder was cut obliquely at one end. The length of the development would be πD, the circumference. The oblique face has been divided into 12 equal parts and numbered. You can see where each number will touch the flat surface as the cylinder is rolled.

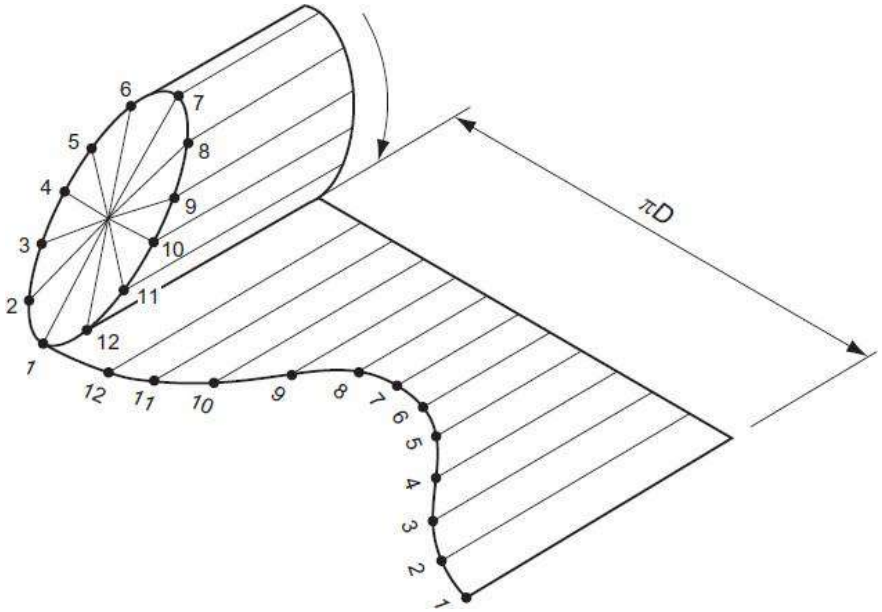


Fig. 2.2: The development of a cylinder.

2.2.1 Developing a cylinder in elevation with a circular piece cut

The plan of the cylinder is divided into 12 equal sectors and the location of the sectors that are within the circular cut-out are projected down to the front elevation and across to the development. There are some more points that must also be plotted.

These are 3`, 5`, 9` and 11`. Their positions can be seen most easily on the front elevation and they are projected up to the plan. The plan shows how far they are away from points 3, 5, 9 and 11 and these distances, *a* and *b* , can be transferred to the development. The exact positions of these points can then be projected across from the front elevation to the development.

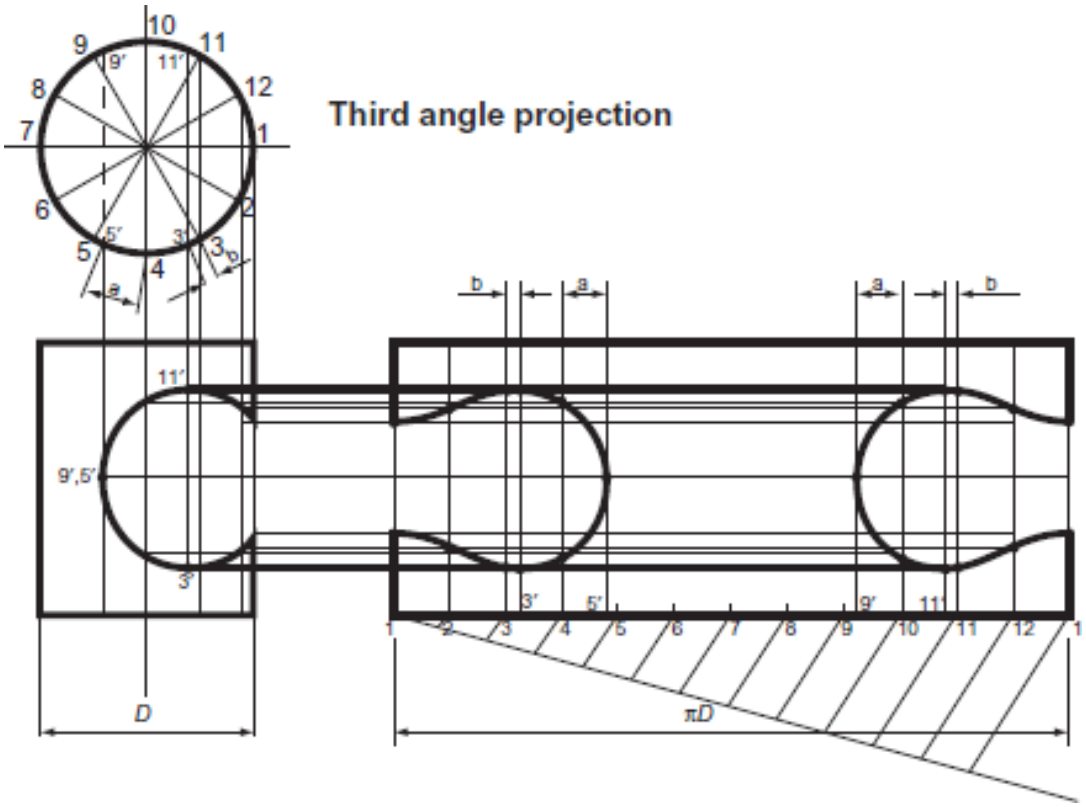


Fig. 2.3**:** Developing a cylinder with a circular piece cut.

2.2.2 Developing an intersecting cylinder

The shape of the development is determined by the shape of the line of intersection.

Once this has been found, the development is found using the same methods as in previous cases.

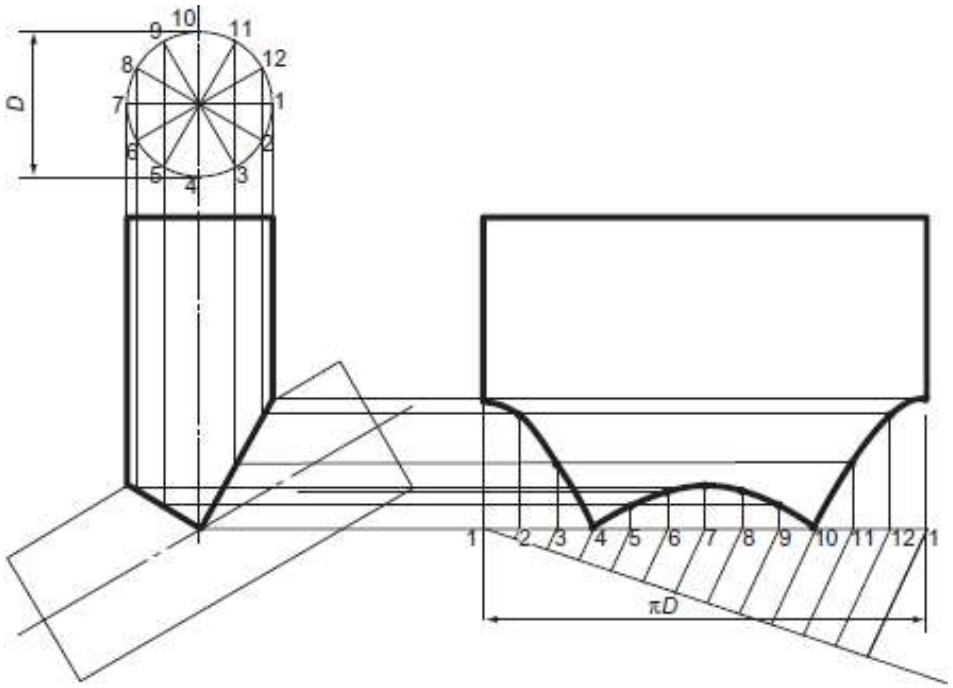


Fig. 2.4: Developing an intersecting cylinder.

2.2.3 Developing both intersecting cylinders

Extra points are added to the circumference of the larger cylinder (2`, 3`, 11` and 12`) so that the development can be drawn more accurately. The diameters of the two cylinders are different; therefore the lengths of the development are different. Both cylinders are divided into 12 equal sectors and the points where these sectors meet the line of intersection are different on each development, fig. 2.5.

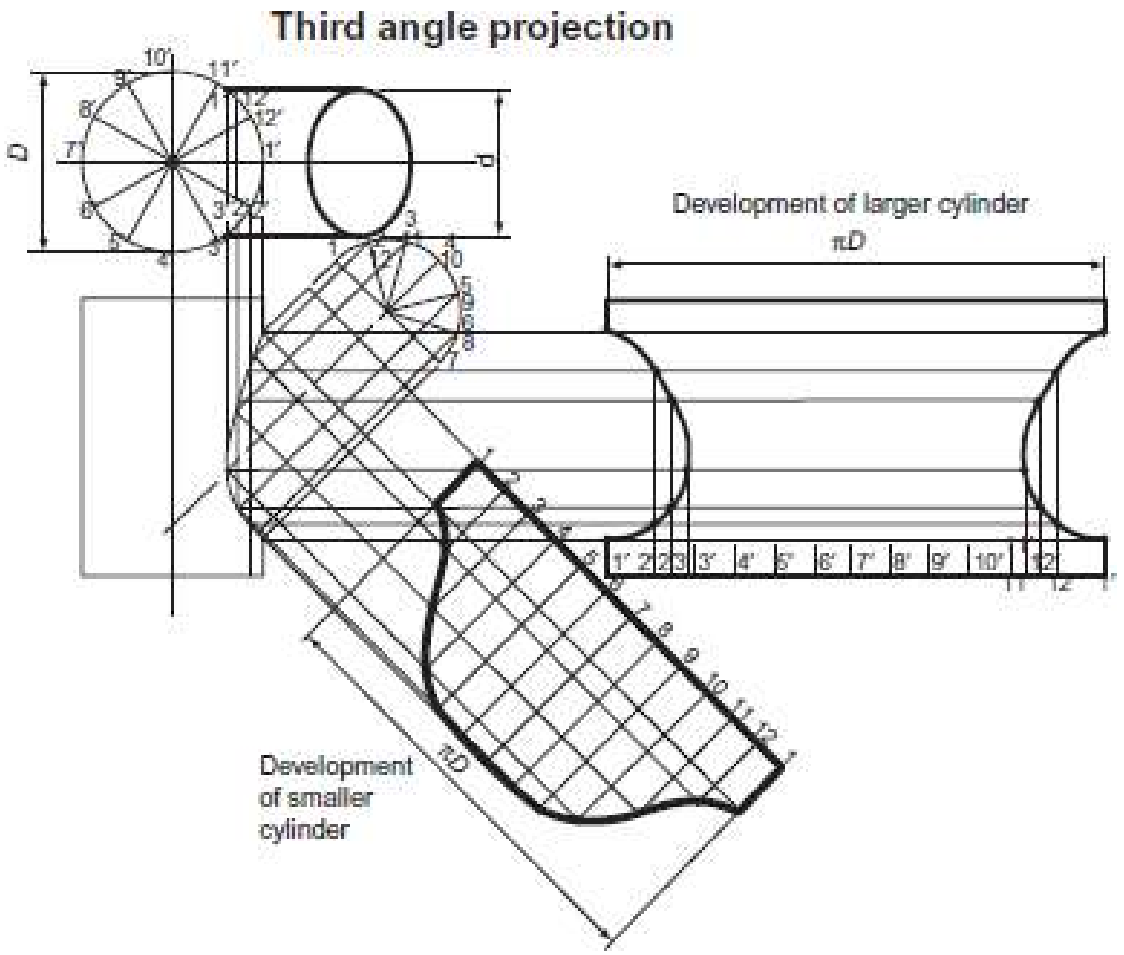


Fig. 2.5: Developing both intersecting cylinders.

2.3 Development of Pyramids

If a pyramid is tipped over so that it lies on one of its sides and is then rolled so that each of its sides touches in turn, the development is traced out. The development is formed within acircle whose radius is equal to the true length of one of the corners of the pyramid, fig. 2.6.

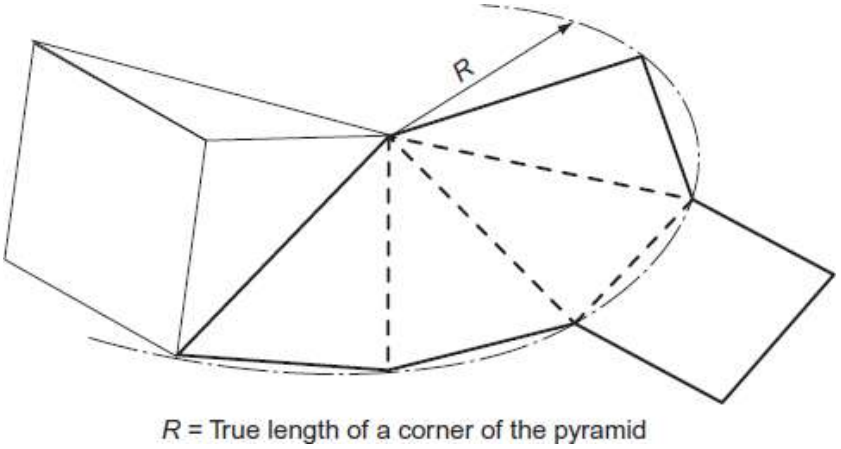


Fig. 2.6: developing of a pyramid

2.3.1 Developing the sides of the frustum of a square pyramid

The true length of a corner of the pyramid can be seen in the front elevation. An arc is drawn, radius equal to this true length, center the apex of the pyramid. A second arc is drawn, radiusequal to the distance from the apex of the cone to the beginning of the frustum, center the apexof the cone. The width of one side of the pyramid, measured at the base, is measured on the planand this is stepped round the larger arc four times, fig. 2.7.

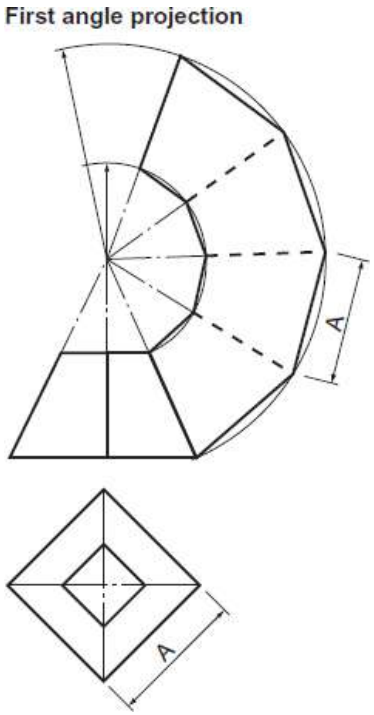


Fig. 2.7: Developing the sides of the frustum of a square pyramid

2.3.2 Developing the sides of a hexagonal frustum with an oblique cut

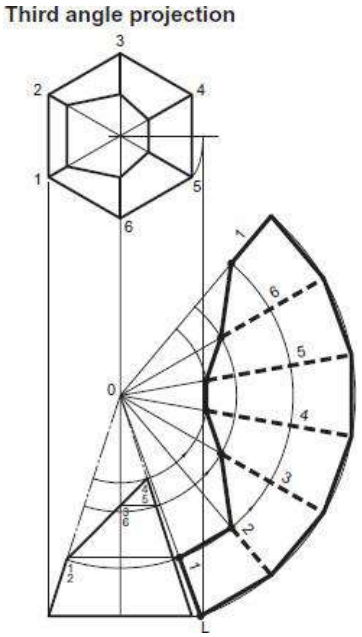


Fig. 2.8: Developing of a hexagonal frustum with an oblique cut

2.3.3 Development of Cones

The development forms a sector of a circle whose radius is equal to the slant height of thecone. The length of the arc of the sector is equal to the circumference of the base of the cone. If the base of the cone is divided into 12 equal sectors that are numbered from 1 to 12, the pointswhere the numbers touch the flat surface as the cone is rolled can be seen, fig. 2.9.

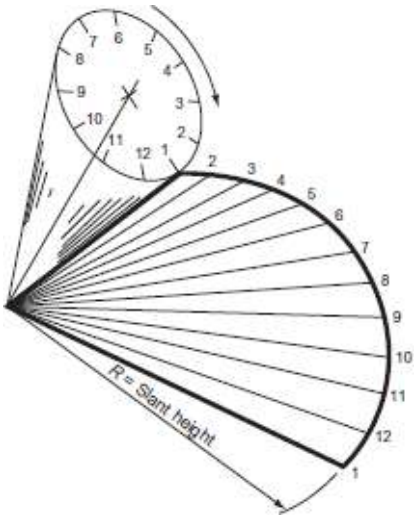


Fig. 2.9: Developing of a cone

2.3.4 Developing the frustum of a cone

The plan and elevation of the frustum of a cone are shown in Fig. 2.10; the plan is divided into 12 equal sectors. The arc shown as dimension A is 1/12 of the circumference of the base of the cone.

With center at the apex of the cone draw two arcs, one with a radius equal to the distance from the apex to the top of the frustum (measured along the side of the cone) and the other equal to theslant height of the cone. With dividers measure distance A and step this dimension around the larger arc 12 times. (This will not give an exact measurement of the circumference at the base of the cone, but it is a good approximation.)

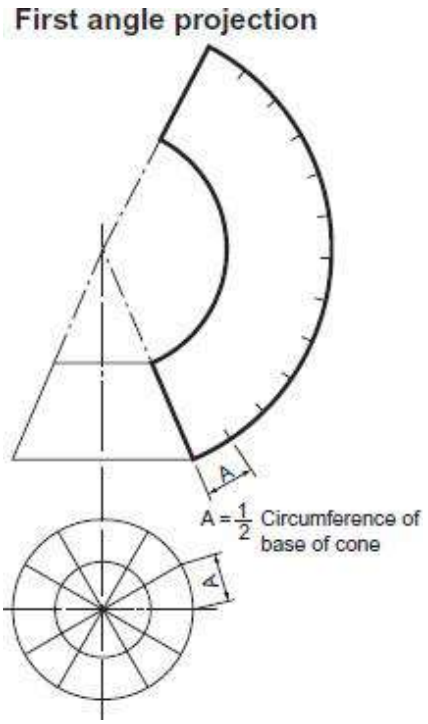


Fig. 2.10: Developing the frustum of a cone

2.3.5 Developing the frustum of a cone with an oblique cut

Divide the plan into 12 equal sectors and number them from 1 to 12. Project these down tothe front elevation and draw lines from each number to the apex A. You can see where each of these lines crosses the oblique top of the frustum. Now draw the basic development of the cone and number each sector from 1 to 12 and draw a line

between each number and the apex A. Lines A_1 and A_7 on the front elevation are the true length of the slant height of the cone.

In fact, all of the lines from A to each number are equal in length but, on the front elevation, lines A_2 to A_6 and A_8 to A_{12} are shorter than A_1 and A_7 because they are sloping 'inwards' towards A.

The true lengths from A to the oblique top of the frustum on these lines are found byprojecting horizontally across to the line A_1. Here, the true length can be swung round with compasses to its respective sector and the resulting series of points joined together with a neat curve, fig. 2.11.

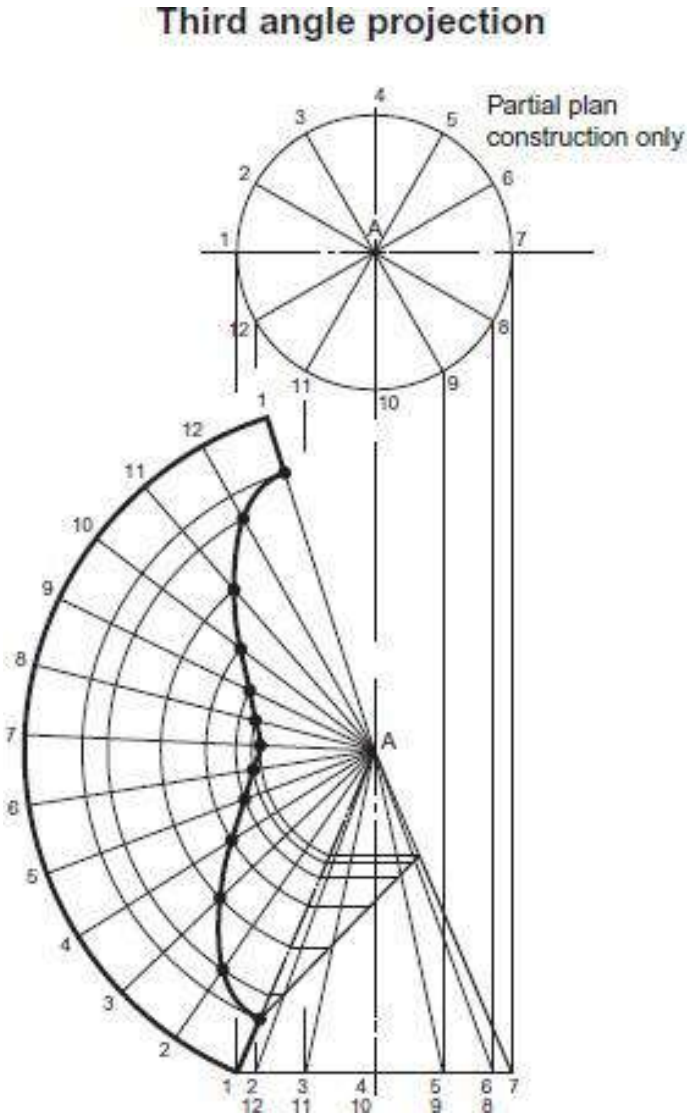


Fig. 2.11: Developing the frustum of a cone with an oblique cut

Chapter 3

Steel Structures

Steel-framed buildings require structural engineering and shop drawings. As a drafter in an engineering or architectural firm, you may be drafting engineering drawings similar to the one shown in fig. 3.1.

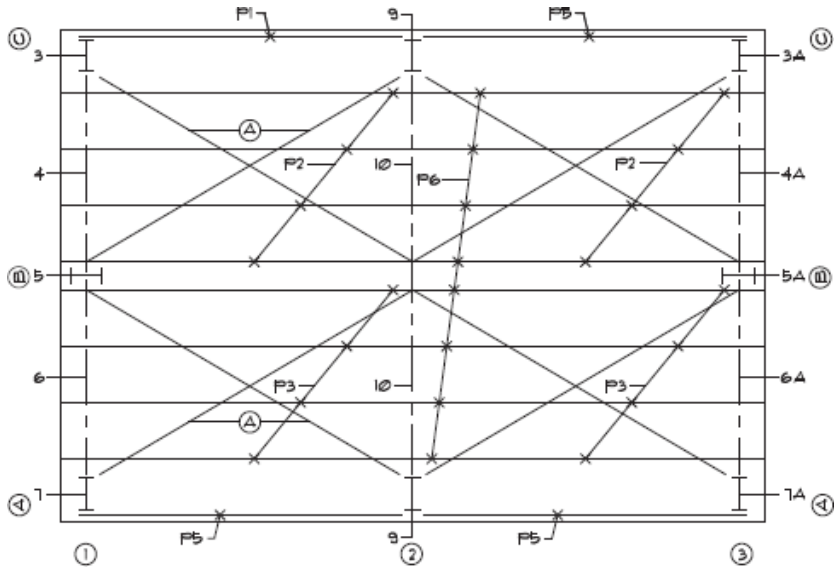


Fig. 3.1: Structural Steel Engineering Drawing

3.1 Common Structural Steel Structure Shapes

Structural steels are commonly identified as plates, bars, or shape configurations. **Plates** are flat pieces of steel of various thickness used at the intersection of different members and for Structural steel is also available in several different manufactured shapes as shown in fig. 3.2. Plates are typically specified on a drawing by giving the thickness, width, and length in that order and with or without inch marks, for example, 1/4 x 6 x 10. The symbol is often used to specify plate material.

Bars are the smallest of structural steel products and are manufactured in round, square, rectangular, flat, or hexagonal cross sections. Bars are often used as supports or braces for other steel parts or connectors. Flat bars are usually specified on a drawing by giving the width, thickness, and length, in that order.

Angles are structural steel components that have an L shape. The legs of the angle can be either equal or unequal in length but are usually equal in thickness. Channels have a squared C cross-sectional area and are designated with the letters C or MC.

Structural tees are produced from W, S, and M steel shapes. Common designations include WT, ST, and MT. **Structural tubing** is manufactured in square, rectangular, and round cross-sectional configurations. These members are used as columns to support loads from other members. **Tubes** are also commonly used for beams and truss members. Tubes are specified by the size of the outer wall followed by the thickness of the wall. **Steel pipe** is also commonly used for columns and bracing. Available steel pipe strengths are standard, extra strong, and double-extra strong. The wall thickness increases with each type.

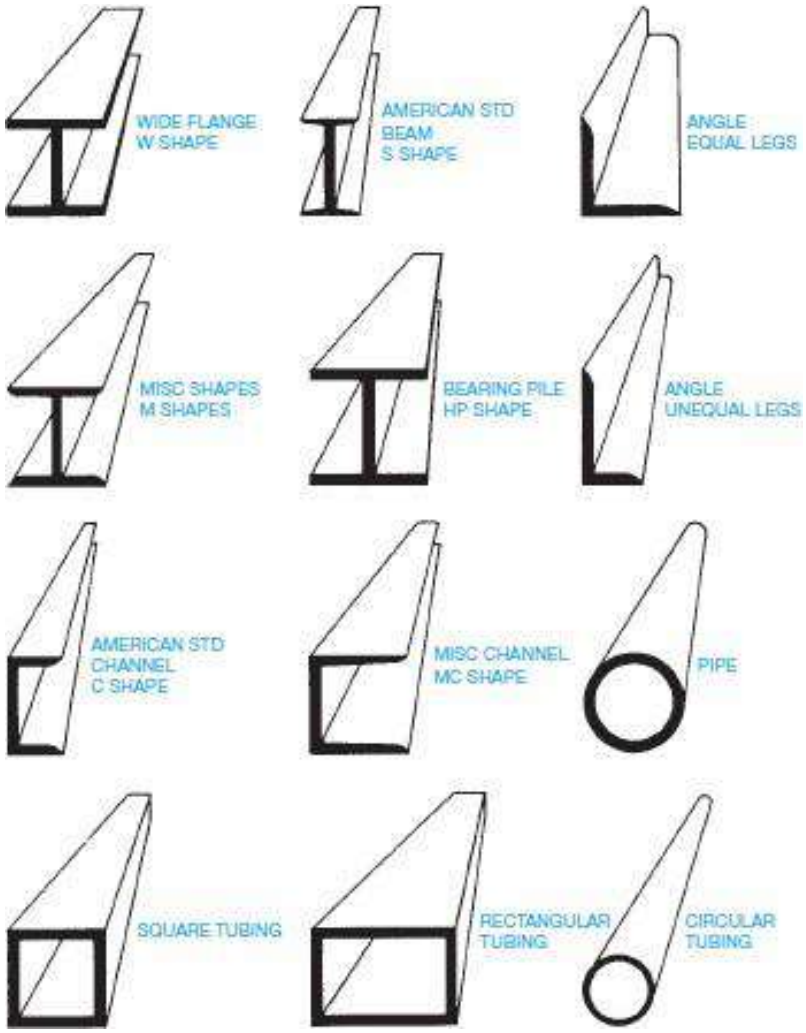
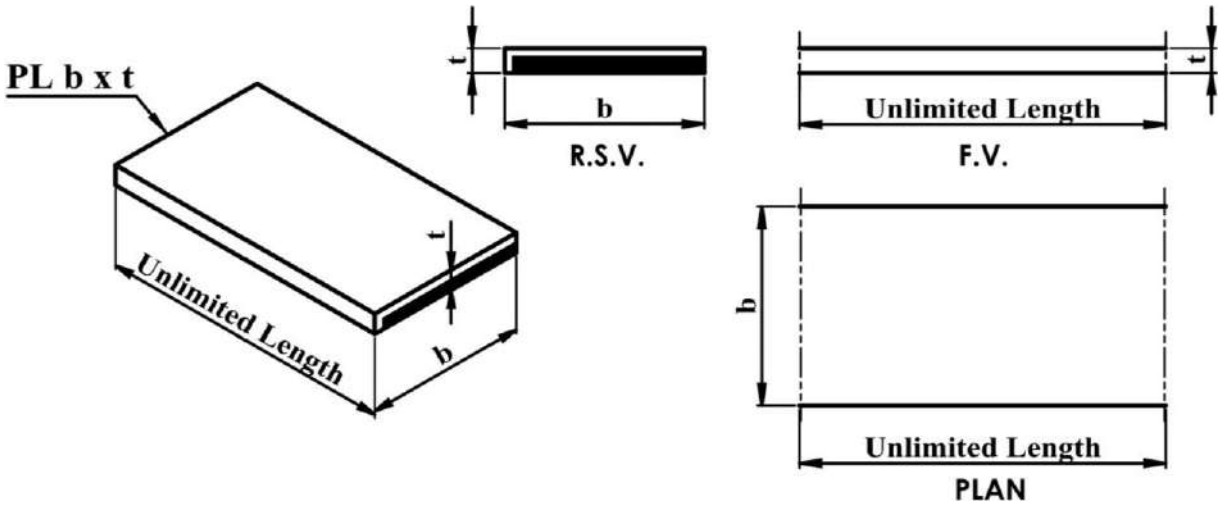


Fig. 3.2: Standard Structural Steel Shapes

3.1.1 Steel Sections

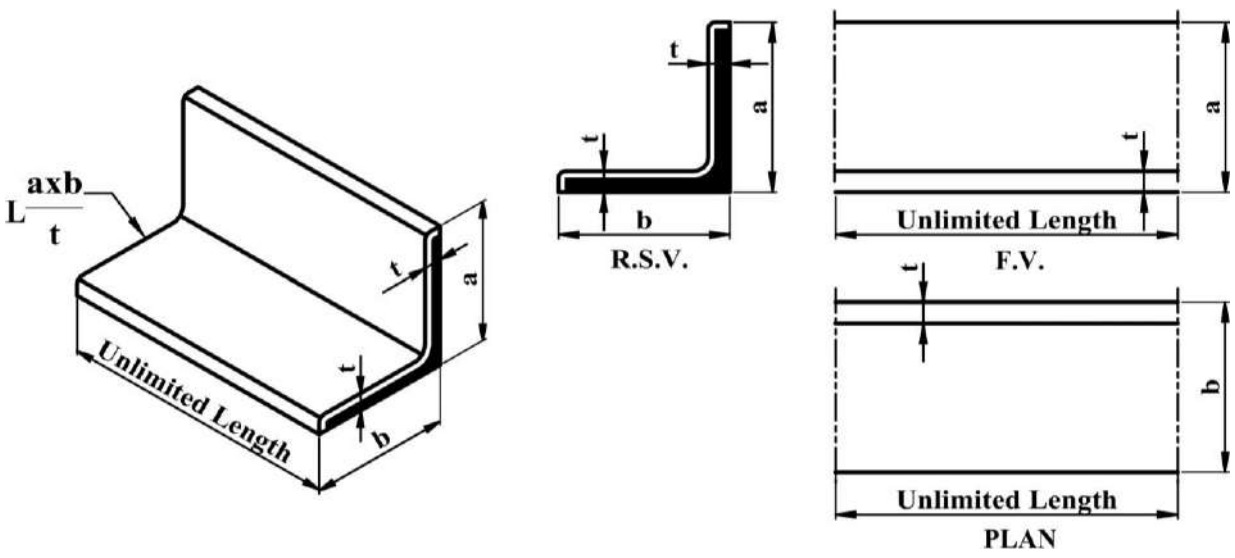
3.1.1.1 STEEL PLATE

PL b x t



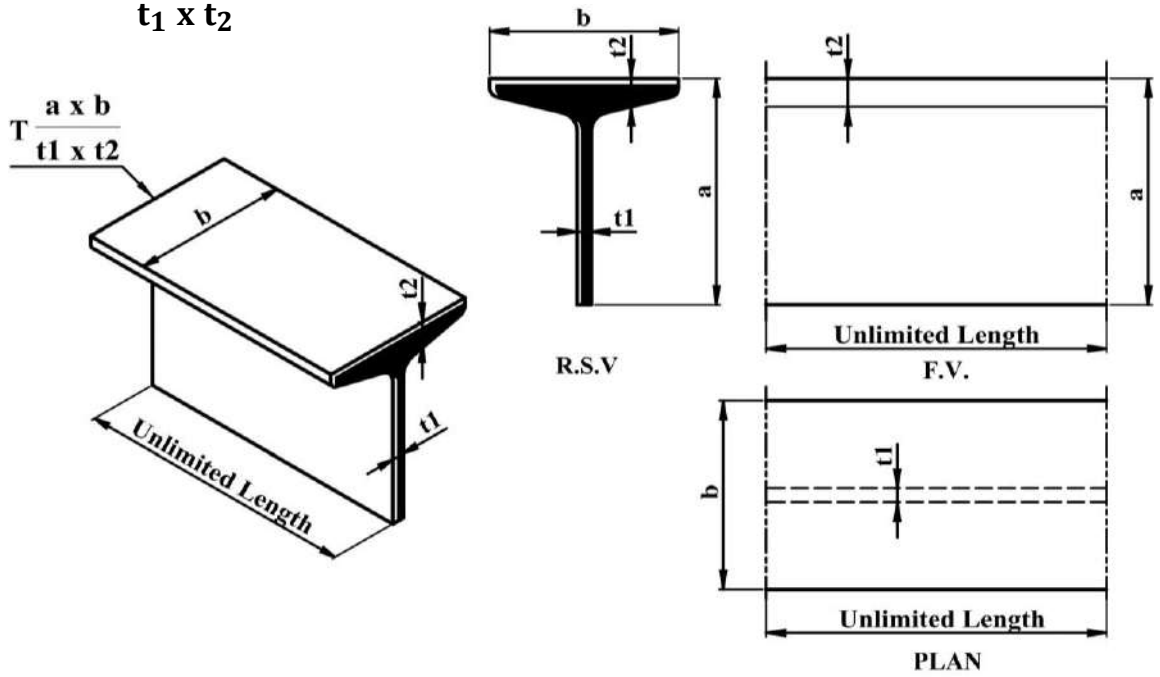
3.1.1.2 ANGLE SECTION

$$\mathbf{L\ \frac{a \times b}{t}}$$



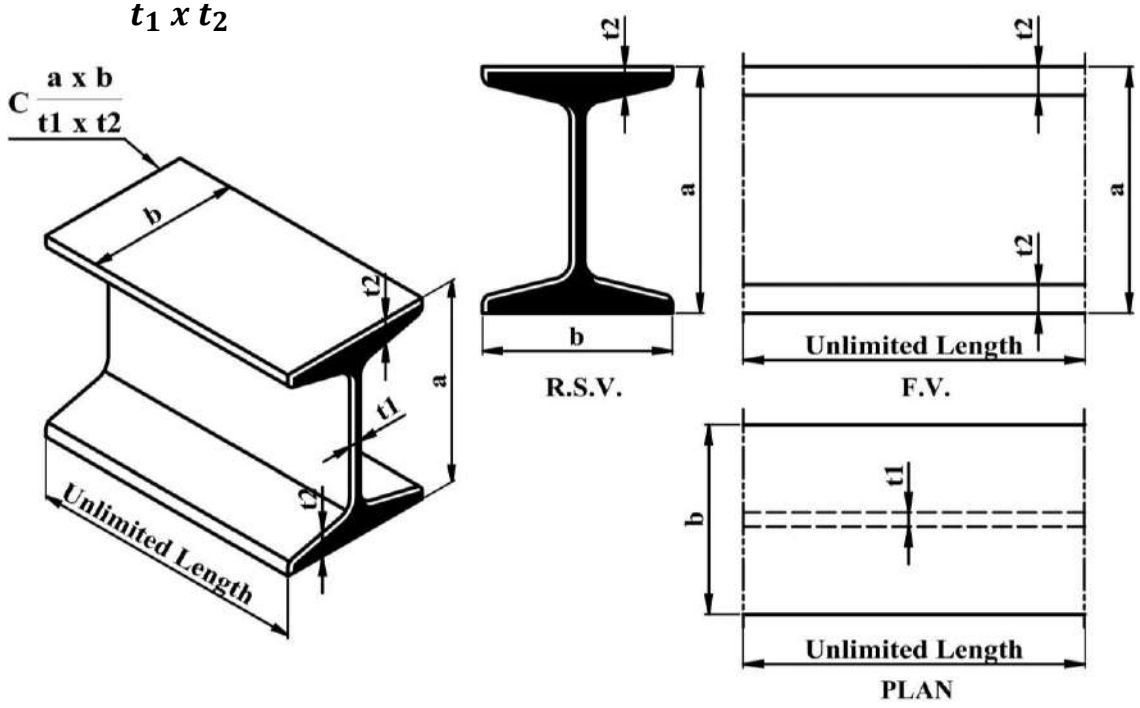
3.1.1.3 T – SECTION:

$$\mathbf{T}\ \frac{\mathbf{a\ x\ b}}{\mathbf{t_1\ x\ t_2}}$$



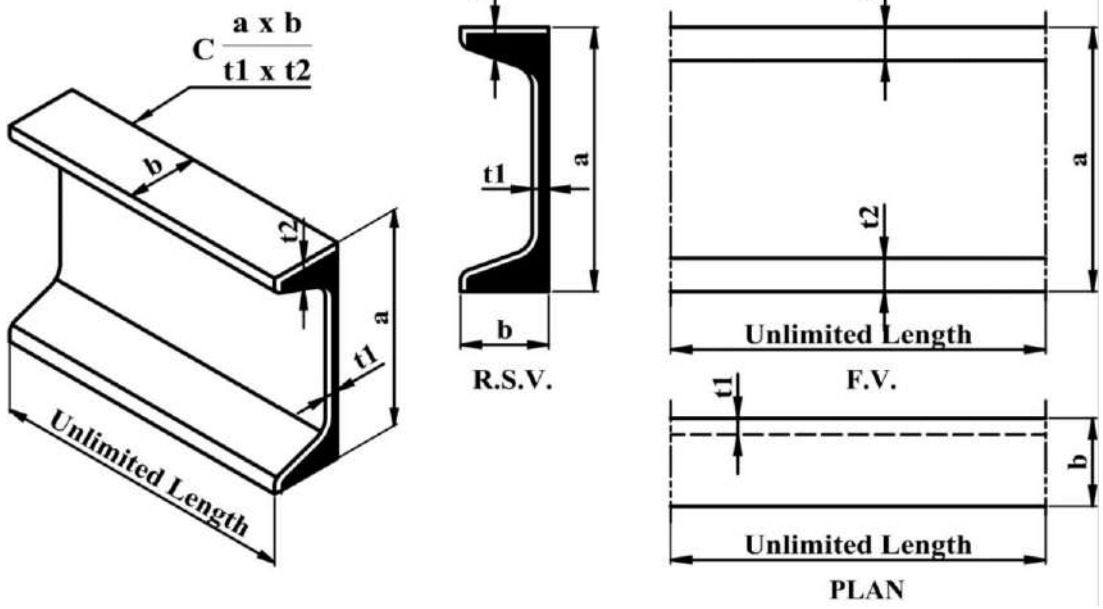
3.1.1.4 I – SECTION:

$$\mathbf{I}\ \frac{\boldsymbol{a\ x\ b}}{\boldsymbol{t_1\ x\ t_2}}$$



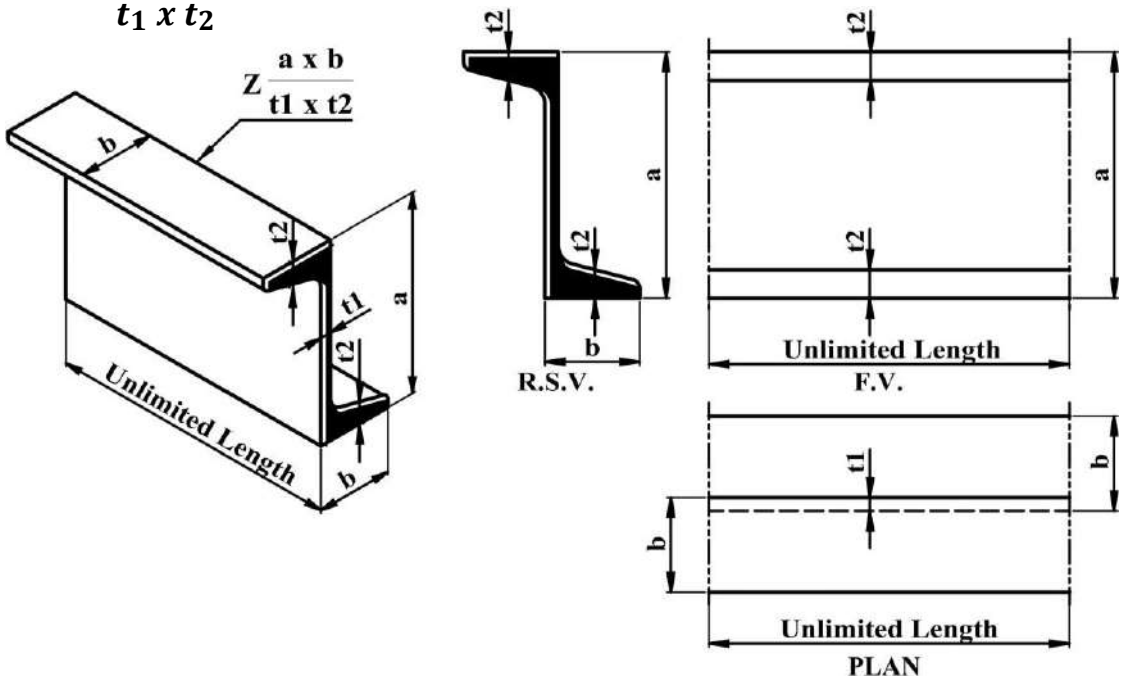
3.1.1.5 C – SECTION:

$$C\ \frac{a \times b}{t_1 \times t_2}$$



3.1.1.6 Z – SECTION:

$$Z\frac{a \times b}{t_1 \times t_2}$$



3.2 Steel Structure Shape Specification

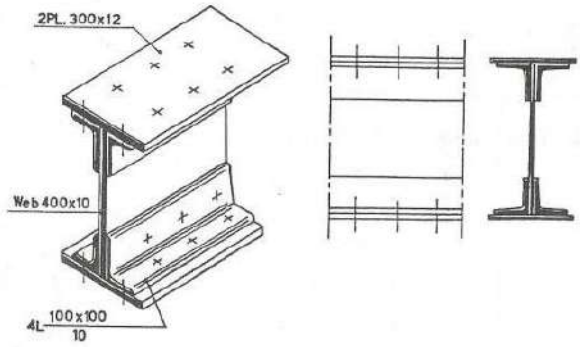
When specifying a steel shape on a drawing, the shape identification letter is followed by the depth multiplied by the weight in pounds per linear foot. For example; W 12 x 22 and C 6 x 10.5.

The AISC Manual of Steel Construction, specific information regarding dimensions for detailing and dimensioning is clearly provided along with typical connection details. The representative numbers for the W 12 x 22 wide flanges and the C 6 x 10.5 are shown in fig. 3.3.

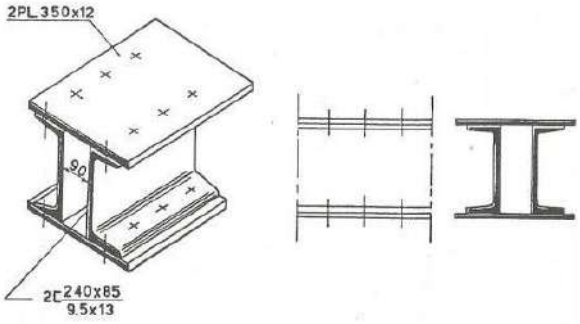
Fig. 3.3: Dimensions elements of the wide flange and channel shapes

The W, S, and M shapes all have an I-shaped cross section and are often referred to as **I** beam. The three shapes differ in the width of their flanges. In addition to varied flange widths, the S-shape flanges are tapered, making them stronger than equivalently sized **W** beams and suitable for train rail or monorail beams. The W shape is commonly used for columns. All can beused for horizontal or vertical members.

3.3 Steel Structure Solved Examples

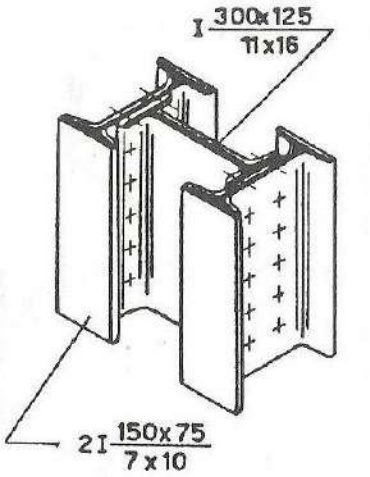


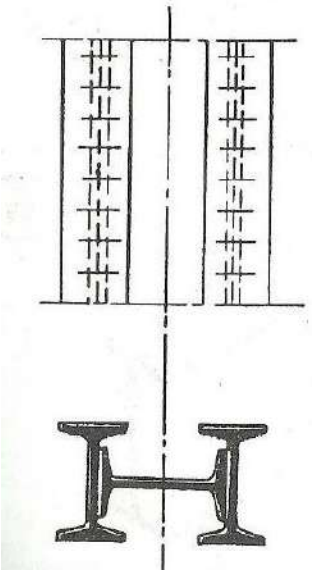
(1)



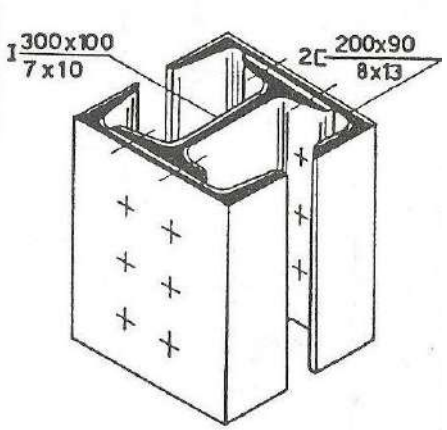
(2)

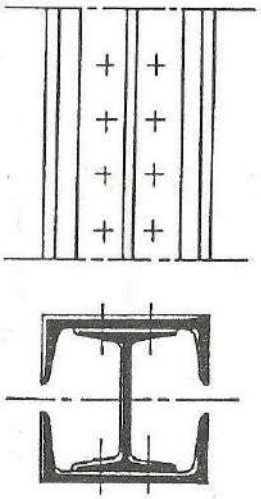
(2)





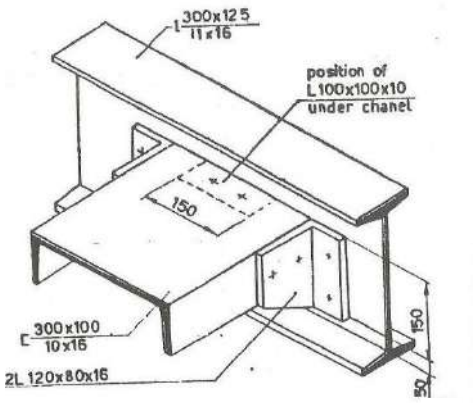
(4)

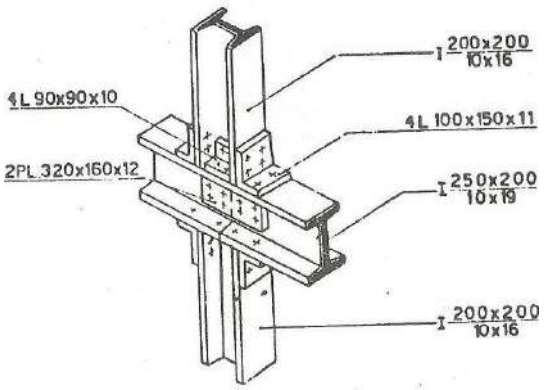


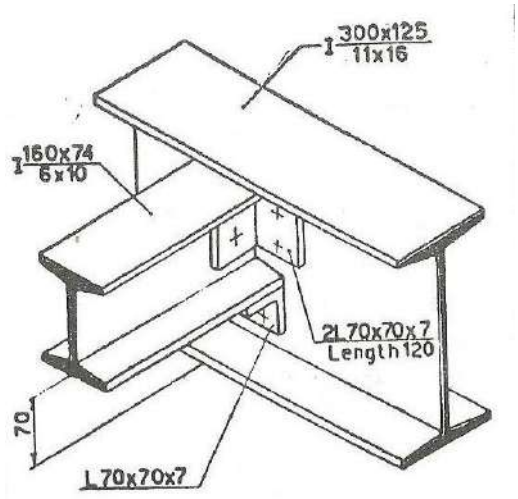


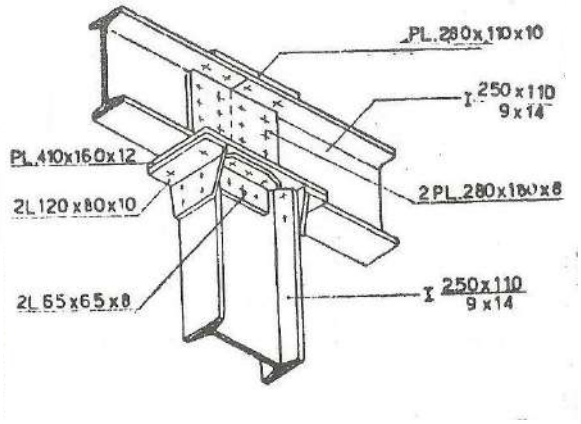
3.4 Exercise

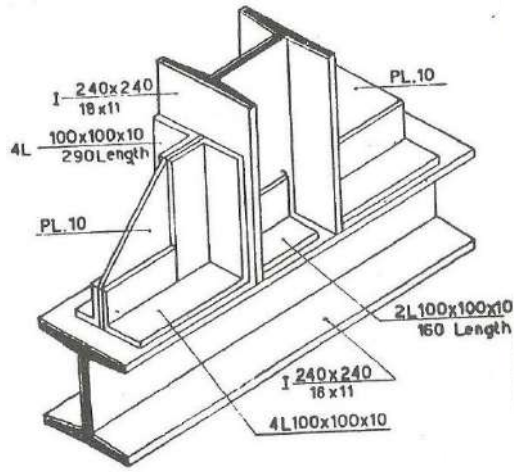
For the following draw the projection views

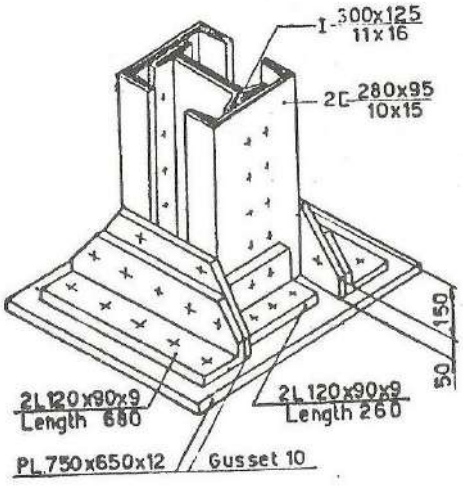


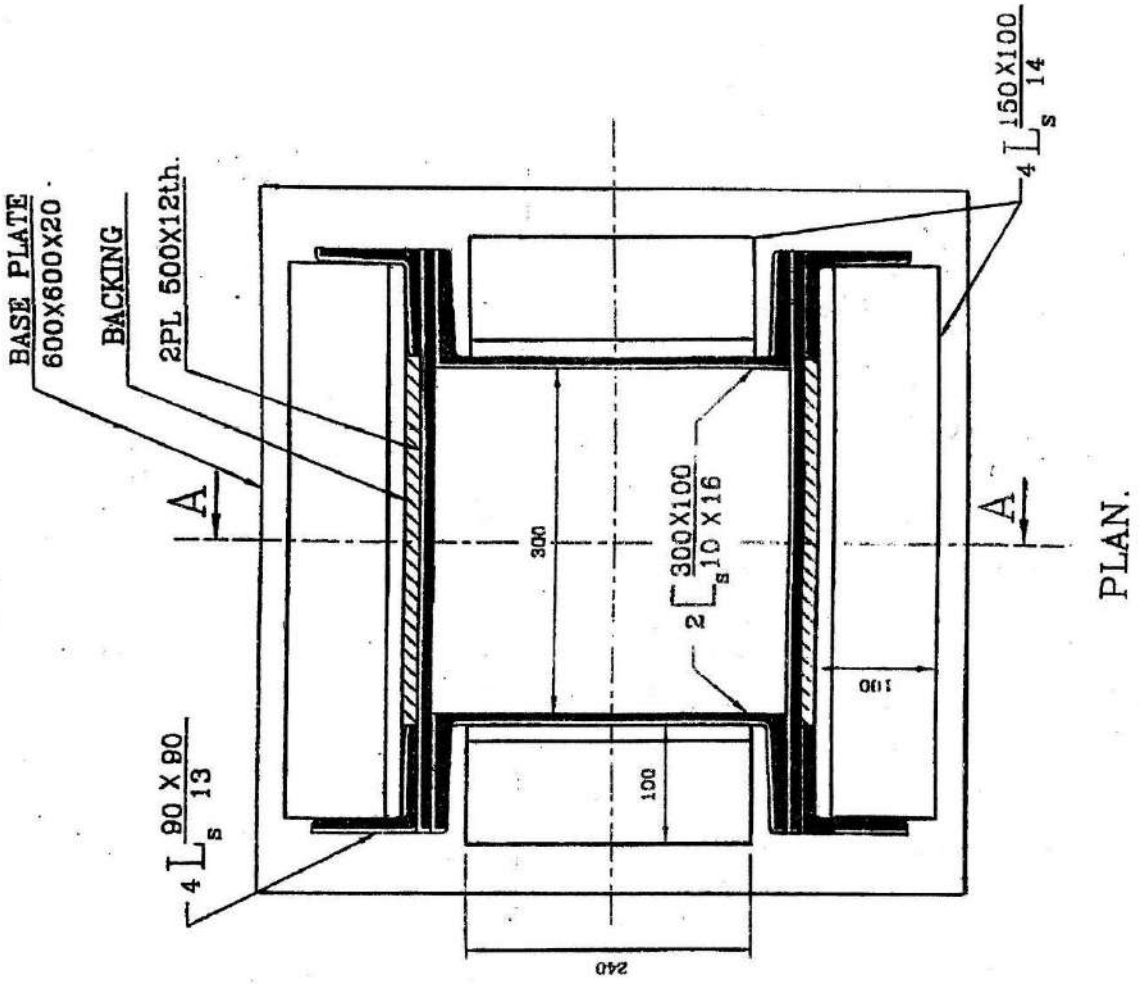




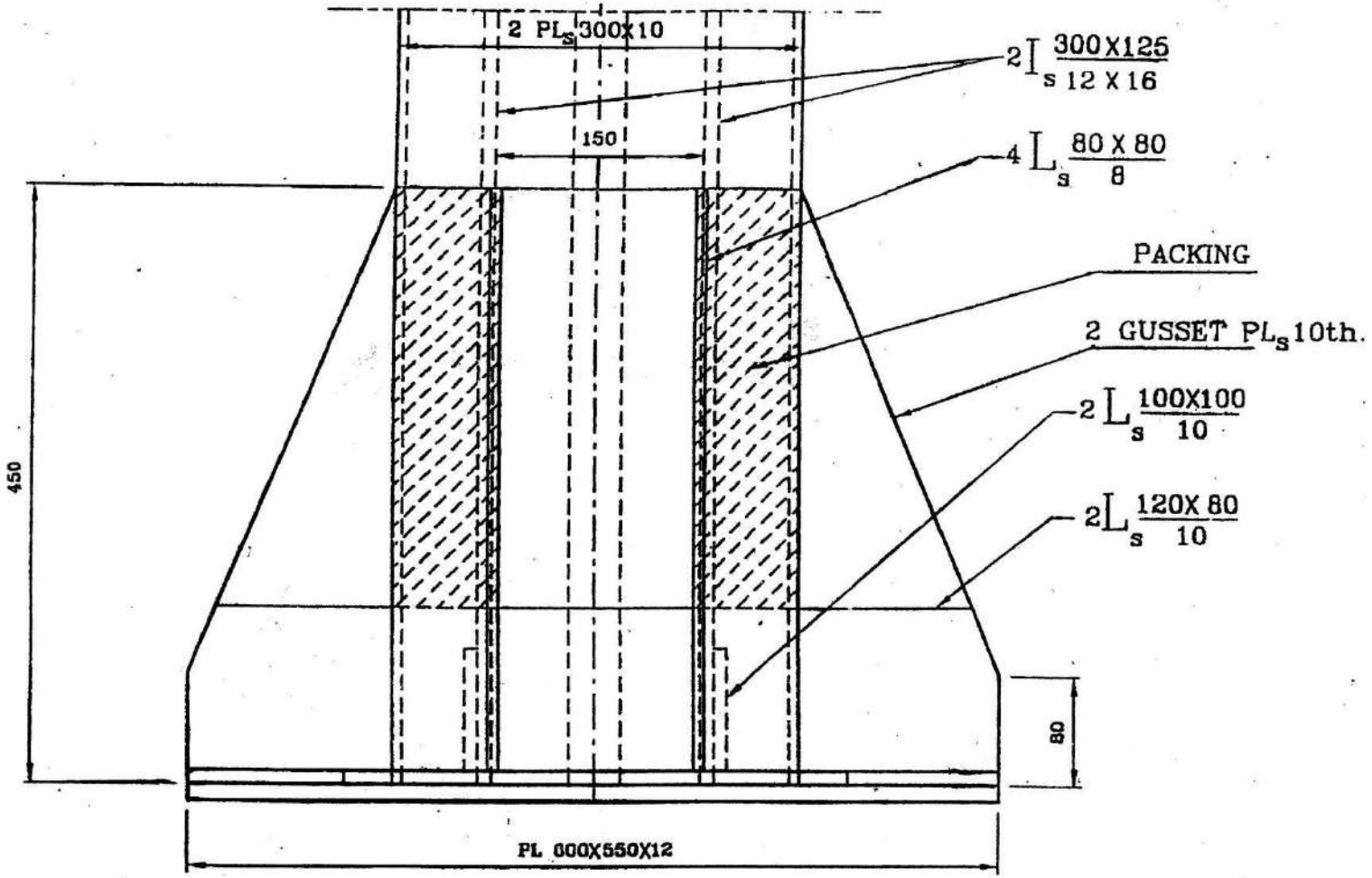




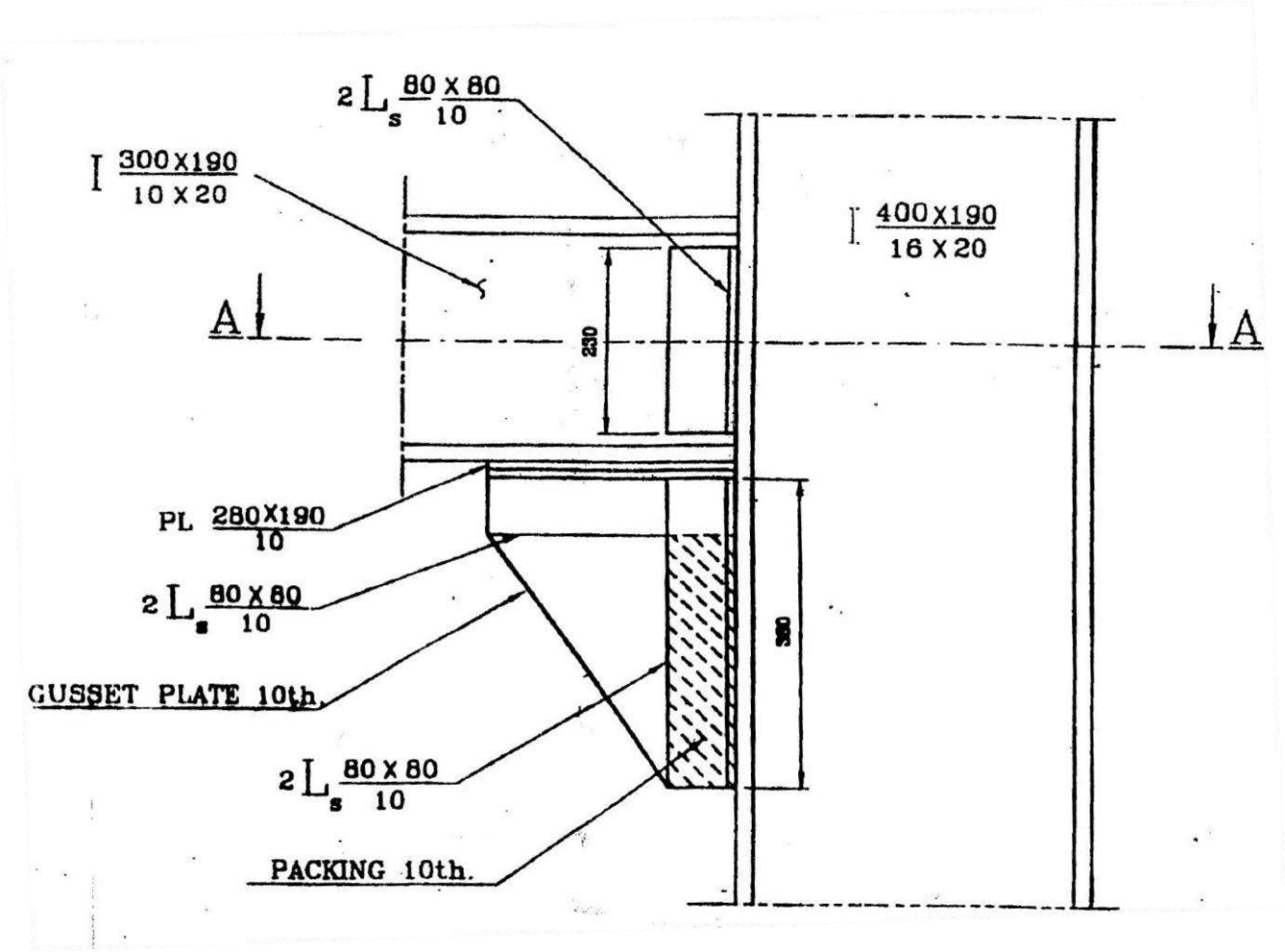




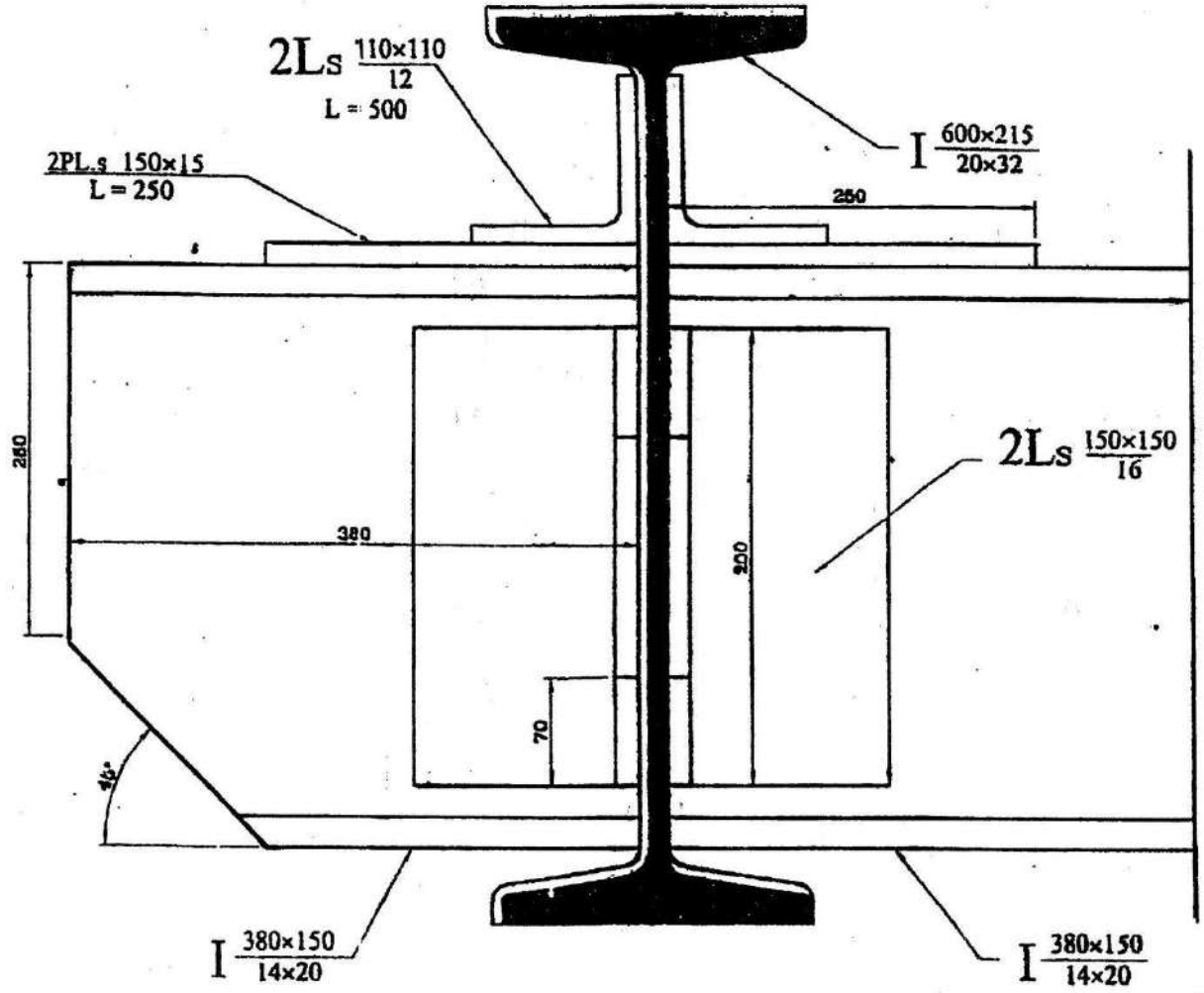
SHEET NO.	STEEL CONNECTIONS	DRAW TO A SCALE 1:5 1- F. VIEW 2- GIVEN SEC. PLAN 3- SECTIONAL SIDE VIEW ALONG A-A



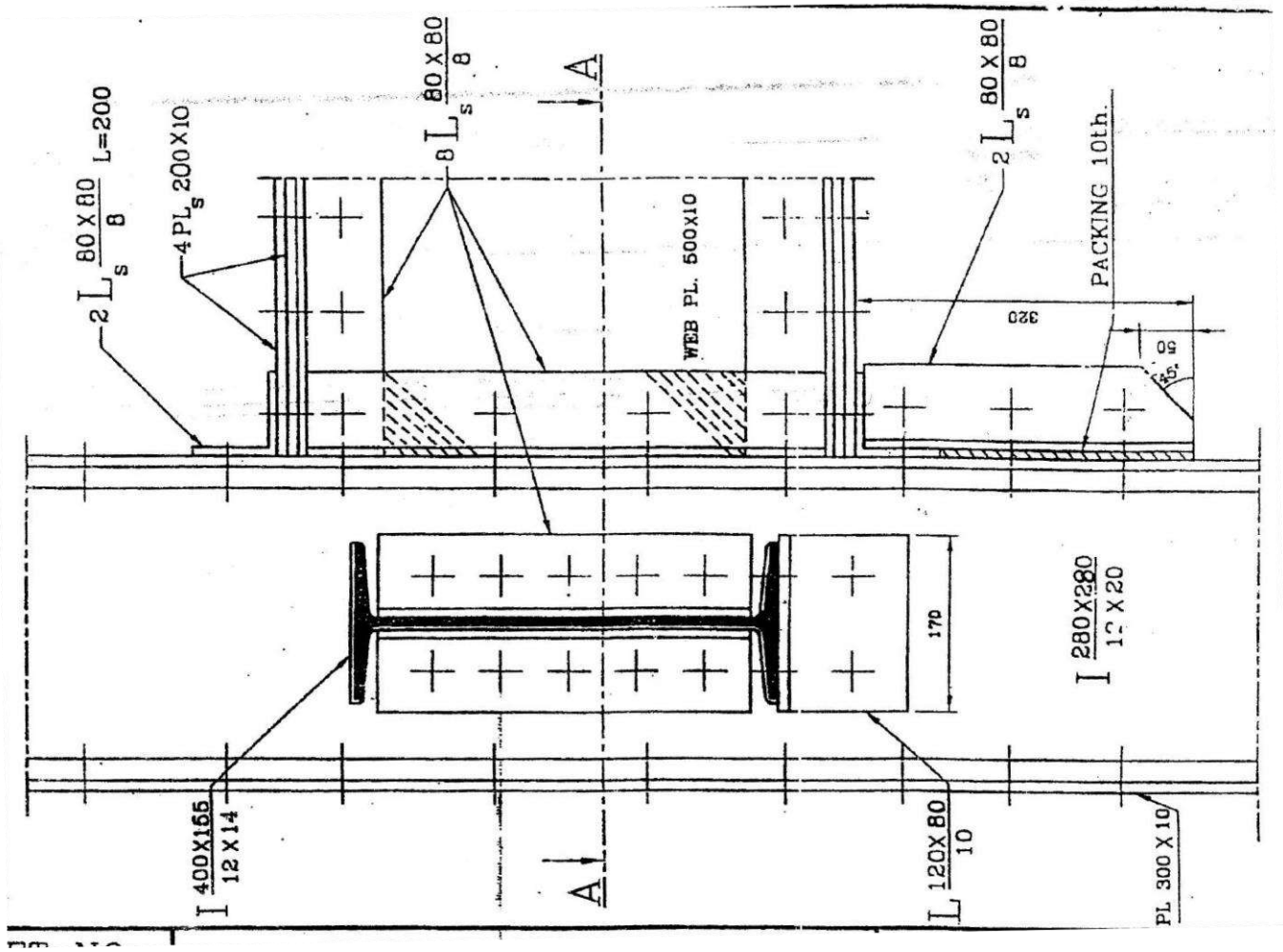
SHEET NO.	STEEL CONNECTIONS	DRAW TO A SCALE 1:5 1- F. VIEW 2- R. S. VIEW 3- PLAN VIEW



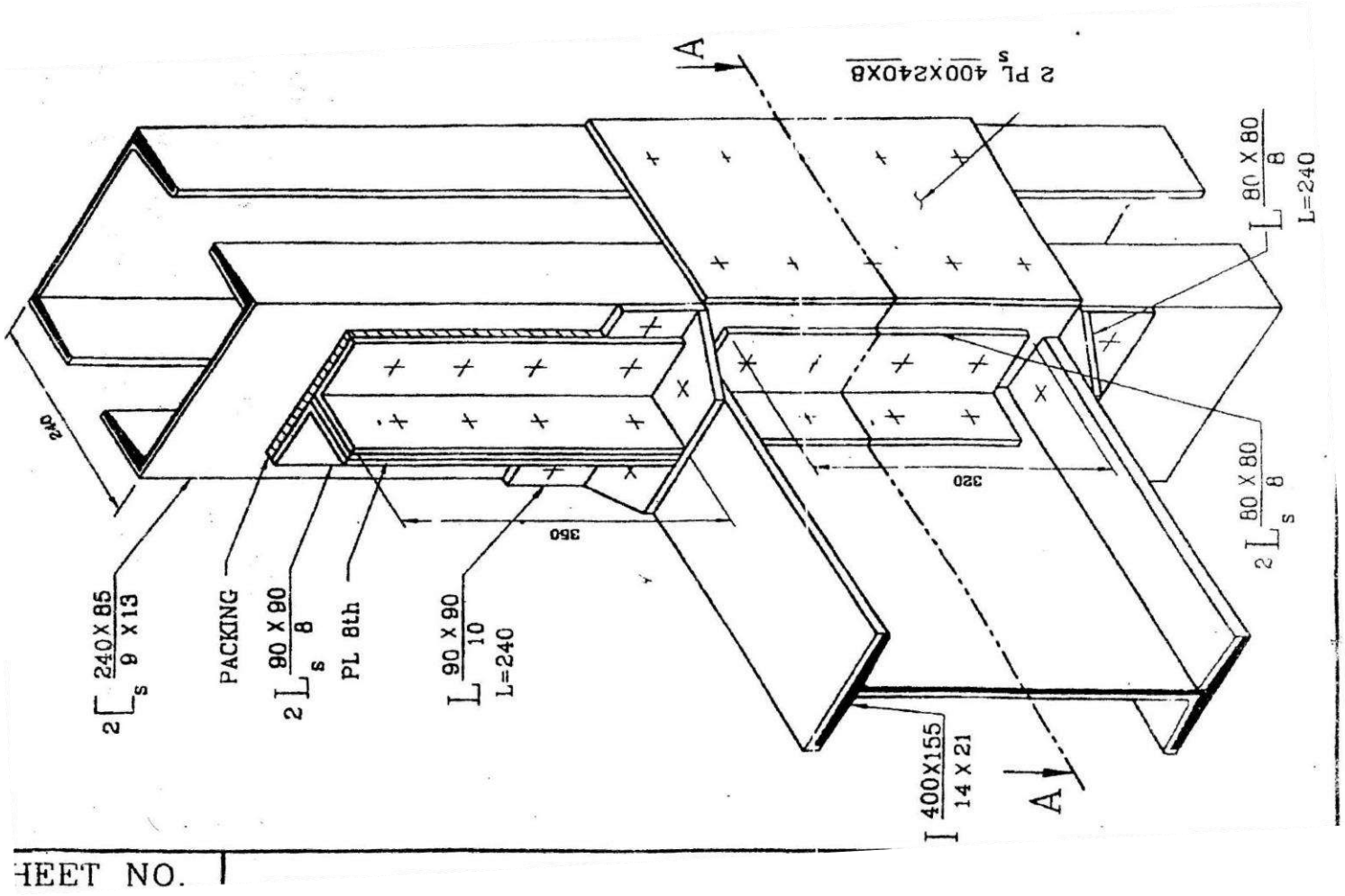
SHEET NO.	STEEL CONNECTIONS	DRAW TO A SCALE 1:5 1- F. VIEW 2- L. S. VIEW 3- SECTIONAL PLAN ALONG A-A



SHEET NO.	STEEL CONNECTIONS	DRAW TO A SCALE 1:5 1- F. VIEW 2- L. S. VIEW 3- PLAN



SHEET NO.	STEEL CONNECTIONS	DRAW TO A SCALE 1:5 1- F. VIEW 2- R. S. VIEW 3- SECTIONAL PLAN ALONG A-A



HEET NO.

SHEET NO.	STEEL CONNECTIONS	DRAW TO A SCALE 1:5 1- F. VIEW 2- L. H. S. VIEW 3- SECTIONAL PLAN ALONG A-A

Chapter 4

Fasteners

4.1 Screw Threads

The screw thread is probably the most important single component in engineering. The application of the screw thread to nuts, bolts, studs, screws, etc., provides us with the ability to join two or more pieces of material together securely, easily and, most importantly of all, not permanently.

There are other methods of joining materials together but the most widely used ones – riveting,welding and (very common these days) using adhesives – are all permanent. It is true that these methods are cheaper, but when we know that we might have to take the thing apart again we use the screw thread. Since the screw thread is so important it is well worth while looking at the whole subject more closely.

The International Standards Organization (ISO) has formulated a complex set of standards to cover the whole range of engineering components. Their thread, the ISO, is now the international standard thread. The ISO and unified thread profiles are identical. The unified thread is the Standard International thread for countries which are still using imperial units.

Thread Forms

Unified threads are the most common threads used on thread fasteners. Fig. 4.1 shows the profile of a unified thread.

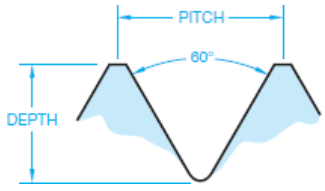


Fig. 4.1: Unified thread form

American national threads, shown in profile in fig. 4.2 are similar to the unified thread but have a flat root. **The sharp-V thread**, although not commonly used, is a thread that fits and sealstightly. It is difficult to manufacture because the sharp crests and roots of the threads are easily damaged, fig. 4.3.

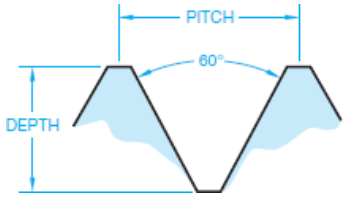


Fig. 4.2: American national thread form

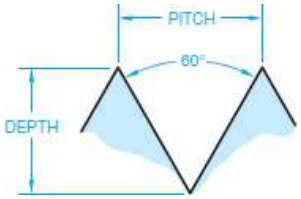


Fig. 4.3: Sharp-V thread form

The International Organization for Standardization (ISO) was established that thread specifications(**Metric thread forms**) are similar to the unified thread form, fig. 4.4. **Whitworth threads** are the original British standard thread forms developed in 1841. These threads have been referred toas parallel screw threads, fig. 4.5.

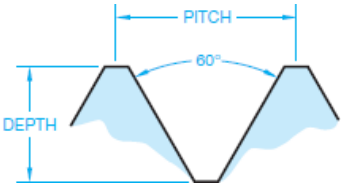


Fig. 4.4: Metric thread form

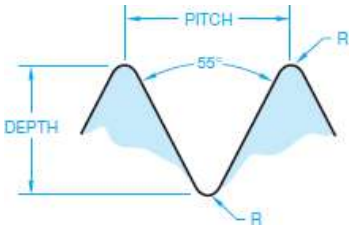


Fig. 4.5: Whitworth thread form

Square thread forms, shown in fig. 4.6, have a longer pitch than unified threads. Square threads were developed as threads that would effectively transmit power. Square threads are difficult to manufacture because of their perpendicular sides. The square thread is generally replaced by Acme threads.

Acme thread forms are commonly used when rapid traversing movement is a design requirement. Acme threads are popular on such designs as screw jacks, vise screws, and other equipment and machinery that require rapid screw action, fig. 4.7.

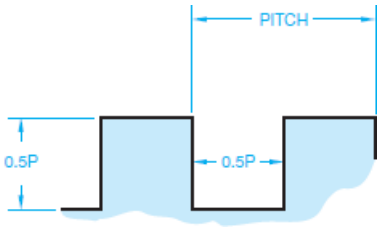


Fig. 4.6: Square thread form

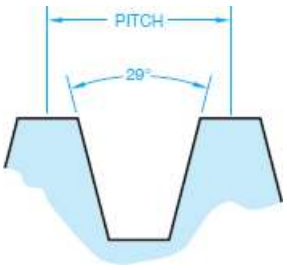


Fig. 4.7: Acme thread form

Buttress threads are designed for applications where high stress occurs in one direction alongthe thread axis. The buttress thread is commonly used in situations where tubular features are screwed together and lateral forces are exerted in one direction, fig. 4.8.

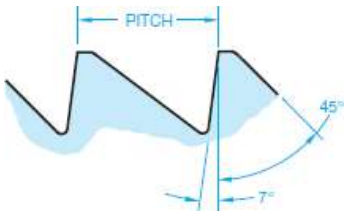


Fig. 4.8: Buttress threads form

4.2 Thread Representations for Drawings

Three methods of thread representation are in use: detailed, schematic, and simplified. The simplified thread representation is most used method of drawing thread symbols. Simplified representations clearly describe threads, and they are easy and quick to draw. They are also very versatile and can be used in all situations, whereas the other representations cannot be used in all situations. Fig. 4.9 shows simplified threads representation for both internal and external threads. Detailed drawing for threaded hole is presented in fig. 4.10.

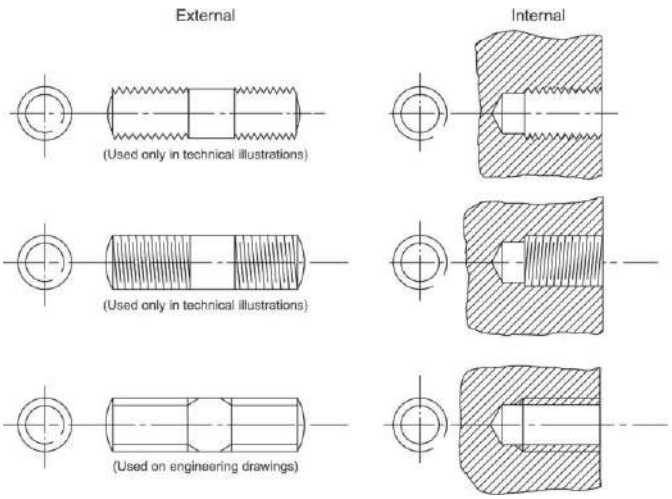


Fig. 4.9: Simplified threads representation

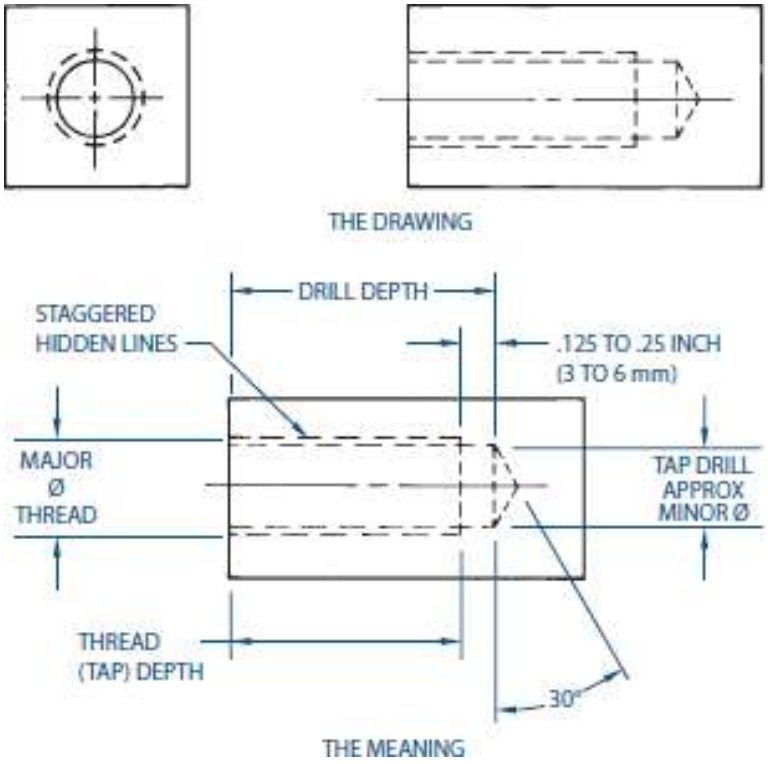
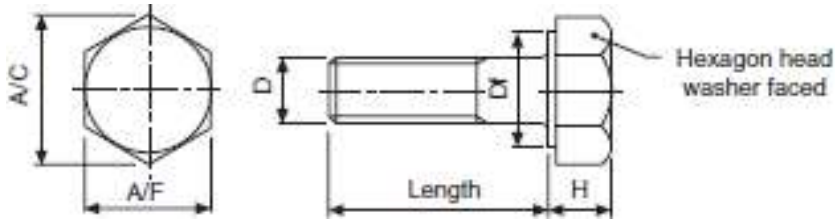


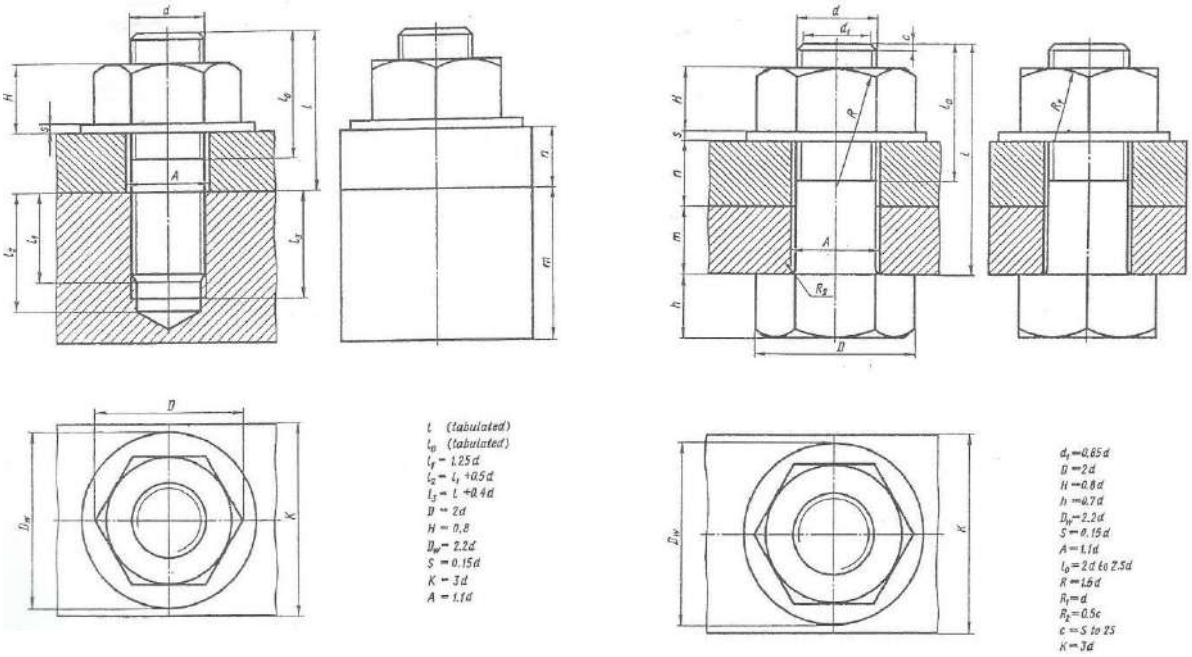
Fig. 4.10: Simplified representation of a screw thread in a hole

4.3 Bolts and Nuts

The term fixed fastener includes a stud or a threaded hole for a bolt or screw relates to an application in which one of the parts to be assembled has a held in-place fastener. This applies to all holes of the same size in a pattern in which the same positional tolerance is specified. An example of a fixed fastener is shown in fig. 4.1a.



(a)



(b) (c)

Fig. 4.11: Detailed drawing for fasteners

Notice in fig. 4.11c, that part A has a clearance hole, and part B is threaded. Part B acts as part of the fastener, much like a nut. Example: M 14 bolt is used to fasten two parts together, where part A has a clearance diameter hole of 14.4/14.2 and part B is threaded with metric thread matched with the diameter of 14 for bolt. The most widespread application of the screw threadis the nut and bolt showing full details to whenever a nut or bolt is drawn; it is essential that the first view drawn is the one which shows the regular hexagon. If the across-flats (A/F) dimension is given, draw a circle with that diameter. Construct a regular hexagon round the circle with a60° set square. Project the corners of the hexagon onto the side view of the nut and bolt and markoff the thickness of the nut or bolt head, fig. 4.12.

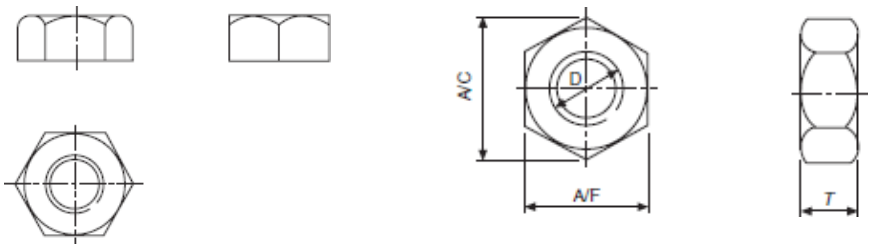
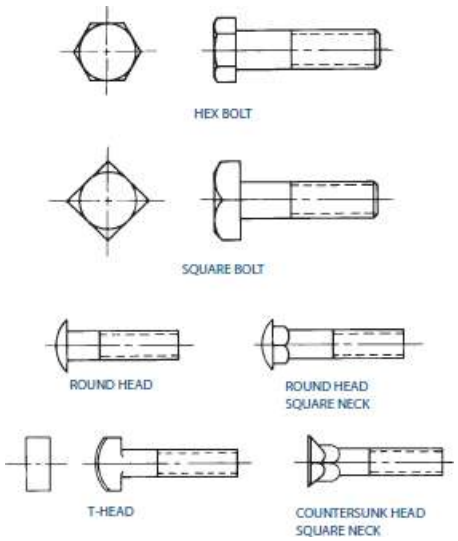


Fig. 4.12: A/C (across corner) and A/F (across flats) for chamfered nuts

Nuts and bolts are chamfered and, when viewed from the side, this chamfer is seen as radii on the sides of the nut or bolt. If you ensure that the first view projected from the hexagon is the onewhich shows three faces of the nut (the other view shows only two faces), you can draw a radius equal to D, the diameter of the thread, on the center flat. The intersection of this radius and the corners of the neighboring flats determine the size of the two smaller radii.

These must start at this intersection, finish at the same height on the next corner and touch the top of the nut or bolt at the center of the flat. This may be done by trial and error with compasses,or with radius curves. Remember that the center of the radius lies midway between the sides. This view is completed by drawing the 30° chamfer which produced the radii. The third view of the nut or bolt is drawn in a similar fashion. The width and heights are projected from the two existing views and the radii are found in the same way as shown on the other view.

The length of a bolt is determined simply by the use to which the bolt is to be put. There is a very large selection of bolt lengths for all diameters. The bolt should not protrude very far past the nut and so there is no need to thread all of the shank.



Fig, 4.13: Bolts head typed

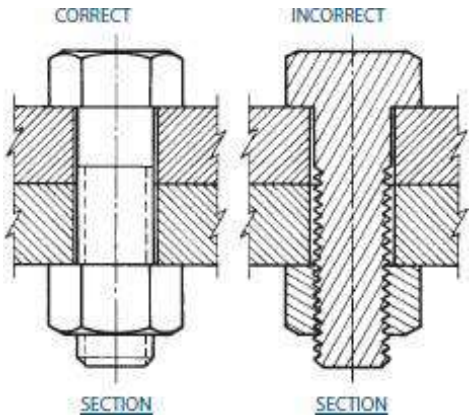


Fig. 4.14: Bolt representation in sectioning

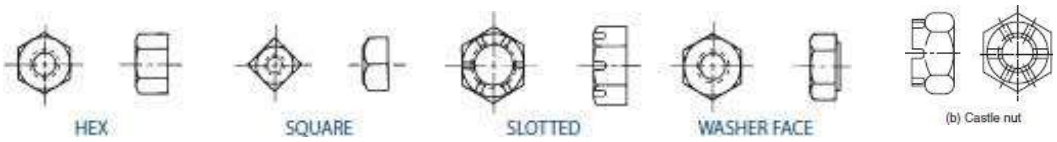
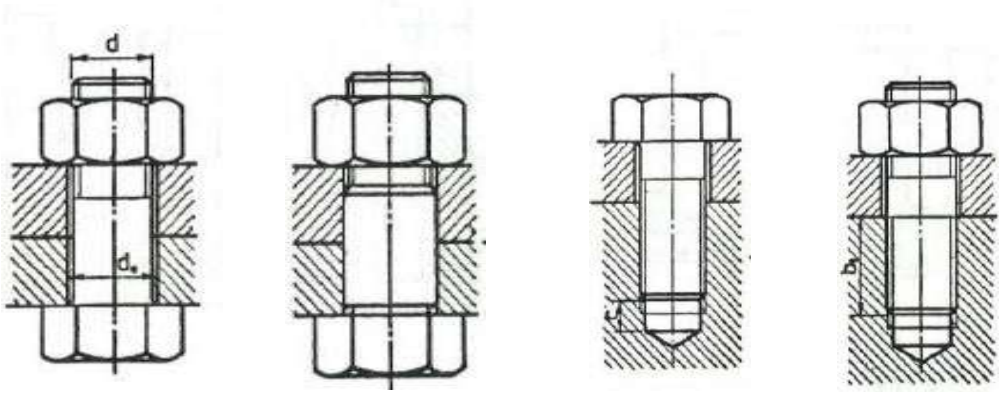


Fig. 4.15: Nuts types



Through bolt Fitted bolt Tap bolt stud

Fig. 4.16: Famous fasteners used in drawings

Chapter 5

Assembly Drawing

There are not many engineering items that are completely functional by themselves. There are some even a simple object like a wood chisel has three components and a good pair of compasses may have 12 component parts. Each part should be drawn and dimensioned separately and then a drawing is made of all the component parts put together. This is called an ‘assembly drawing.

The parts must fit together and be held together, either because they interlock or there is something holding them together. There is always an obvious component to start drawing, and, while you are drawing that, the rest of the assembly will become apparent as you become more familiar with the details.

In the previous chapter, we have already seen how to draw a standard nut and bolt used commonly in assembly drawing to join parts together.

5.1 Lathe Gear Assembly

The drawings in Fig. 5.1 show a sketch of a -change lever to act as a guide to show how its parts are fitted together, details of the various parts of the gear-change lever partly finished viewsof the gear bracket and lever handle of the lathe gear-change lever.

You are required to do the following:

1- Complete the front view by adding the parts to make the whole assembly.2- Complete the sectional plan on A – A.

Do not show any hidden detail.

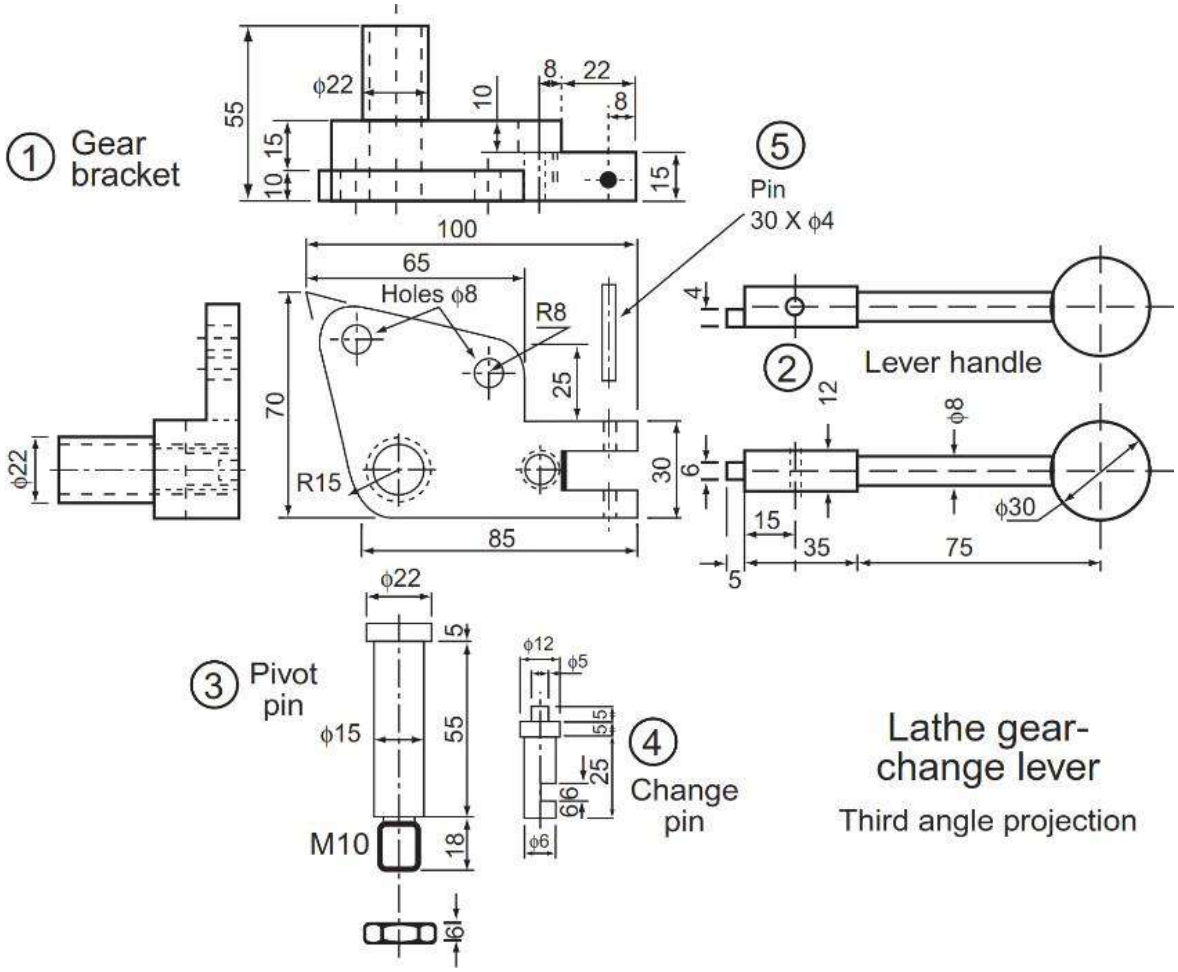


Fig.5.1: Lather gear change lever

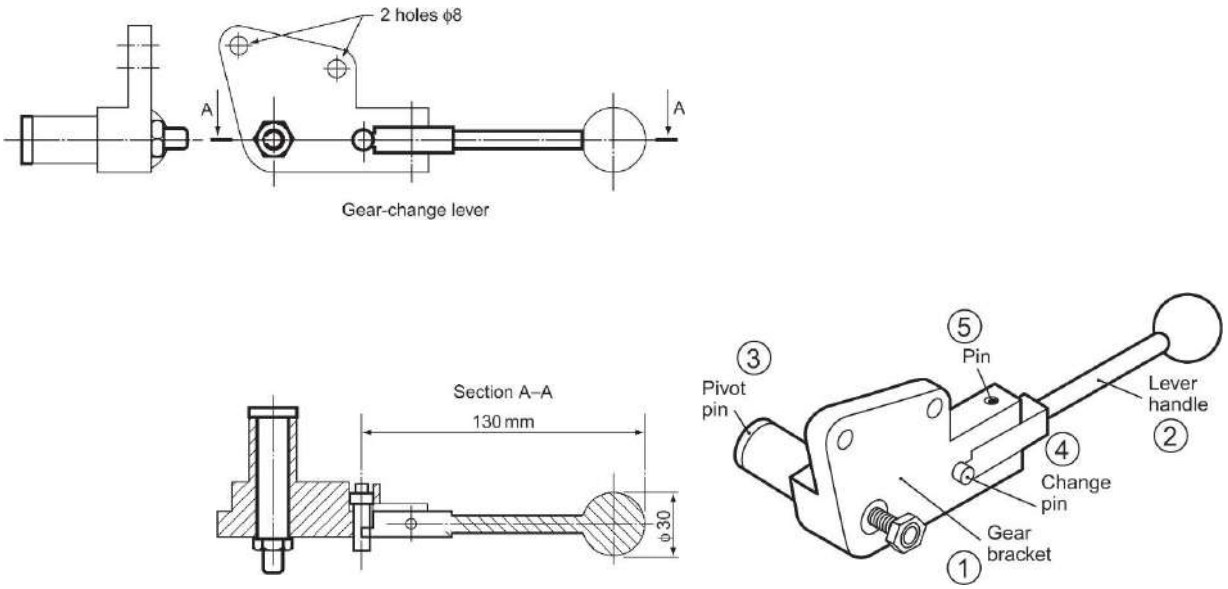


Fig. 5.2: Solution shows assembly of a lathe gear

5.2 Lever Bracket Assembly

A sketch and views of a lever bracket are given in Fig. 5.3. The pin fits into the hole in thebracket and is held in position by means of an M18 hexagon nut.

You are required to do the following:

Draw, full size, the following views of the assembled bracket, including the nut:

(a) Front elevation looking in the direction of arrow X

(b) Sectional side view on AA looking in the direction of the arrows.

(c) Sectional plan on BB looking in the direction of the arrows.

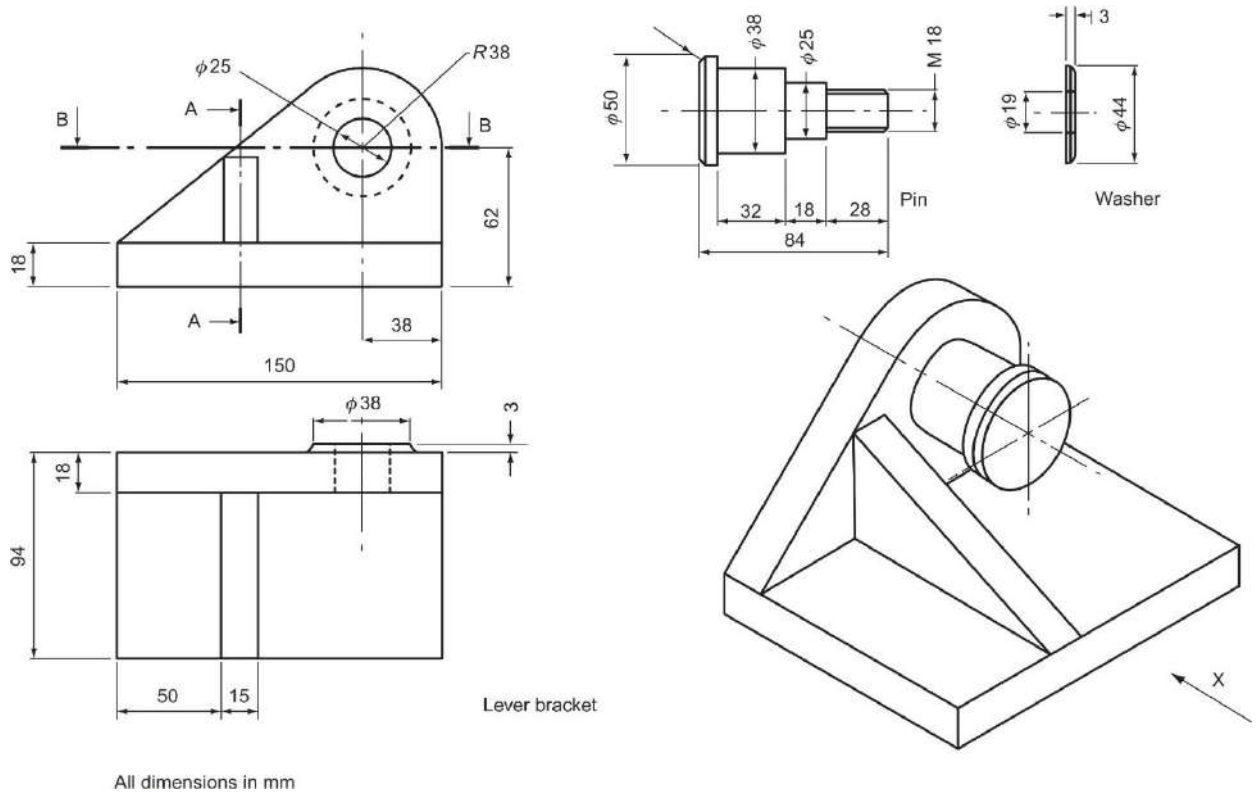


Fig. 5.3

5.3 Lever Sub Assembly

For the parts show in fig. 5.4, you are required to draw the following views of the assembledlever:

Sectional elevation looking at A-A

Complete plan for assembled lever

Complete side view

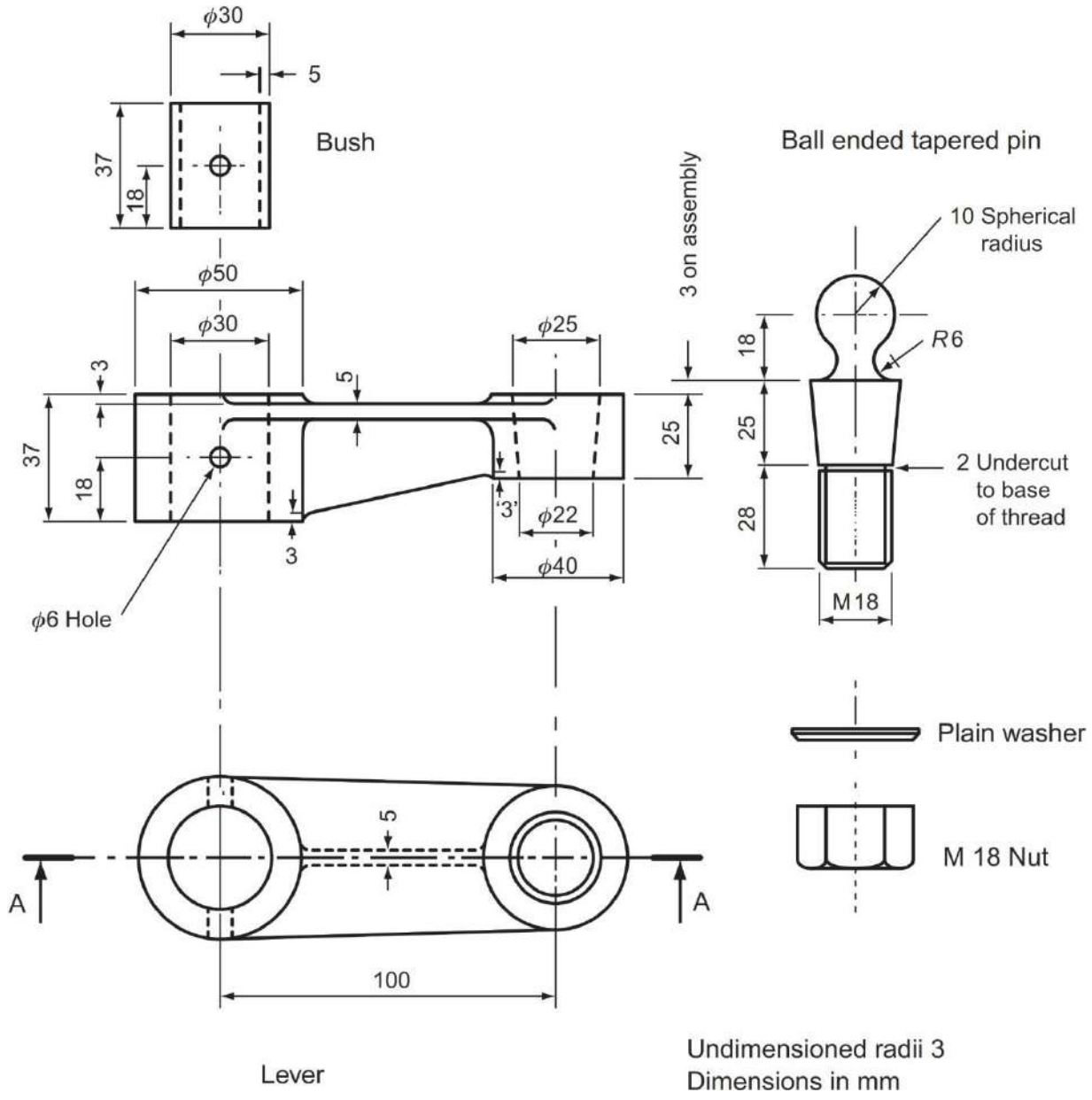
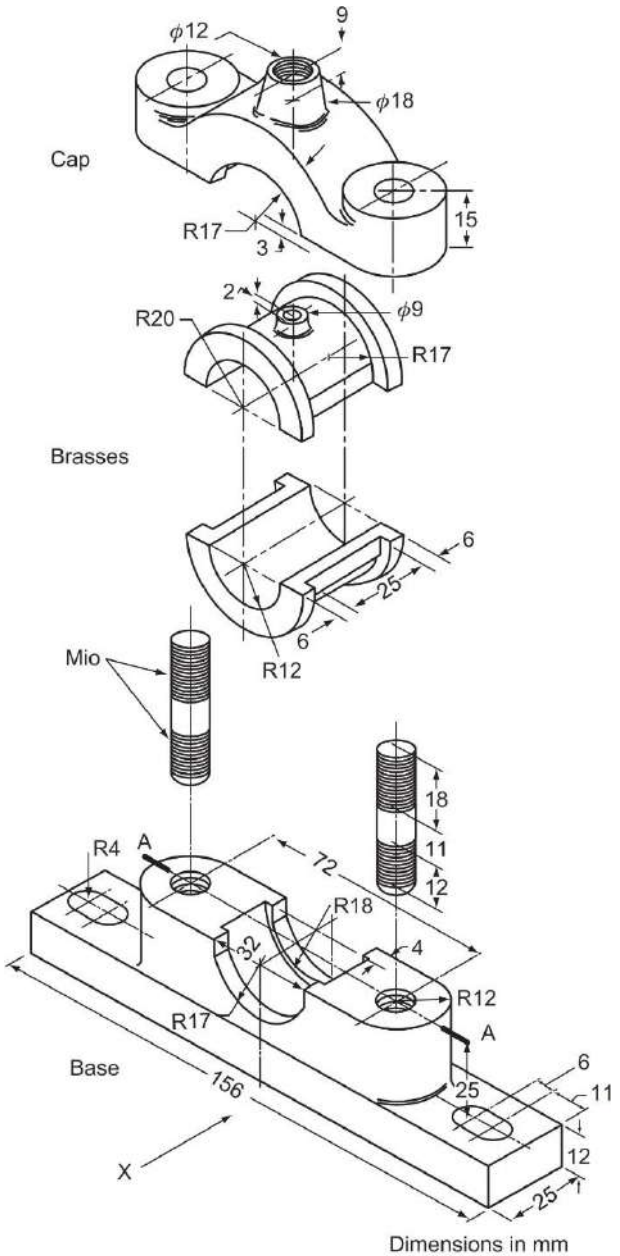


Fig. 5.4

5.4 Plummer Block Bearing Assembly

Draw to a scale of 2:1 in first angle orthographic projection the following views of theassembled bearing at fig. 5.5:

Sectional elevation in the direction of X. The cutting plane to be vertical and to pass through AA.



Part No.	Part	Matl	No. Off
6	Nut	M.S.	2
5	Washer	M.S.	2
4	Stud	M.S.	2
3	Brass	G.M.	2
2	Cap	C.I.	1
1	Base	C.I.	1

Fig. 5.5

5.5 Small Machine vice Assembly

Figure 5.6 shows the details of a small machine vice and the key to its assembly. Draw thefollowing views of the completely assembled vice:

Sectional elevation passing through the axis of the square-headed screw, in thedirection indicated by XX in the key.

Plan projected from the above.

Sectional side view at AA

Either first or third angle methods of projection may be used; the method chosen must be statedon the drawing.

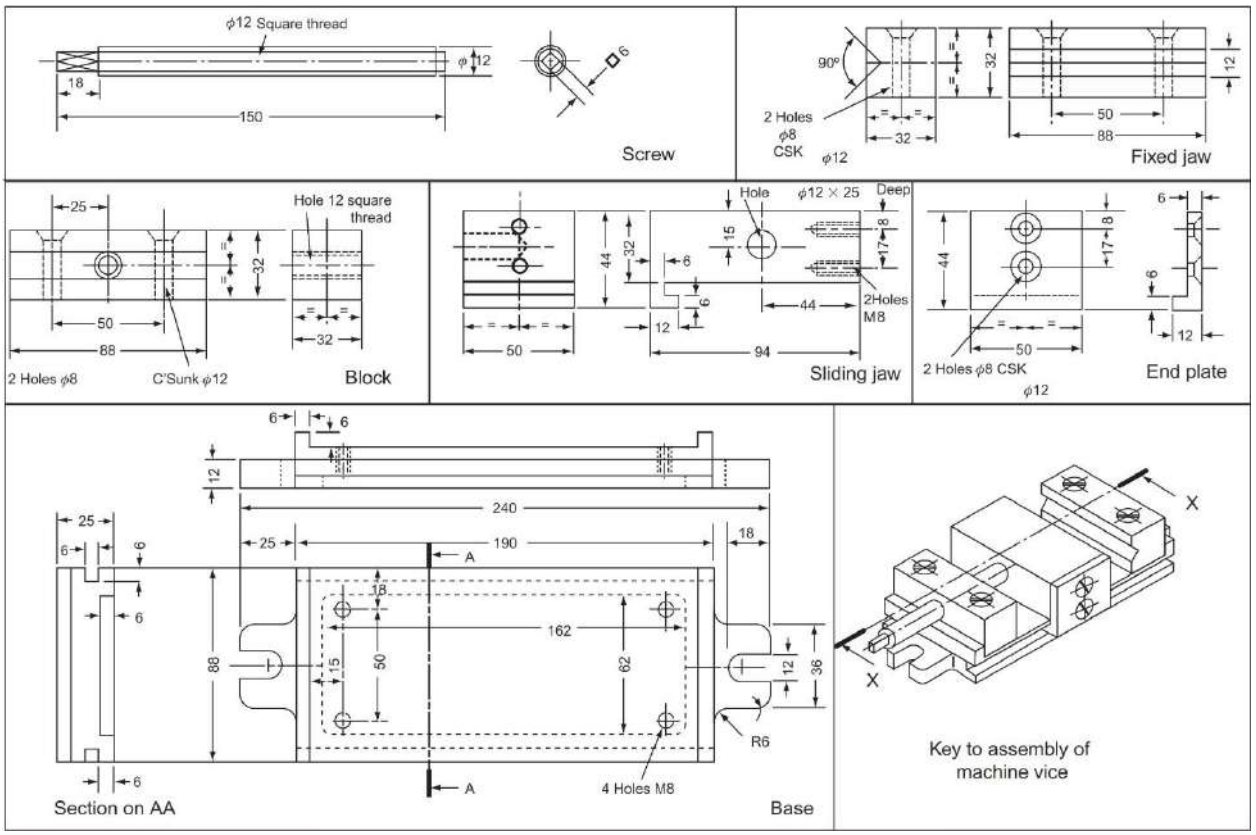


Fig. 5.6

Chapter 6

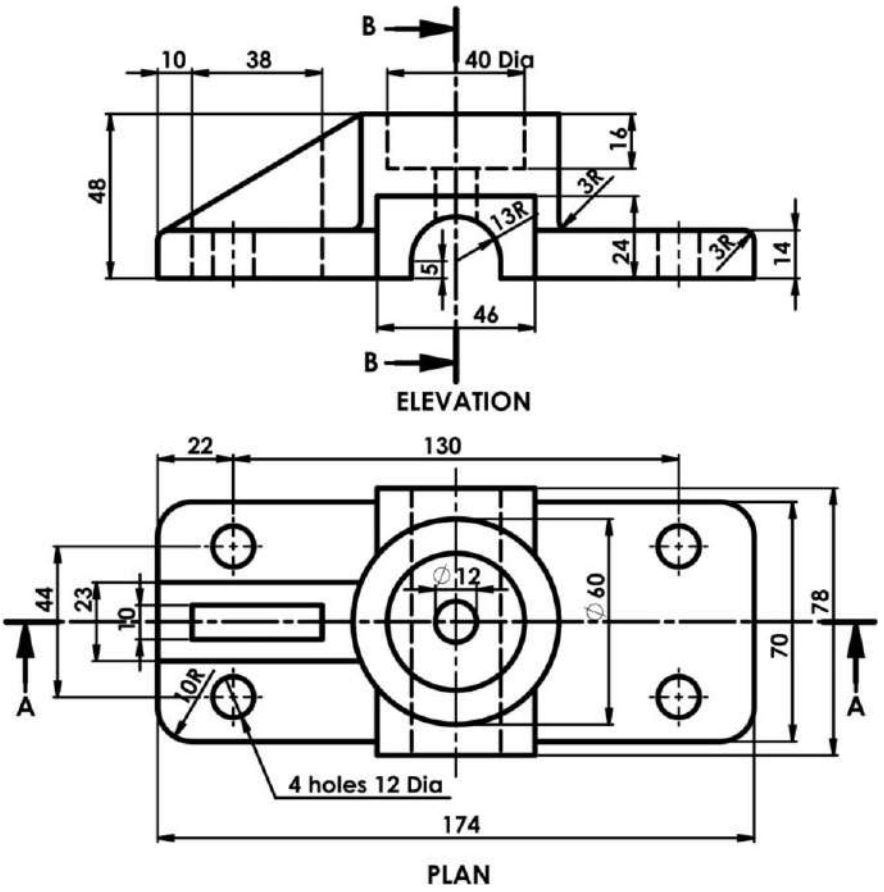
Previous Exams

6.1 Mid -Term Exam (1)

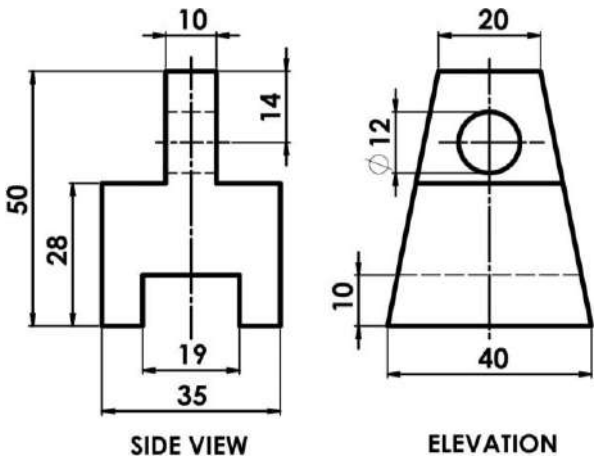
(1) *for the cast iron bracket shown, draw to a scale full size the following:*

(a) Sectional elevation at A-A (b) Sectional side view at B-B

(c) Complete plan view



(2) Draw to a scale full size the isometric for the part shown:

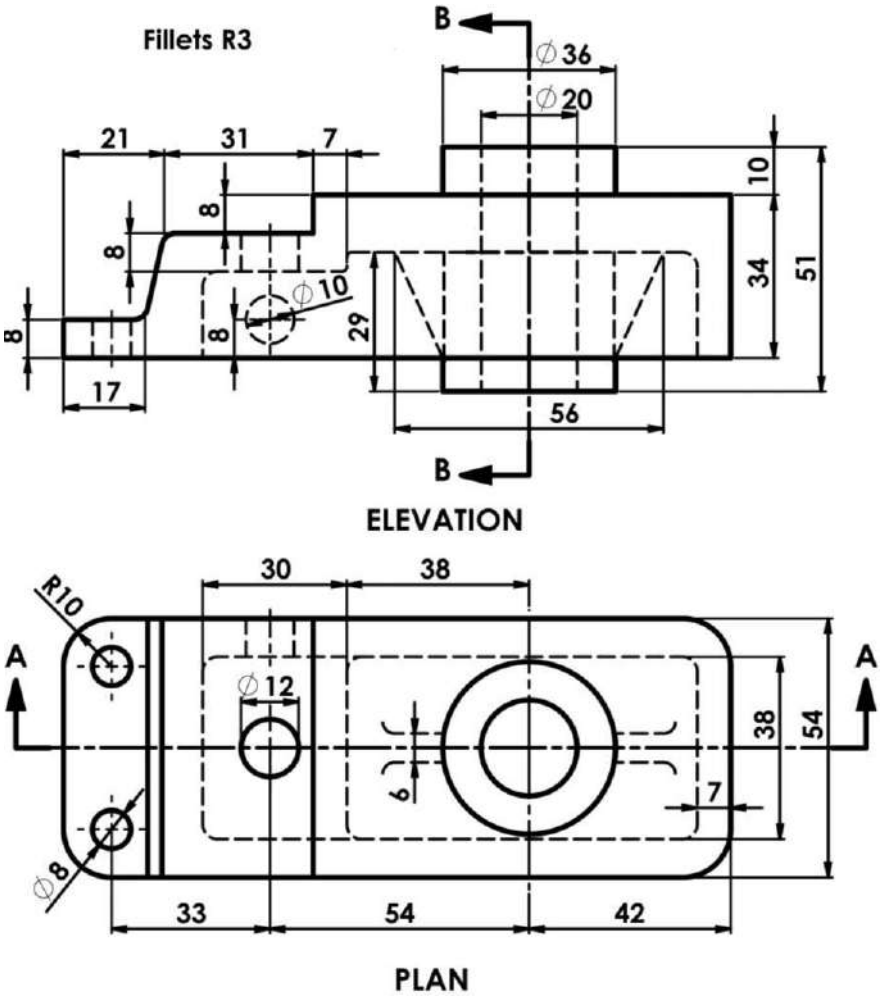


6.2 Mid -Term Exam (2)

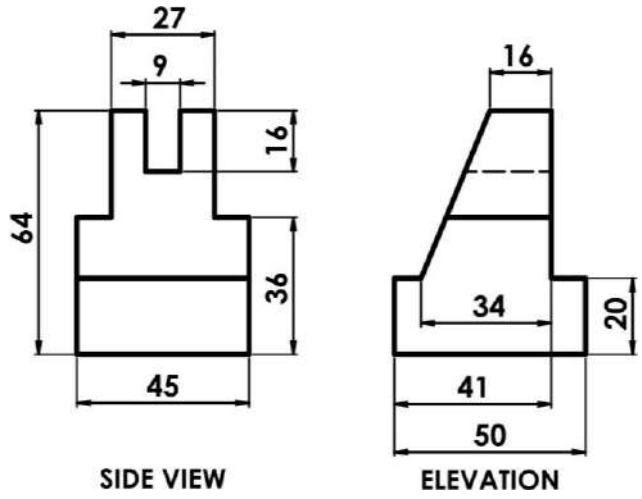
(1) *For the cast iron bracket shown, draw to a scale full size the following:*

(a) Sectional elevation at A-A (b) Sectional side view at B-B

(c) Complete plan view



(2) Draw to a scale full size the isometric for the part shown:



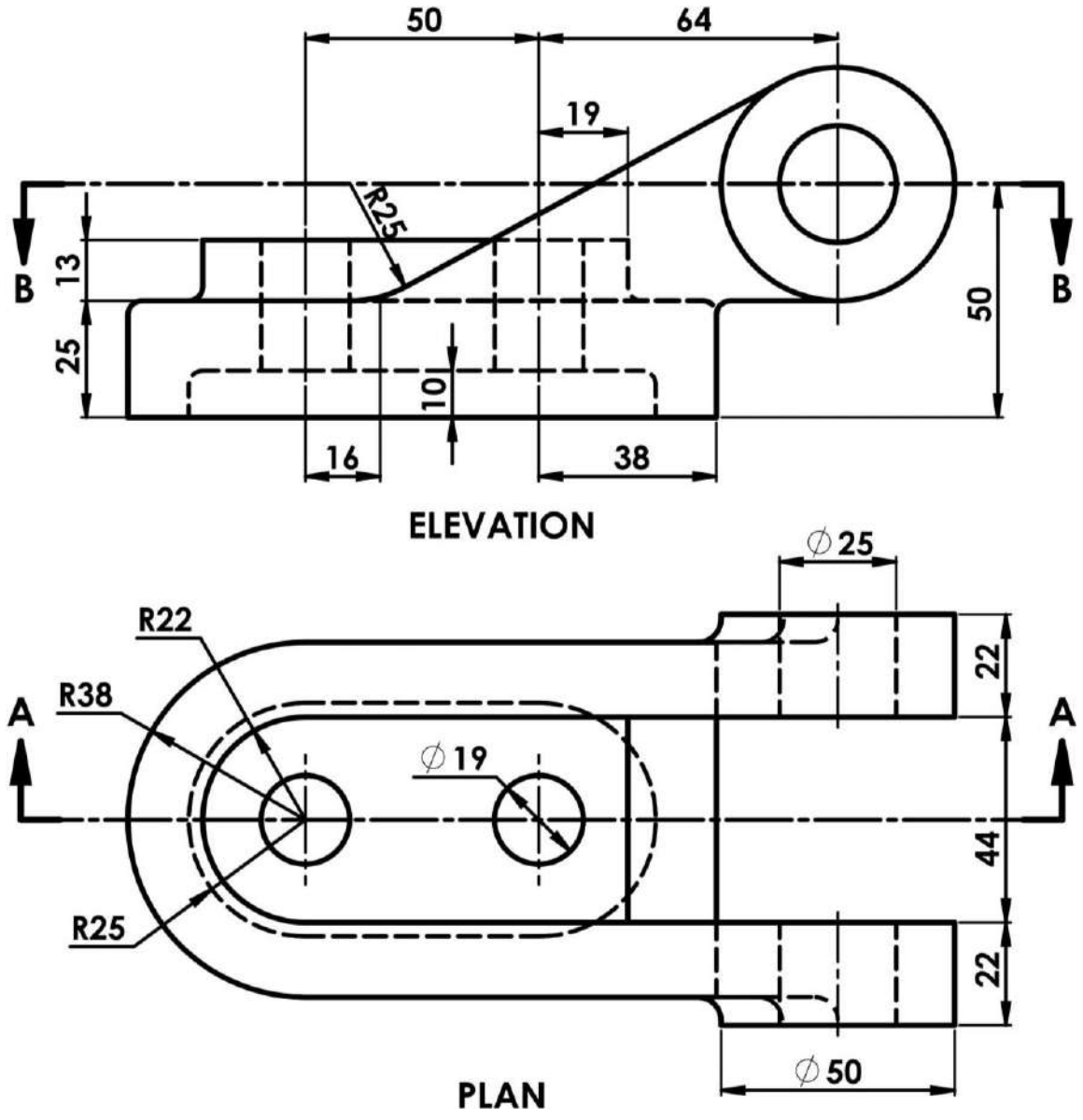
6.3 Mid -Term Exam (3)

1- Draw to a full scale the following views:

(a) Sectional elevation at A-A

(b) Sectional plan at B-B

(c) Complete side view



6.4 Final Term Exam (1)

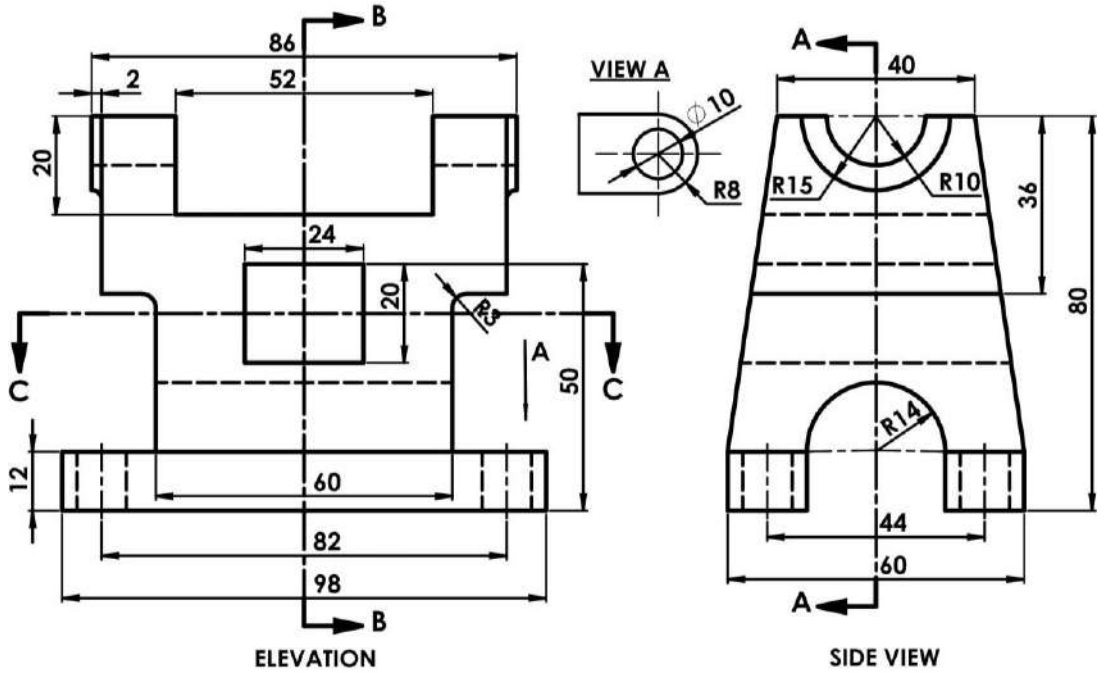
Question (1):

For the shown machine part, draw to a scale full size the following:

(1) Sectional elevation at A-A

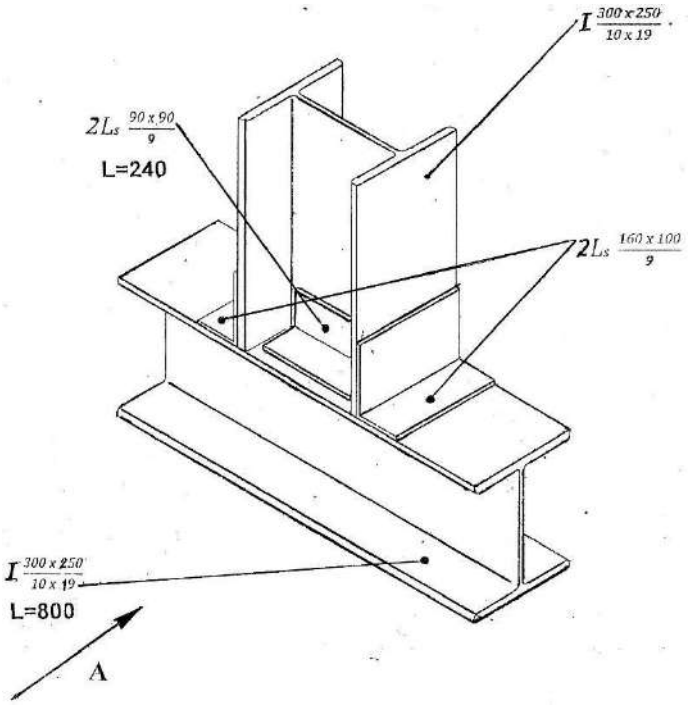
(2) Sectional side view at B-B

(3) Sectional plan at C-C



Question (2):

Draw to a scale 1:5 the elevation view only (from direction A) for the following steel construction


I 300 x 250 / 10 x 19
2Ls 90 x 90 / 9
L=240
2Ls 160 x 100 / 9
I 300 x 250 / 10 x 19
L=800
A

6.5 Final Term Exam (2)

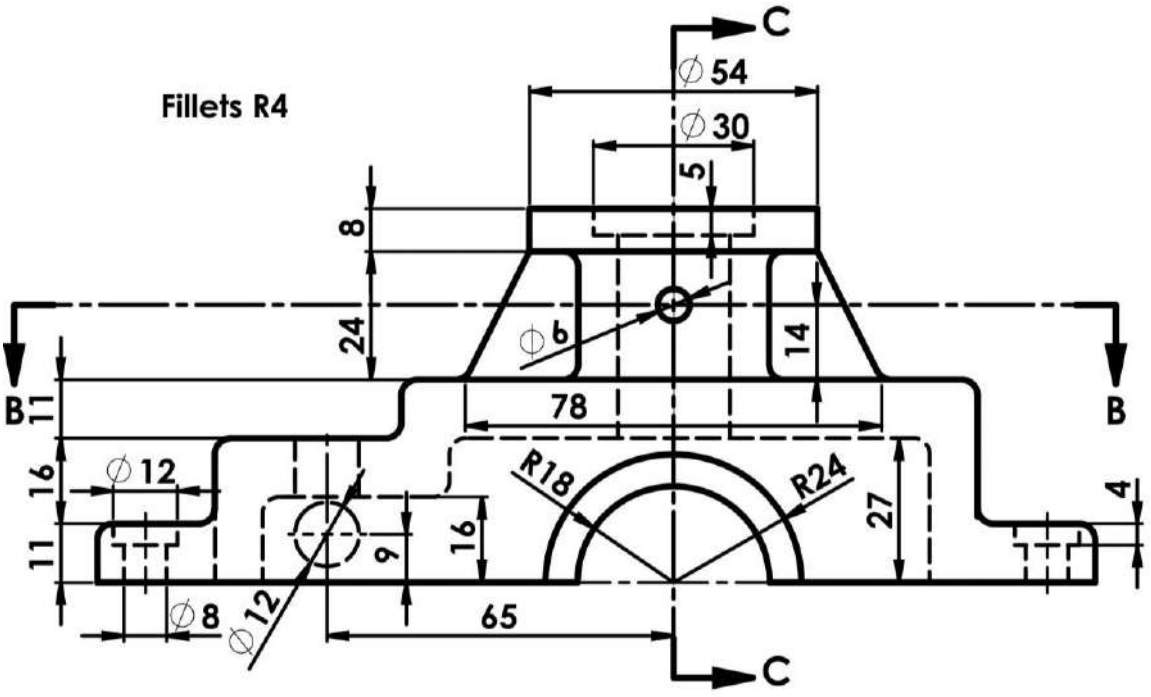
Question (1):

For the given views, get the following:

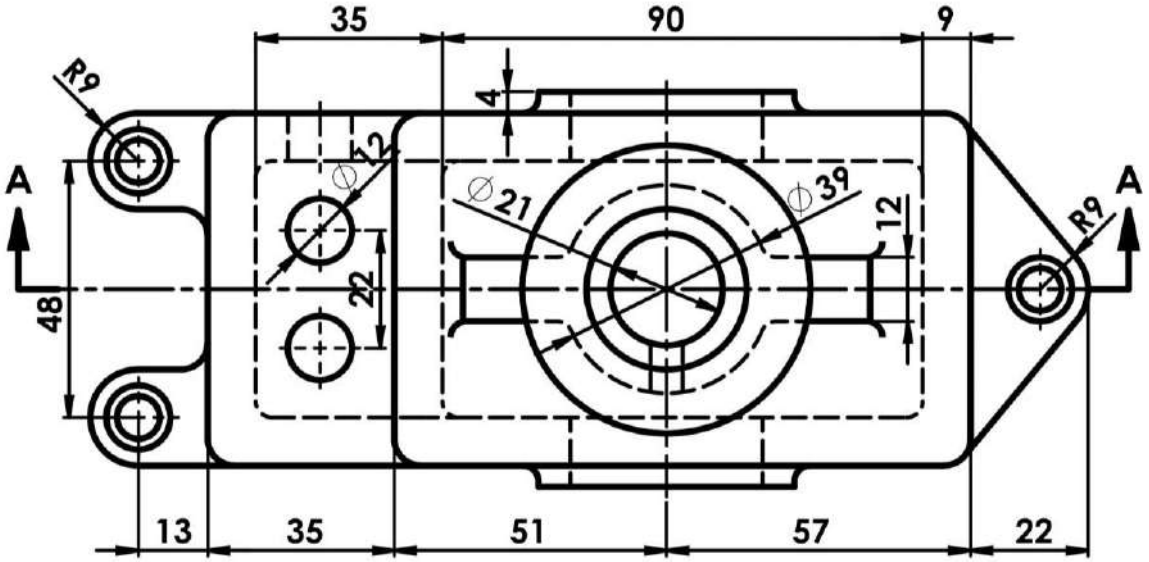
(a) Sectional elevation at A-A

(b) Sectional plan at B-B

(c) Sectional side view at C-C



ELEVATION

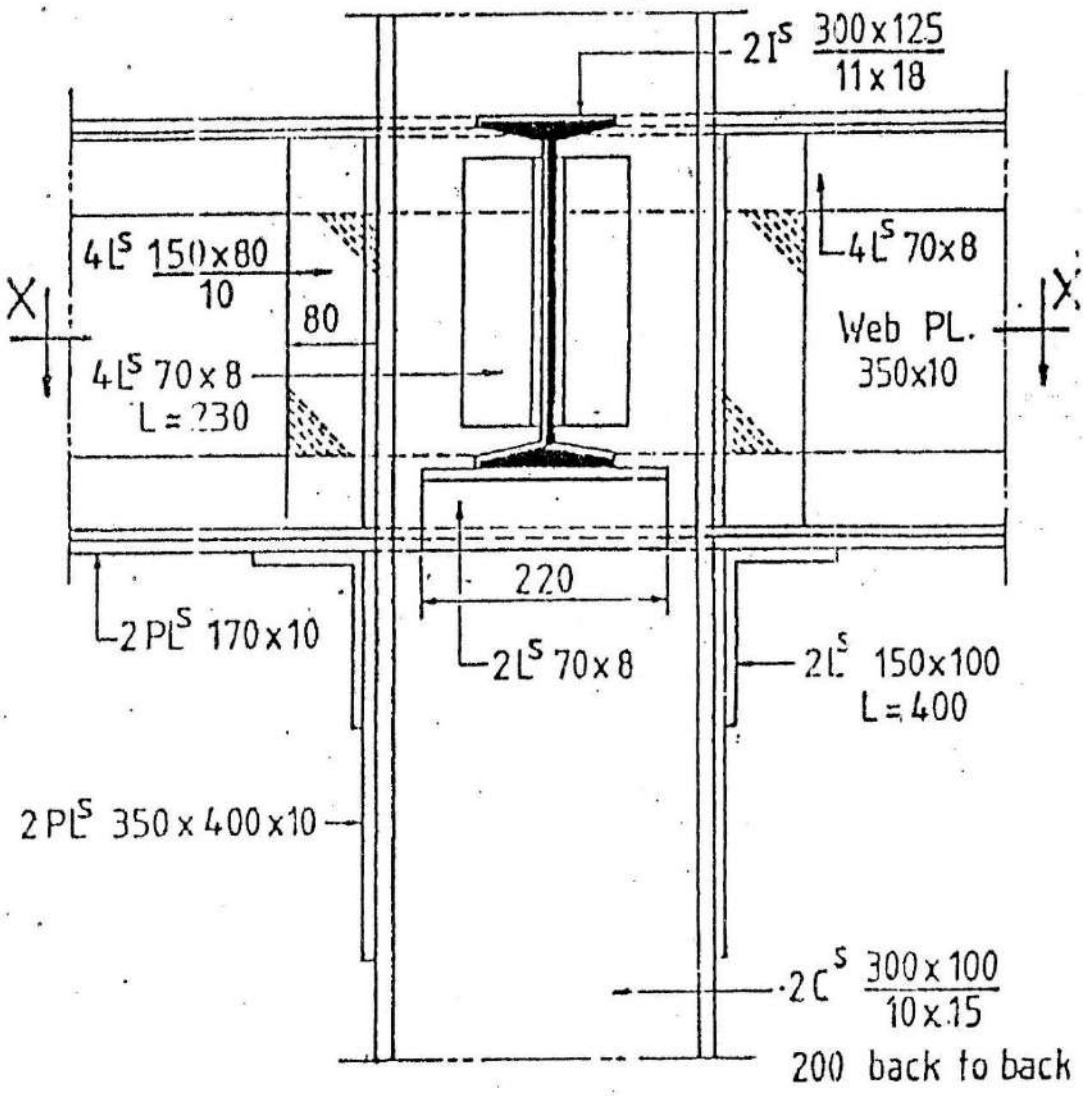


PLAN

Question (2):

For the following steel structure:

Redraw the front view and get the complete plan (scale 1:5)



6.6 Final Term Exam (3)

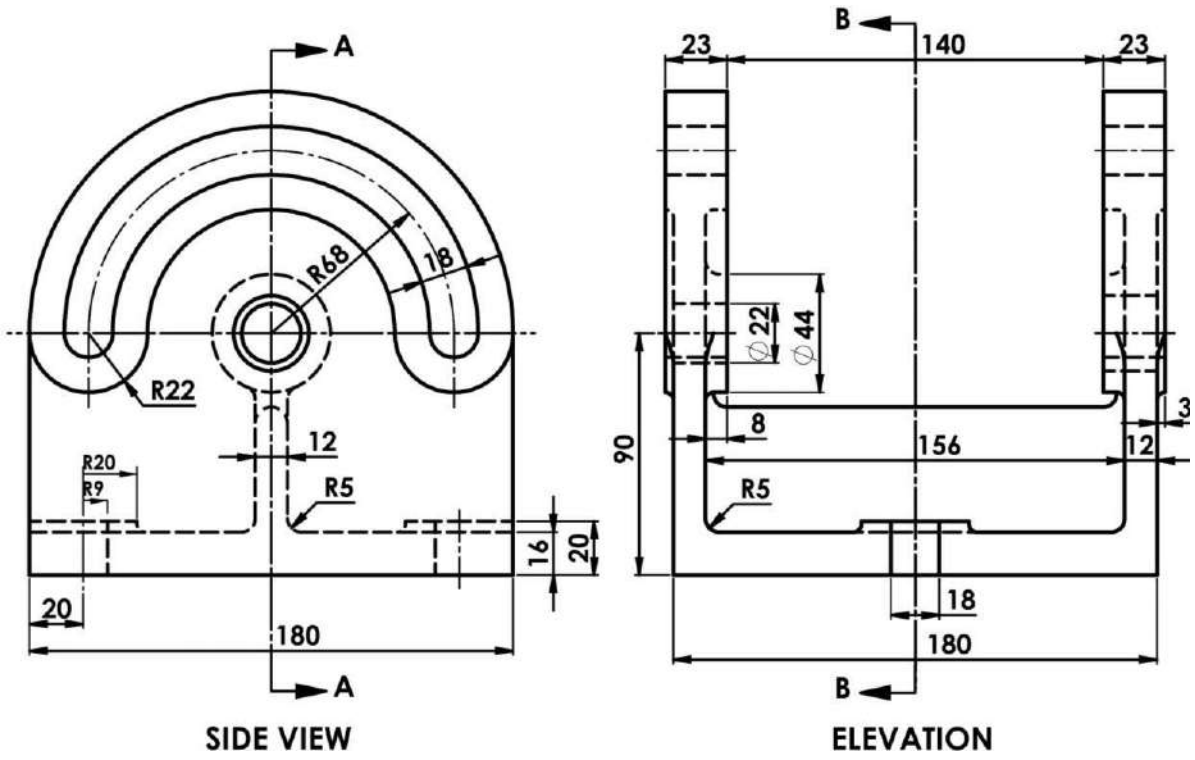
Question (1):

For the following drawing:

(1) Sectional elevation at A-A

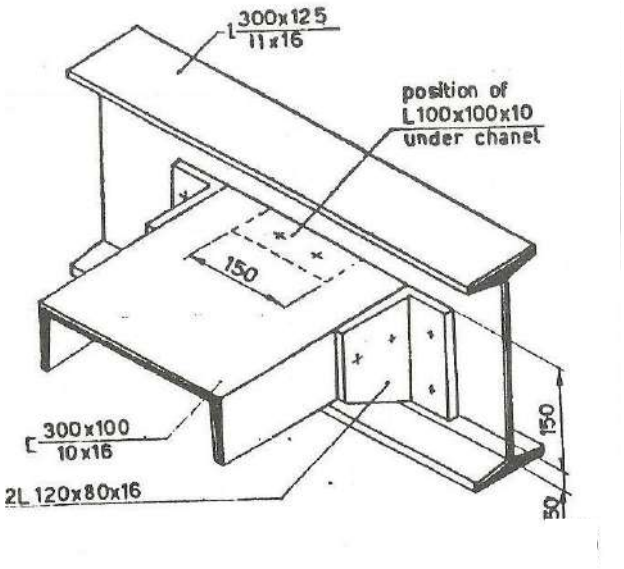
(2) Sectional side view at B-B

(3) Complete plan



Question (2):

Draw to scale 1:5 the elevation view only (from direction A) for the following steel construction



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