



# Politechnika Wroclawska

## Fundamentals of engineering drawing, p.5

dr inż. Stanisław Frąckowiak



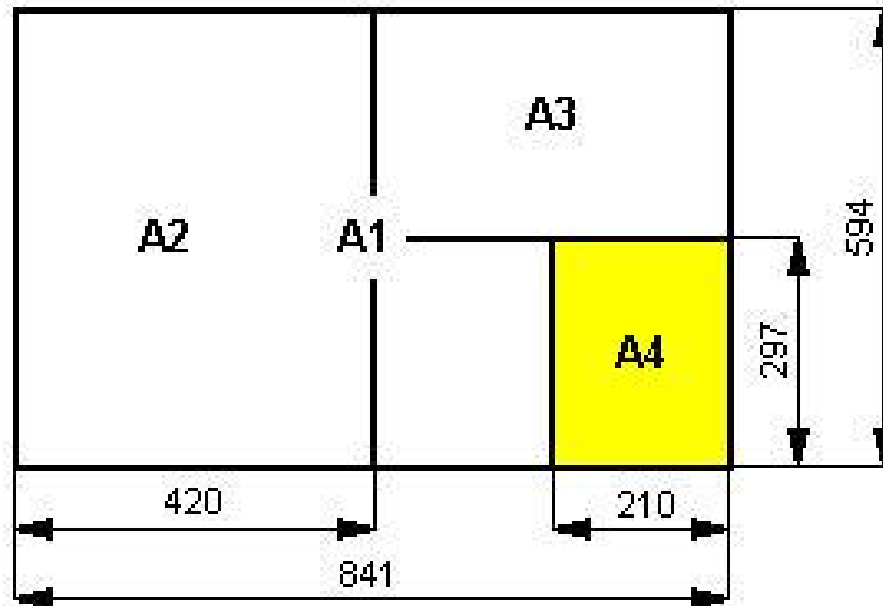
# SHEET FORMATS

- Sheet formats for technical drawings are standardized (PN-80/N-01612)
- A sheet of 297 x 210 mm was adopted as the basic format and was marked with the symbol A4.



# SHEET FORMATS

The basic formats are multiples of the basic A4 format and marked with the symbols A3, A2, A1, A0.

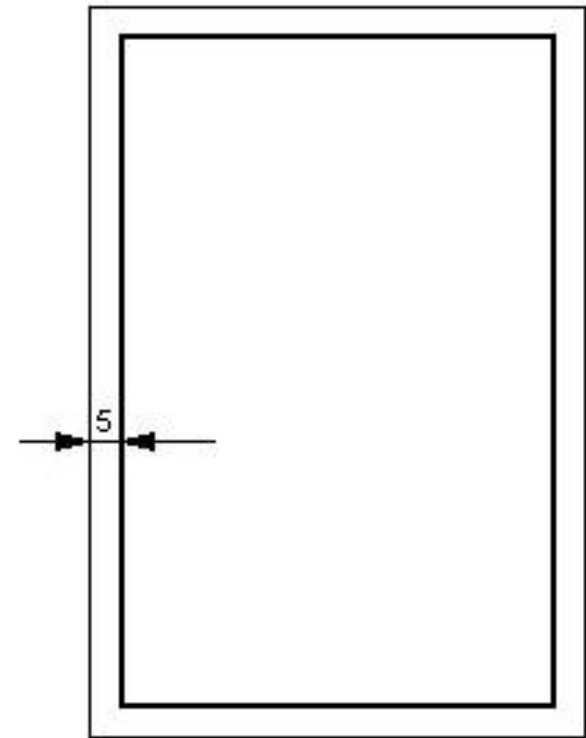


# BORDER, FRAME

Each technical drawing, regardless of its format, must be framed.

The frame should be made with a continuous line at a distance of  $a=5\text{mm}$  from the edge of the sheet on A3 and smaller formats and  $a=7-10\text{mm}$  on larger formats.

Border line thickness min.  $0.7\text{mm}$ .



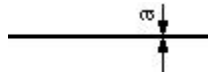


# STANDARDIZED MACHINE DRAWING ELEMENTS

## Types of drawing lines

The following types of lines are used for making technical machine drawings:

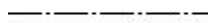
solid line



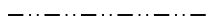
dash line



dotted line



two-point line



wavy line



zigzag line



In addition, the following lines are distinguished: very thick line (2a thick), thick line (thickness a), thin line (thickness  $b=a/3$ )



# STANDARDIZED MACHINE DRAWING ELEMENTS

## **Solid thick line**

Application: visible edges and clear outlines of objects in views and sections, outlines of shifted layouts,

- sheet border lines,
- outer outline of the drawing plate,
- short lines marking the ends of the section plane.



# STANDARDIZED MACHINE DRAWING ELEMENTS

## Solid thin line

### Application:

- dimension lines,
- auxiliary dimension lines,
- section hatching,
- reference lines,
- outlines of local layers,
- thread outlines,
- wheel axles with a diameter of  $\leq 12\text{mm}$ ,
- diagonals of rectangles,
- squares, trapezoids with an axis of symmetry,
- interpenetration lines,
- roughness marks,
- lines limiting the enlarged detail of the construction of the object,
- graph lines.



# STANDARDIZED MACHINE DRAWING ELEMENTS

## **Dashed line**

Application:

- invisible edges and outlines of objects graph lines

## **Thin dot line**

Application:

- axes of symmetry
- traces of planes of symmetry
- graph lines





# STANDARDIZED MACHINE DRAWING ELEMENTS

## Thin two-point line

Application:

- extreme positions of moving parts,
- outlines of adjacent objects, drawn for orientation
- purposes,
- the original shape of the object
- bending lines of items presented in the
- development,
- axis of gravity lines



# STANDARDIZED MACHINE DRAWING ELEMENTS

## **Wavy and zigzag line**

Application:

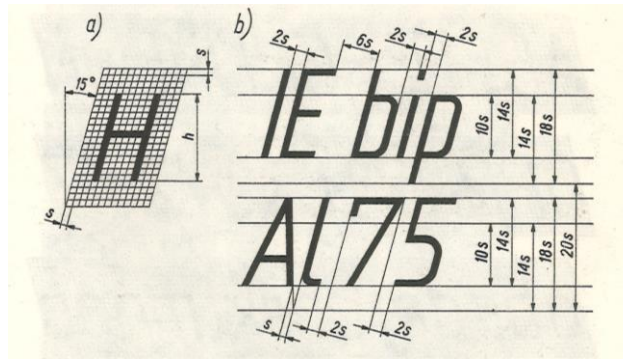
- break lines and end-break lines
- lines limiting partial sections



# STANDARDIZED MACHINE DRAWING ELEMENTS

## Technical writing

Cursive writing is mainly used to describe technical machine drawings. It is based on a rhombic grid with a rhombus height  $s$ , equal to the thickness of the lines of letters, numbers and characters. The angle of inclination of the grid relative to the vertical is 15 degrees.





# STANDARDIZED MACHINE DRAWING ELEMENTS

## Title box

A significant part of the explanations and comments concerning the drawing are included in the title box, which is placed in the lower right corner of the sheet so that it adheres to the border line.

We distinguish:

basic boxes,

reduced,

and simplified tables.



# STANDARDIZED MACHINE DRAWING ELEMENTS

## Drawing scale

numerical ratio of linear dimensions shown in the figure to the appropriate actual linear dimensions of the drawn object.

We distinguish the scale:

Enlarging: 100: 1, 50: 1, 20: 1, 10: 1, 5: 1, 2: 1

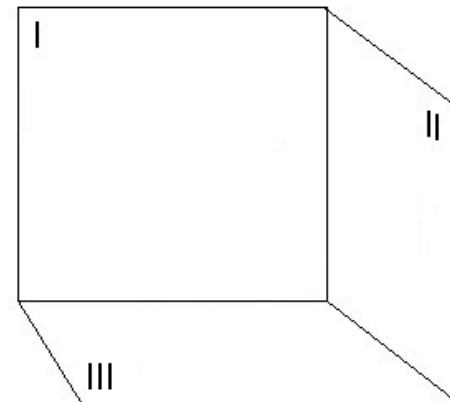
Natural: 1: 1

Reduction: 1: 2, 1: 5, 1:10 etc.

# Orthographic projection

Orthographic projection using the European method E. It consists in determining the rectangular throws of an object on mutually perpendicular viewing, assuming that the projected object is located between the observer and the projection plane.

- I - vertical projection plane, main,
- II - side projection plane,
- III - horizontal projection plane.



Układ trzech rzutni wzajemnie prostopadłych

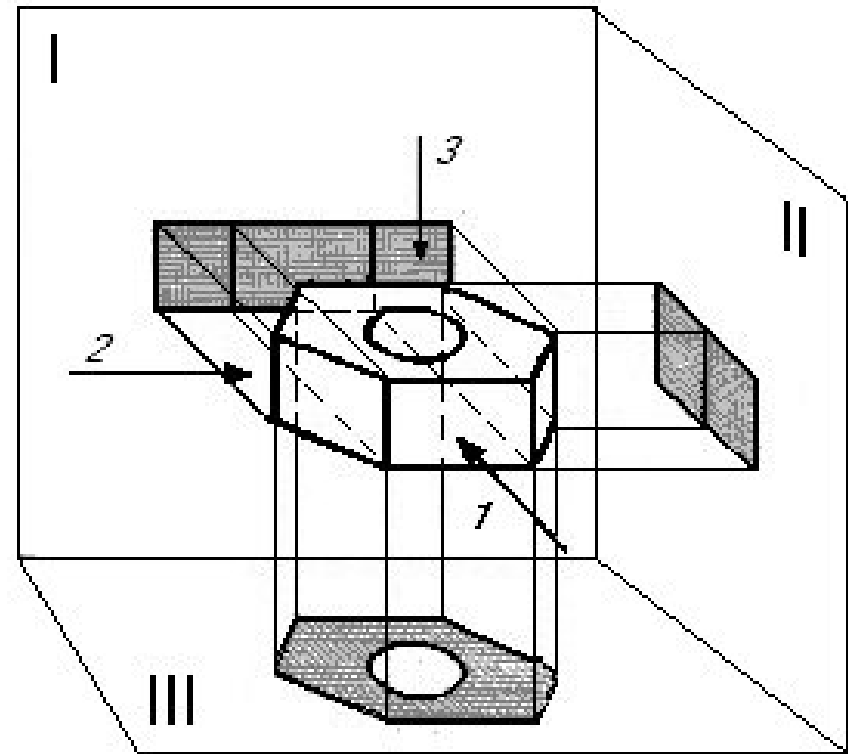


# Orthographic projection

We make a rectangular object to each of the planes perpendicular in the specific direction. According to direction 1 we will receive a vertical (main) projection.

On the side projection plane II, according to direction 2, we will get a lateral projection (from the left side).

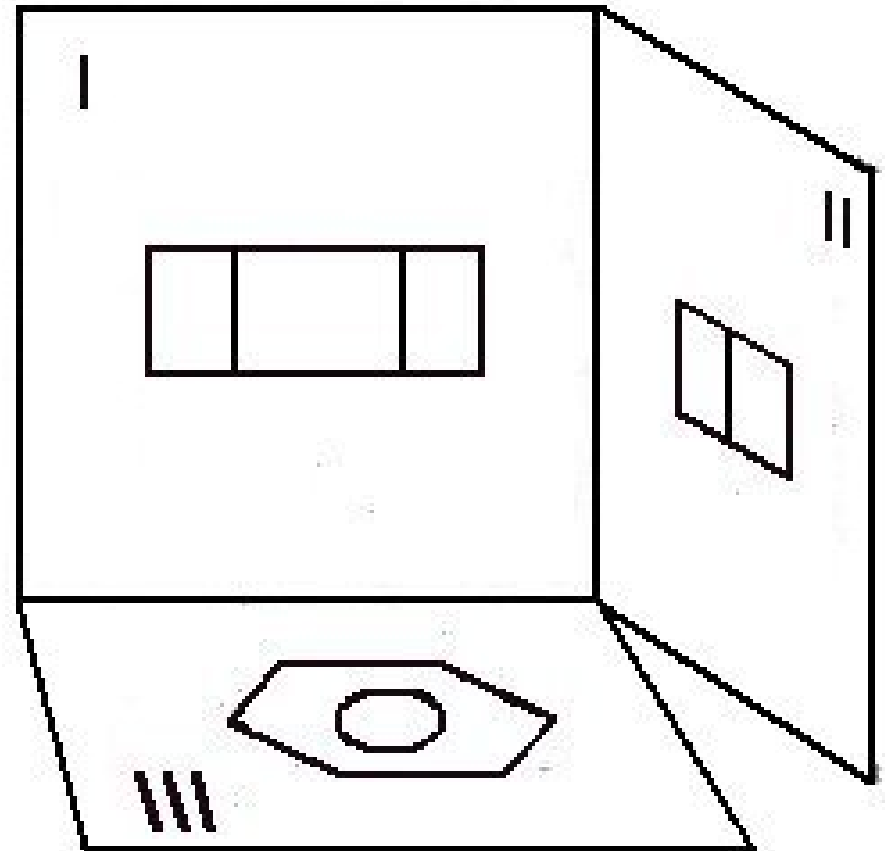
For horizontal 3rd viewer, according to direction 3, we will get an upper projection.





# Orthographic projection

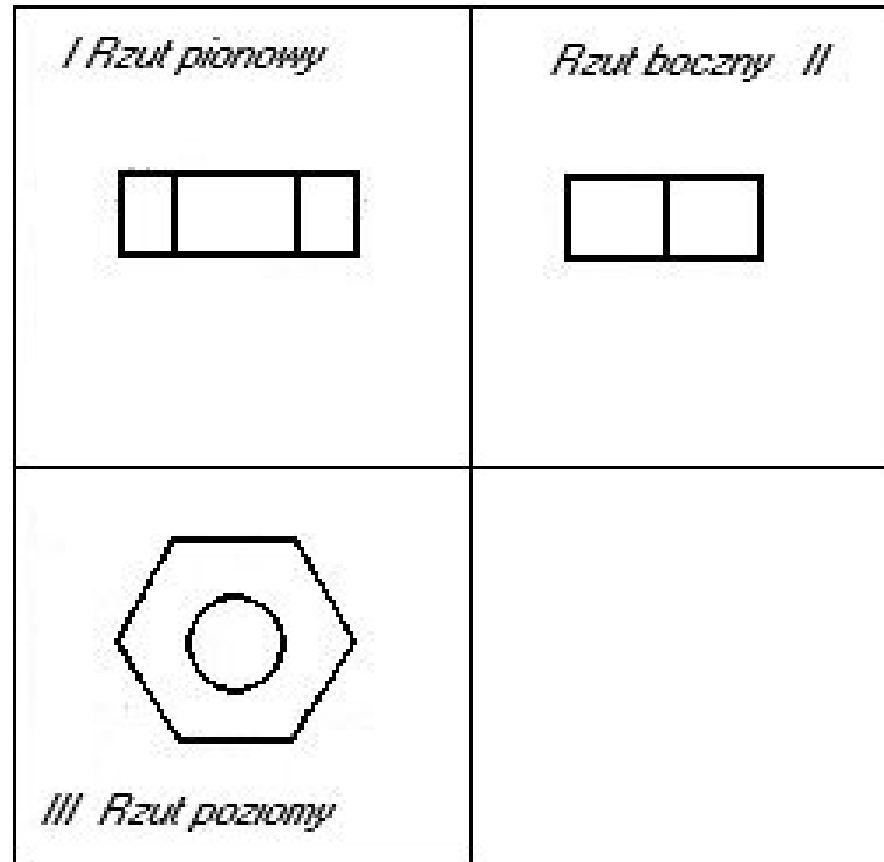
The spatial layout of three planes distorts the drawings, which is why we separate them from each other and put them in one plane.





# Orthographic projection

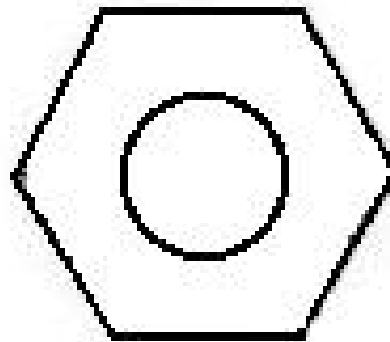
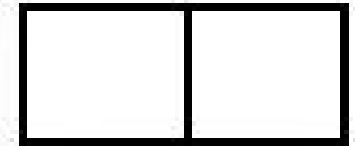
After unfolding at each projection plane, we have the correct-looking rectangular projections of the item from three different directions.





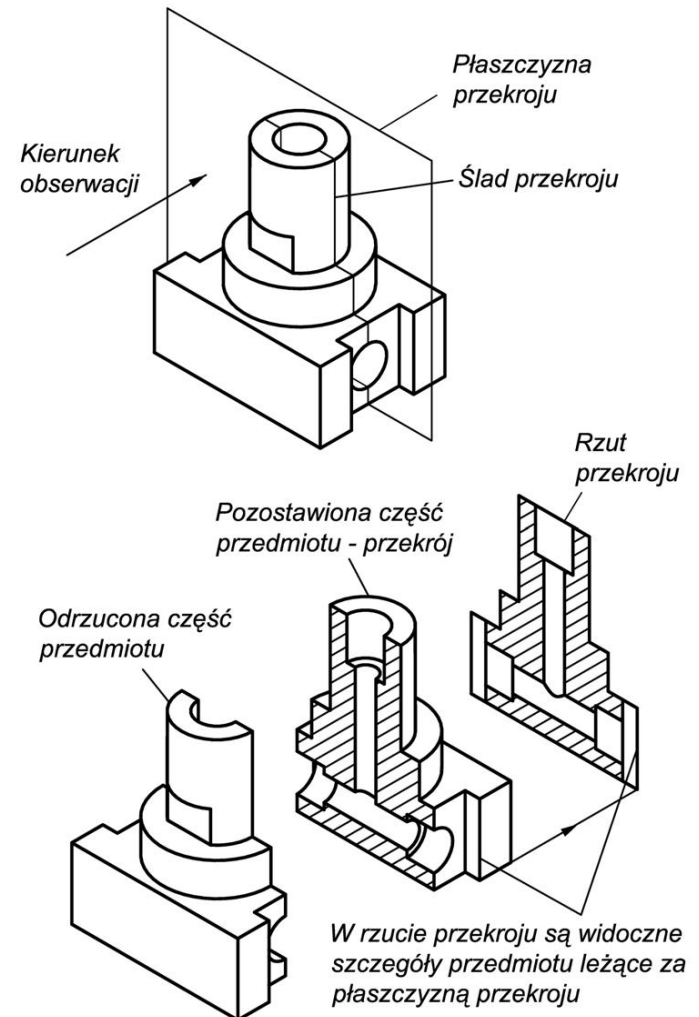
# Orthographic projection

In technical drawings, we do not draw traces of projection planes, because they only exist in the imagination. We recognize individual projections after their mutual position relative to each other.



# Views and cross-sections

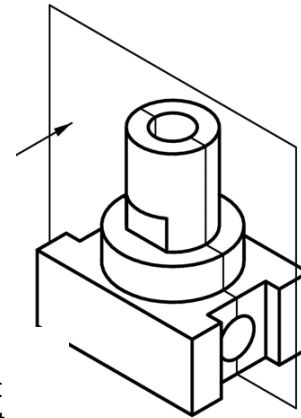
The projections of objects can be both views that show their external shapes and cross-sections, which show the internal structure of hollow objects.



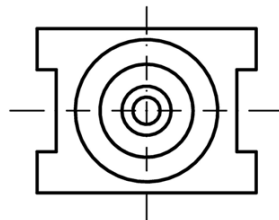
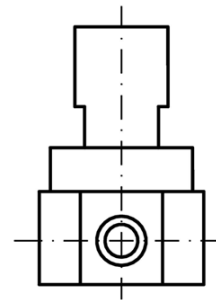
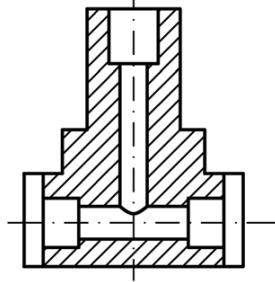


# Placing the cross-section in orthographic projection

section  
observation  
direction



sections are placed in the places of  
appropriate views when they are not  
needed, or in any place on the sheet





# Placing the cross-section in orthographic projection

- Note: outlines and visible edges of views and sections (including the edges of sections resulting from the intersection of the object with the section plane) are drawn with a solid thick line

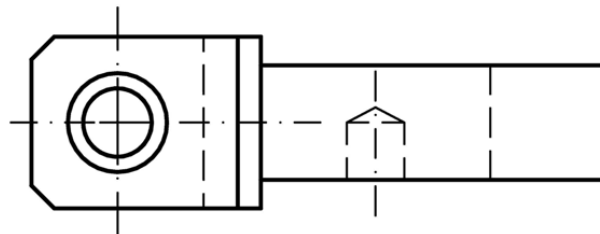
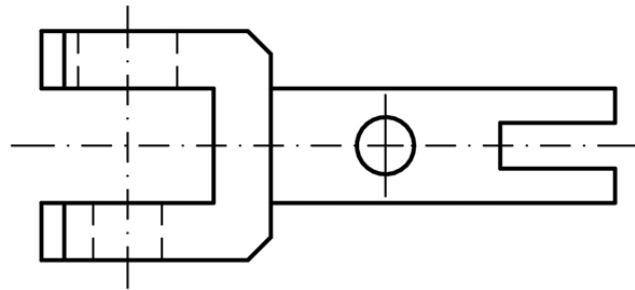
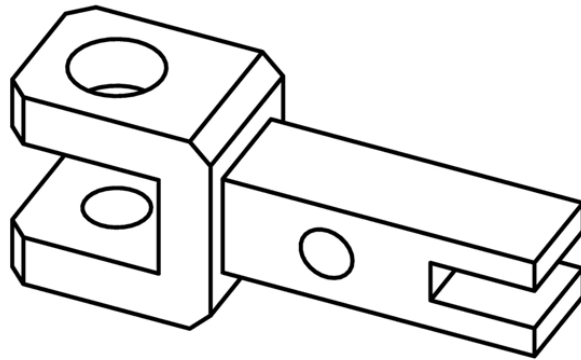


# DRAWING INVISIBLE OUTLINES AND EDGE OF THE OBJECT

- The outlines and invisible edges of the object can be drawn with a thin dashed line, when it does not reduce the readability of the drawing and allows you to avoid an additional projection.
- It is not recommended to draw only some invisible lines and omit others. Accurate and legible presentation of the internal structure of the object is provided by cross-sections.



# DRAWING INVISIBLE OUTLINES AND EDGE OF THE OBJECT





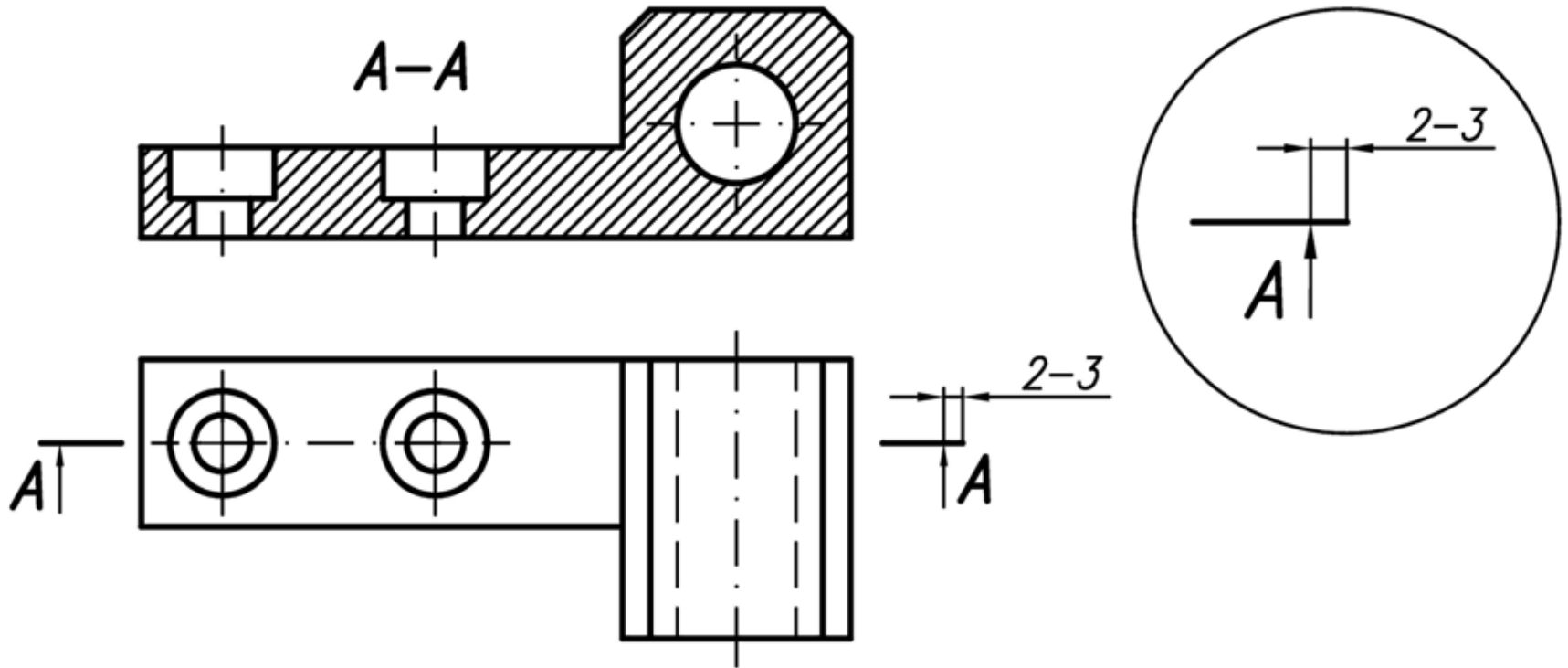
# SECTIONS MARKING

- The location of the section plane is marked in the projection on the plane perpendicular to it with two thick lines not intersecting the external outline of the object and with arrows indicating the direction of projection. The plane of the section is marked with two identical letters.





# SECTIONS MARKING





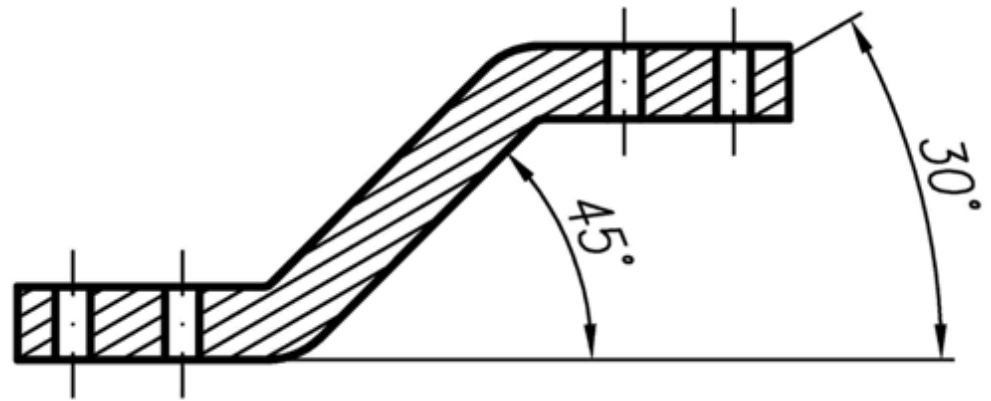
# SECTIONS MARKING

If the section is on the same sheet as the projection on which the location of the section plane is marked and is drawn in accordance with the European method, you can:

- omit the cross-section letter,
- omit arrows,
- omit the section designation if the drawing clearly shows where it was made.

# SECTION HATCHING

- The hatch line is a thin line inclined at an angle of  $45^\circ$  to the outline of the object, to the axis or horizontal, *exceptionally*  $30^\circ$ , if the inclination of the object justifies it. Very thin sections (g less than 1mm) can be blackened.



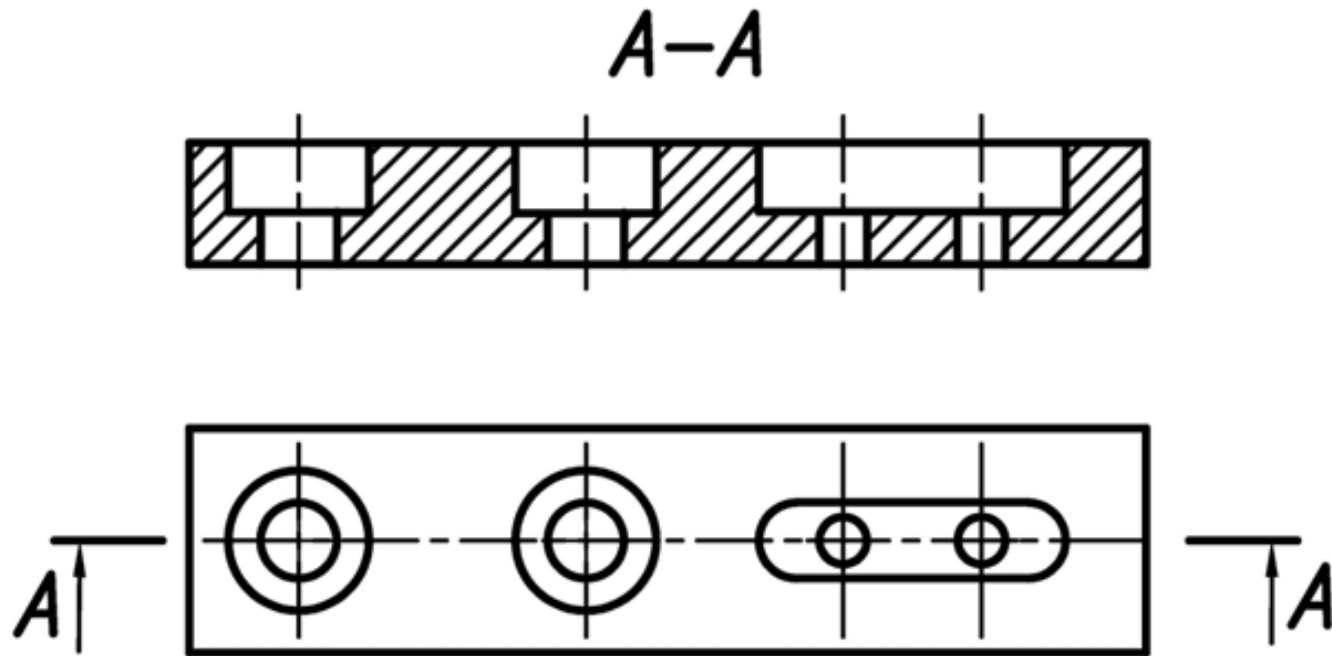


# Types of cross-sections

There are different types of cross-sections:  
simple - the object is cut by one plane,  
complex: broken and gradual - the object is cut by two or more planes

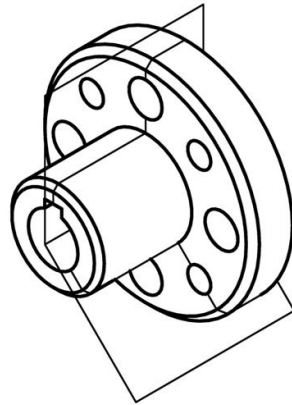


# Simple cross-section

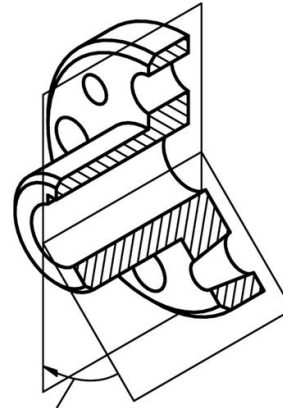




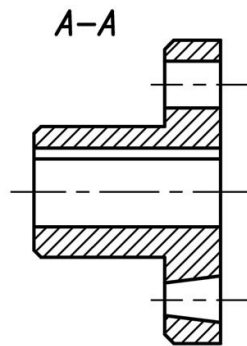
# Broken cross-section



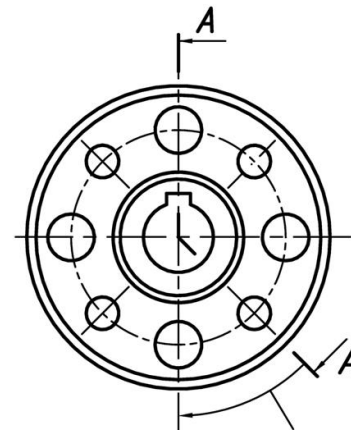
*Przekrój łamany*



*Obrót części przekroju*



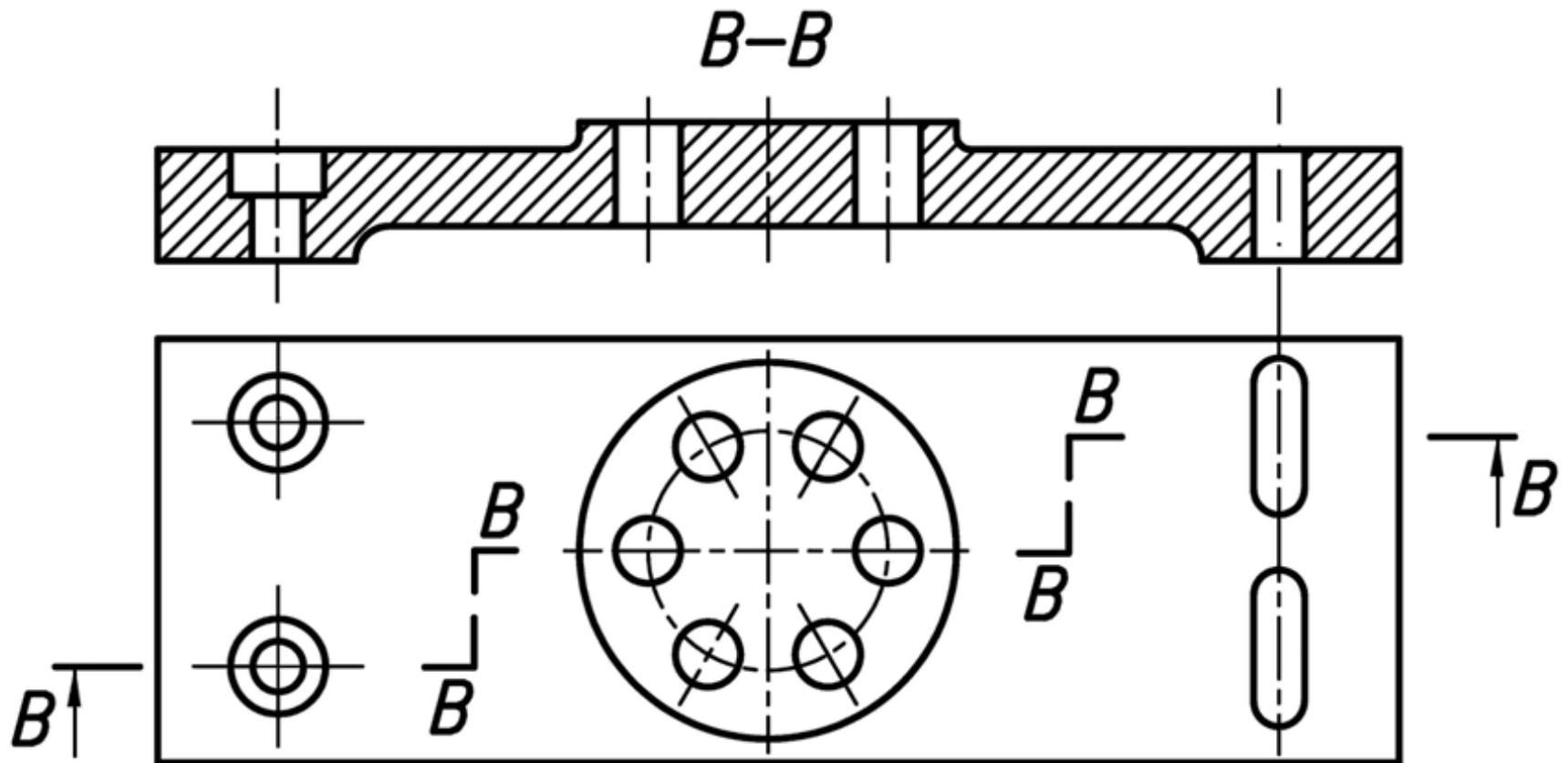
*Rzut przekroju łamanego*



*Obrót przekroju do płaszczyzny pionowej*



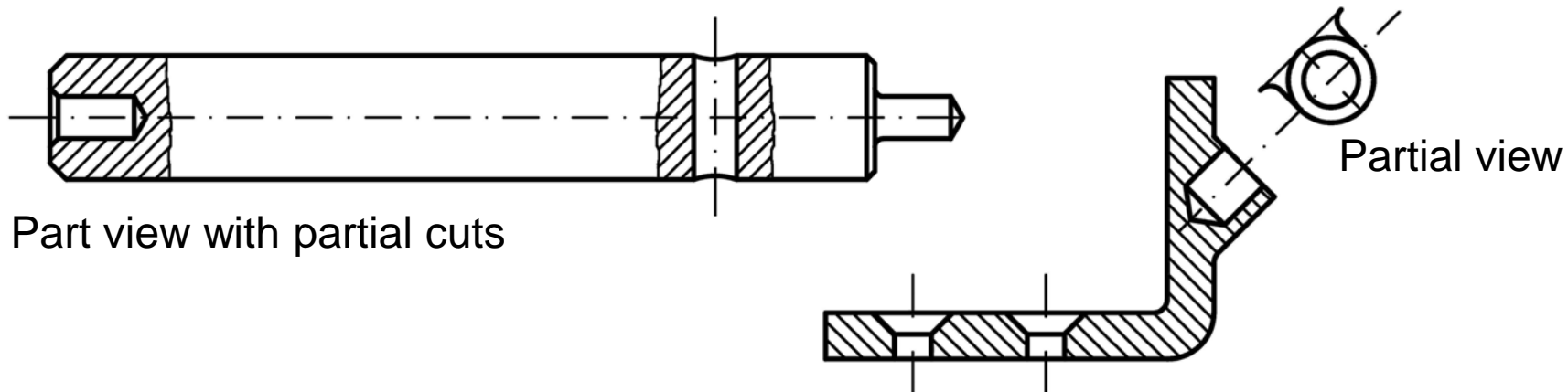
# Gradual cross-section





# Partial views and sections (breakouts)

These are parts of projections (views or sections) that are relevant to the representation and dimensioning of an object. This is how the fine details of items are depicted.







# VIEWS AND SECTIONS OF SYMMETRICAL OBJECTS

The symmetry of an object or its fragment in relation to an axis or a plane is marked by drawing a thin dotted line with an axis of symmetry parallel to the plane of symmetry or a trace of the plane of symmetry perpendicular to the plane of the drawing.



# VIEWS AND SECTIONS OF SYMMETRICAL OBJECTS

- When drawing objects with a symmetrical structure, you can omit parts of projections or sections by selecting the symmetry of the object.



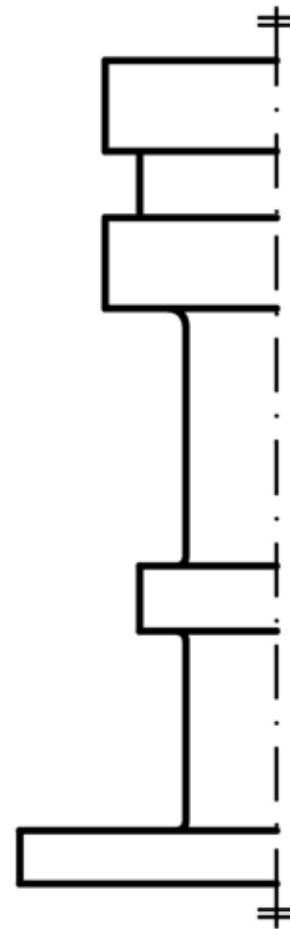
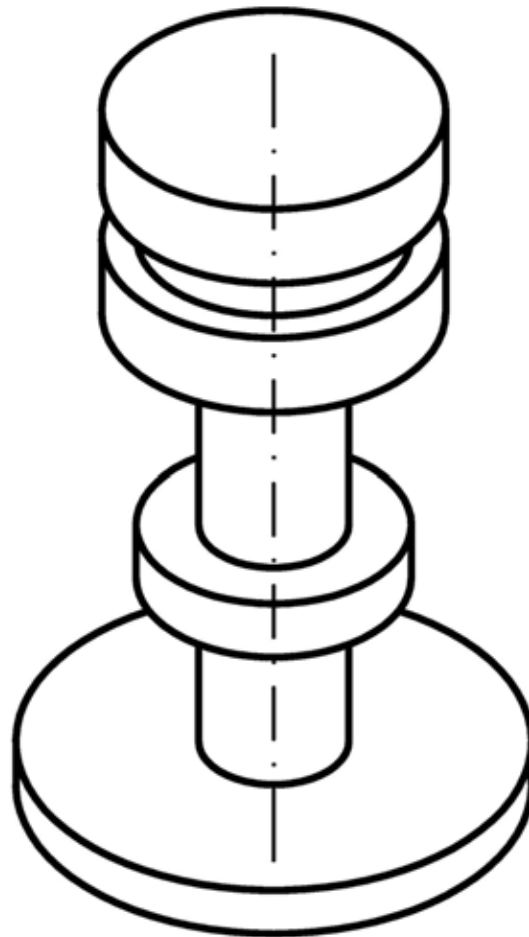
# VIEWS AND SECTIONS OF SYMMETRICAL OBJECTS

Ways of presenting objects with a symmetrical structure:

- half view,
- half-section,
- half view - half section,
- quarter view,
- quarter section

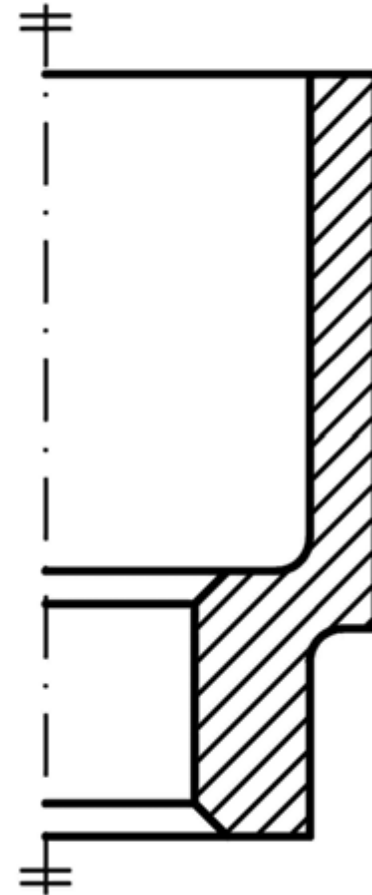
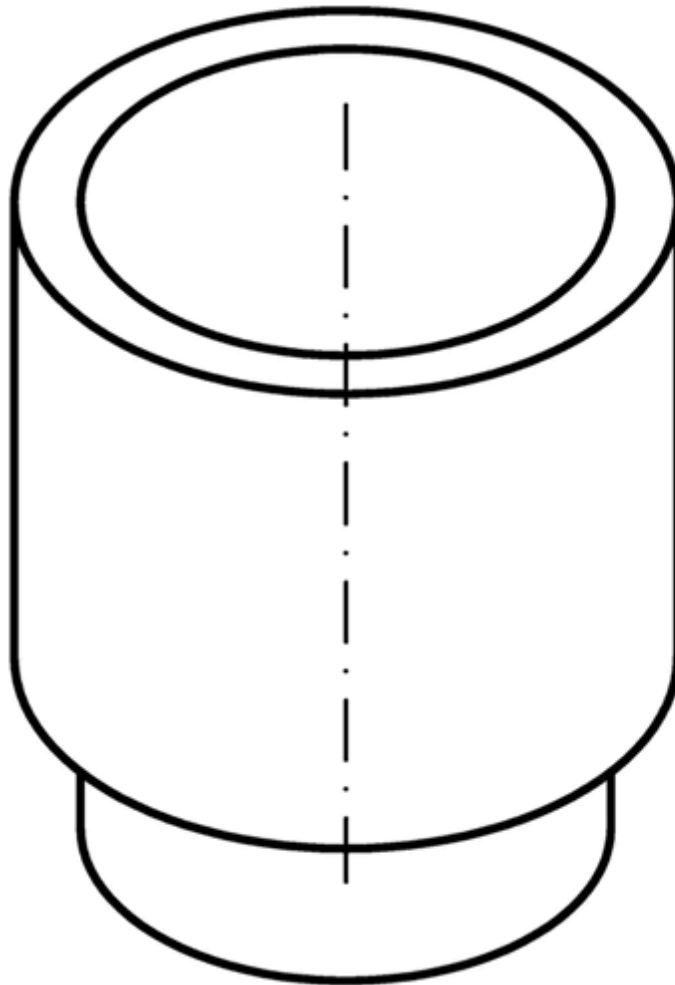


# Cylinder-type symmetrical object and its half-view



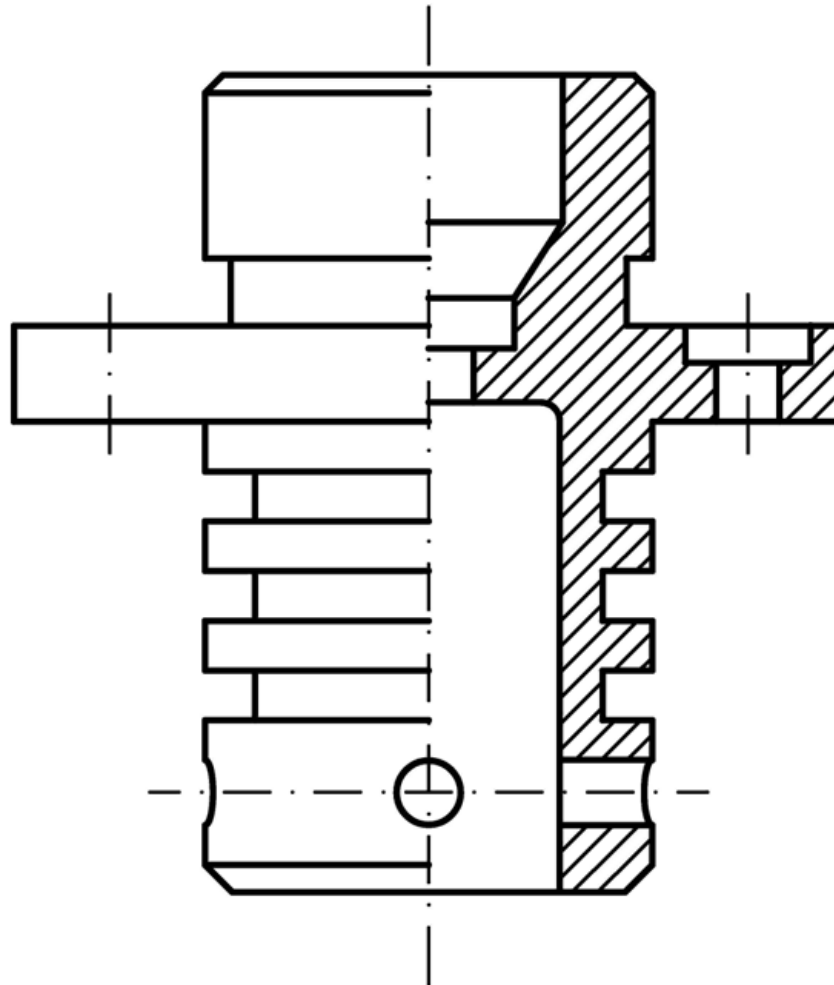


# A symmetrical object of the sleeve type and its half-section



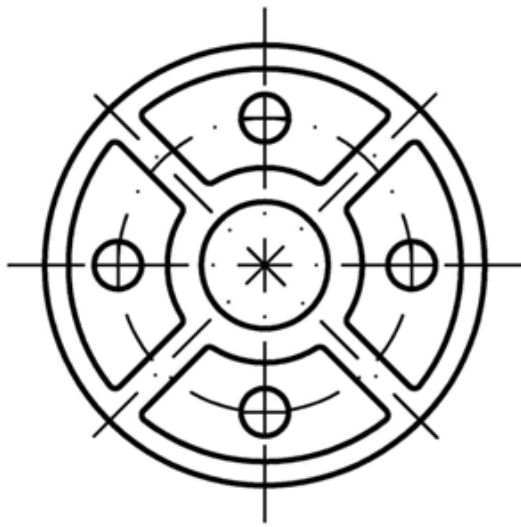


# Half-view - half-section of the object

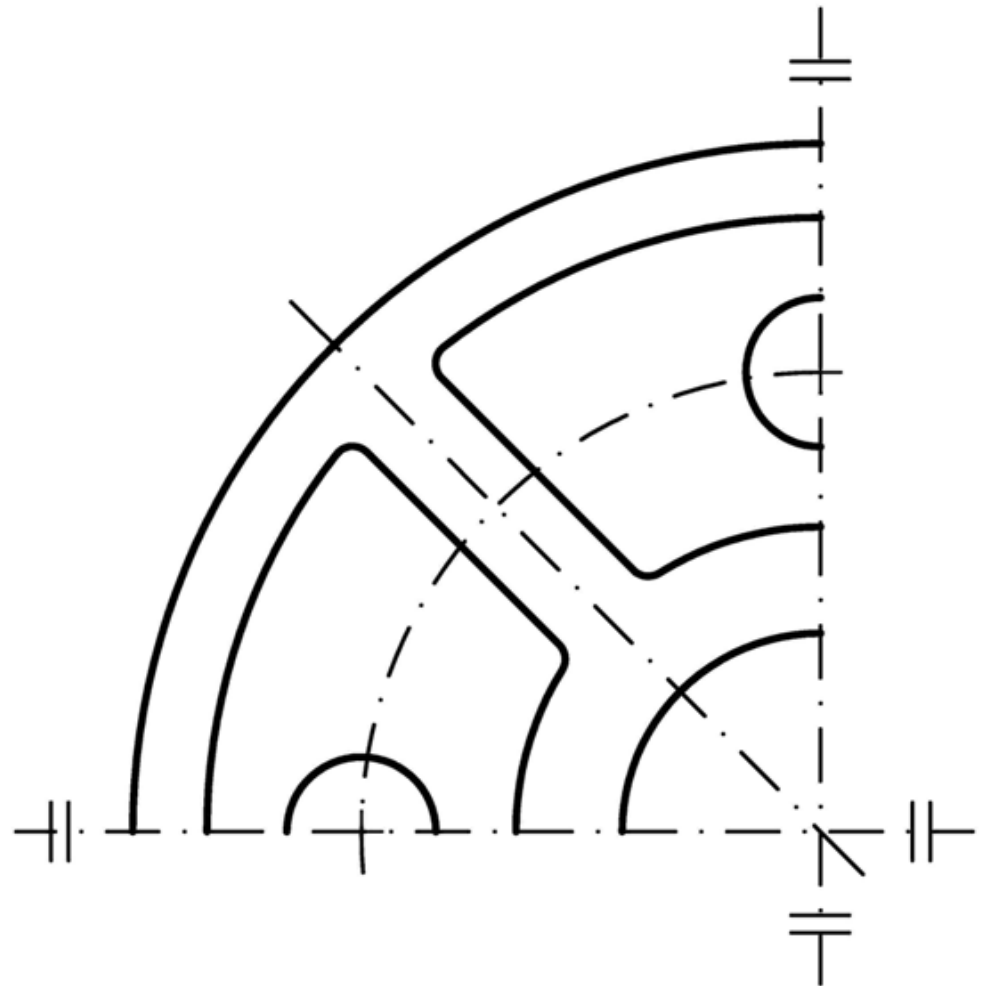




# A quarter view of a symmetrical object

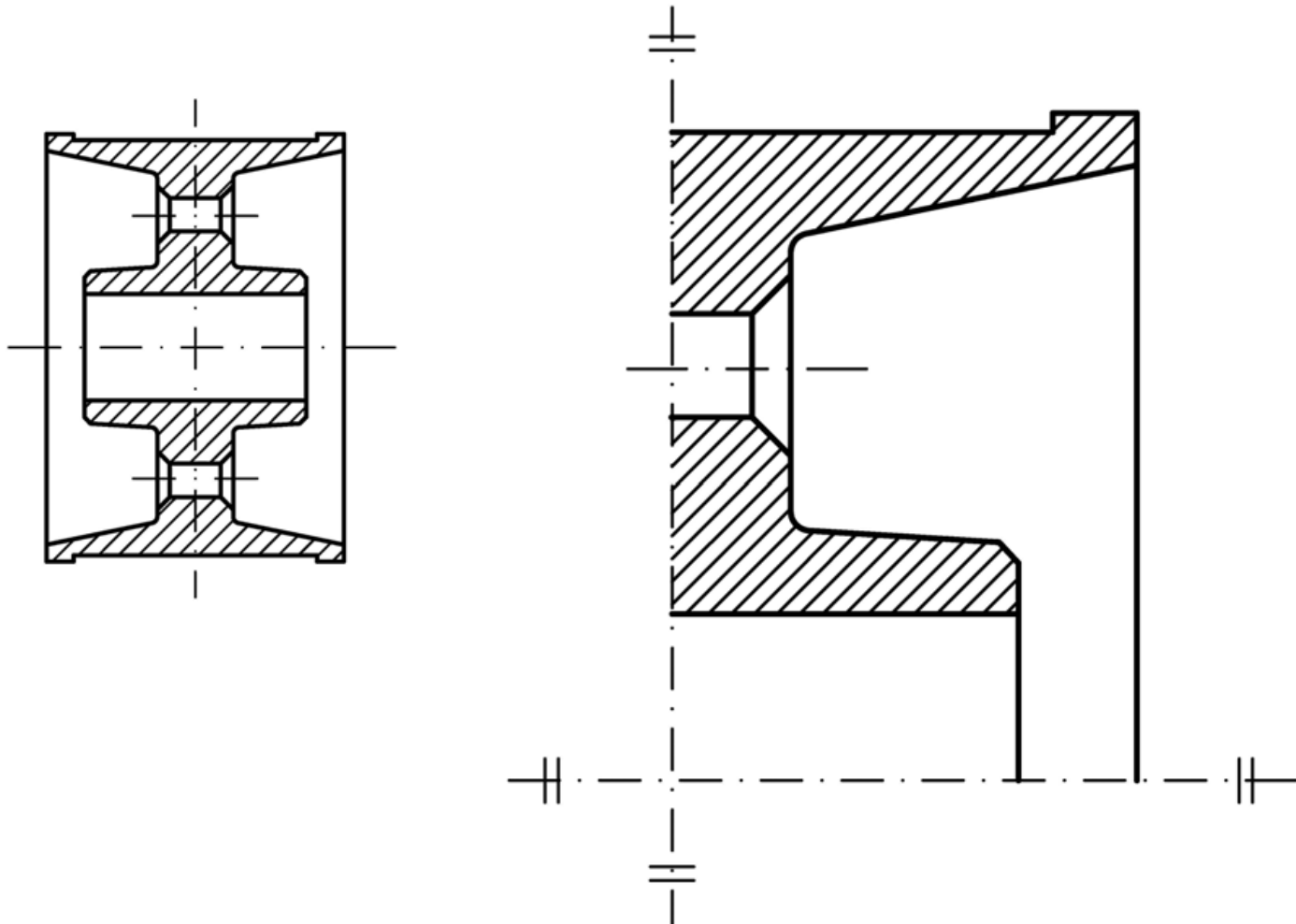


Full view





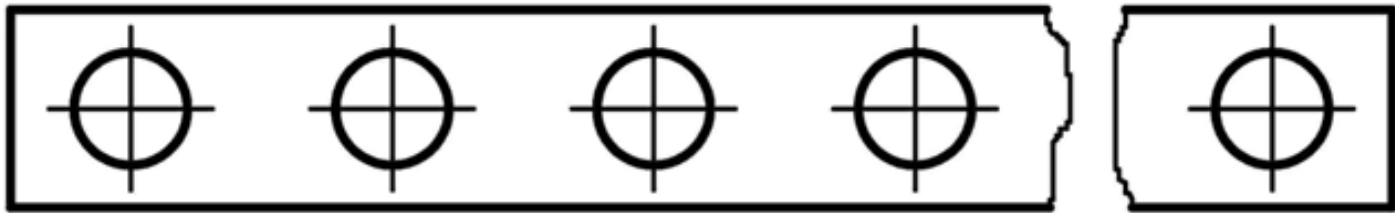
# A quarter-section of a symmetrical object



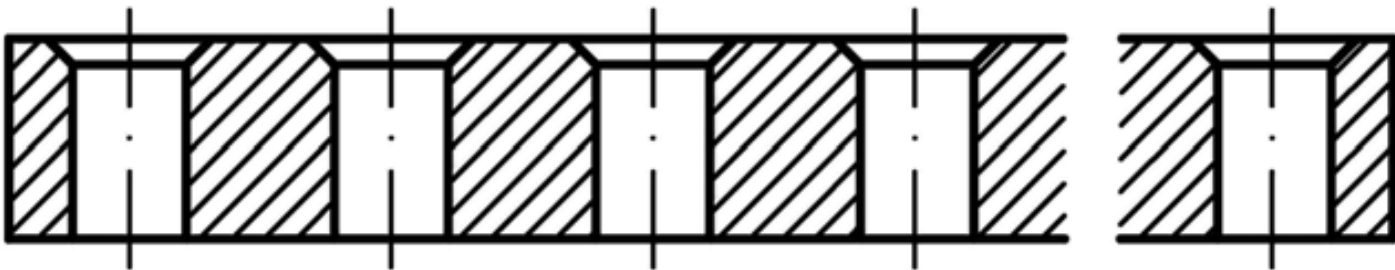




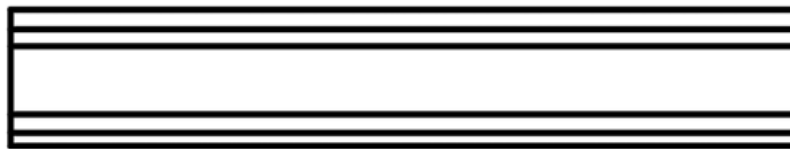
# Broken (interrupted) views, cross-sections



Broken view



Broken cross-section



Broken view

