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of URBAN ECONOMY in KHARKIV**

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LECTURES
on the subject

«ENGINEERING GRAPHICS»

*(for 1st-year full-time and part-time students education level “bachelor”
specialty 241 – Hotel and Restaurant Business)*

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INTRODUCTION

Engineering Graphics is a discipline that requires training for students of all specialties. Design and construction, understanding the principle of technological depicted product closely are associated with images: drawings, paintings, sketches.

This poses discipline “Engineering Graphics” a number of important tasks. The course “Engineering Graphics” should provide future professionals skills and presentation skills of technical ideas by drawing.

The main purpose of the discipline is acquisition of knowledge and skills necessary for students to perform and read technical drawings, sketches implementation details and working with documents.

LECTURE 1 PROJECTION

1.1 First angle and third angle projection

1.2 The straight line

1.1 First angle and third angle projection

Orthographic projection is the solution to the biggest problem that a draughtsperson has to solve – how to draw, with sufficient clarity, a three-dimensional object on a two-dimensional plane. The drawing must show quite clearly the detailed outlines of all the faces and these outlines must be fully dimensioned. If the object is very simple, this may be achieved with a freehand sketch. A less simple object could be drawn in either isometric or oblique projections, although both these systems have their disadvantages. Circles and curves are difficult to draw in either system and neither shows more than three sides of an object in any one view. Orthographic projection, because of its flexibility in allowing any number of views of the same object, has none of these drawbacks.

Orthographic projection has two forms: first angle and third angle; we shall discuss both. Traditionally, British industry has used first angle while the United States of America and, more recently, the continental countries used the third angle system.

There is no doubt that British industry is rapidly changing to the third angle system and, although this will take some years to complete, third angle will eventually be the national and international standard of orthographic projection.

Figure 1.1 shows a stepped block suspended between two planes. A plane is a perfectly flat surface. In this case one of the planes is horizontal and the other is vertical. The view looking on the top of the block is drawn directly above the block on the horizontal plane (HP). The view looking on the side of the block is drawn directly in line with the block on the vertical plane (VP). If you now take away the stepped block and, imagining that the two planes are hinged, fold back the HP so that it lines

up with the VP, you are left with two drawings of the block. One is a view looking on the top of the block and this is directly above another view looking on the side of the block. These two views are called “elevations”.

Figure 1.1 shows the block in in first angle orthographic projection. The same block is drawn in Figure 1.2 in third angle orthographic projection. You still have a VP and a HP but they are arranged differently. The block is suspended between the two planes and the view of the top of the block is drawn on the HP and the view of the side is drawn on the VP. Again, imagining that the planes are hinged, the HP is folded down so that the planes are in line. This result in the drawing of the side of the block being directly above the drawing of the top of the block (compare this with the third angle drawings).

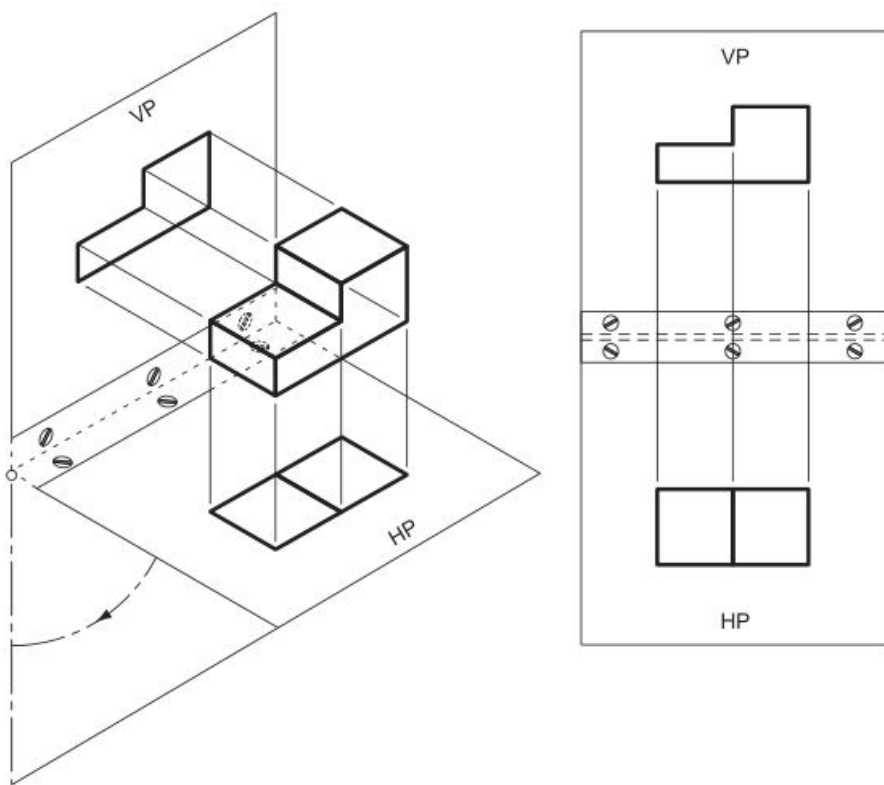


Figure 1.1 – First angle orthographic projection

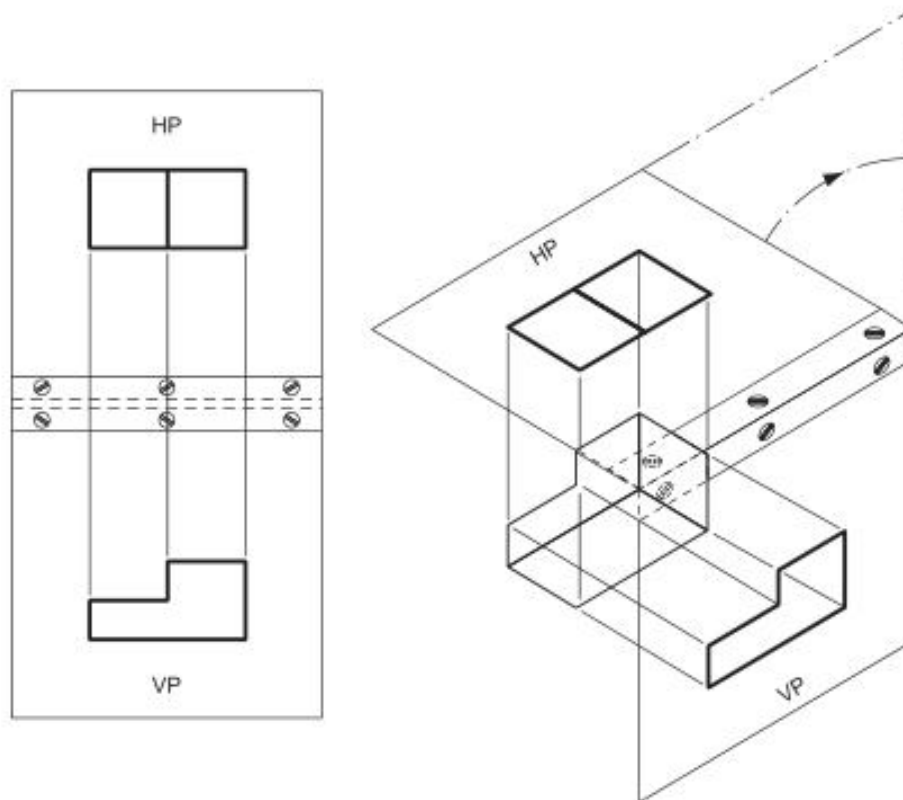


Figure 1.2 – Third angle orthographic projection

The reason why these two systems are called first and third angle is shown in Figure 1.3. If the HP and the VP intersect as shown, it produces four quadrants. The first quadrant, or first angle, is the top right and the third is the bottom left. If the block is suspended between the VP and the HP in the first and third angles, you can see how the views are projected onto the two planes.

So far we have obtained only two views of the block, one on the VP and one on the HP. With a complicated block this may not be enough. This problem is easily solved by introducing another plane. In this case it is a VP and it will show a view of the end of the block and so, to distinguish it from the other VP, it is called the end vertical plane (EVP), and the original vertical plane is called the front vertical plane (FVP).

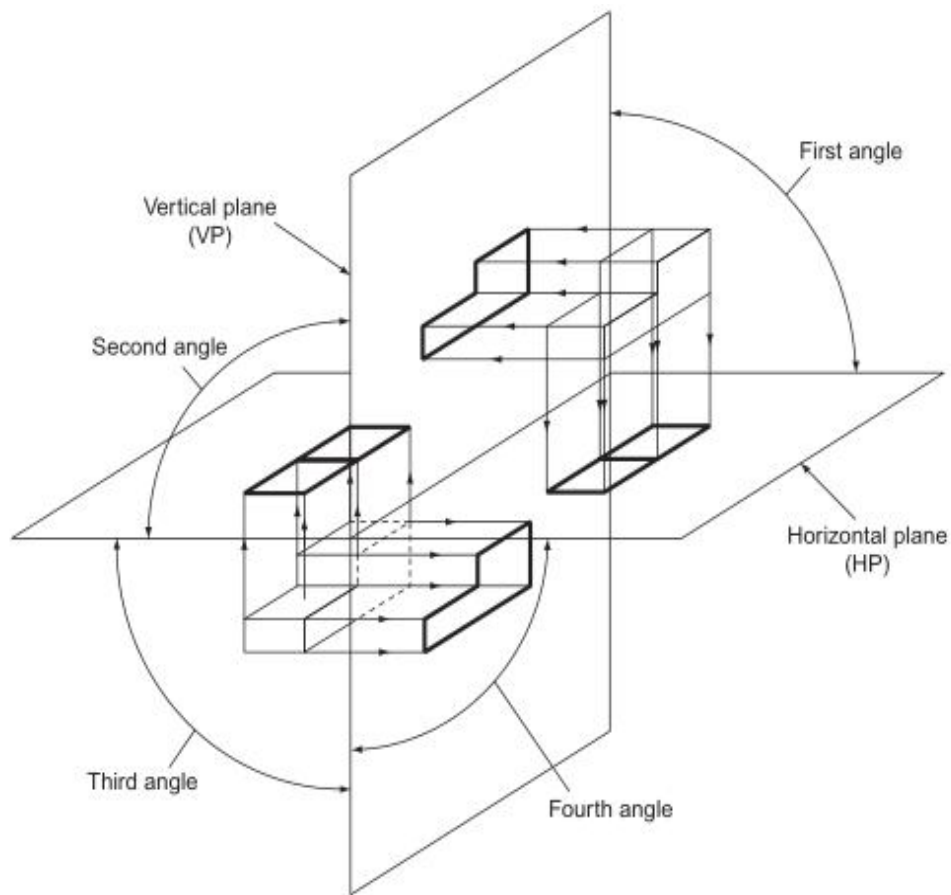


Figure 1.3 – Relative positions of first and third angle projections

The EVP is hinged to the FVP and when the views have been projected onto their planes, the three planes are unfolded and three views of the block are shown in Figure 1.4.

The drawing on the FVP is called the front elevation (FE), the drawing on the EVP is called the end elevation (EE) and the drawing on the HP is called the plan. All three views are linked together: the plan is directly above the FE; the EE is horizontally in line with the FE; and the plan and the EE can be linked by drawing 45° projection lines. This is why orthographic projection is so important; it is not just because several views of the same object can be drawn, it is because the views are linked together.

Figure 1.4 shows three views of the block drawn in third angle; Figure 1.5 shows three views of the same block drawn in first angle.

In this case the FE is above the plan and to the left of the EE (compare this with third angle). Once again, the EE and the plan can be linked by projection lines drawn at 45°.

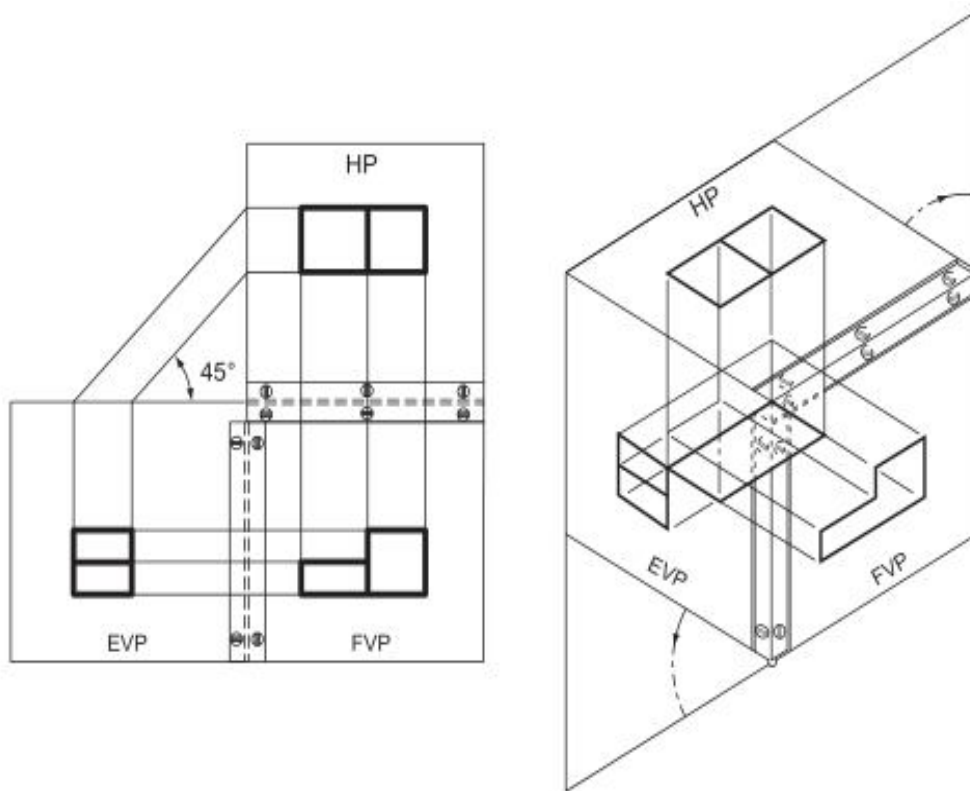


Figure 1.4 – Third angle orthographic projection

The system of suspending the block between three planes and projecting views of the block onto these planes is the basic principle of orthographic projection and must be completely understood if one wishes to study this type of projection any further.

The following system is somewhat easier to understand and will meet most of the reader's needs.

Figure 1.6 shows the same shaped block drawn in third angle projection. First, draw the view obtained by looking along the arrow marked FE. This gives you the FE. Now look along the arrow marked EE 1 (which points from the left) and draw what you see to the left of the FE. This gives you an EE. Now look along the arrow marked EE 2 (which points from the right) and draw what you see to the right of the FE. This gives you another EE. Now look down onto the block, along the arrow

marked “plan” and draw what you see above the FE. This gives the plan and its exact position is determined by drawing lines from one of the EE at 45° .

Note that with third angle projection, what you see from the left you draw on the left, what you see from the right you draw on the right and what you see from above you draw above.

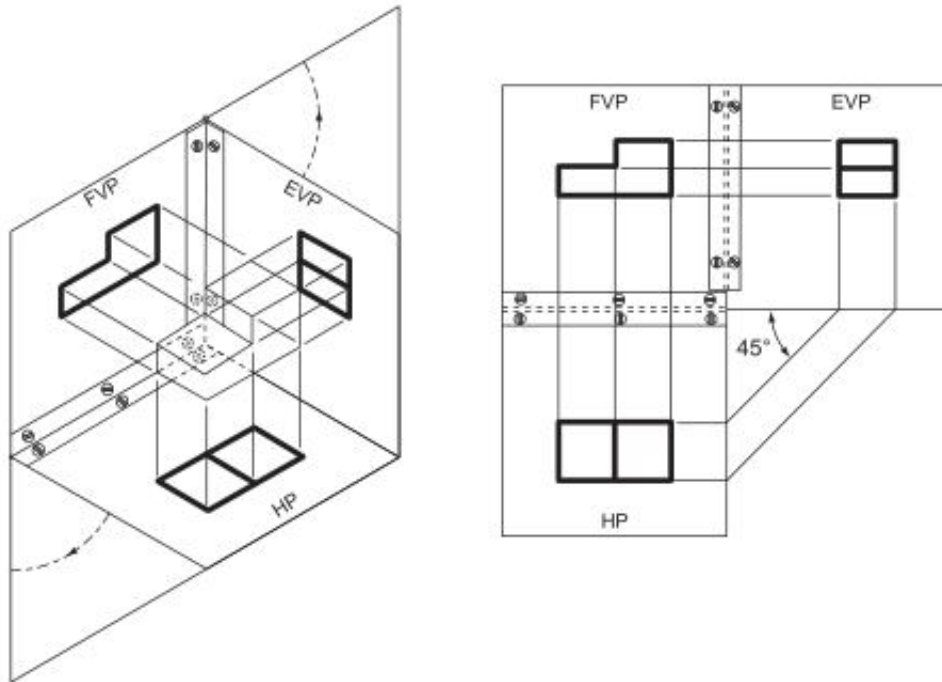


Figure 1.5 – First angle orthographic projection

Figure 1.6 shows the same shaped block drawn in third angle projection. First, draw the view obtained by looking along the arrow marked FE. This gives you the FE. Now look along the arrow marked EE 1 (which points from the left) and draw what you see to the left of the FE. This gives you an EE. Now look along the arrow marked EE 2 (which points from the right) and draw what you see to the right of the FE. This gives you another EE. Now look down onto the block, along the arrow marked “plan” and draw what you see above the FE. This gives the plan and its exact position is determined by drawing lines from one of the EE at 45°.

Note that with third angle projection, what you see from the left you draw on the left, what you see from the right you draw on the right and what you see from above you draw above.

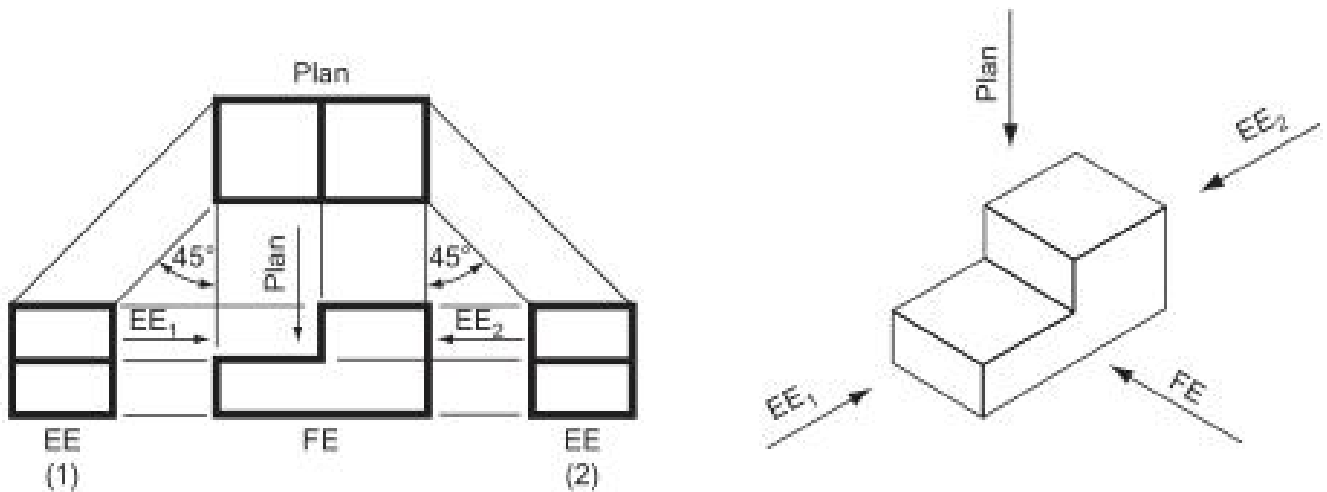


Figure 1.6 – Third angle orthographic projection

Figure 1.7 shows the same block drawn in first angle projection. Again, first draw the view obtained by looking along the arrow marked FE. This gives the FE.

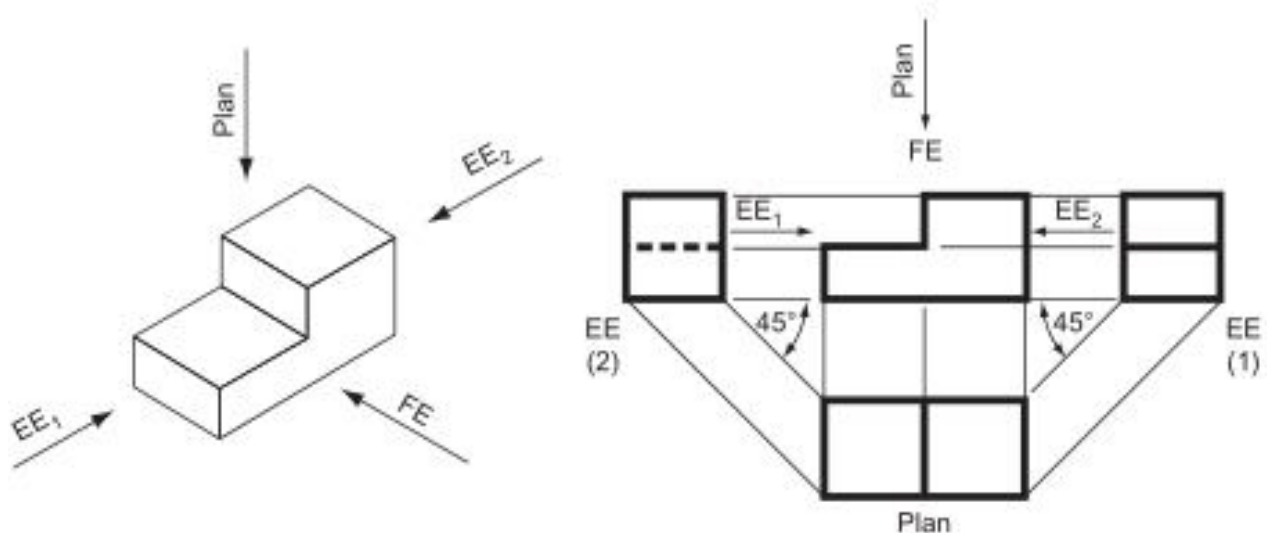


Figure 1.7 – First angle orthographic projection

Now look along the arrow marked EE 1 (which points from the left) and draw what you see to the right of the FE. This gives you an EE. Now look along the arrow marked EE 2 (which points from the right) and draw what you see to the left of the FE. This gives you another EE. Now look down on the block, along the arrow marked “plan” and draw what you see below the FE. This gives the plan and its exact position is determined by drawing lines from one of the EE at 45°.

Note that with first angle projection, what you see from the left you draw on the right, what you see from the right you draw on the left and what you see from above you draw below.

1.2 The straight line projection

The projection of a line that is not parallel to any of the principal planes.

Figure 1.8 shows a straight line AB suspended between the three principal planes. Projectors from A and B, perpendicular to the planes, give the projection of AB on each of the principal planes. On the right of Figure 1.8 can be seen the projections of the line after rabatment.

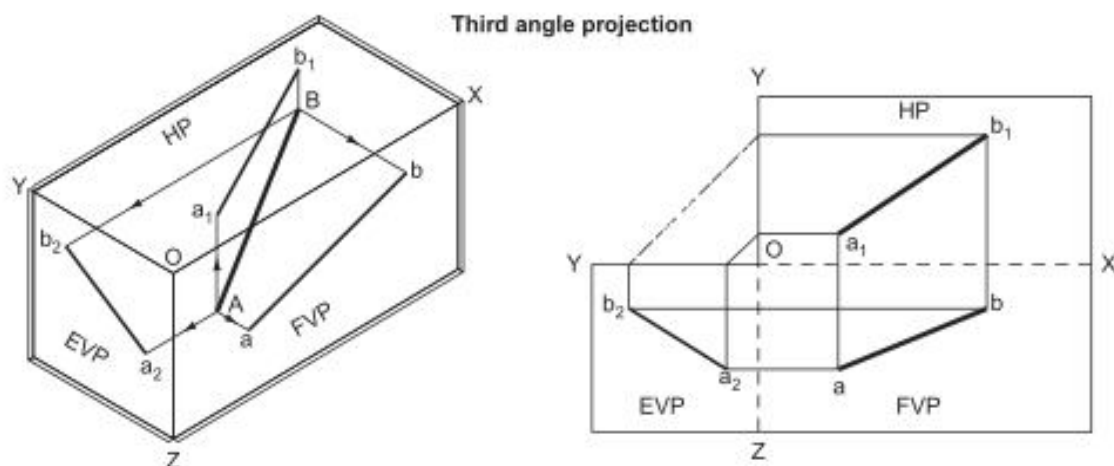


Figure 1.8 – Third angle orthographic projection

To find the traces of a straight line given the plan and elevation of the line (Fig. 1.9).

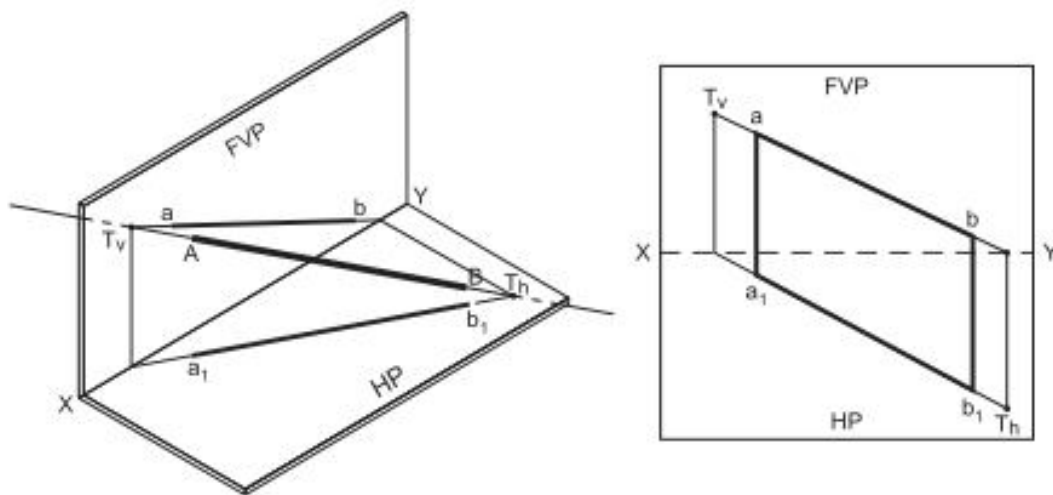


Figure 1.9 – The traces of a straight line

The line is AB. If the line is produced it will pass through both planes, giving traces T_v and T_h . The line ab is produced to meet the XY line. This intersection is projected down to meet $a_1 b_1$ produced in T_h . The projection of $a_1 b_1$ is produced to meet the XY line. This intersection is projected up to meet ab produced in T_v .

To draw the elevation and plan of a line AB given its true length and the distances of the ends of the line from the principal planes, in this case a_v and a_h , and b_v and b_h (Fig. 1.10).

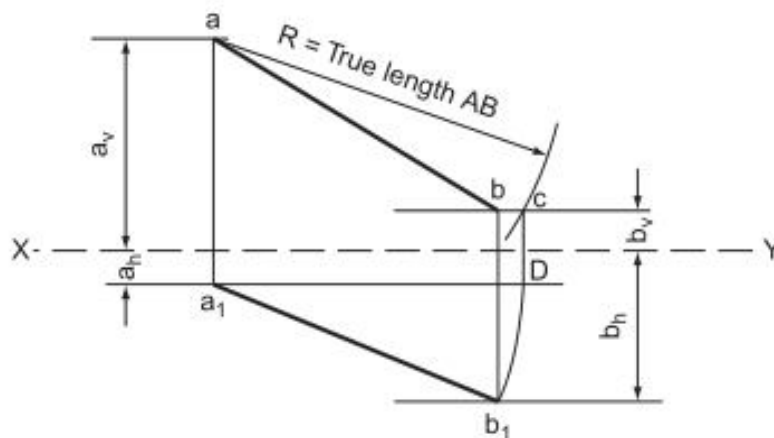
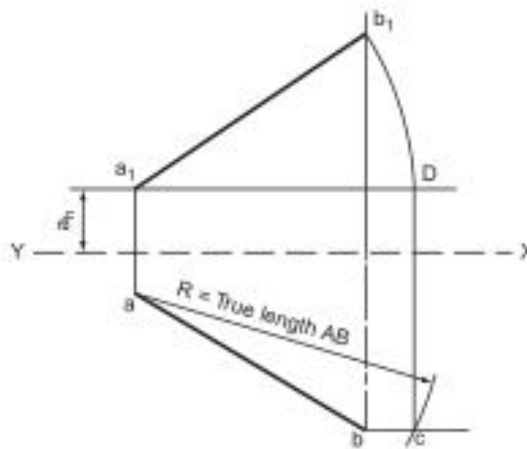


Figure 1.10 – True length of AB (first angle projection)

Task algorithm

1. Fix points a and a_1 at the given distances a_v and a_h from the XY line. These are measured on a common perpendicular to XY.

- To construct the plan of a line AB given the distance of one end of the line from the XY line in the plan (a_h), the true length of the line and the elevation (Fig. 1.11).



4. With centre a_1 , radius equal to a_1D , draw an arc to meet a line drawn from b

To construct the elevation of a line given the distance of one end of the line

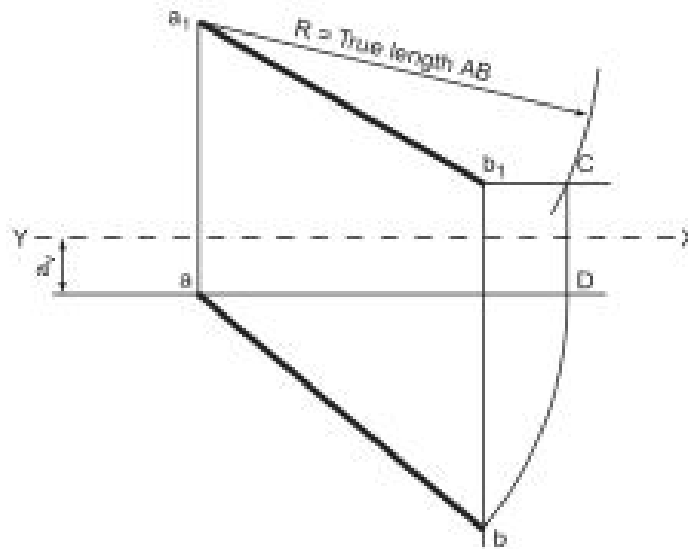


Figure 1.12 – True length of AB

This construction is very similar to the last one and can be followed from the instructions given for that example.

To construct the elevation of a line AB given the plan of the line and the angle that the line makes with the HP (Fig. 1.13).

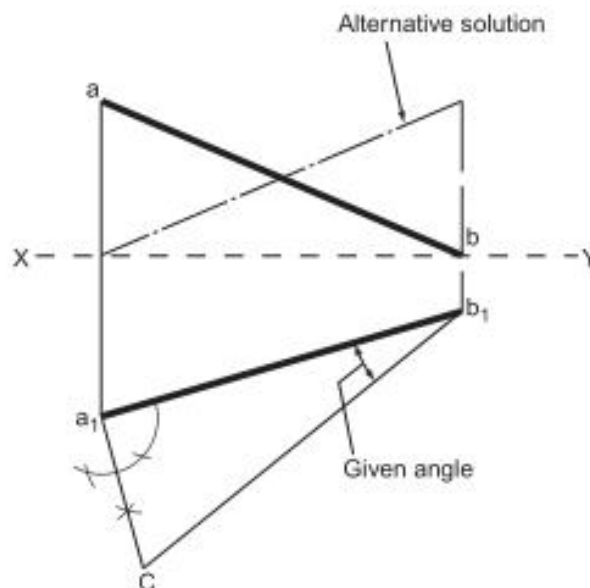


Figure 1.13 – Plan of the line and the angle to HP

Task algorithm

1. Draw the plan and from one end erect a perpendicular.
 2. From the other end of the plan draw a line at the angle given to intersect the perpendicular in C.
 3. From b_1 draw a line perpendicular to XY to meet XY in b.
 4. From a_1 draw a line perpendicular to XY and mark off XY to a equal to a_1c .
- The line ab is the required elevation. An alternative solution is also shown.

LECTURE 2 TRANSFORMATION OF THE COMPLEX DRAWING

2.1 Finding the true length of the lines

2.2 Projections on auxiliary planes

2.1 Finding the true length of the lines

A trace is the line resulting from the intersection of two planes. The trace of the FVP and the HP is the line OX. The trace of the EVP and the HP is the line OY.

The trace of the FVP and the EVP is the line OZ. These lines are often very useful for reference purposes and they should be marked on your drawings. The O is often ignored and the traces are then shown as XY and YZ.

To find the true length of a line that is not parallel to any of the principal planes and to find the angle that the line makes with the FVP (Fig. 2.1).

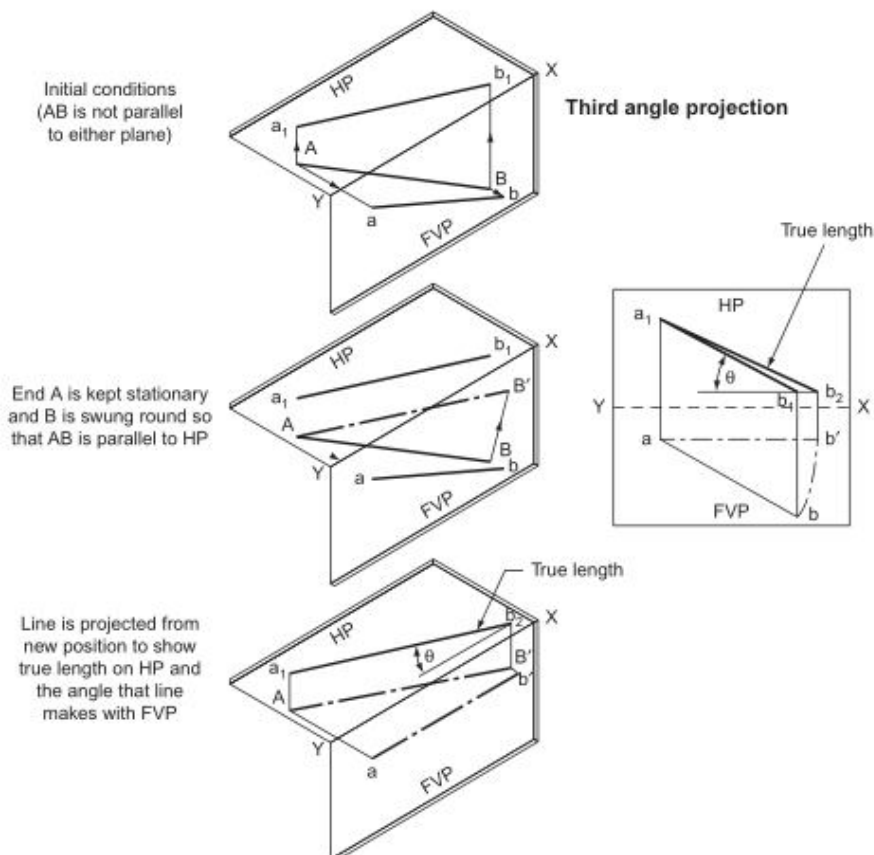


Figure 2.1 – The true length of the line AB and the angle θ on HP

The line is AB. On the FVP it is seen as ab and on the HP as a_1b_1 .

One end of the line A is kept stationary whilst B is swung round so that AB is parallel to the HP. B is now at B_2 and on the FVP, b is now at b_2 . Since the line is parallel to the HP it will project its true length onto the HP. This is shown as a_1b_2 .

Note that b_1 and b_2 are the same distance from the line XY.

Since AB (and ab) are parallel to the HP, the angle that AB makes with the FVP can be measured. This is shown as θ .

To find the true length of a line that is not parallel to any of the principal planes and to find the angle that the line makes with the HP (Fig. 2.2).

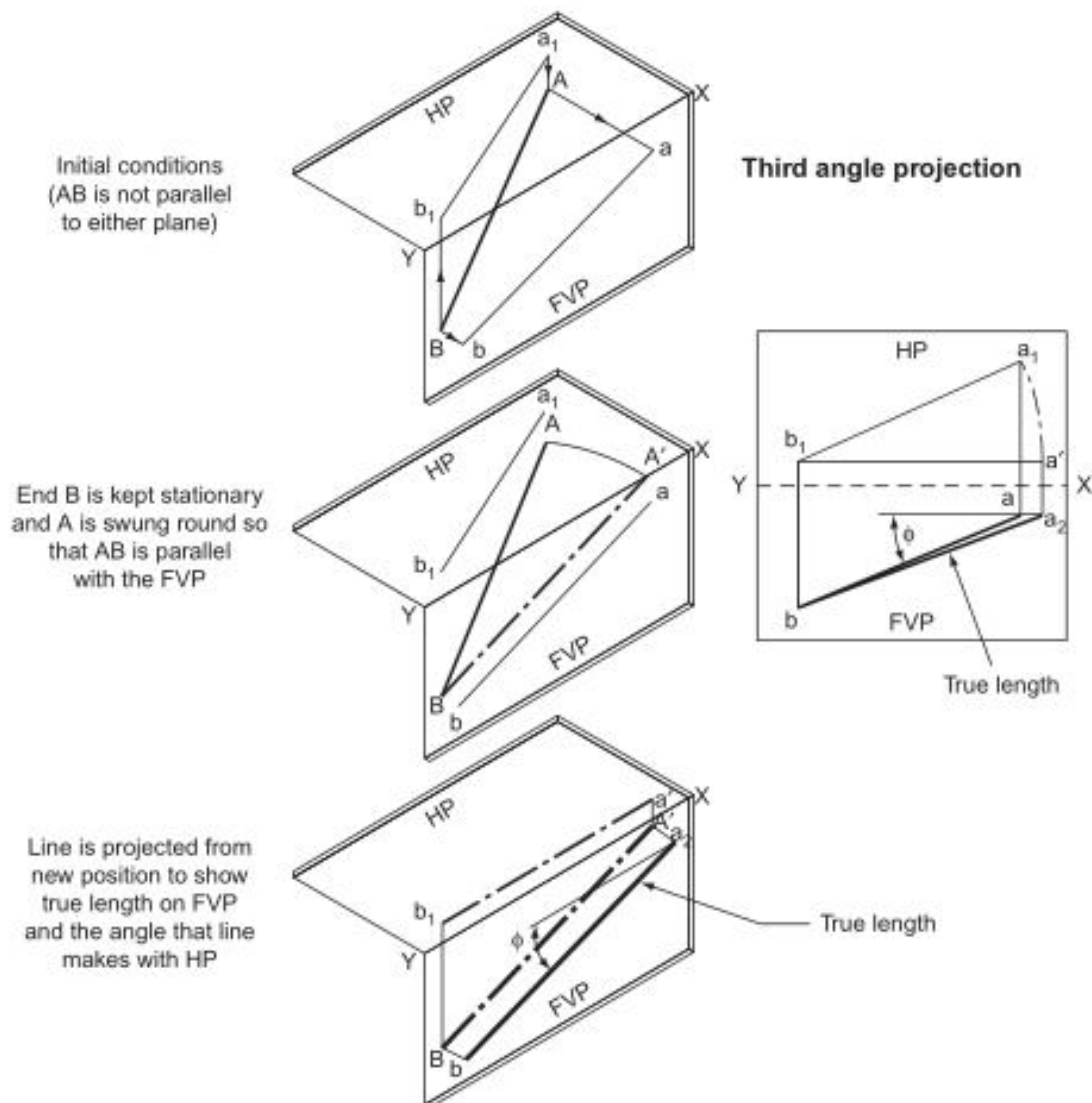


Figure 2.2 – The true length of the line AB and the angle θ on FVP

The line is AB. On the FVP it is seen as ab and on the HP as a_1b_1 .

One end of the line B is kept stationary while A is swung round so that AB is parallel to the FVP. A is now at A' and, on the HP, a is now at a' . Since the line is now parallel to the FVP it will project its true length onto the FVP. This is shown as a_2b . Note that a_2 and a are the same distance from the line XY.

Since BA' (and b_1a') are parallel to the FVP, the angle that AB makes with the HP can be measured. This is shown as ϕ .

Figure 2.3 is an example of an application of the theory shown above. It shows how simple it is to apply this theory.

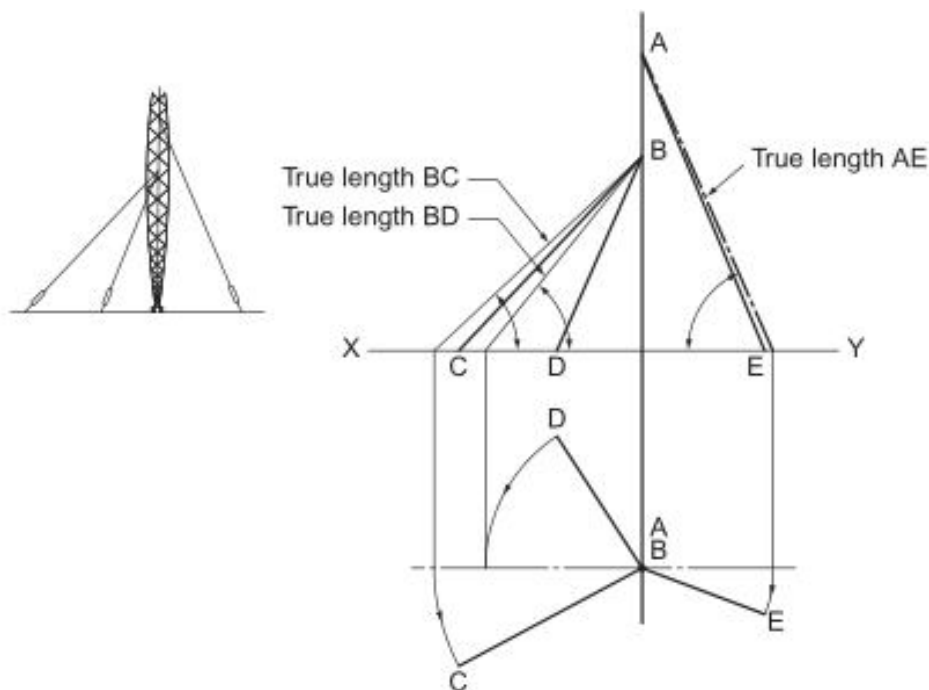


Figure 2.3 – True length of AE, BC and BD

A pylon is supported by three hawsers. Given the plan and elevation of the hawsers, find their true lengths and the angle that they make with the ground.

In the plan, each hawser is swung round until it is parallel to the FVP. The new positions of the ends of the hawsers are projected up to the FE and joined to the pylon at A and B. This gives the true lengths and the angles.

The line is AB. If the line is produced it will pass through both planes, giving traces T_v and T_h .

The line ab is produced to meet the XY line. This intersection is projected down to meet a_1b_1 produced in T_h . The line b_1a_1 is produced to meet the XY line. This intersection is projected up to meet ba produced in T_v .

2.2 Projections on auxiliary planes

Sometimes none of the three principal orthographic views of an object show the different edges and faces, lanes and planes of an object in their true sizes, since these edges and faces, are not parallel to any one of the three principal planes of projection. In order to show such edges and faces, lanes and planes in their true sizes, it becomes necessary to set up additional planes of projection other than the three principal planes of projection in the positions which will show them in true sizes. If an edge or a face is to be shown in true size, it should be parallel to the plane of projection. Hence the additional planes are set up so as to be parallel to the edges and faces, lanes and planes which should be shown in true sizes. These additional planes of projection which are set up to obtain the true sizes are called auxiliary planes.

The types of planes are shown in Figure 2.4.

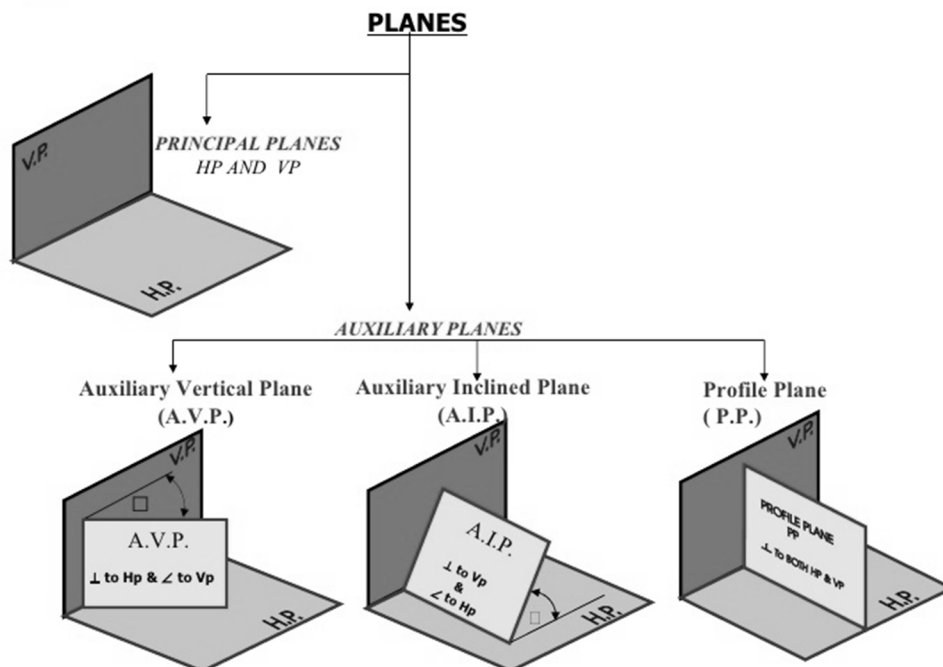


Figure 2.4 – Types of planes

Point on the Auxiliary Plane is shown in Figure 2.5.

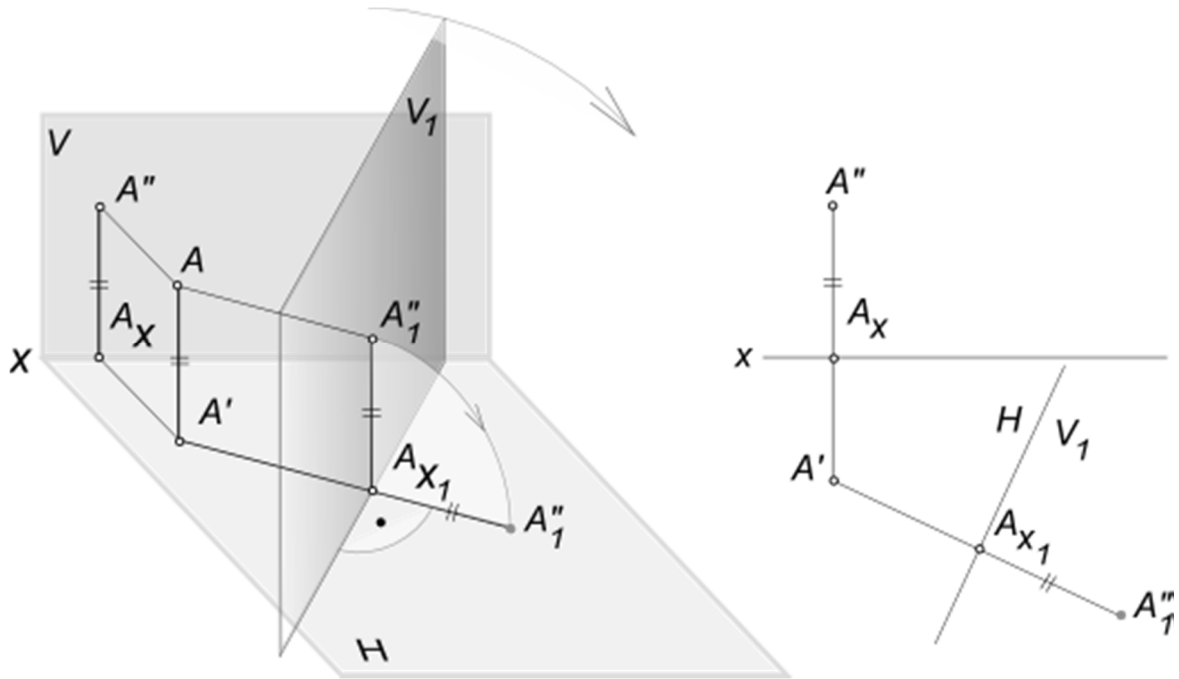


Figure 2.5 – Point on the auxiliary plane

The length of a line can only be measured if it is seen in true length.

A line can be seen true length if projected onto a plane parallel to it. So to find the true length of a line we draw an auxiliary folding line parallel to it (Fig. 2.6).

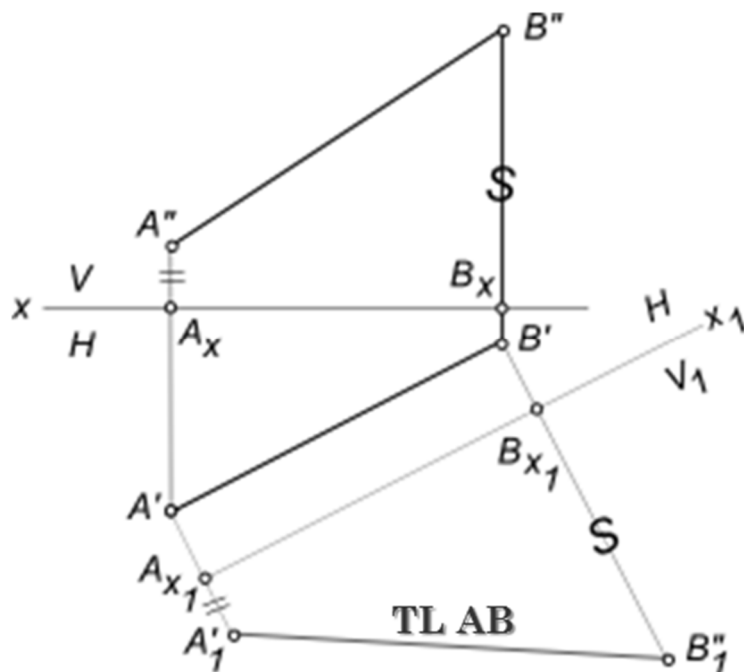


Figure 2.6 – The line AB on the auxiliary plane

The true size of a plane on the auxiliary plane is shown in Figure 2.7.

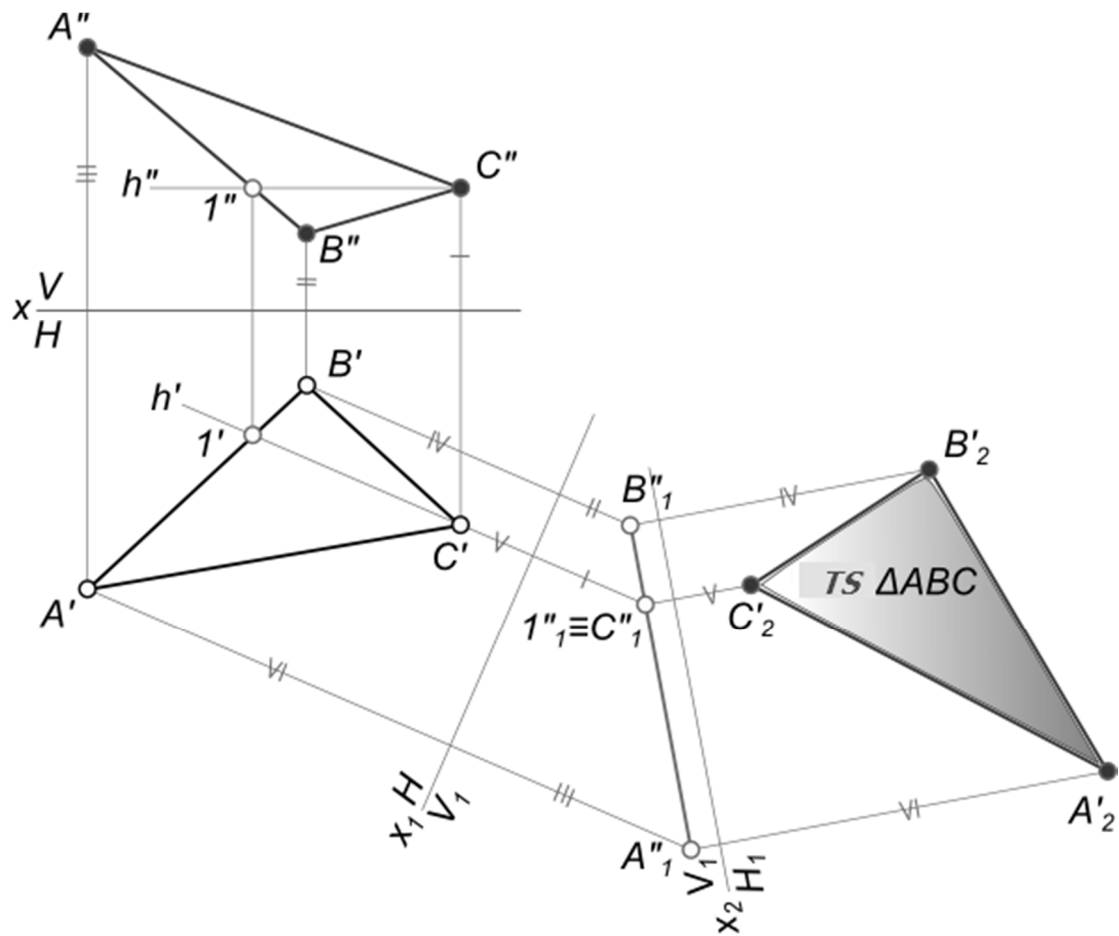


Figure 2.7 – The plane of triangle ABC on the auxiliary plane

The auxiliary view method may be applied: to find the true length of a line; to project a line which is inclined to both HP and VP as a point; to project a plane surface or a lamina as a line.

LECTURE 3 SURFACES

3.1 Polyhedrons

3.2 Curved surfaces

3.3 Isometric projection

3.4 The intersection of the surfaces

There are two basic types of solids – polyhedrons and curved solids.

Dimensional parameters of different surfaces are shown in Figure 3.1.

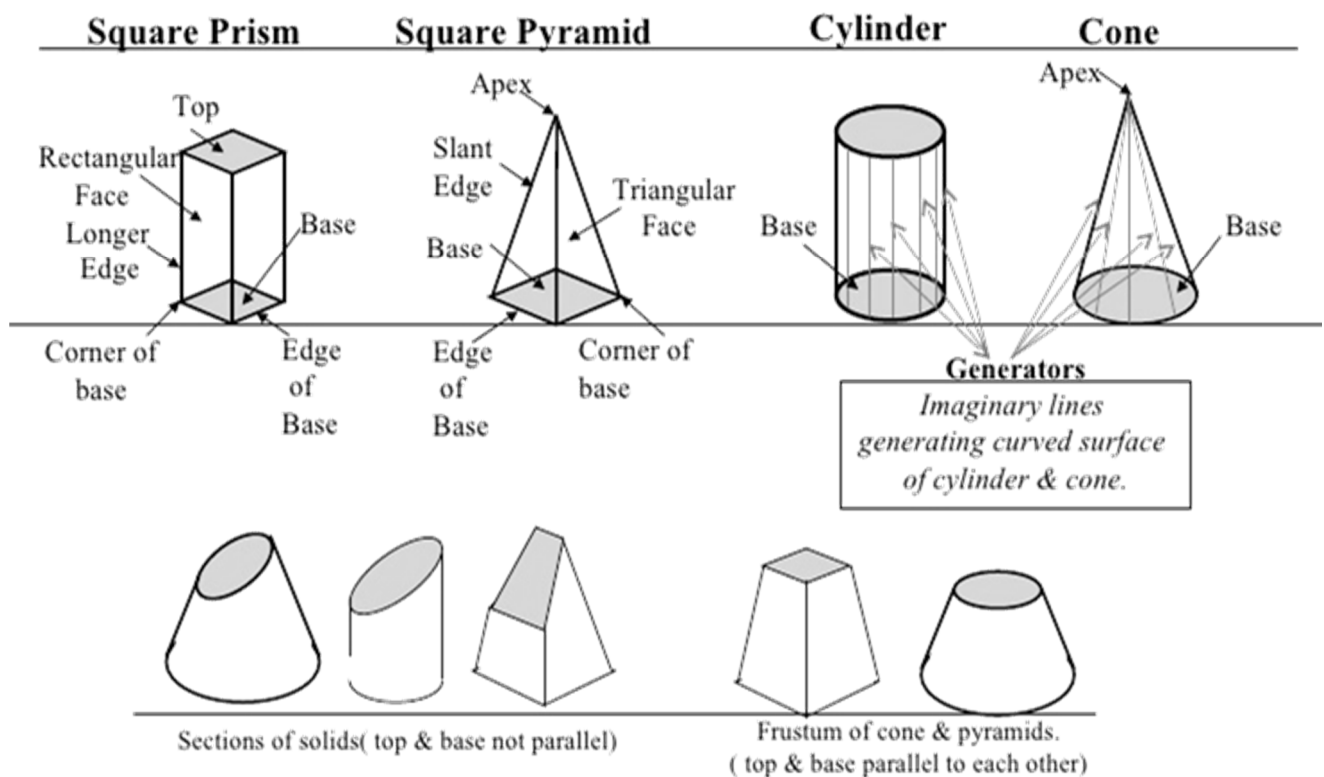


Figure 3.1 – Parameters of surfaces

3.1 Polyhedrons

A prism is a polyhedron with 2 polygonal bases parallel to each other. The two polygonal bases are joined by lateral faces. The numbers of lateral faces are equal to the number of sides in the base. The lateral faces in a prism are perpendicular to the polygonal bases (Fig. 3.2).

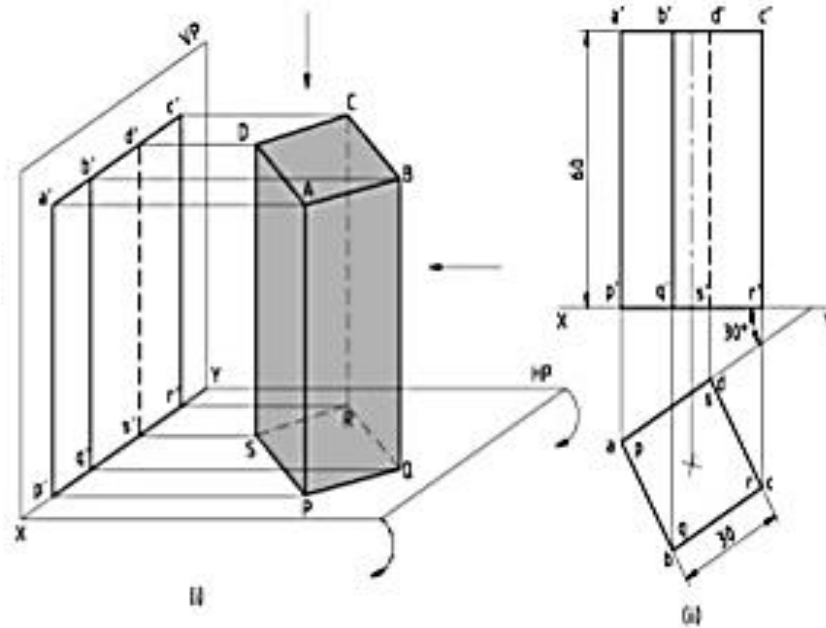


Figure 3.2 – Projection of prism

A pyramid is a polyhedron formed by connecting a polygonal base ABC and a point S, called the apex (Fig. 3.3).

Each base edge and apex form a triangle, called a lateral face. It is a conic solid with polygonal base. A pyramid with an n -sided base will have $n + 1$ vertices, $n + 1$ faces, and $2n$ edges.

A right pyramid has its apex directly above the centroid of its base.

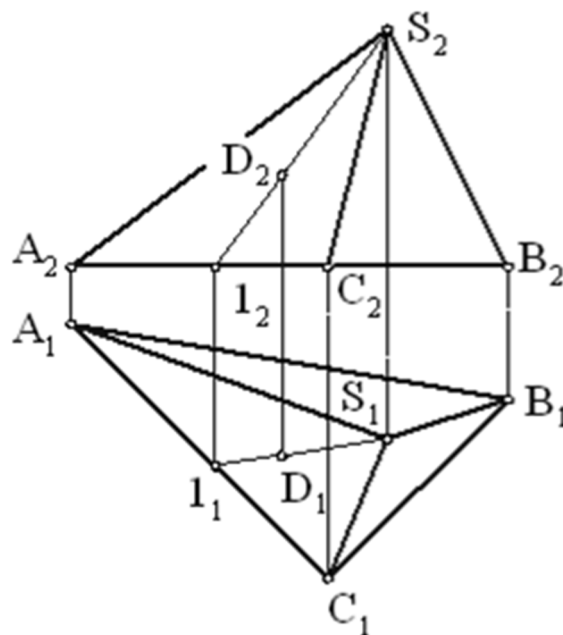


Figure 3.3 – Projection of pyramid

3.2 Curved surfaces

Curved solids are solids whose boundary contains some curved surfaces.

Regular curved surfaces are sphere (all points on the surface are equidistant from the center), ellipsoid (a form whose plane surfaces are either ellipses or circles), ovoid and torus (a rounded form on a circular base in the case of a circle, resembling a doughnut).

Cone is a solid with a circular base connected by a curved surface to a single vertex (Fig. 3.4).

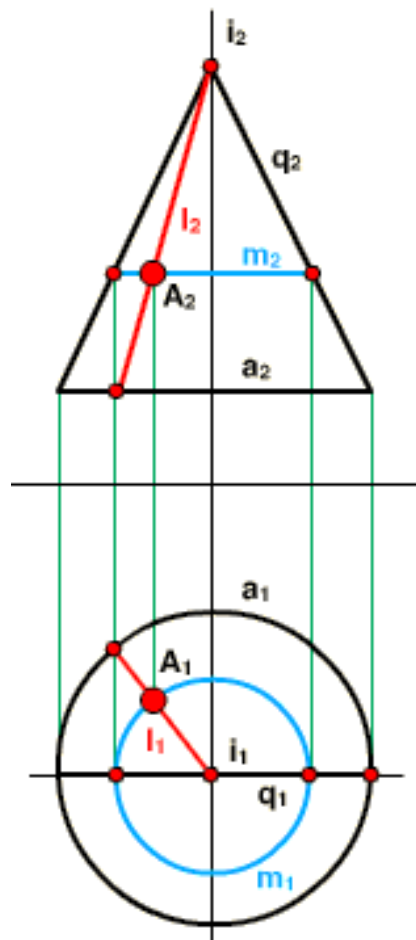


Figure 3.4 – Projection of cone

Cylinder is a solid with congruent parallel circular bases connected by a curved surface (Fig. 3.5).

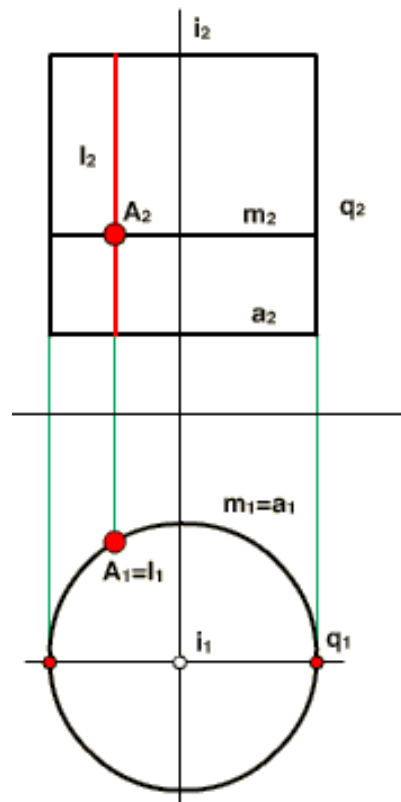


Figure 3.5 – Projection of cylinder

Sphere is set of points in space that are the same distance from a given point. A sphere has no faces, edges, or vertices (Fig. 3.6).

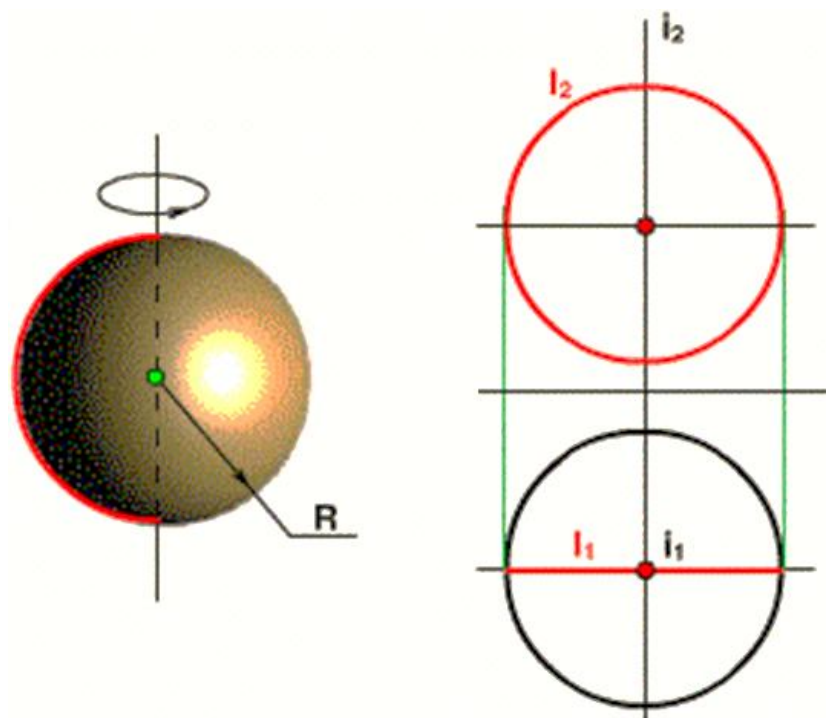


Figure 3.6 – Projection of sphere

3.3 Isometric projection

Isometric projection is a method of drawing with instruments which gives a pictorial view of an object. It is not often used in industry and, when it is, the vast majority of drawings are made using conventional isometric projection. Conventional isometric projection is a distorted and simplified form of true isometric. True isometric is found by taking a particular view from an orthographic projection of an object.

The three isometric axes are still at 120° to each other. In conventional isometric, distances measured parallel to these axes are true lengths. In true isometric projection they are no longer true lengths although they are proportional to their true lengths. However, the horizontal distances on a true isometric projection are true lengths. The reduction of lengths measured parallel to the isometric axes makes the overall size of the true isometric drawing appear to look more natural, particularly when directly compared with an orthographic or plane view of the same object.

Isometric drawing ignores perspective altogether. Lines are drawn parallel to each other and drawings can be made using a T-square and a set square. Figure 3.7 shows a shaped block drawn in conventional isometric projection.

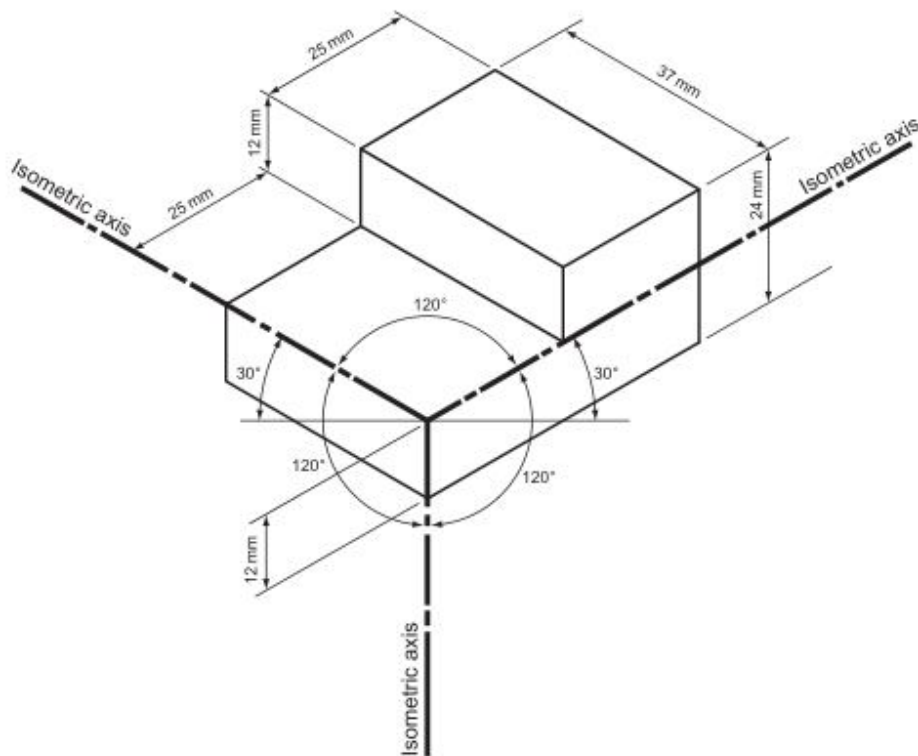


Figure 3.7 – Shaped block drawn in conventional isometric projection

You will note that there are three isometric axes. These are inclined at 120° to each other. One axis is vertical and the other two axes are therefore at 30° to the horizontal. Dimensions measured along these axes, or parallel to them, are true lengths.

The faces of the shaped block shown in Figure 3.7 are all at 90° to each other. The result of this is that all of the lines in the isometric drawing are parallel to the isometric axes. If the lines are not parallel to any of the isometric axes, they are no longer true lengths. An example of this is shown in Figure 3.8 which shows an isometric drawing of a regular hexagonal prism. The hexagon is first drawn as a plane figure and a simple shape, in this case a rectangle, is drawn around the hexagon. The rectangle is easily drawn in isometric and the positions of the corners of the hexagon can be transferred from the plane figure to the isometric drawing with a pair of dividers.

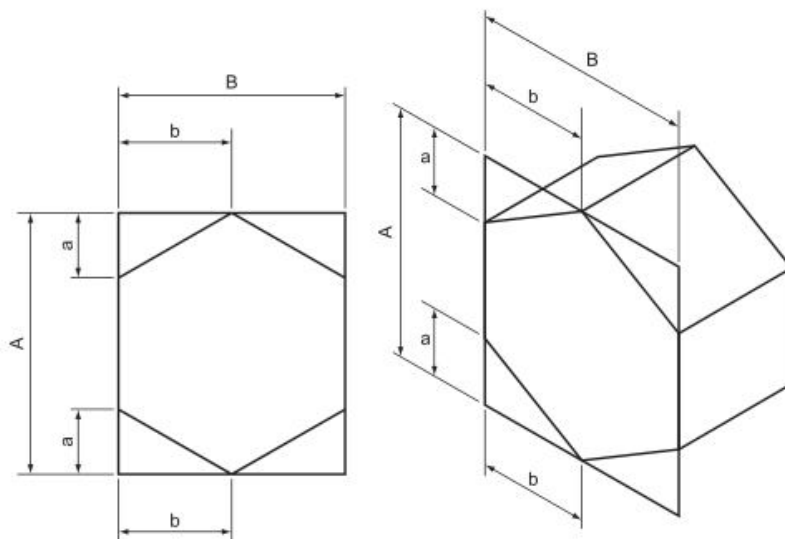


Figure 3.8 – An isometric drawing of a regular hexagonal prism

The dimensions of the hexagon should all be 25 mm and you can see from Figure 3.8 that lines not parallel to the isometric axes do not have true lengths.

Figure 3.9 shows another hexagonal prism. This prism has been cut at an incline and this means that two extra views must be drawn so that sufficient information to draw the prism in isometric can be transferred from the plane views to the isometric drawing. This figure shows that, when making an isometric drawing, all dimensions must be measured parallel to one of the isometric axes.

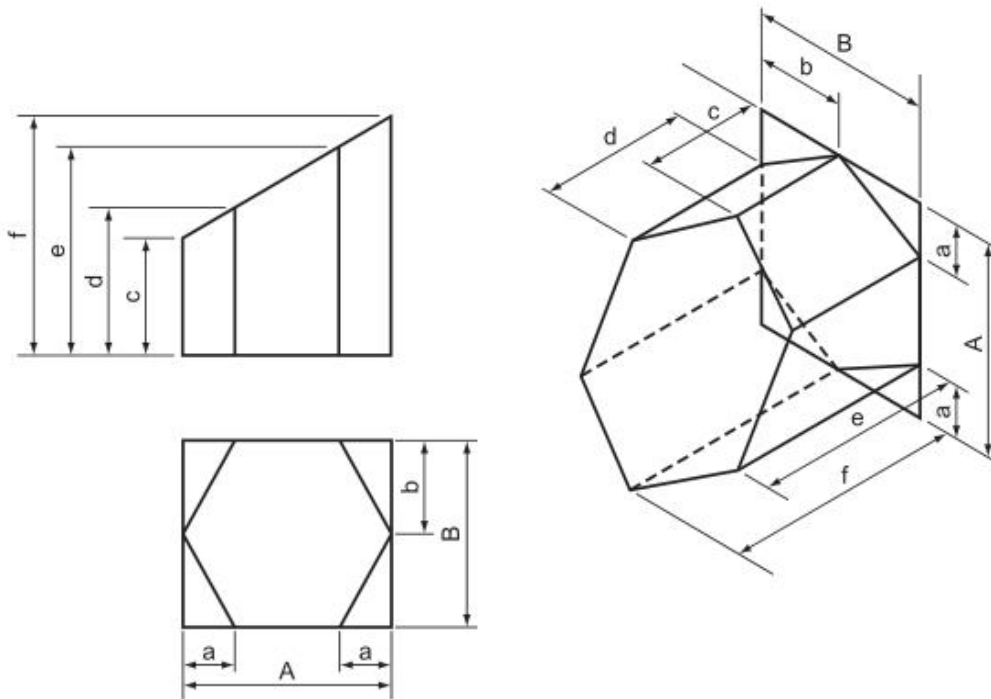


Figure 3.9 – A hexagonal prism cut obliquely

Figure 3.10 shows a cylinder cut at 45° . Two views of the cylinder have to be drawn: a plan view and an elevation. The plan view is divided into strips and the positions of these strips are projected onto the elevation.

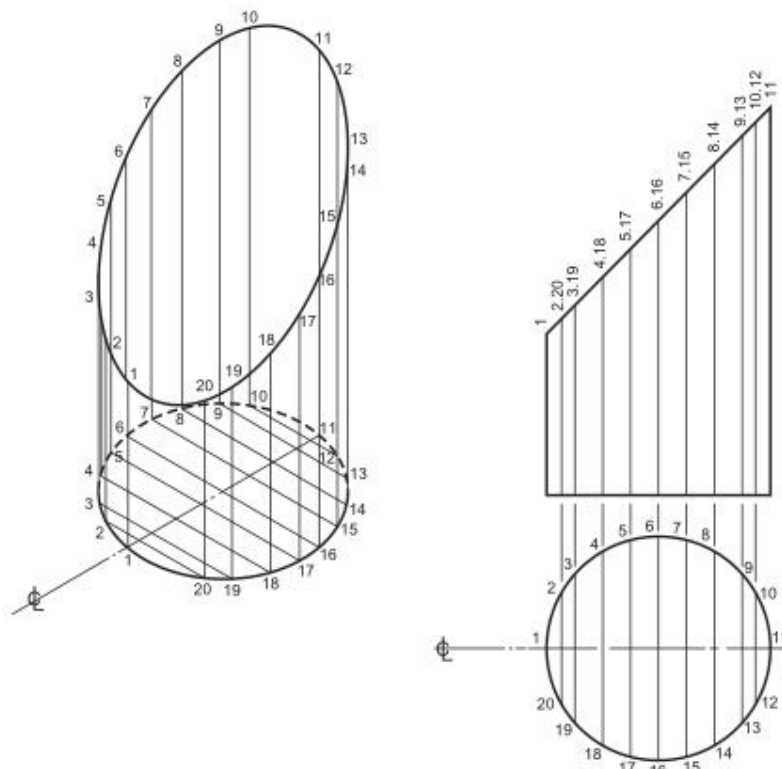


Figure 3.10 – A cylinder cut obliquely

The base of the cylinder is drawn in isometric projection in the usual way. Points 1 to 20, where the strips cross the circle, are projected vertically upwards and the height of the cylinder, measured from the base with dividers, is transferred for each point in turn from the elevation to the isometric view. These points are then carefully joined together with a neat freehand curve.

3.4 The intersection of the surfaces

When two solids interpenetrate, a line of intersection is formed. It is sometimes necessary to know the exact shape of this line, usually so that an accurate development of either or both of the solids can be drawn. This chapter shows the lines of intersection formed when some of the simpler geometric solids interpenetrate.

Two dissimilar square prisms are meeting at right angles (Fig. 3.11).

The EE shows where corners 1 and 3 meet the larger prism and these are projected across to the FE. The plan shows where corners 2 and 4 meet the larger prism and this is projected up to the FE.

Two dissimilar hexagonal prisms are meeting at an angle (Fig. 3.12).

The FE shows where corners 3 and 6 meet the larger prism. The plan shows where corners 1, 2, 4 and 5 meet the larger prism and these are projected up to the FE.

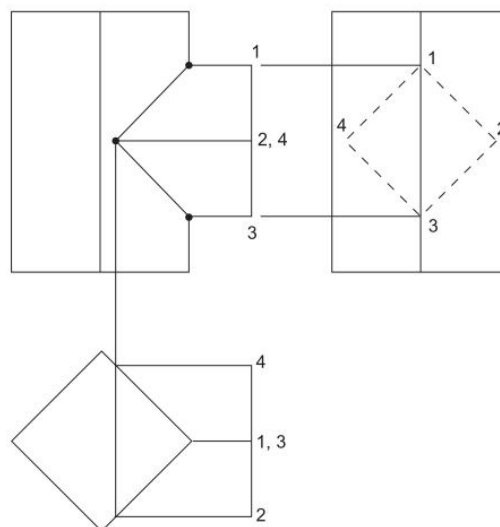


Figure 3.11 – A square prism

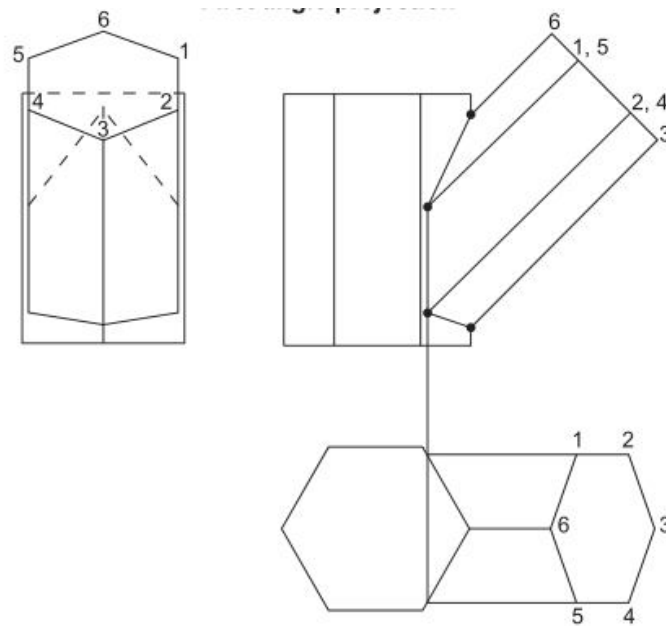


Figure 3.12 – A hexagonal prism

A square pyramid and a hexagonal prism are meeting at an angle (Fig. 3.13).

The FE shows where corners 1 and 4 meet the pyramid.

Corners 2 and 6 lie on the same plane X–X. If this plane is marked on the plan view of the pyramid (follow the arrows) it results in the line X–X–X. Corners 2 and 6 lie on this plane; their exact positions are as shown.

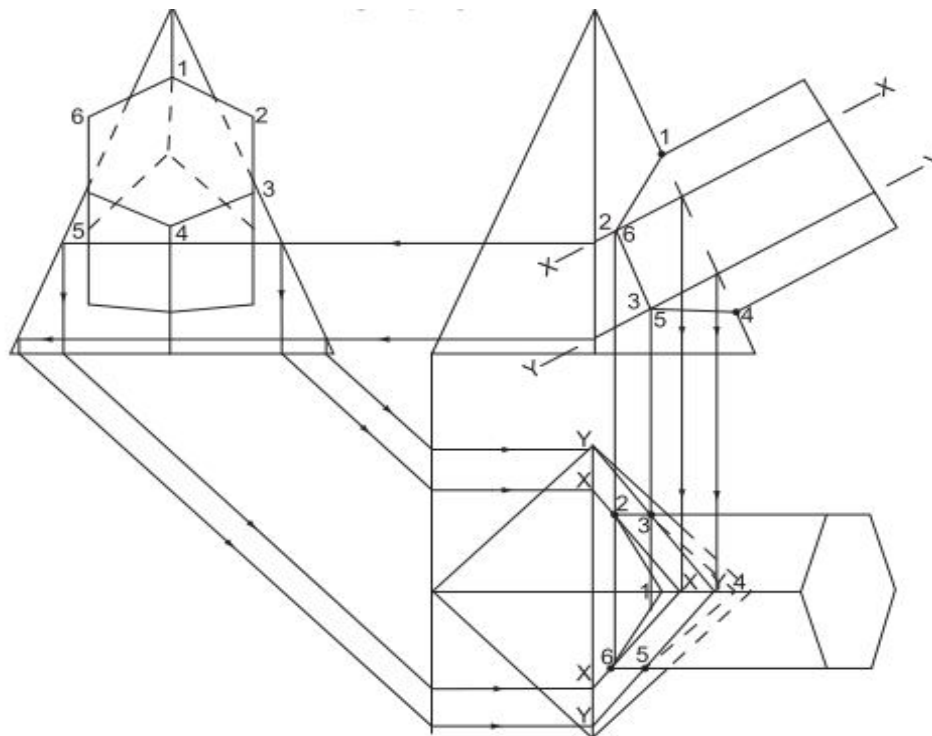


Figure 3.13 – Intersection of square pyramid meeting a hexagonal prism

A cylinder meeting a square pyramid at an angle (Fig. 3.14). The FE shows where points 1 and 7 meet the pyramid and these are projected down to the plan.

Consider the position of the point 2. In the FE it lies somewhere along the line marked 2,12, while in the plan it lies on the line marked 6,2. If that part of the pyramid above the line 2,12 in the FE was removed, the point 2 would lie on the perimeter of the resulting section. This perimeter can be drawn on the plan and, in Figure 12.12, it is shown as the line marked “SECT 2,12”. Point 2 must lie on this line; it must also lie on the line marked 6,2 and its exact position is the intersection of these two lines.

Point 12' is the intersection of the same section line and the line marked 8,12.

This process is repeated for each point in turn. When the plan is complete, the intersection can be projected onto the other two views. For the sake of clarity, these projections are not shown.

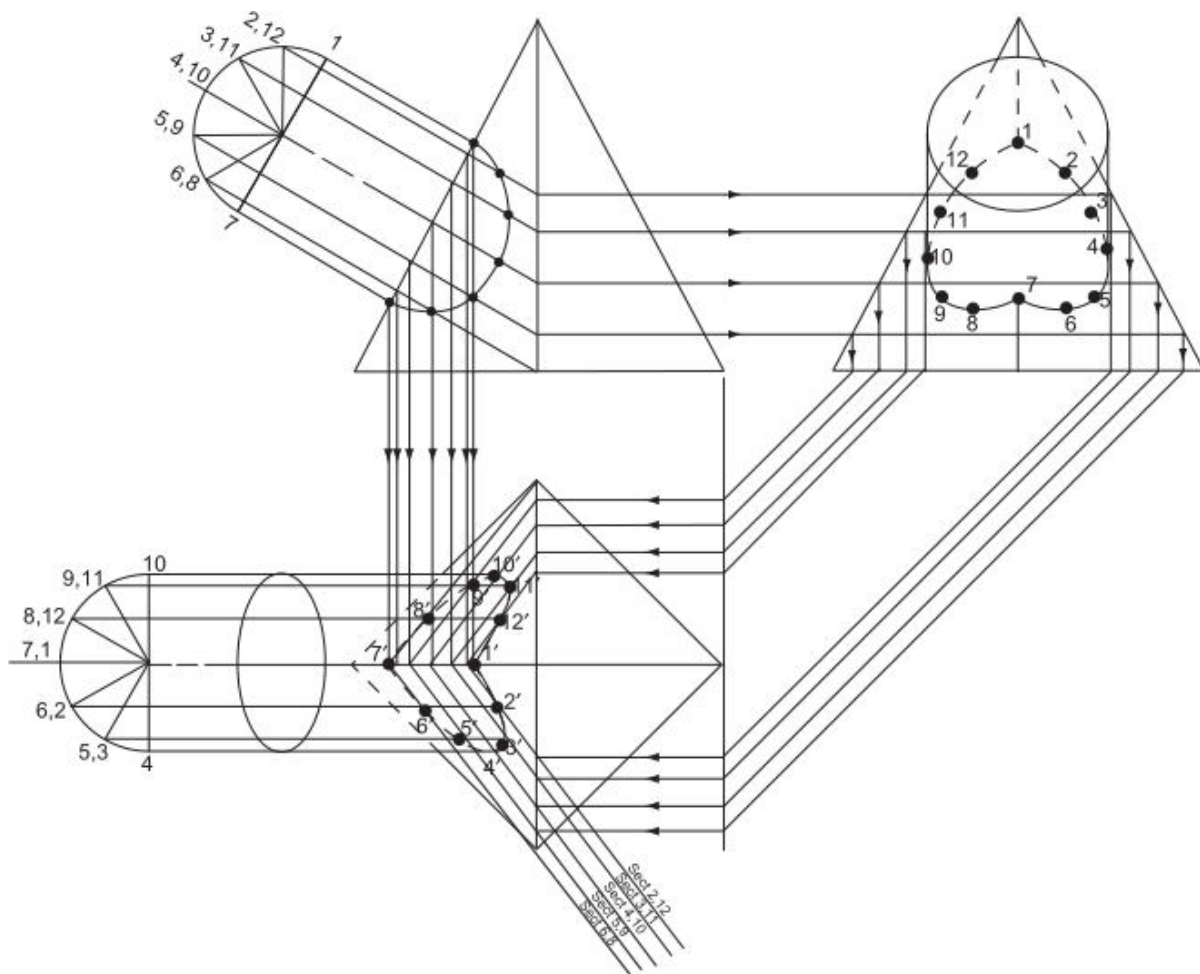


Figure 3.14 – Intersection of cylinder meeting a square pyramid

A cylinder meeting a cone, their centres not being in the same VP (Fig. 3.15).
Divide the cylinder into 12 equal sectors on the FE and on the plan.

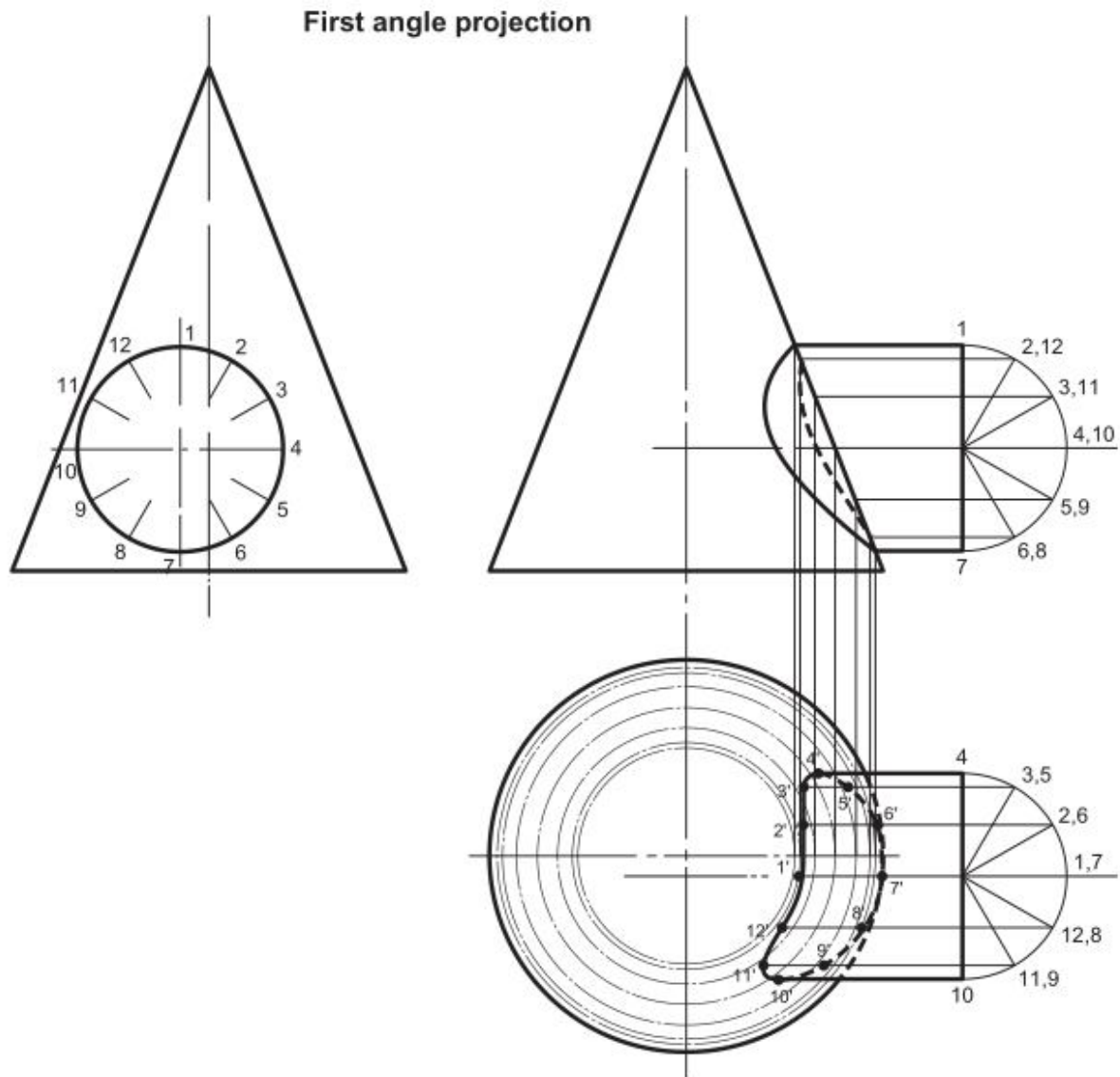


Figure 3.15 – Intersection of cylinder meeting a cone

Sections are projected from the FE to the plan, the section planes being level with lines 1; 2,12; 3,11; 4,10; etc. These sections appear on the plan as circles. On the plan the sectors from the cylinder are projected across to meet their respective section at points 1'; 2'; 3'; etc. The complete interpenetration can then be projected up to the FE. For the sake of clarity, this construction is not shown.

LECTURE 4 ASSEMBLY DRAWINGS

4.1 Sections

4.2 Connections

4.2.1 *Types of bolts and screws*

4.2.2 *The stud and set bolt*

There are not many engineering items that are completely functional by themselves. There are some, a spanner or a rule for instance, but 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 student at school or college is often instructed to draw the assembled components only and is shown the dimensioned details in no particular order. If the assembly is particularly difficult, the parts are often shown in an exploded view and the assembly presents no difficulty. The assembled parts may form an object which is easily recognisable, but the real problem occurs when there seems to be no possible connection between any of the component parts. In an examination, when loss of time must be avoided at all costs, the order of assembly needs to be worked out quickly.

The only approach is to view the assembly somewhat like a jigsaw puzzle. The parts must fit together and be held together, either because they interlock or there is something holding them together.

Learn to look for similar details on separate components. If there is an internal square thread on one component and an external thread of the same diameter on another component, the odds are that one screws inside the other. If two different components have two or more holes with the same pitch, it is likely that they are joined at those two holes. A screw with an M10 thread must fit an M10 threaded hole. A tapered component must fit another tapered component.

The important thing, particularly in examinations, is to start drawing. Never spend too long trying to puzzle out an assembly. 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.

4.1 Sections

When sections are used in engineering drawing, although the true shape is still found, the section is really used to show what is inside the object.

A drawing must be absolutely clear when it leaves the drawing board. The person or persons using the drawing to make the object must have all the information that they need presented clearly and concisely so that they are not confused – even over the smallest point.

Suppose that you had to draw the assembly of the three speed gearbox on the rear hub of a pedal cycle. You probably know nothing about the interior of that hub. The reason that you know nothing about it is that you cannot see inside it. If you are to produce a drawing that can be read and understood by anybody, you can draw as many views of the outside as you wish, but your drawing will still tell nothing about the gear train inside. What is really needed is a view of the inside of the hub and this is precisely what a section allows you to show.

Figure 4.1 shows two sections projected from a simple bracket. You will note that the sections are both projected from the FE. Sections can be projected from any elevation – you are not limited to the FE only. Thus, you can project a sectioned FE from either the plan or the EE. A sectioned EE is projected from the FE and a sectioned plan is projected from the FE. It is not usual to project a sectioned EE from the plan nor vice versa.

The lines X–X and Y–Y are called the sectional cutting planes and this is a good description because you are, in fact, pretending to cut the bracket right through along these lines. Both the sectioned EE are what you would see if you had physically cut the brackets along X–X and Y–Y, removed the material behind the cutting planes (i.e. the side away from the arrowheads) and projected a normal EE with the

material removed. To avoid any misinterpretation, and to show the section quite clearly, wherever the cutting plane has cut through material the drawing is hatched.

The standard hatching for sectioning is at 45° although it will be seen later that in exceptional circumstances this rule may be broken. You should also note that the cutting plane passes through the hole in the bracket and this is not hatched. Hatching should only be done when the cutting plane passes through a solid material.

The lines X–X and Y–Y are of a particular nature. They are chain dotted lines thickened at the end of the chain dotted line. The letters X–X and Y–Y are not a random choice either. Sectional cutting planes are usually given letters from the end of the alphabet although you will sometimes see other letters used.

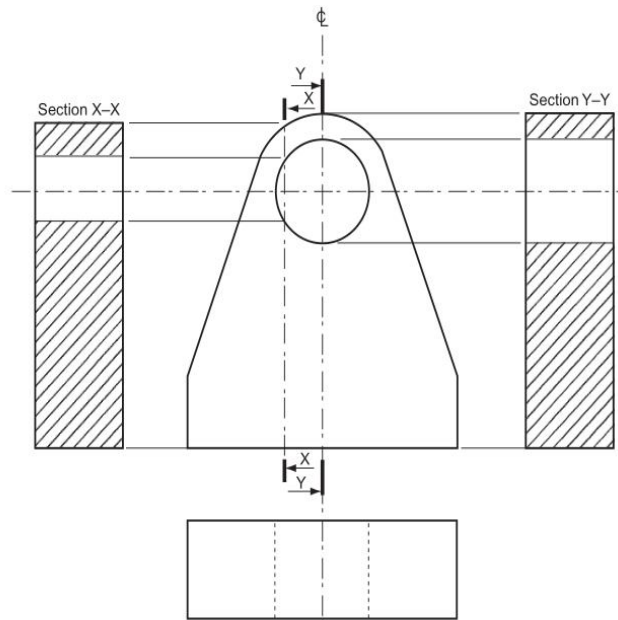


Figure 4.1 – Two sections projected from a simple bracket

Sectioning is a process which should be used only to simplify or clarify a drawing. You should certainly not put a section on every drawing that you do. There are some engineering details that, if sectioned, lose their identity or create a wrong impression and these items are never shown sectioned. A list of these items is shown below.

Figure 4.2 attempts to show, in a completely hypothetical arrangement, as many details as possible about sectioning on one drawing. The drawing shows two

lengths of shaft joined by keyed flanges which are bolted together. The shafts are supported by two identical plunger blocks which are, in turn, bolted to the base via four studs for each block.

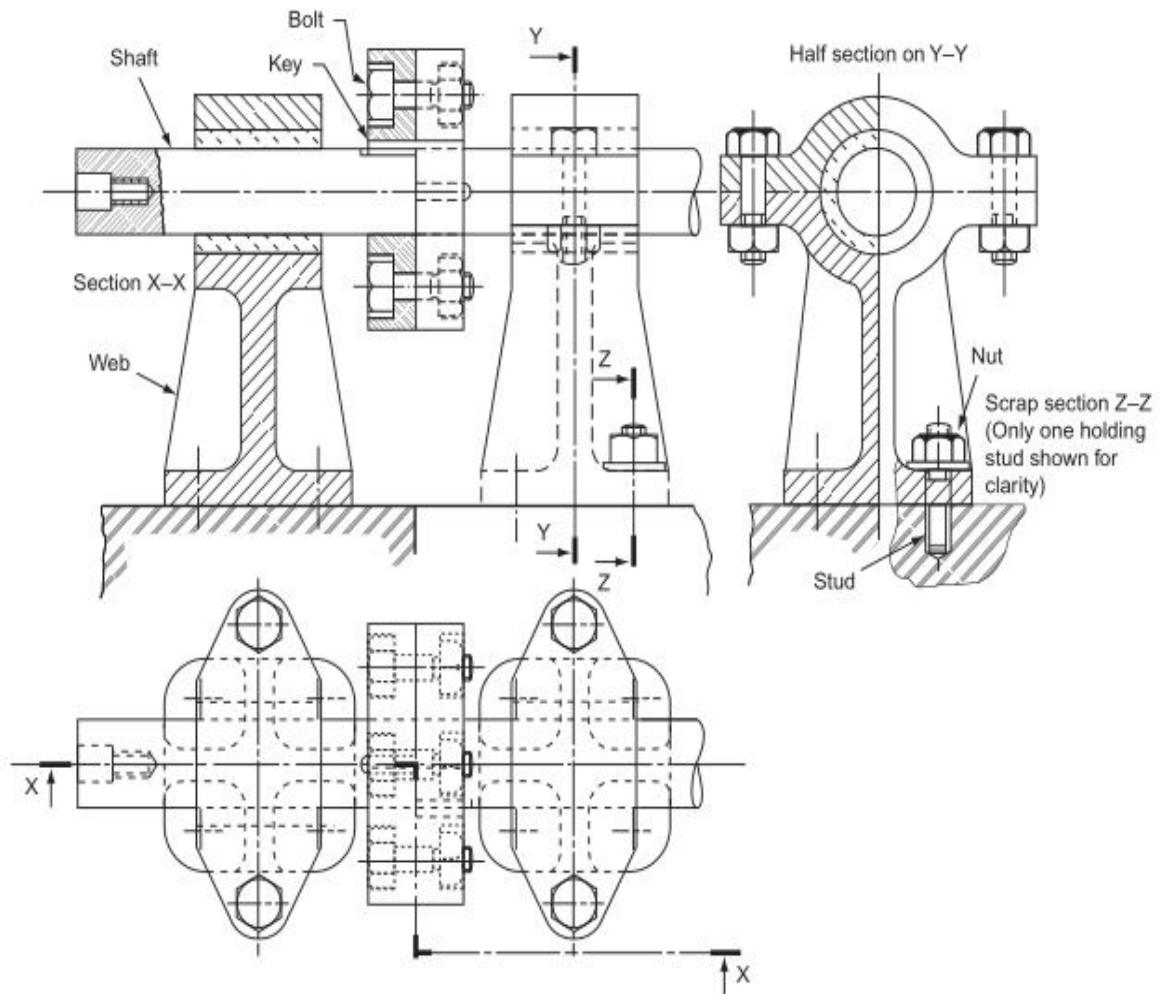


Figure 4.2 – The shaft joined by keyed flanges which are bolted together

Only one stud is shown on the drawing. This is common practice on a complicated drawing when, rather than simplifying the drawing, it is complicated by too much detail.

4.2 Connections

4.2.1 Types of bolts and screws

There are many types of heads for bolts and screws apart from the standard hexagonal head. Figure 4.3 shows only a few types of bolt and screw heads that are in

use. There are wedged-shaped heads, tommy heads, conical heads, hook bolts and eye bolts. There are small, medium and large headed square screws, 60°, 120° and 140° countersunk screw heads with straight slots, cross slots and hexagonal slots. There are instrument screws and oval cheese-headed screws to name only a few. The dimensions for all these screws can be obtained from any good engineering hand-book. However, BS 308 also recommends a simplified method of drawing screws.

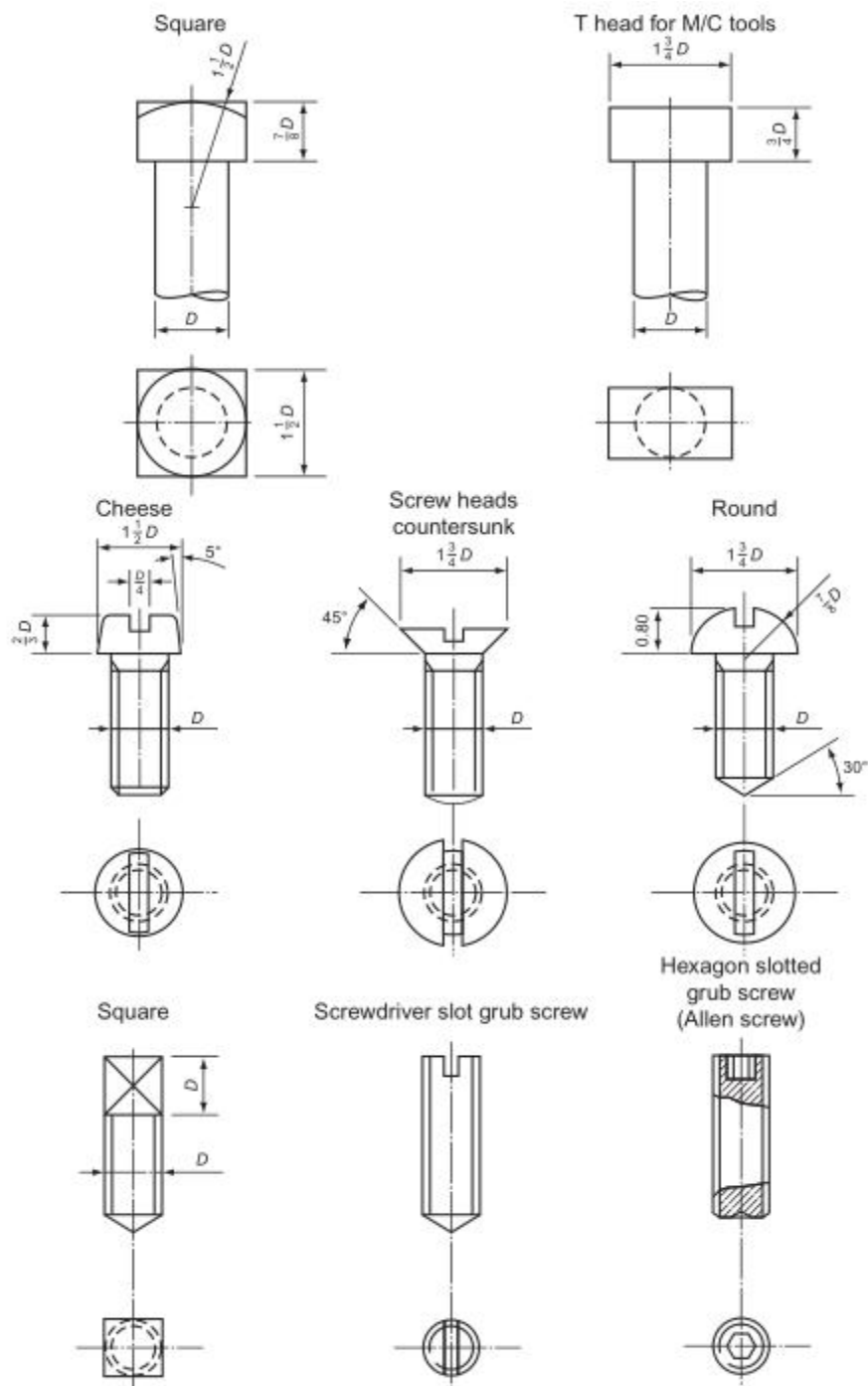


Figure 4.3 – Types of bolt and screw heads

4.2.2 The stud and set bolt

The stud and set bolt (sometimes called a tap bolt or cap screw) are used when it is impossible or impractical to use a nut and bolt. Figure 4.4 shows both in their final positions. They are both screwed into a tapped hole in the bottom piece of material.

The top piece of material is drilled slightly larger than the stud or screw and is held in position by a nut and washer in the case of the stud, and by the head of the set bolt and washer in the case of the set bolt.

The stud would be used when the two pieces of material were to be taken apart quite frequently; the set bolt would be used if the fixing was expected to be more permanent.

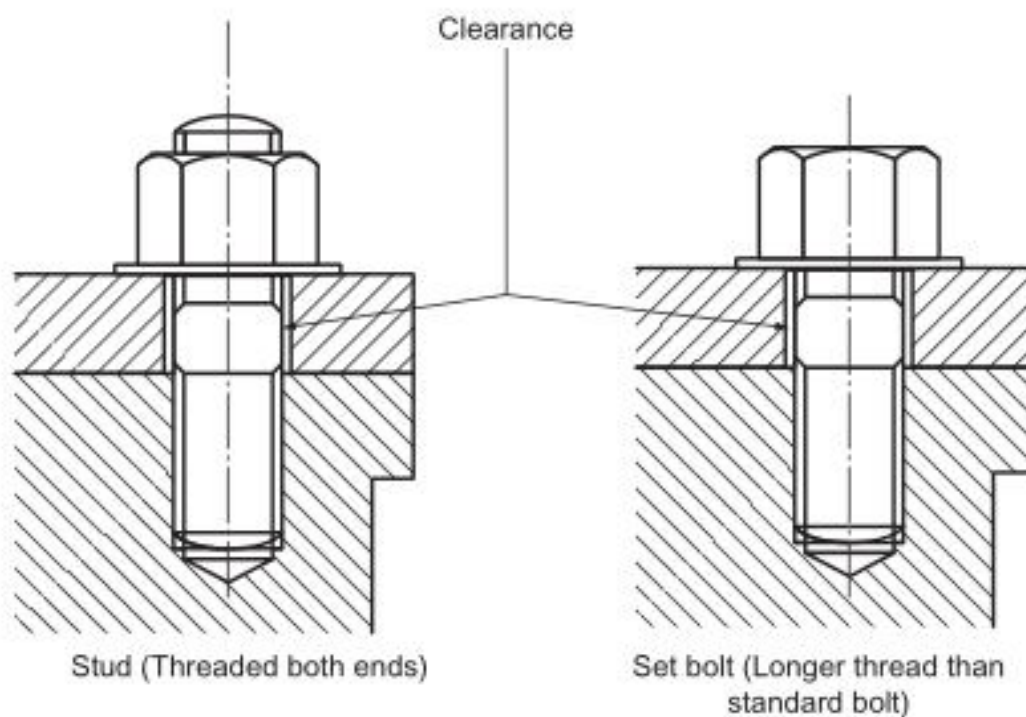


Figure 4.4 – Stud and set bolt

Figure 4.5 shows a detail from a stationary engine. Draw this detail with the parts assembled.

You may use either first or third angle projection.

a) a sectional FE in the direction of arrow B . The section should be parallel to the longitudinal axis of the rod and pass through the centre of the hinge bolt;

Safety valve
operating linkage

All dimensions in mm

All fillets 2 radius

Figure 4.6 shows an exploded view of a tool rest holder of a wood turning lathe. The drawing shows the bolt, washer, the main casting and the clamp plate.

Draw, full size, in first or third angle projection, an assembly drawing of all these parts as follows:

a) a sectional FE seen in the direction of arrow X taken along the centre line of the main casting;

b) a complete plan projected from view (a).

Hidden detail need not be shown. Insert the following dimensions: the width and thickness of the clamp plate; the width of the main casting; the distance between the centres of the slot; print the title: tool rest holder and clamp; state the system of projection used.

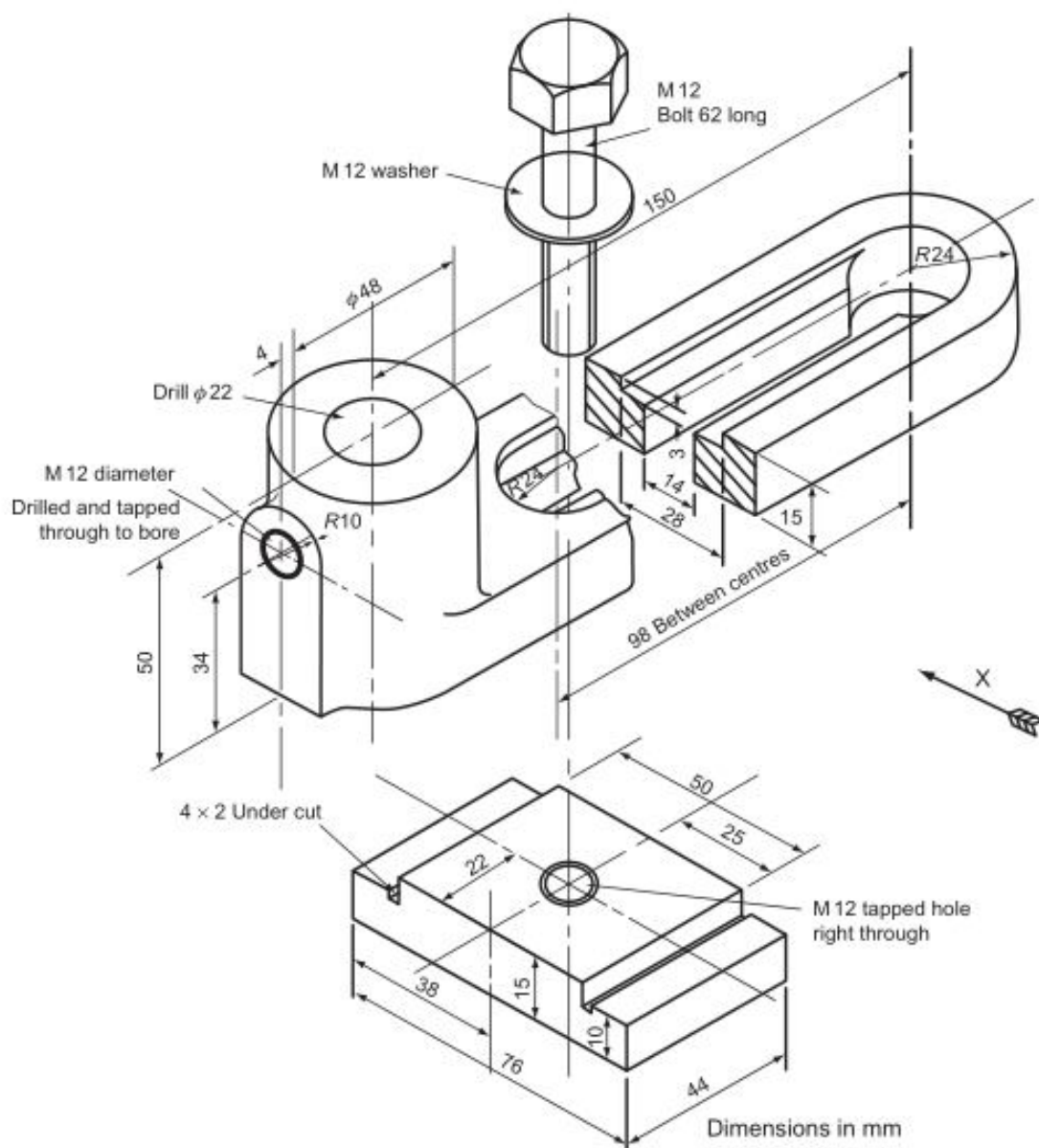


Figure 4.6 – A tool rest holder of a wood turning lathe

LECTURE 5 THREE-DIMENSIONAL MODEL IN A COMPAS-3D

5.1 Compas-3D main window

5.2 Creating a 3D model

5.3 Editing the model

5.1 Compas-3D main window

It is necessary to open a document by pressing the New – Part. Solid 3D model consists of some 3D elements, which form faces, edges, vertexes, origin, planes in it.

Let us observe more in part separate elements of the interface of the main window.

The Main Menu which is in the overhead part of a window under title by the form does not differ from a menu toolbar at flat modeling (Fig. 5.1).

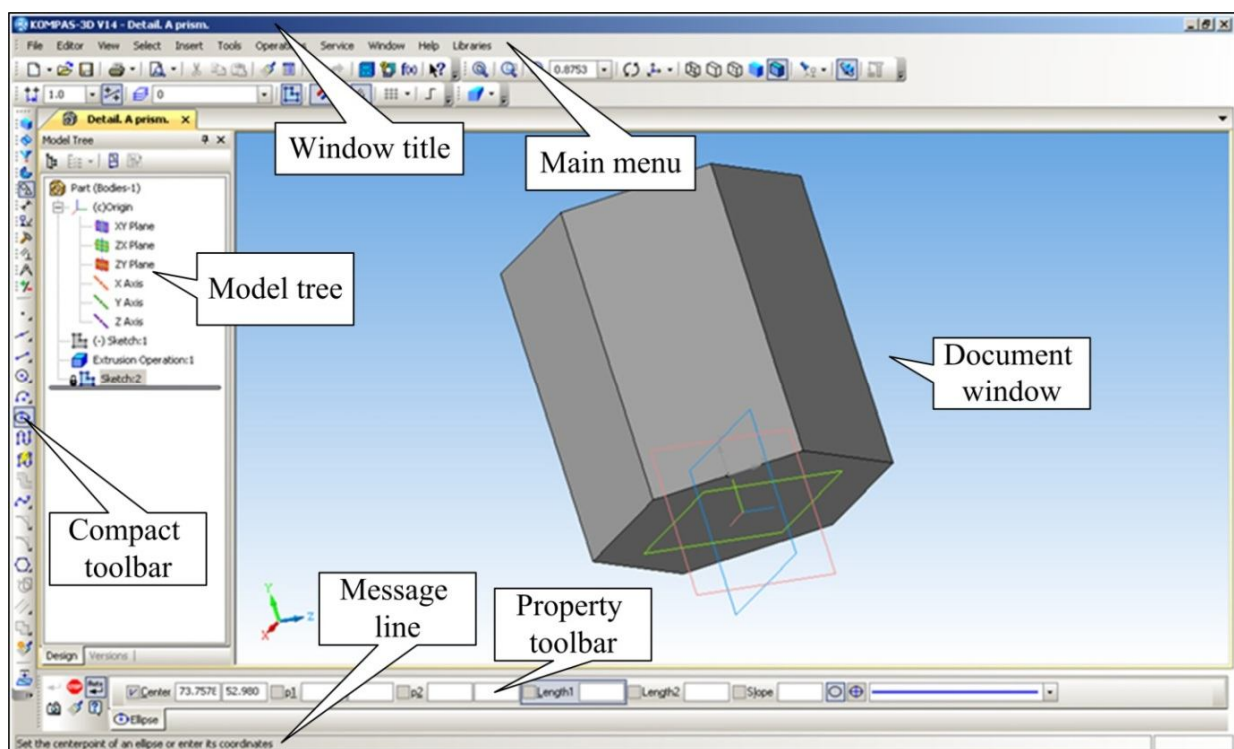


Figure 5.1 – Main window

Each menu contains the related commands and it will be observed later.

On a Control Panel are placed the most often used commands (Fig. 5.2, 5.3).

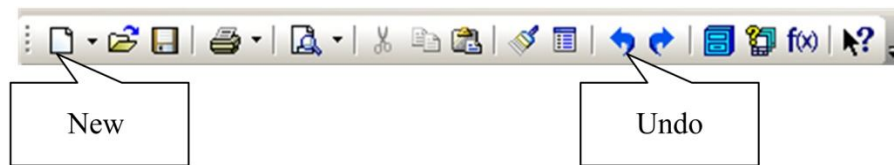


Figure 5.2 – Standart toolbar

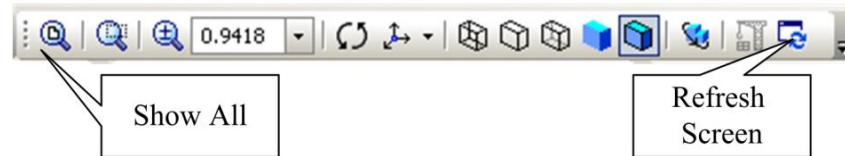


Figure 5.3 – View bar

The most part of the Main Window is occupied with a Document Window in which the image of an open part takes places. In this window all operations on construction and model editing are carried out.

In Model Tree the sequence of operations of formation of model are represented and displayed: The name of a part, a plane in which sketches for formation of elements of a part are under construction, a symbol of the origin of coordinates and sketches (Fig. 5.4).

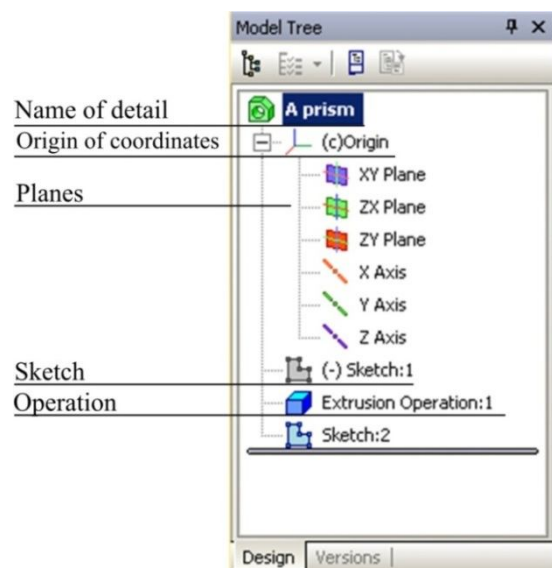


Figure 5.4 – Model tree

There is Message Line in Property Toolbar. In Message Line various system messages and inquiries are imaged. One or more tabs are located on it, as well as Advanced Control Panel.

Message line is located in the bottom part of application window. Various system messages and queries are displayed there (Fig. 5.5).

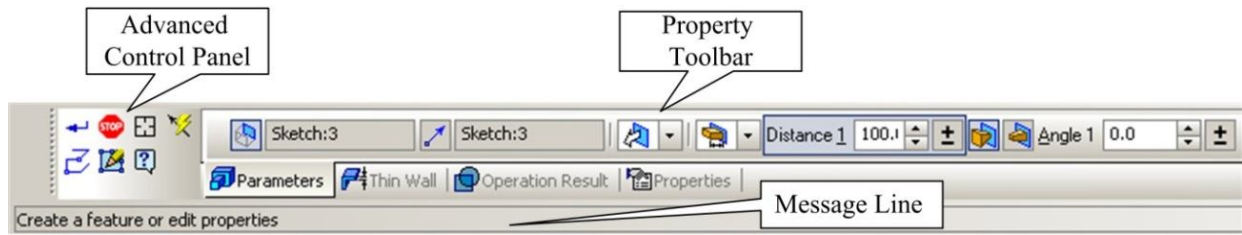




Figure 5.5 – Property toolbar

Current Status Bar is located in the top part of the window, right above the document window. The bar content is determined by the system operation mode. For example, when working with a drawing, sketch, or a fragment, there are management tools for cursor, layers, etc.

On the Toolbar buttons are grouped according to some options and have a context menu. These buttons are marked with a small black triangle in the lower right corner. To access this menu you need to click on the button and hold it for a while. When the shortcut command button is selected, move the cursor to the desired button and release the mouse button.

KOMPAS-3D system allows to zoom the image of the model on the screen, move, and rotate the image, select different options for its display. Control commands picture collected on the Service, the most frequently used duplicated by the buttons on the control panel.

If you want to show the entire document in a window after its opening or during the work on it is necessary to click Show All (F9) . The system automatically selects the highest possible zoom level at which the entire model is displayed in the document window.

If necessary, zoom in on any part of the model, for example, to edit its element, it is convenient to use the Zoom in by Marquee. You should press the button to Zoom In by Marquee . To mentally conclude 2D model in a rectangular marquee,

click in one of the corners and move the cursor diagonally to the opposite corner. As soon as the phantom of the frame will cover the whole selected marquee, click again. The window shows a larger scale model of the selected area. After editing, you can switch back to display the entire model by clicking Show All (Fig. 5.6).

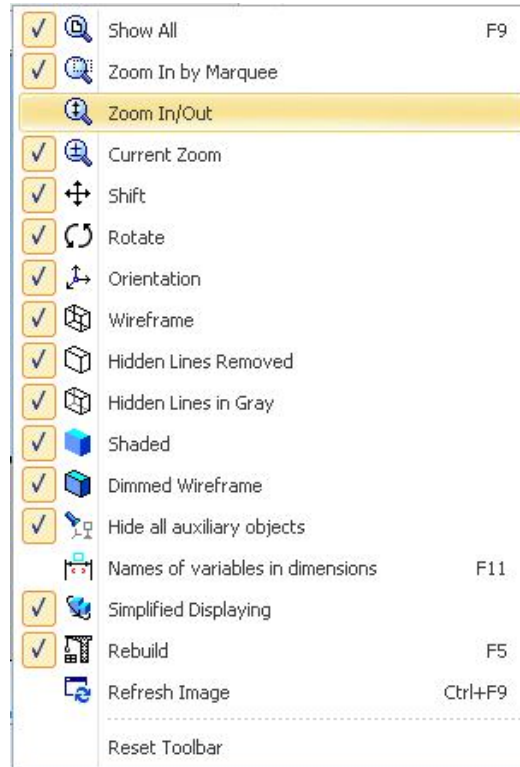





Figure 5.6 – Options of the images


Button Current Zoom  the magnification allows discretely increasing or decreasing the magnification of the image in a fixed number of times.

Button Zoom In/Out  can smoothly change the zoom, closer to or removing it relative to the point in which mouse button was pressed.


An image shift

The shift of the image in the document window is the command Shift, the inclusion of a button .


An image rotation

Convenient to view the model, turning it in any direction using the button Rotate .

Management mode display model

The buttons  allow to apply the commands to control the display in the following modes: Wireframe, Hidden Lines Removed, Hidden Lines in Gray, Shaded and Dimmed Wireframe.

Mode control orientations of standard model

The model can be located differently relative to the projection planes. Standard types of views model are front, back, top, bottom, left and right. To obtain the desired orientation of the model need to click on the button Orientation  in the Control Panel and choose from the list the desired projection (Fig. 5.7).

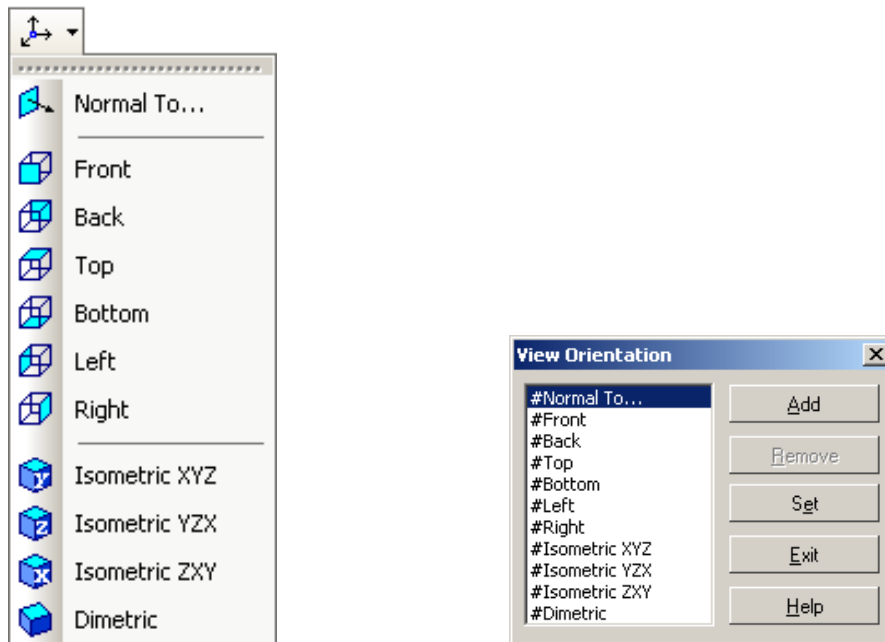


Figure 5.7 – View orientation

System KOMPAS-3D allows placing parallel to the screen every aspect of the model, or constructed by the user subsidiary plane. It must click to indicate that edge or auxiliary plane, and then select from a list of line Normal To... (Fig. 5.7).

5.2 Creating a 3D model

To create a solid model, the operations of move (if the surface of the angular) or rotation (if the surface of rotation) flat contours is applied. Flat contour formed a solid body model is a projection of the base of the model or its element on a plane

projections, either on the face of the model. The movement of the contour is called operation. Operations have additional features which allow to change the parameters of a model. In the contour you can copy an image from a previously created drawing or fragment.



Creating a three-dimensional model begins with the construction of a flat circuit on one of the standard projection planes.

KOMPAS-3D system defines a set of requirements for the construction of the contour: contour is always displayed using line style Normal, contours are made drawing the base of model should not overlap and have points in common.

If there are multiple paths one of them must be external and others nested in it.

There is only one level of nesting loops.

To open a document, you must click New Part  or execute the File – New – Part.

In the main window of KOMPAS-3D appear a document window with the Model Tree and the name of the new part (model) – Part. It is advisable to change the name to a more appropriate design a document. To do this highlights the name by clicking the right mouse button. In the menu that appears, click Model Properties  and write down the parts of the dialog box, name the new parts – Prism (pyramid), press button  Create Object (Ctrl+Enter) (Fig. 5.8).

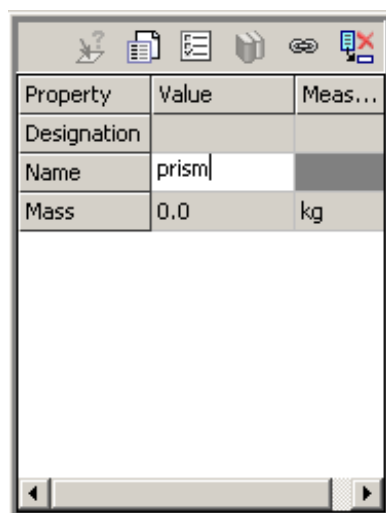





Figure 5.8 – Model properties

How to build models

1. Activating click the  ZX Plane (horizontal) in the Model Tree of projection and position it parallel to the plane of the screen, clicking sequentially in the current Orientation of the image press  Normal to...

2. Press  Sketch (Enable/Disable Sketch) and the system switches to build and edit the circuit grounds. In this mode, change the set of buttons on the Control Panel, the Toolbar and the composition of the Current Status Bar, which takes the form corresponding work in 2D modeling (Fig. 5.9).

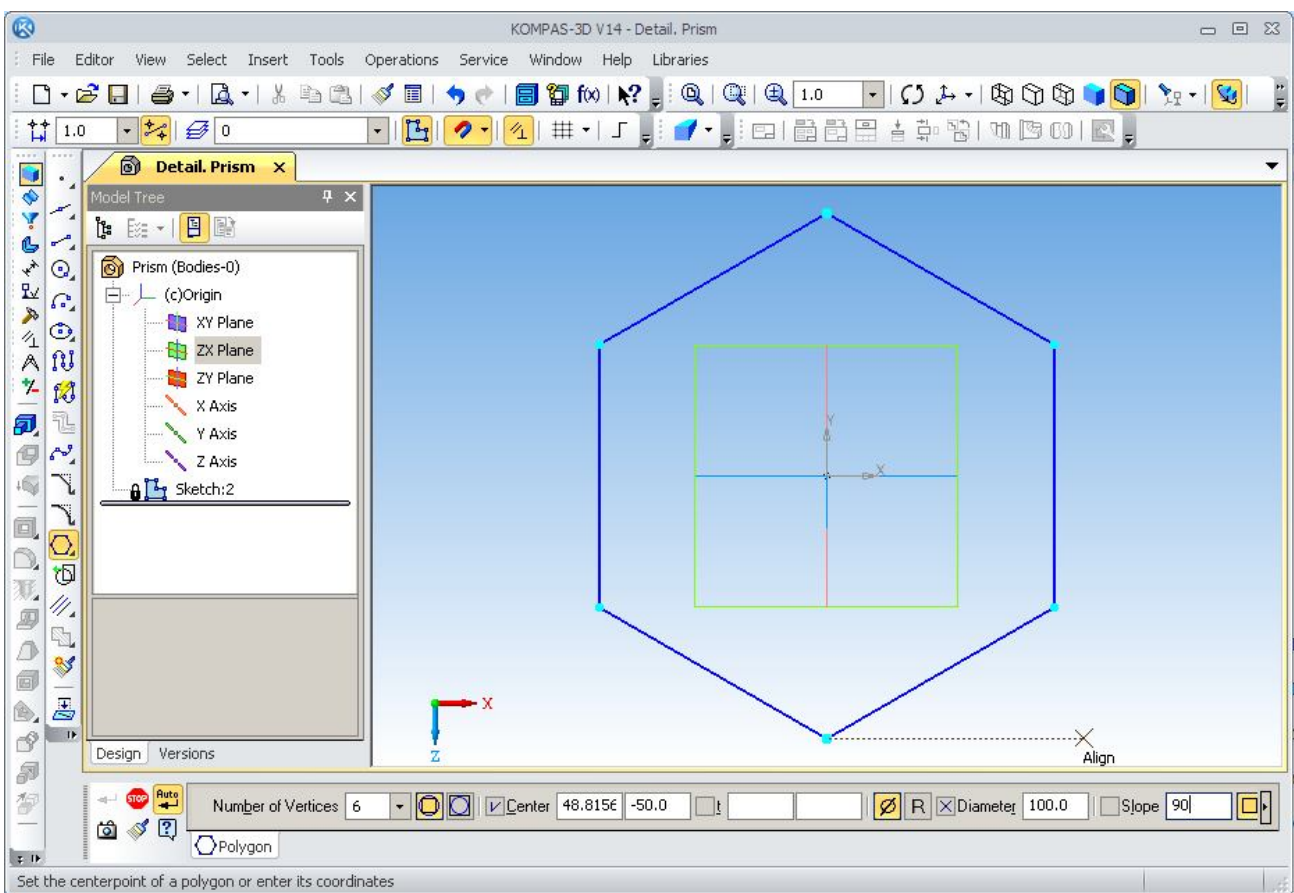




Figure 5.9 – Sketch of the part

3. Press the button  of the Polygon, and to put in field of Property Toolbar: the value of sides of the polygon – 6, the diameter of circumscribed circle – 100 mm, the angle of the first vertex – 90. Press the button  By Circumscribed Circle.




4. To fix the end of the construction of the base circuit by pressing again  Sketch (Enable/Disable Sketch). Then the system goes into constructing a model built on the base. The Toolbar changes its appearance it is active on only one button Operation Extrude  with context menu  (Fig. 5.10).



Figure 5.10 – Context menu of extrude




5. Press the button Extrude  on Compact Toolbar and the Property Toolbar to specify the distance of 100mm (and also to introduce the parameter of the draft to the pyramid) and press the create button (Fig. 5.11).



Figure 5.11 – Property toolbar

Set the display mode of the Dimmed Wireframe  clicking and set the Orientation – Isometric XYZ.

As a result of commands creates a prism (or pyramid) with the specified dimensions in Figure 5.12.

Optionally in the display all the graphic elements of the model for this you should use the command Show all pressing .

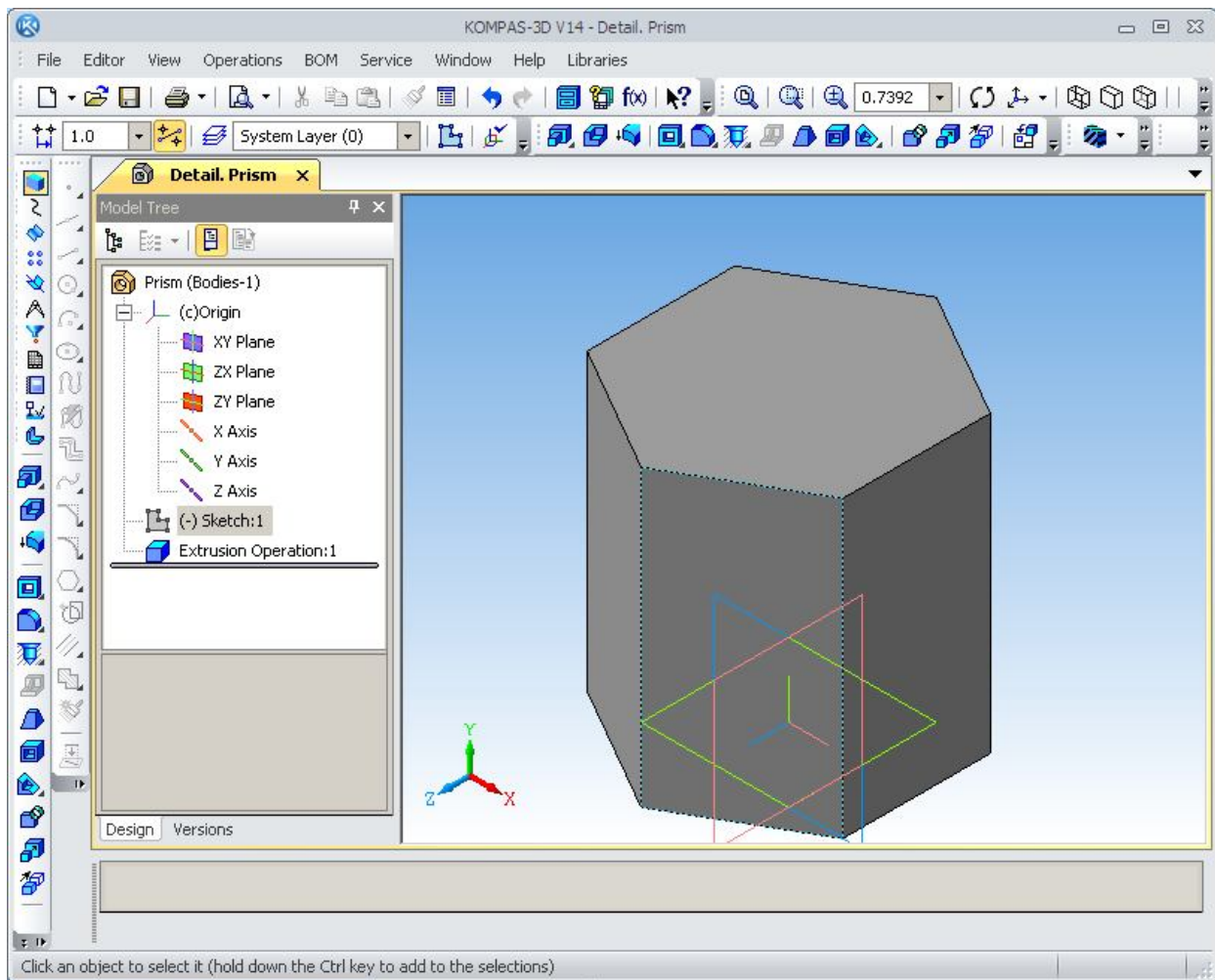






Figure 5.12 – The prism

6. The next stage of model construction is truncation model by horizontal planes:

- a) press  Sketch (Enable/Disable Sketch) and the system switches in 2D modeling;
- b) activating the  XY Plane (front) in the Model Tree and then clicking sequentially in the current Orientation of the image press  Normal to...;
- c) using the Toolbar (the button Geometry) are building the necessary cut line, i.e. front projection parts;

d) press  Sketch (Enable/Disable Sketch) and the system switches in 3D modeling. The toolbar of Geometry constructions were replaced to the Compact Toolbar (Fig. 5.13).

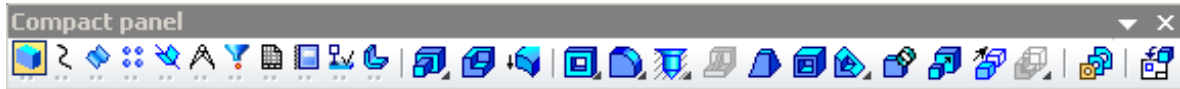



Figure 5.13 – Compact panel

In the dialog box that appears after clicking on the Operations – Trim – By Sketch, set operation parameters on the Property Toolbar: the forward or reverse direction, then press the key to  Create Object (Fig. 5.14).

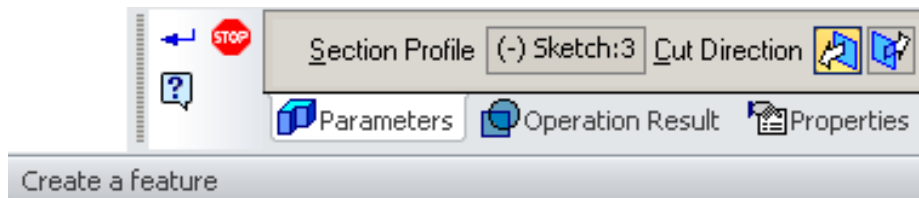


Figure 5.14 – Create a feature



5.3 Editing the Model

Consider some of the questions the model editing. Information on the operations carried out in the process of Model Tree, written in the tree model and based on it, you can go back to editing any of them. General principles cancel or modify of the model is the following:

- trigger menu commands to perform actions on the selected object by clicking on the right mouse button;
- enter the appropriate command from the menu.

According to the model create the part drawing

1. On the top toolbar, activate the function File (or .

2. On the Main menu, select create New – Drawing a blank mode for the drawing. On the Compact panel select Views  – Standart Views  – From file (Fig. 5.15).

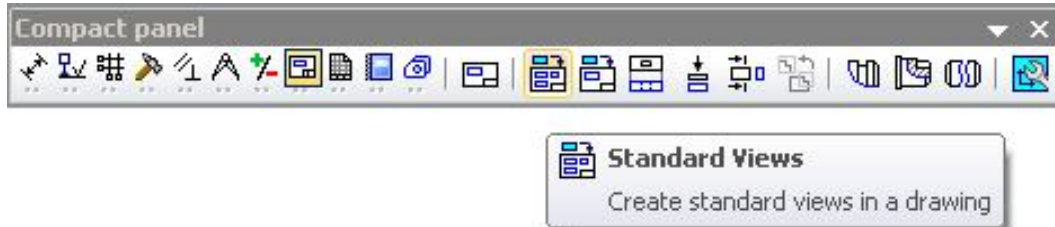


Figure 5.15 – Compact panel

3. In the dialog box note the appropriate types (front, top, left and isometric) (Fig. 5.16).

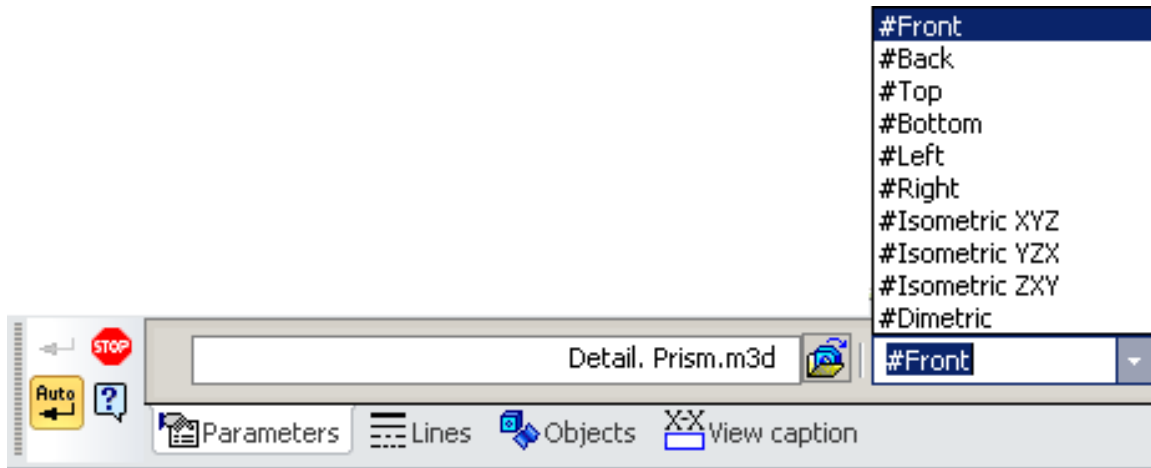


Figure 5.16 – Views of parts

4. Fill in the title block by activating the button “size and technological notation” toolbar.

LECTURE 6 CONSTRUCTION DRAWINGS

6.1 General information about the construction drawings

6.2 Structural elements of buildings and schemes

6.3 Graphic images are on the construction drawings. Door and window symbols

6.1 General information about the construction drawings

Construction drawings are contained from projection images of building objects or their parts and other necessary for their construction data.

Building objects depending on their purpose are subdivided into 4 groups:

- residential and public buildings (civil);
- industrial buildings;
- agricultural buildings;
- engineering structures (bridges, tunnels, overpasses, embankments, etc.).

When performing design and construction plans should be guided by GOSTs ESKD and CDDS (system of design documentation for construction).

Scale drawings are selected in accordance with GOST 2.302–68. For residential and public buildings:

- floor plans, basement, foundations, sections, elevations, installation plans overlap – 1:100, 1:200, 1:500;
- plans sections, fragments of plans, sections and elevations – S 1:50, 1:100;
- products and components – S 1:5, 1:10, 1:20 editing model.

International, or ISO, sheet sizes

Papers manufactured and sold outside of North America are based on 1 square meter.

The International Standards Organization (ISO) system of paper sizes applies to all grades of paper and paper board and consists of five series of sizes: A, RA, SR,

B, and C. Within each series, each sheet is twice the size of the next smaller sheet and half the size of the next larger sheet (Fig. 6.1).

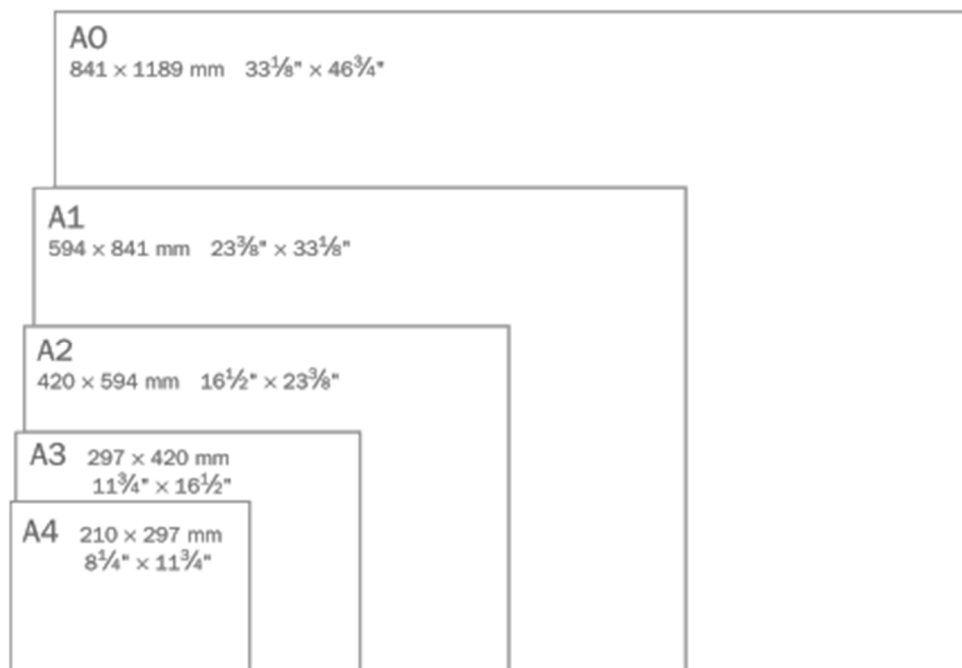


Figure 6.1 – Sheet sizes

Object lines

Object lines are used to show the shape of an object. All visible edges are represented by object lines. All the lines in Figure 6.2 are object lines. Drawings usually include many solid lines that are not object lines, however. Some of these other solid lines are discussed here.

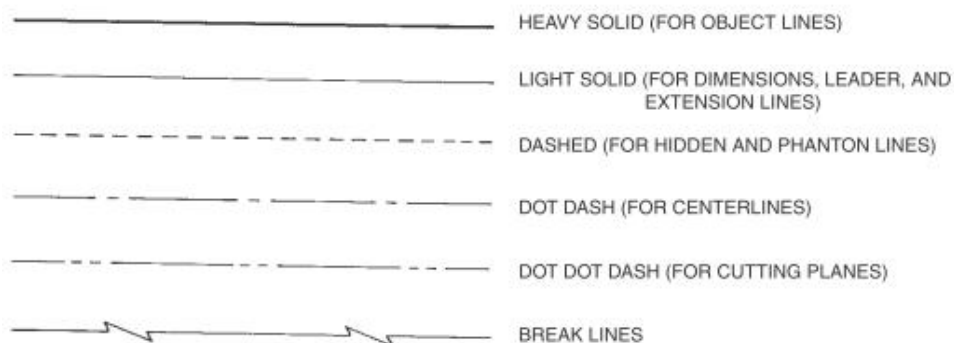


Figure 6.2 – Alphabet of lines

6.2 Structural elements of buildings and schemes

Building objects consist of separate parts – designs. Design teams are composed of individual elements, and monolithic, manufactured on site.

Foundation from wall or under a separate support (column) is called the underground part of the building, through which the load is transferred to the ground. Foundations are tape and columnar. The walls in the building are divided into external and internal. Walls are carriers (which transmit the load on the foundation of its own weight and the weight of ceiling and roof), self-supporting (only its own weight) and wall (hung on the columns consist of individual panels and the weight of the load is transferred to the column).

Partitions – internal walling.

Cap – the lower part of the outer wall, resting on the foundation.

Span – the inner horizontal design that separates the building into floors.

Cover – upper cladding separating the building from the outer space environment.

Roof – top water shut coating layer or roof of the building.

Opening – through a hole in the wall, designed for the windows, doors, gates, etc.

Window unit – sash box.

Door unit – door leaf box. Stairwell – fenced capital (bearing) walls room stairs.

Flight of stairs – ramp stairs with steps (no more than 18 steps).

Staircase – horizontal element stairs between marches. Summary - level floors, intermediate – to move from one to another march.

Rafters – roofing truss structures that represent beams, resting on walls and internal support.

Coordination axis

The construction plan begins with the drawing axis on a number of elements. These axes define the location of the main load-bearing structures and are called coordinating the longitudinal and transverse axes. Distance between axes of the plan is called the step. Step can be longitudinal or transversal.

Coordination axes put phantom lines and indicate brands in the circles of diameter 8–12 mm. For marking to applied Arabic numerals and capital letters. Font size one or two rooms are larger than the font size of numbers.

The figures mark the axis side of the building with a bigger number of axes. The sequence of marks – left-to-right, bottom-up (Fig. 6.3).

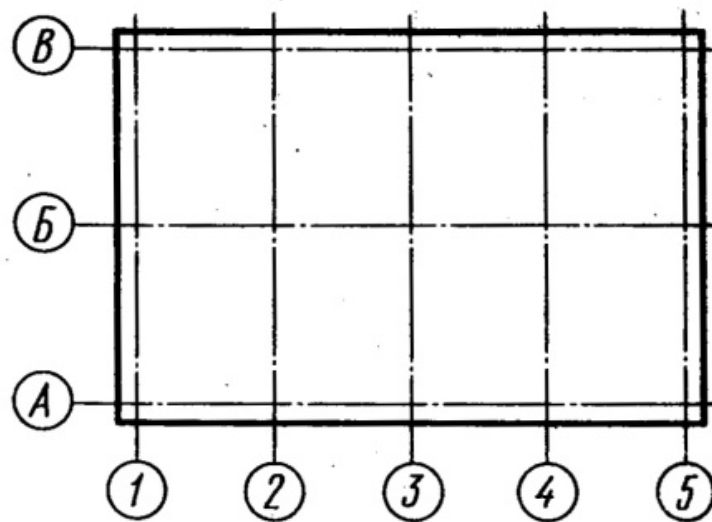


Figure 6.3 – Mark the axis

In buildings with bearing longitudinal and transversal walls binding coordination axes external and internal walls make as follows:

- on beams leaning against walls and internal support:
- inside face of the outer wall is placed on the coordination axis at a distance M or $2M$, i.e. 100 or 200 mm (modular binding);
- coordination axis coincides with the inner wall surface (no binding);
- in internal walls coordination axis must coincide with the axis of symmetry walls, except the walls, staircases and walls with ventilation ducts (center binding).

Dimensions on the construction drawings

Dimensions are given for the sizes and locations of all walls, partitions, doors, windows, and other important features. On frame construction, exterior walls are usually dimensioned to the outside face of the wall framing.

Dimensions in mm without affix represent units of measure and applied as closed circuit (Fig. 6.4).

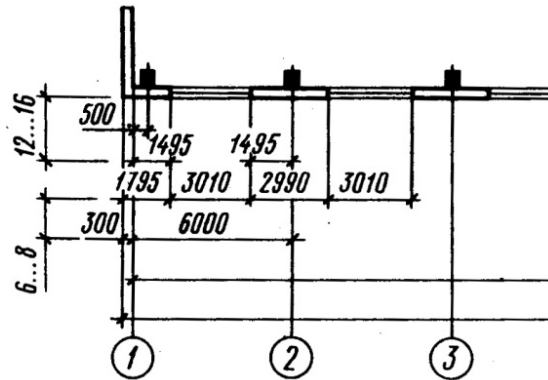


Figure 6.4 – Dimension lines in the drawing

When dimensioning diameters, radii and angles instead of serif put arrows. Mark levels (height, depth) of an element of a building or structure from the indicating any level, taken as zero, is placed on the outrigger lines or contour lines and designated by the symbol (Fig. 6.5).

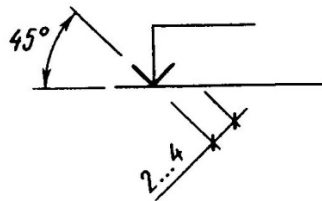


Figure 6.5 – Extension lines in the drawing

Mark indicated in meters with three decimal places. Conditional marks indicate 0.000. The level is below the zero conditional mean minus sign, mark above the zero – unsigned. As a zero mark for buildings usually take the floor level of the first floor. Marks are accompanied by explanatory titles – LCP (the level of the clean floor), GL (ground level).

On the plans, if necessary, marks indicate with a plus sign.

On the plans of the slope direction of the plane cursor over which (if needed) write down the value of the slope (Fig. 6.6).

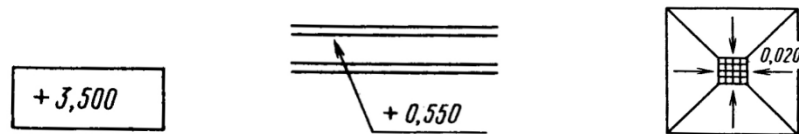


Figure 6.6 – Marks on the plane

Construction drawings of buildings and constructions consist of the General rules rectangular projection on the basic plane projections. Images of the buildings have their own names.

6.3 Graphic images on the construction drawings. Door and window symbols

Door and window symbols show the type of door or window used and the direction the door or window opens. There are three basic ways for household doors to open – swing, sliding or fold shown in Figure 6.7. Within each of these basic types there are variations that can be readily understood from their symbols. The direction a swing-type door opens is shown by an arc representing the path of the door.

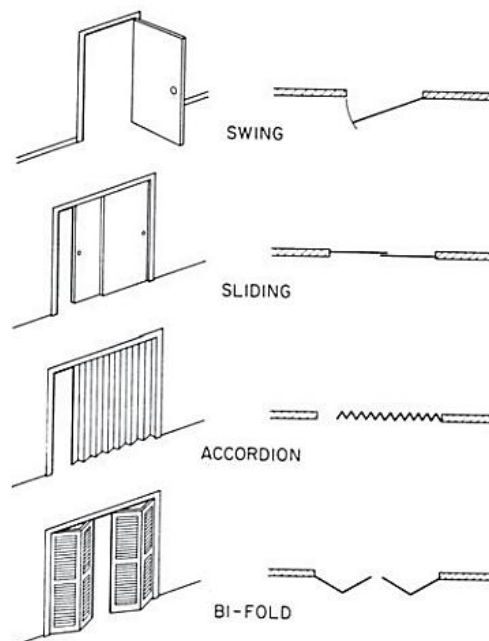


Figure 6.7 – Types of doors and their plan symbols

There are seven basic types of windows. They are named according to how they open (Fig. 6.8). Other symbols on the drawings shown in table 1.

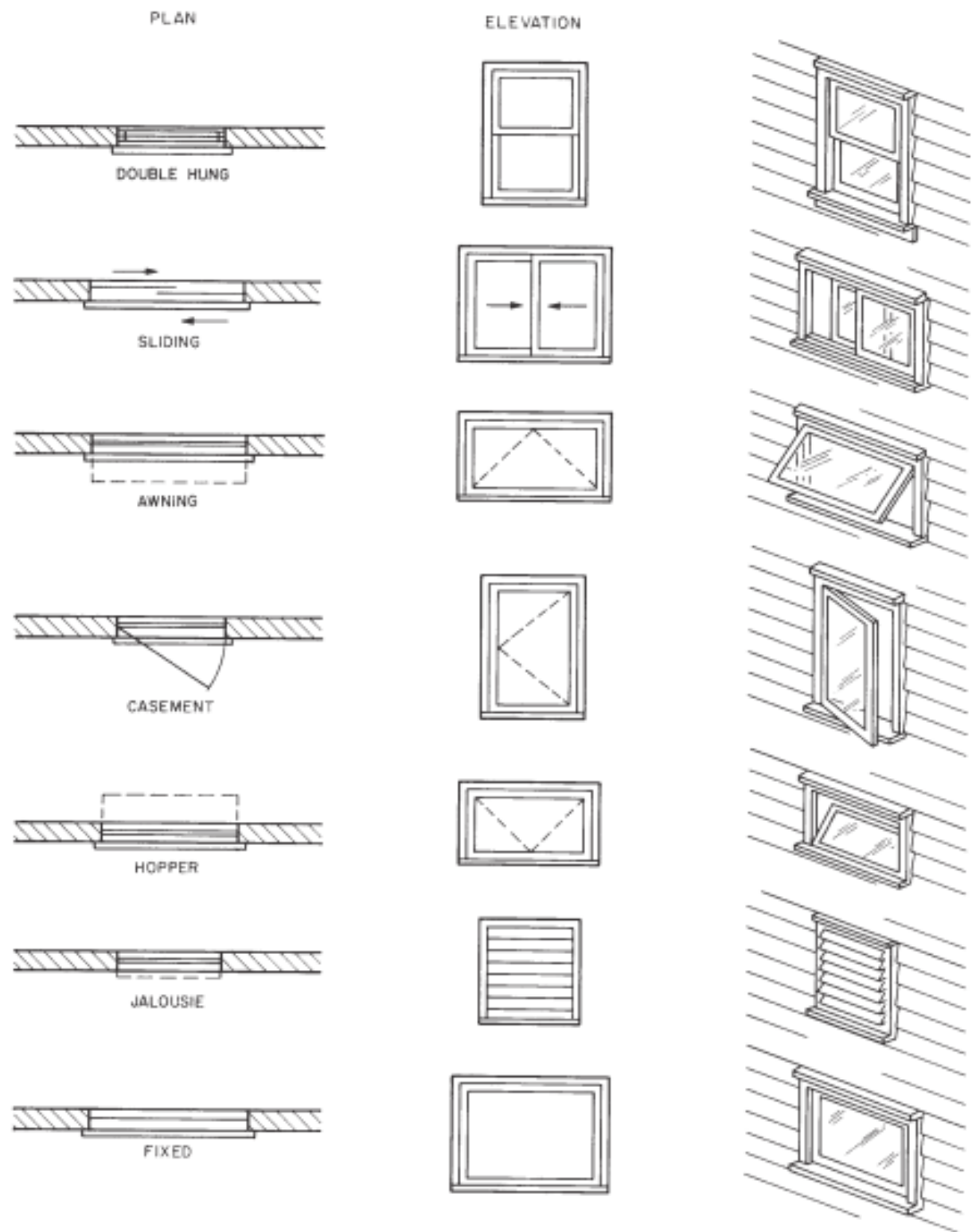
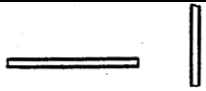



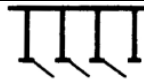
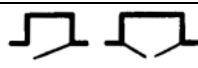













Figure 6.8 – Types of windows








Table 1– Symbols on the drawings

| Name | Image |
|---|--------------------------|
| 1 | 2 |
| Windows | |
| 1 Opening without-quarters of a wall or partition Window | <p>В плане В разрезе</p> |
| 2 Window opening without quarters | <p>В плане В разрезе</p> |
| 3 Window opening with quarters | <p>В плане В разрезе</p> |
| Doors (gates) | |
| 4 The door from the door opening without quarters | |
| 5 The door from the door opening without quarters | |
| 6 The door from the door opening with quarters | |
| 7 The double door opening of the quarters | |
| 8 The door from swaying canvas | |
| 9 The sliding door from | |
| 10 Revolving door | |
| Stairs | |
| 11 Ladder in terms of upper marsh | |
| 12 Stairs in the plan – interim marches | |
| 13 Ladder in terms of lower marsh | |
| 14 Ladder in terms of scale 1:100 and smaller | |

Continue the table 1

| 1 | 2 |
|--|---|
| Partitions, cabins, cupboards | |
| 15 The partition wall in plan and section |  |
| 16 Partition team shield plan |  |
| 17 Wall of glass in the plan and the section |  |
| 18 Cockpit shower in the plan |  |
| 19 Cab latrines in terms |  |
| 20 Built-in wardrobe in the plan |  |
| Vents, ducts in the walls | |
| 21 The hole rectangular, round |  |
| 22 Chimney in the plan |  |
| 23 Channel ventilation in the plan |  |
| Ovens, stoves, refrigerators | |
| 24 Furnace heating (General purpose) |  |
| 25 Furnace heating stationary gas |  |
| 26 Stove (General purpose) |  |
| 27 Fixed electric stove |  |
| 28 Plate fixed on gas |  |
| 29 Stove, portable gas |  |
| 30 Stove portable electric |  |
| 31 Electric refrigerator |  |

Ending the table 1

| 1 | 2 |
|-------------------------------------|--|
| Sanitary-engineering devices | |
| 32 Sink |  |
| 33 The kitchen sink |  |
| 34 Washbasin |  |
| 35 Bath |  |
| 36 Bidet |  |
| 37 The floor toilet |  |
| 38 The wall-mounted urinal |  |

LECTURE 7 CONSTRUCTION DRAWINGS AND ELEMENTS OF THE BUILDING

7.1 Drawings of the building plan

7.2 Section drawings

7.3 Elevation drawings

7.4 Computer drawing of the building

7.1 Drawings of the building plan

The plan of the building is called the image of the building, mentally dissected by a horizontal plane at the level of window and door openings (about 1 m) and projected onto the horizontal plane of projection. The plan shows what is clipping plane and what is underneath it.

On the plan of the building show window and door openings, the location of the stairs, partitions and capital walls, built-in cabinets, sanitary-technical equipment and other. The plan placed under the elevation in the flat connection with it.

The position of all structural elements is determined by reference to the coordination axes.

Outside the building contour put the size of window and door openings “in the light” and spaces between them (the first dimensional chain), coordination between axes (second dimensional chain) and the axis (the third dimensional chain).

Internal dimensions of premises, thickness of walls and partitions should be put on internal dimensional chains. They spend at least 8...10 mm from a wall or partition. Also bind all the inner main walls to the axes.

Floor space is put down in the lower right corner of the plan of the premises in square meters without designation of units with two decimal places and a bar beneath.

The plans show what direction the door opens. Exterior doors from the street to the house should open outwards, and the door from the stairs to the apartment is in-

side the apartment. Opening the other doors is depended on the convenience of planning and operation.

Brand of Windows and external doors should be put on the outer side of the wall. On the open plan line shows the clipping plane for the corresponding section (Fig. 7.1).

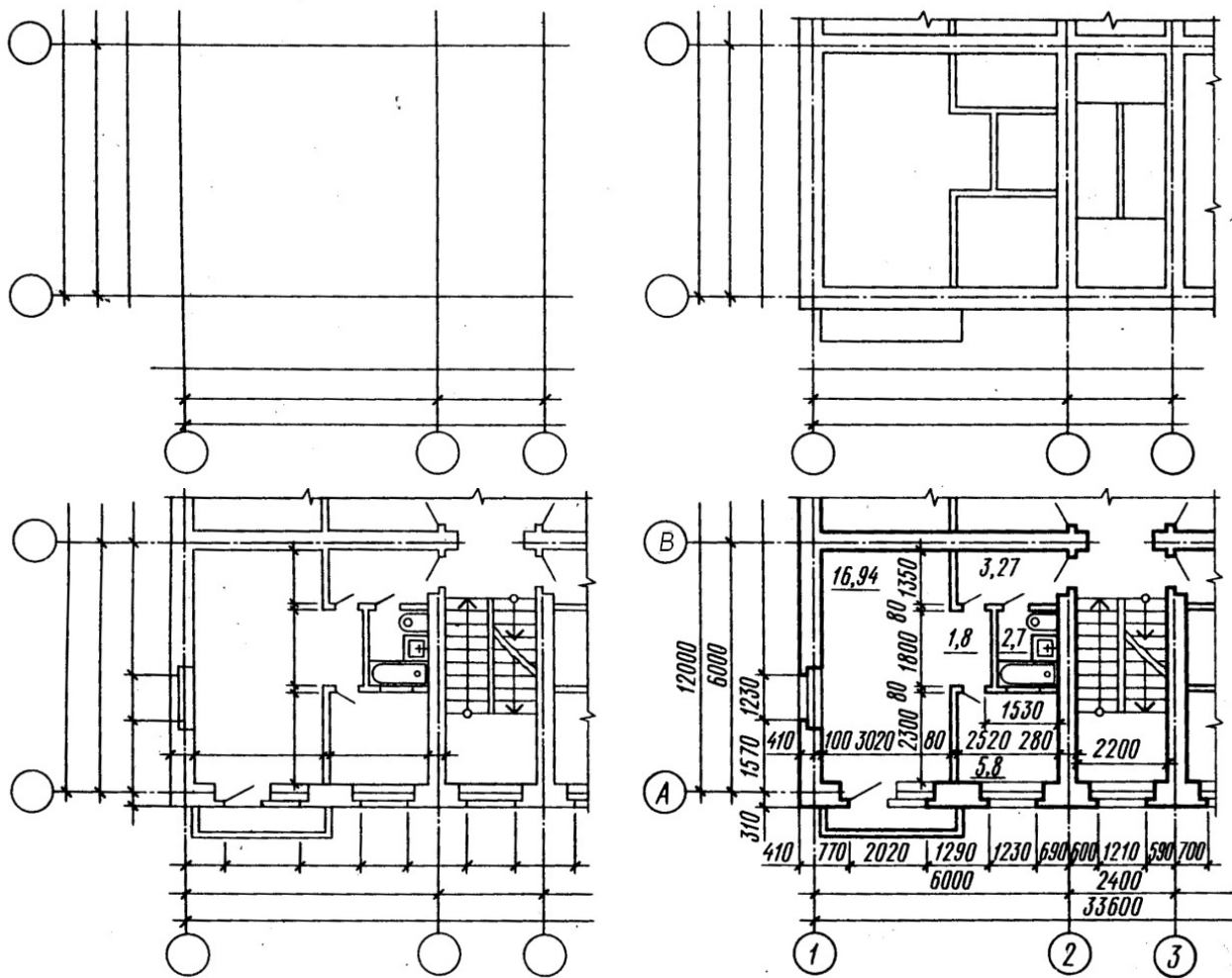


Figure 7.1 – The sequence drawing of the building plan

A building plan is drawn in the following order:

- conduct longitudinal and transversal coordination axis;
- draw all external and internal walls, partitions and columns;
- produce a breakdown of window and door openings in the external and internal walls and partitions, conditionally show opening doors;

- draw stairs, sanitary appliances, built-in wardrobes, mezzanine, balcony fences and other elements;
- put the necessary external and dimension lines show the cutting line;
- put down all sizes, make appropriate titles, check the drawing;
- make a final stroke.

Contours of cuts and sections operate continuous main line. Elements that do not fit in the plane of section are performed by a thin line.

7.2 Section drawings

A sectional image of the building is called, mentally dissected vertical plane and projected onto the projection plane.

Direction of the cutting plane is marked on the ground floor open plan line with arrows at the ends, showing the direction of gaze. About the shooter put arabic numerals or lowercase, but in the context of making the inscription type: Section 1–1.

On the cuts visible contour lines that do not fit in the plane of section, perform a continuous thin line.

On sections focal axis endure down and affix label sizes between adjacent axes.

Position of structural elements height is determined by the elevations and dimensions, which appears on the remote lines levels of the respective elements.

Inside the cut applied height floors, doors and windows, as well as elevations and floor levels stairwells.

For installation of staircases and platforms is a section along the stairs. The section plane is held by fellow flight of stairs to the observer.

On the exterior side of the cut at a distance of 12–15 mm spend dimensional chain, determines the size of the window openings and piers, cap, outside the doorway. At a distance of 10–15 mm from the chain cause elevations of the ground level and the top of the walls, shelves turned out.

Also the marks are applied to the floor stairwell in the vestibule, entrance areas – one step above the sidewalk. The level of these sites increases towards a flight of stairs, so that rainwater does not fall into the stairwell.

Industrial buildings in sections depict not all items in the cutting plane, but only those that are in close proximity.

The section drawings are shown in Figure 7.2.

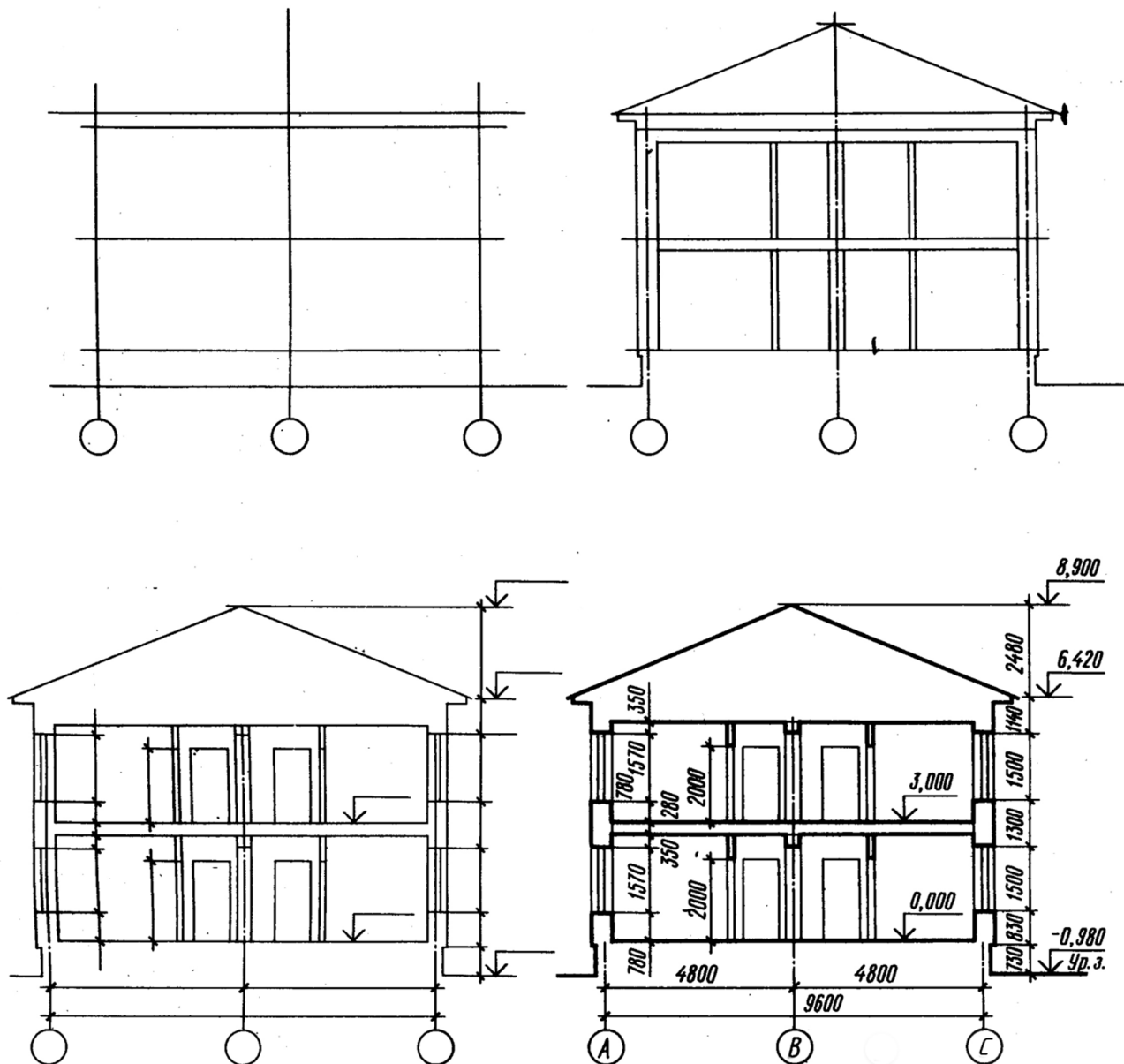


Figure 7.2 – Section drawings

A building section is drawn in the following order:

- draw coordination axis main load-bearing structures and perpendicular to them, horizontal lines of levels: land surfaces, floor all floors and the attic floor and the top of the cornice;
- contours applied exterior and interior walls, partitions, caught in the cut, as well as the height of intercommunication and attic floors and roof ridge is drawn takeaway cornice and plinth, draw the roof slopes;
- scheduled in the exterior and interior walls and partitions of windows and doors, as well as visible doorways and other elements located behind the cutting plane;
- carried outrigger and dimension lines, circles marking axes and signs elevations;
- produce the final stroke, dimensions and elevations make explanatory inscriptions and indicate the name of the section.

7.3 Elevation drawings

Types of buildings in the front, rear, right and left are called elevations. In the name of elevations indicate extreme focal axis. Elevations give an idea of the appearance of the building, its overall shape, size, number of floors, the presence of balconies and loggias.

View of the building from the street called the main elevation, from the yard – yard and side – end.

In the elevation drawings show the location of windows, doors, balconies, door trims, etc. In the large-panel buildings and walls the blocks and the panels are shown. Dimensions are not applied on elevation but only the extreme axis shown on it. The right or left a ground line, the top and bottom openings, eaves, top roof are shown on this drawing.

Elevations are usually performed in scale 1:100, 1:200 (civic buildings) and 1:200, 1:500 (industrial buildings). Complex view elevations are in the fragments in scale 1:10, 1:20.

The elevation drawings are shown in Figure 7.3.

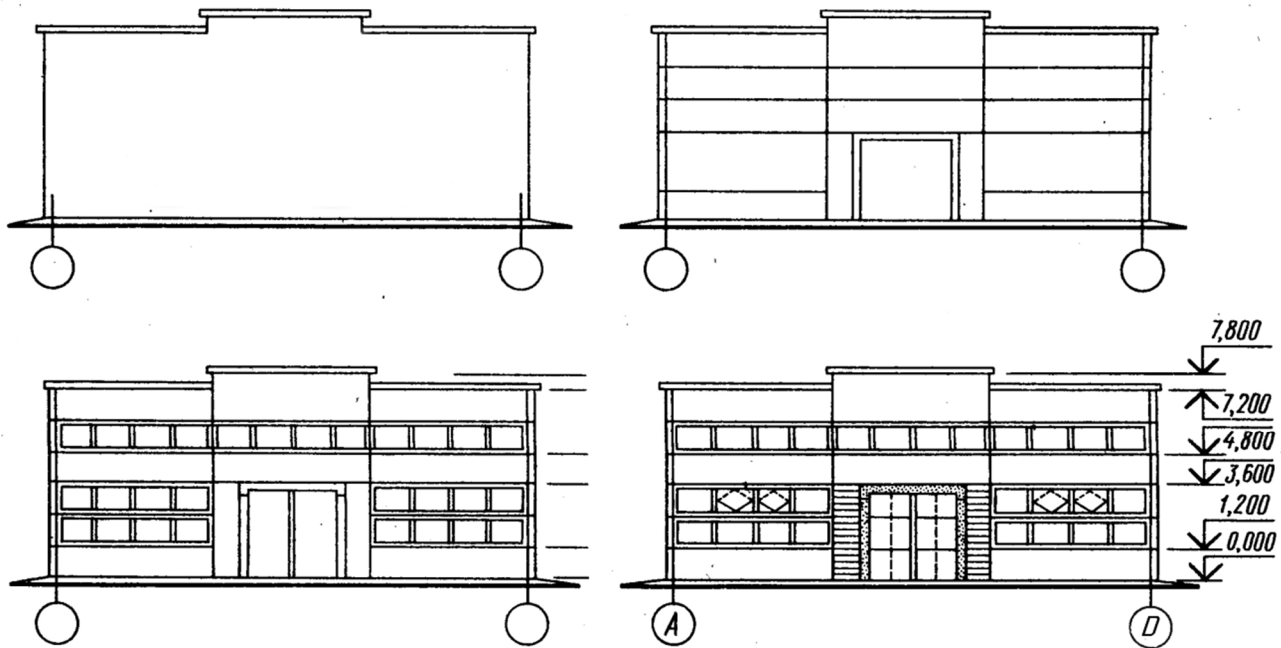


Figure 7.3 – Elevation drawings

A building elevation is drawn in the following order:

- draw the axis and the outline of the building;
- draw the windows and doorways, balconies, canopies plates, cornice and others architectural elements;
- draw the window frames, doors, fences balconies, vents and chimneys on the roof, put down markers icons;
- applied levels of the appropriate heights, marked focal axis;
- after verification of compliance with the plan and make the final circuit.

Draw the main line of the ground. Land line make thickened line that goes beyond the elevation view. On the architectural drawings on walls sometimes show shadows and elements entourage.

Sometimes necessary information can be conveyed without showing the interior construction. A large scale may be all that is needed to show the necessary details.

Many details are best shown by combining elevations and sections or by using isometric drawings.

7.4 Computer drawing of the building

1. On the top toolbar, choose the command **New document**.
2. Activate the command **Service**. You should choose **Settings** → Document Options → Settings first sheet – Format (A3 – horizontal) → Registration → Drawing and design → The first sheet.
3. The menu command **Insert** select mode **View** and in the opened window enter the value of the scale (1:100).
4. Activate the command **Tools** → Library Manager → Library of drawing plans of buildings and constructions.
5. For rendering of the coordination axes selectable mode **Drawing axes** → coordination axes. The opened window specify mesh parameters: step, the number of steps, total length of axes, type the ending axis, the length of departure axes.
6. Draw bearing walls and partitions. In the current library included in the regime of the Elements of frame structures. In the desktop window, enter all required parameters.
7. Insert the Windows and doors. Are alternately in the modes **Window** and **Door** in the current library. In the opened boxes, enter the necessary parameters: width, height, and type of binding is on the drawing.
8. Insert the stairs and sanitaryware call dialogs **Ladder** and put all the necessary dimensions and annotations on the finished drawing plan of the building.

In the left part of the dialog, open the library window displays a list of commands the current library that can be grouped in sections. To expand the content of any section, place the cursor on the plus icon next to the title of the section and click the left mouse button. Another click on this symbol (after you expand a partition, it appears as a minus) will lead to the collapse of the content section.

In the right part of the dialog box displays the slides, facilitating the search for necessary command.

To run the library commands for execution, click its name in the list and click OK. You can also double-click the left mouse button on the name of the team. For start of library command for execution choose its name in the list and press the OK button. It is possible to left-click on the command named twice also.

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