

Projecting a Figure onto a Surface and Its Application in Technical Graphics

Manh Hong Do

School of the Mechanic, Descriptive Geometry and Engineering Drawing Department, Hanoi University of Science and Technology, No. 1, Dai Co Viet Street, Hai Ba Trung district, Hanoi, Viet Nam

Abstract - In technical graphics, solids are created by rotating a flat shape around an axis to obtain a solid of revolution. The axis of rotation must lie in the plane containing the flat shape and must not intersect it alternatively; a flat shape with a certain thickness can also be used to create a solid. Some figures are created by projecting a figure onto a surface. This paper presents a method for projecting an image onto a surface, which can be flat or curved.

Keywords: Projection: pro, Intersection: int, surface: sur.

I. INTRODUCTION

To project a figure onto a surface, we must project any point onto that sur. To draw the pro of any point onto a sur with a known pro direction, we must construct a line passing through the given point and parallel to the pro direction. Next, we find the int point of this line with the sur on which we want to draw the pro.

Conclusion: Thus, to draw the pro of a point onto a sur, the problem of the int of a line with a sur must be solved.

II. PROJECT ONTO A SURFACE

2.1 Project a point on to a plane

Given point A, plane MNP and line t.

Draw point A' as the pro of A onto the plane MNP in the pro direction t (see Fig .1.)

Solution:

- Draw a line d passing through A and parallel to line t
- Construct a plane Q containing line d and perpendicular to the vertical pro plane.
- The int of plane Q with plane MNP is line g.

The int of d and g is A'.

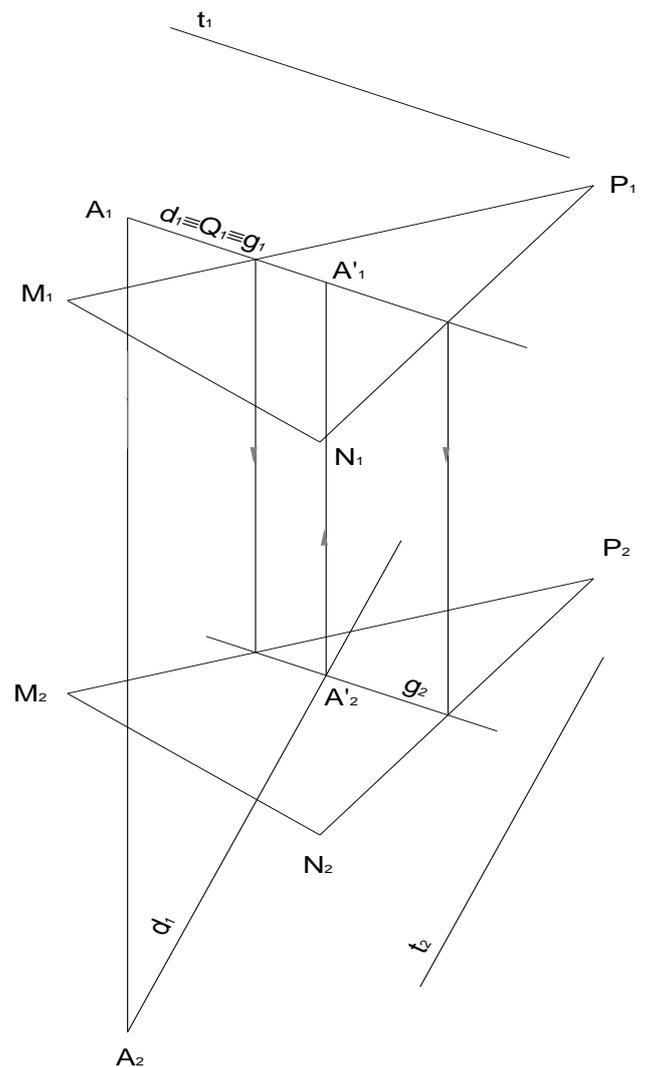


Figure 1

2.2 Project a figure on to a plane

Problem 1:

Project the parallelogram AEHF onto the plane MNP in the pro direction t (See Figure 2).

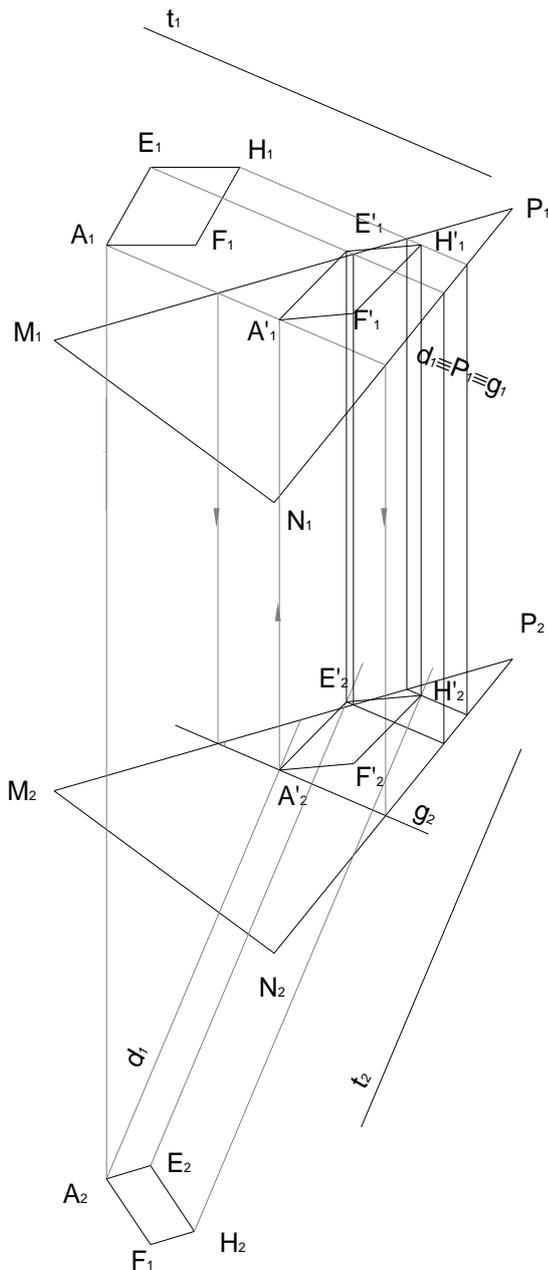


Figure 2

Based on the properties of parallel pro, we only need to project 3 points A, E, H.

We will obtain 2 pro of it, which are also 2 parallelograms.

Problem 2:

The int of planes P and Q is line g. Point A belongs to plane P and its pro is point A' onto plane Q. Circle with center O belongs to plane P.

Draw its pro onto plane Q in the direction of pro AA'.

Solution:

The pro of a circle is an ellipse. The pro of the center of the circle is the center of the ellipse. The pro of a diameter of the circle is a diameter of the ellipse.

To draw the pro of point O, we attach O to line t. This line is determined by connecting point O with point A.

To draw the pro of t, we extend t to intersect g at I. Since g is the int of two planes, its pro coincides with itself. Therefore, point I belongs to g, so I' coincides with I. Thus, connecting I' with A' gives t'. Construct a line passing through O parallel to AA' intersecting t' at O'

Similarly, to draw the pro of a diameter of the circle, we extend it to intersect line g.

This circle has only one diameter parallel to g, then its pro is also parallel to g'.

For an ellipse with thickness b, we will get a cylinder.

(See Figure 3).

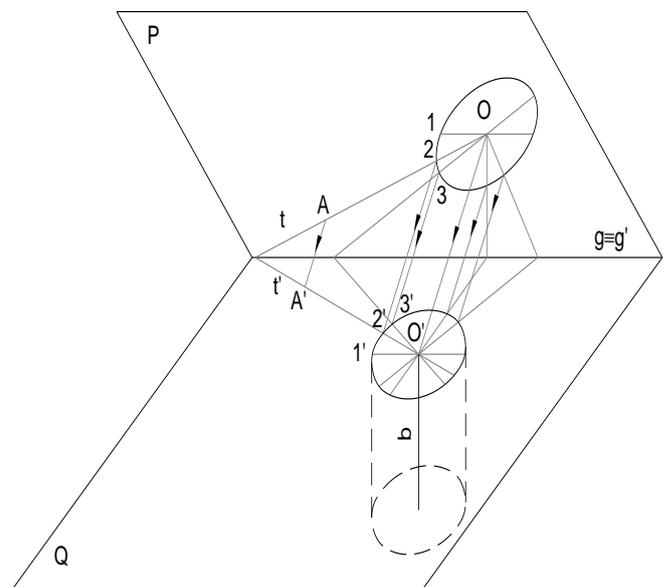


Figure 3

2.3 Project a figure on to a cylinder

To draw the pro of a flat shape onto a cylindrical sur, we must first draw the pro of any point onto the cylinder. To project any point onto the cylinder, we must draw a line passing through this point and parallel to the pro direction. The int of this line with the cylinder is the pro of a point. The same applies to other points.

In short, to draw the pro of an object onto a cylinder, we must solve the problem of the int of a line with the cylinder.

Problem 1:

Draw the int of a line and a cylinder

Case 1

Draw the int point of a line with a projecting cylindrical surface.

A projecting cylindrical sur is a cylinder whose generator is perpendicular to the pro plane.

(See Figure 4).

This cylinder is right circular cylinder. Its generator is perpendicular to the top plane of pro. So the top view of its is a circle. The int of line d and this cylinder are two points. They are point M and point N.

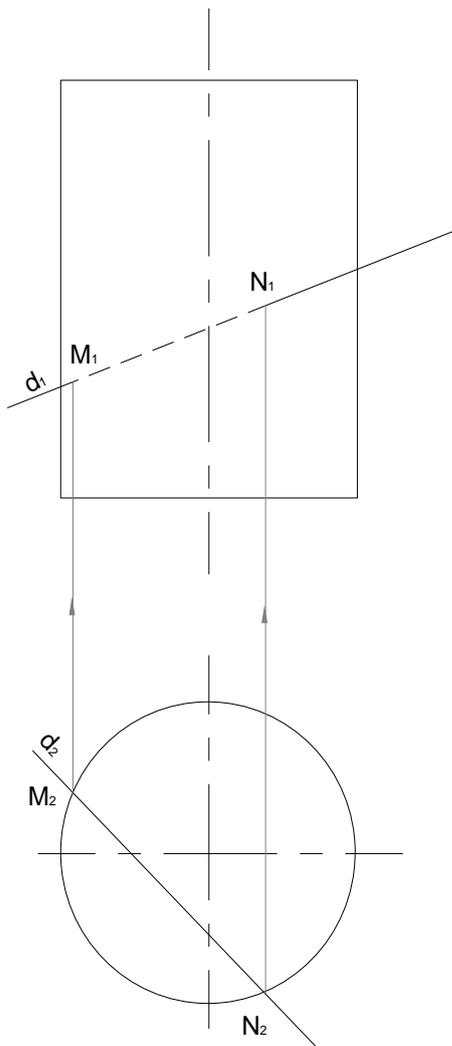


Figure 4

Case 2:

Draw the int of the projecting line with the cylinder.

Line d is perpendicular to the front plane of pro. So the front view d1 is a point.

The int of line d and the cylinder are two points. The front view of these two points coincides with d1. ($d1 \equiv M1 \equiv N1$)

To determine the top view of these two points, we attach them to the generating line of the cylinder.

(See Figure 5).

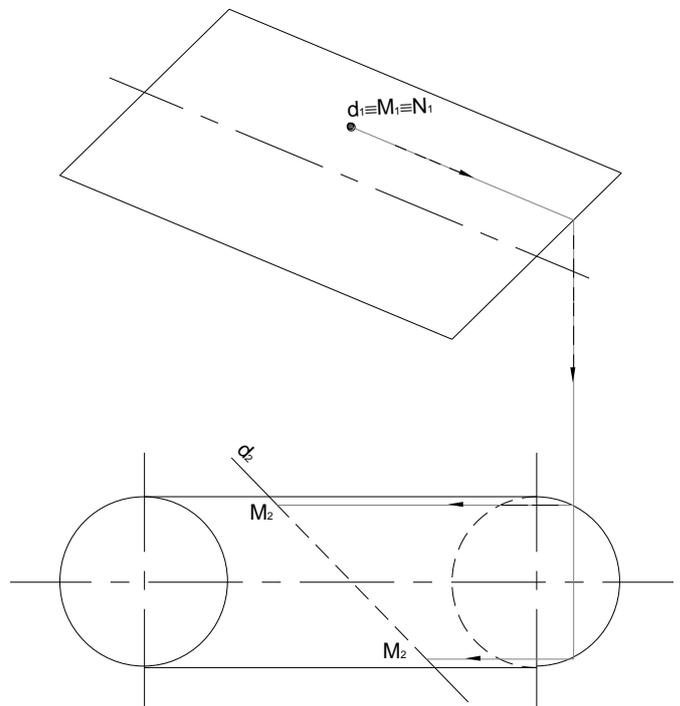


Figure 5

Case 3:

Draw the int of a line and a cylinder

Solution:

- Take two points A and B on line d.
- Construct lines parallel to the generating line of the cylinder, passing through points A and B.
- These two lines intersect the base of the cylinder at points G and H, respectively.
- Through G and H, construct the generating line of the cylinder.

- The int points of line d with these two generating lines are M and N.
- M and N are the int points of line d with the cylinder surface (See Figure 6).

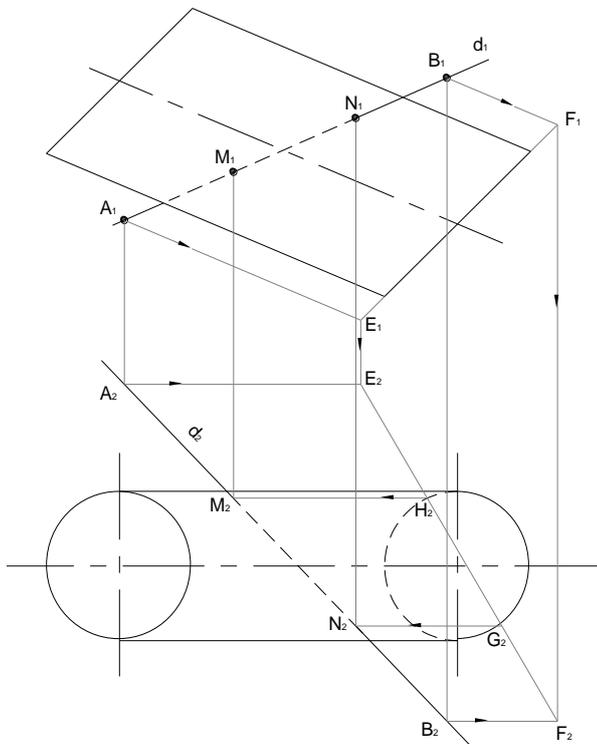


Figure 6

Problem 2: Construct a 3D object by projecting a flat shape onto a cylindrical surface.

Example: Projecting a rectangle onto a cylindrical surface.

The edge parallel to the generating line has a pro that is a segment of the generating line

The edge perpendicular to the generating line has a pro that is an arc

These also solve the problems of the int of a plane with a cylinder. These planes contain the edges of the rectangle and are parallel to the pro direction. (See Figure 7).

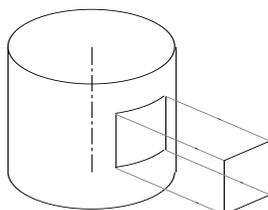


Figure 7

Based on the results of the pro, engineering graphics constructs 3D solid models. (See Figure 8).

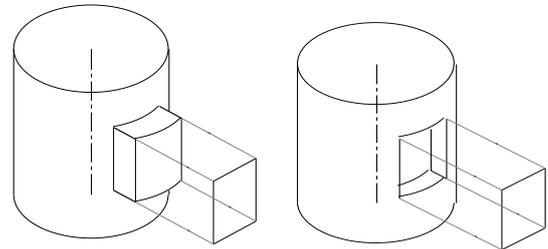


Figure 8

III. CONCLUSION

Geometry is a science that is widely applied in engineering and life. Graphics software is constantly evolving, offering many ways to create complex solids. Projecting a flat image onto a surface and using that pro to create a 3D solid is one of the complex commands involving pro in graphics. This scientific paper presents a method for projecting a flat image onto a surface. Based on this, 3D solidare created.

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