

Application of Simplifying Thought in Engineering Graphics Teaching

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Abstract. Engineering graphics course is a basic professional course for the students majoring in mechanical engineering in our school, which lays a solid theoretical foundation for the subsequent job training. At the same time, this course helps students understand weapons and equipment, and thus enables students know how to use and protect them. Combined with the characteristics of the course, which are concluded as “easy to understand, easy to confuse, easy to make mistakes” and the particularity of teaching targets in military colleges, the complex problem of intersecting line in Engineering Graphics can be solved by the thought of “simplifying”, which can enhance the cadets’ learning enthusiasm and initiative, therefore greatly improve the teaching effect.

Keywords: Engineering graphics course; simplifying thought; intersecting line.

1. Introduction

In military academies, especially academies which are specialize in engineering, mechanical engineering majors or near-mechanical majors (background) are required to set up. Engineering Graphics, as a basic technical course, is a compulsory course for the primary commanding majors, such as mechanical engineering majors and equipment supporting management majors in our school. Engineering Graphics is known as the “language” in engineering field, so there is a saying “One picture is better than thousand words”. The ultimate goal of this course is to enable students master basic theories and methods, learn to read and draw engineering drawings, and lay the foundation for the use and maintenance of weapons and equipment on the premise of abiding by national standards. The course aims to develop students’ knowledge and skills, processes and methods, emotions and attitudes. It is irreplaceable for training students’ spatial thinking ability, logical thinking ability, innovative design ability and engineering practice consciousness. It is the bridge and bond between science and culture courses and on-job training courses [1-4].

The core theory of this course is orthography and the projection rule of three views. Drawing and Reading engineering drawings correctly are the difficult points in the course. The author combines the teaching situation for the past five years, focuses on the first difficult point in “complex intersecting line”, thinks of the actual situation of the cadets, and uses the thought of “simplifying” to help students understand and summarize the main points, disperse the difficult points and break them down [5].

2. Instances of Intersecting Line

Intersecting solid is a common structure in engineering, which is widely used in pipes and fire hydrants. The quasi-core retainer (Fig. 1) in the front of the type 95 automatic rifle is commonly used in target shooting by our students, which is a perforated cylinder going from the top down through a cylinder. The intersecting line on its surface is the learning objective in our study. Intersecting line is not difficult to define, they are formed by the two intersecting solids on the surface, and when we say the two intersecting solids, we usually mean two solids of revolution. In

practical engineering applications, cylinder and cylinder intersection is more common. Therefore, this paper will focus on studying the specific drawing method of intersecting line, taking the cylinder and cylinder intersection as an example.



Fig. 1 Quasi-core retainer

3. Analysis of the Shape

When two orthogonal cylinders intersect, the space and shape of the intersecting lines will also change because of the different diameters of the cylinders. Keep the diameter of the horizontal cylinder remain the same, make the diameter of the vertical cylinder change from small to large, then we use the 3D drawing software (*SolidWorks*) to draw the stereogram of two orthogonal cylinders, as shown in Fig. 2. It can be seen from the stereogram that the intersecting line is a spatial closed curve shared by the two surfaces. Thus, the properties of intersecting line are obtained: superficiality, closure and intercommunity.

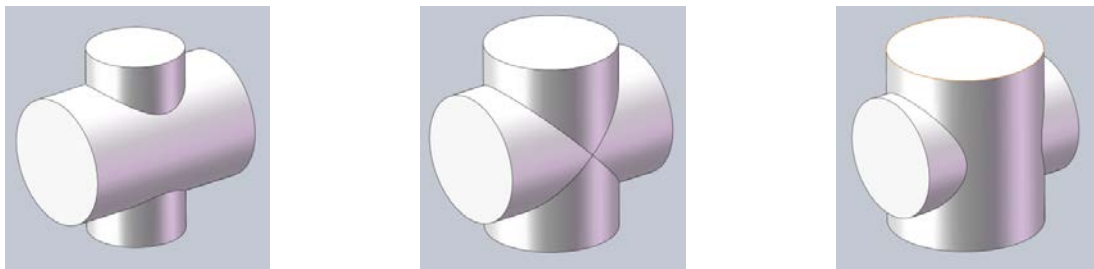


Fig. 2 Stereogram of two orthogonal cylinders intersecting

If we draw the three views of the intersecting cylinders, the key is to draw the intersecting lines. The drawing method of intersecting lines can be obtained according to the definition and properties of the intersecting line. Since the intersecting line is the intersection of two solids' surfaces, we only need to find the common points of two cylindrical surfaces. So we can transform the problem of solving complex intersecting lines into a simple problem of finding points on solid surfaces.

When we use the "two-point method", it's not to look for two points, but to find two types of points, which are special position points and the general position points. Special position points generally refer to the points on the outline of solids of revolution. and the limit position points (including the top, bottom, left, right, forefront and backmost). Sometimes the points on the outline are also the limit points. When we find the special points, which means we have found the scope and the location of the intersecting line. Since the intersecting line is a curve, we need to find more points to get the accurate projection of the intersecting line. However, in the actual drawing, it is obviously unrealistic to find all the points, so we only need to find a few pairs of general position points. In this way, the complex problem of finding intersecting line on solid of revolution is simplified into a simple problem of picking points on the surface of the solid of revolution. Fortunately, we can pick points on the cylindrical surface by using its characteristics of accumulation and the rule of point projection.

The case of two solid cylinders intersecting each other is shown in Fig. 4. The quasi-core retainer of the automatic rifle is a cylindrical hole in intersecting of thin-walled cylindrical in fact, we can

imagine a solid cylinder with a certain velocity that passes through the thin-walled cylindrical and then leaves the solid. Thus, the shape of the intersecting line is exactly the same as that of the two cylinders intersecting. Finally, three basic forms of the intersecting of two cylinders can be obtained and shown in Fig.3: solids intersecting, solid and hole intersecting, holes intersecting.

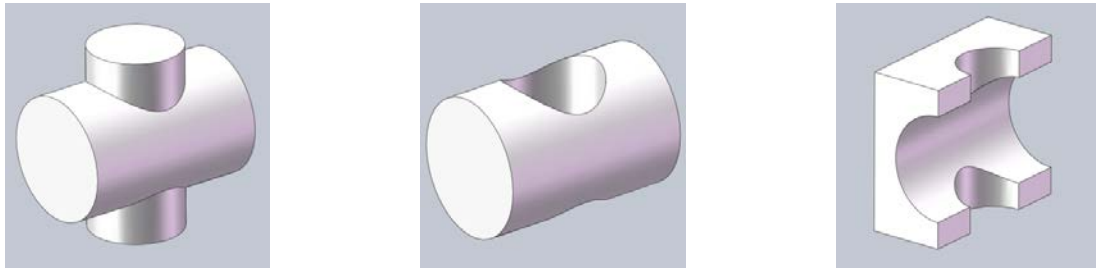


Fig. 3 Three forms of two orthogonal cylinders intersecting

4. Simplifying

In the process of learning the intersecting line, there are many phenomena of intersecting in solid of revolution accompanied by holes. For such a complex intersecting line, we can adopt the idea of turning complexity into simplicity, which can be translated to a formula: analyze from the outside to the inside, realize from substance to void, split the solid, and break it one by one. Now, we can analyze the complex intersecting line taking the Fig. 4 and the specific drawing steps can be expressed as follow.

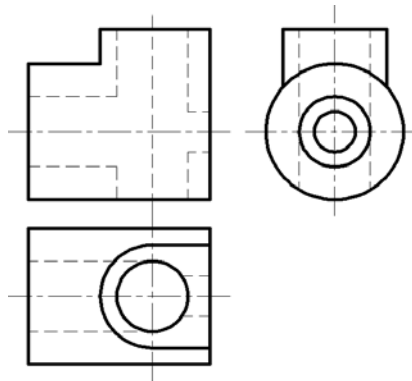


Fig. 4 Complex intersecting line

(1) First step: analysis and simplifying.

Outside: Based on the projection rule of the three views “the length should be justified, the height should be aligned, and the width should be equaled”, we can get the conclusion that the large horizontal cylinder and the vertical u-shaped cylinder are intersecting; that is to say, they are two intersecting solids.

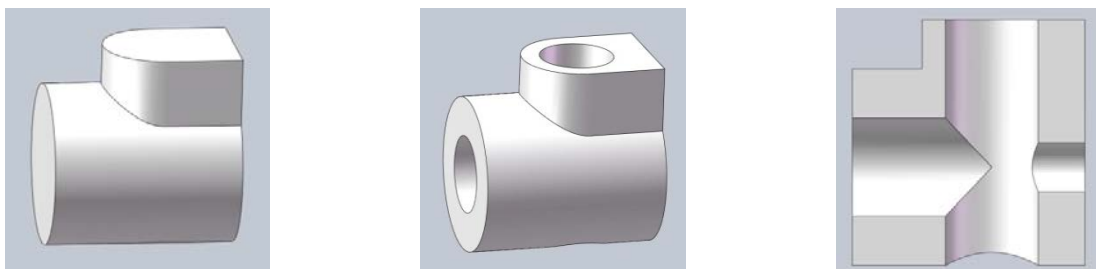


Fig. 5 Simplifying

Inside: From the outside to the inside, and from substance to void. According to the three views of the dotted part, the holes condition is obtained: the hole runs through the whole cylinder from top

to bottom; the left half is a cylinder hole with a larger diameter (and the diameter is equal to the diameter of the cylinder hole in the vertical direction), and the right half is a cylinder hole with a smaller diameter.

(2) Second step: turn lines into points.

In this complex intersecting line, it contains the three forms above. But no matter which form of intersecting, intersecting line can be solved by the “two-point method”. In the process of drawing the three views, we still adopt the method of turning complexity into simplicity, analyzing from the outside to the inside, realizing from substance to void. It should be noted that in the solid part, the left half is the half-cylinder intersecting with the cylinder, and the right half is the cylinder intersecting with the cuboids.

(3) Third step: check the bold.

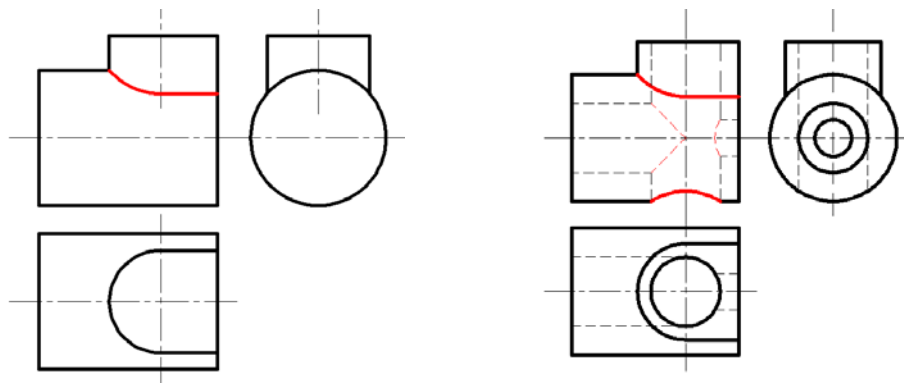


Fig. 6 Three views of the quasi-core retainer

5. Summary

Essentially, the key to find the intersecting line is to transform the lines into points, which means we need to transform the complex problem of finding the intersecting line into a relatively simple problem of taking points from the surface. This is the idea of “simplifying”. When solving complex combinatorial intersecting problems, it is nothing more than the combination of three intersecting forms. We still adhere to the idea of “simplifying”, analyze from the outside to the inside, realize from substance to void, split the solid, break it one by one, and finally integrate into a whole. In this way, complex problems are simplified. The idea of “simplifying” runs through the study of Engineering Graphics. With this method, students are full of confidence when they are acquiring this difficult point, and they are ready to solve complex and difficult problems. On the other hand, the quality of teaching can be improved effectively.

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