Features of projection surface locations in construction engineering in different countries

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Abstract. Engineering graphics is a real language that allows people from different countries to talk to each other, but today it is not universal. In this paper, the authors set out to identify differences in techniques and approaches to projecting objects onto different surfaces. Different countries use different systems, as well as with the International System of Units, which has been used successfully since the last century. The projection of detail in the European part of the world is significantly different than in the western hemisphere. The “European” method of projection formation assumes an opaque projection plane behind the projected object; the “American” method assumes that there is a transparent projection plane between the observer and the object, and the projection rays are directed towards the observer. An experiment was conducted in Russia to teach schoolchildren a particular system, which showed the complexity of the “American” projection system. In the future, countries that will enter a large agglomerate to solve global problems will benefit from creating a common projection standard that takes into account the views and interests of the world scientific and engineering community. This step will improve the speed of communication and design of new technical complexes, as well as eliminate possible mistakes when working in a large, multinational team.

1 Introduction

From the very beginning of the formation of engineering “art”, the people of this noble creative profession were concerned with the issue of transferring the fruits of their thoughts to a certain medium. The first echoes were cave paintings, then sketches on parchment, after which L. da Vinci laid the idea of a drawing, depicting his cars in volume and drawing separately each component part. The idea of dividing an object into three projections was voiced by G. Monge in 1798 [1]. The art of drawing followed two different paths from those times to modern times: “European” and “American”. Whether it is due to the desire of the “new world” to do everything differently or there are other prerequisites, there is no answer to this question yet. However, today mankind has two drawing standards: “American” and “European”. Engineers draw according to the “American” system in the...
2 Materials and methods

Many universal scientific “languages” today all over the world are united, for example, physics or chemistry. All elements of the periodic table are the same in all countries. Despite this, there are two views on how to project objects from reality onto three planes. In this part of the work, authors will discuss two issues:

1. Why to this day there are both views on the solution of the problem.
2. What are the “American” and “European” approaches. Their differences and problems associated with perception will be discussed in the second part of the work. A projection system different from the more common “European” one is used in the United States of America. After observing all the differences in science and units of account in the states, it can be noticed the correlation of topic of discussion and the situation with miles, Fahrenheit, and, in total, with a lack of desire to apply the International System of Units (SI system) in the United States. The origin of this was the times when the general SI system was invented. At that time, Fahrenheit was already used in the United States, since the Fahrenheit scale appeared 18 years earlier. This was inconvenient, relative to the more logical and simpler SI system. Therefore, the USA Congress convened the Metric Conversion Act in 1975 with the goal of a smooth conversion to metric within a few years. But this did not lead to the desired result, because many processes, techniques, computer programs and complexes had to be rewritten and replaced, and this entailed huge time and money losses.

The discussed projection method was left for the same main reasons. One problem with the complete processing of technical documentation in aviation and mechanical engineering puts the transition to the “European” system into question, and this, in turn, entails the republication of manuals and teaching materials for teaching in American universities. It is also worth remembering about a decrease in the productivity of people who are accustomed to working according to the “European” method. Summing up the above, it can be concluded that bringing all countries to one standard is rather difficult both financially and procedurally.
students was equal. The first group of students studied the “European” projection system and the second group studied the “American” one. The students performed a drawing of a part of the object.

3 Results and discussion

Let’s start with the “European” system. The idea of projecting an object from the world displayed object, where the projection is a shadow cast by all illuminated faces, and the “in the shadow” faces are displayed with dashed-dotted lines (Fig. 1).

An example of work in the “European” format is shown in the following image (Fig. 2).

![Diagram of projection planes and views](image-url)
Fig. 2. Detail in the “European” style.

This method is quite simple in perception due to the associativity with the observer, as well as intuitive. This simplifies learning and the speed of perception of projections when reading them, which undoubtedly gives a huge plus to this technique.

“American” method has a different principle for the arrangement of projection planes and projected bodies. It consists in the location of the object in the third octant (Fig 3), behind the projection planes.

Fig. 3. Positioning of projection surfaces.

This can be thought of as a cube containing a projected body. Three planes are also used, but they are located between the observer and the body. The light source explanation is not so obvious here already, so it doesn’t fit that well. Another association may come up here. The edges and planes of the part seem to fall towards the observer and leave a “stamp” on the projection plane. An example of details in three projections of the discussed technique is shown in Fig 4.
The advantages are not so obvious for the user of the “European” system, but the information on the three views is also enough to compose a three-dimensional object. To read foreign drawings, a special sign is used that shows the location of the projections relative to the part. The generally accepted designation is a cone and its projection.

If a drawing is created in Europe according to the USA standard, then a sign from Fig. 4 is drawn above the table with information or in the lower right corner. Sizes are also given differently in the state standard. First of all, it should be noted that all dimension numbers and labels are always located parallel to the title block and at the breaks of the dimension lines (if there is enough space for this). If there is not enough space, the dimension numbers are taken out beyond the extension lines and placed so that the extensions of the dimension lines or the shelves of the lead lines rest against them. A knowledgeable person at first glance will understand what type the drawing belongs to and how the object and its projections are connected. Comparison of one part in two methods is shown in Fig. 5.
If it is necessary to create a drawing or projections according to the “American” method, people working according to the “European” scheme may have a number of difficulties, for example, such as:

1. Problems in the location of projections relative to each other.
2. Loss of projection links.
3. If more than three views are required, there may be an error in the location of the flat pattern.
4. Increased time to create projections.
5. Requirement for increased care.

This can be traced in an experiment, where schoolchildren of the Lyceum No. 1 in the city of Kiselevsk were selected as engineers, who study drawing for a year. Two groups of 8 people were created with the task to create a drawing using two methods. The graphic preparation of the students was equal. The first group of students studied the “European” projection system, the second group studied the “American” one. The students performed a drawing of a part in three views. When drawing three types of part, the problems faced by students performing work according to the “American” system were identified:

1. The perception of the object was difficult.
2. The time spent on the performance of the work for the students performing the drawing according to the “European” system is 23 minutes faster.
3. The quality of the work performed according to the “American” system is 25% lower.
4. More errors were made in the construction of views (omissions of detail elements, violation of projection connections).

Based on the training of two groups using different methods during the year and the results shown, it can be concluded that it is the “European” methodology that has the best receptivity to learning. The habit factor in the experiment was excluded, due to the lack of experience in a different projection approach in both groups of students. The non-stochastic distribution of results, just as in mechanics, can tell about a possible controversial situation and ambiguity of conclusions [19]. Experienced people have a habit factor, therefore, when creating a drawing, the problem with the arrangement of views will be of paramount importance. This problem is caused by the direction of rotation of the projections in the two systems. In the “European” technique, the frontal projection remains in place (when the observer is facing this projection), while the horizontal and frontal projections are turned in the direction away from the observer [20].
the object, describing six projections (cube), then the turn in the “American” goes around the farthest plane relative to the closest frontal plane to the observer. In the “European”

4 Conclusions

Talked about the greater efficiency of the “European” method, due to its more clear and intuitive perception. Its prevalence plays an important role in the choice of this method. However, the role of the United States of America and Japan in the development of new mechanisms and machine complexes is difficult not to appreciate, these are big players in the scientific and technical arena. These factors equalize the importance of the two world projection practices.

In the future, countries that will enter a large agglomerate to solve global problems will benefit from creating a common projection standard that takes into account the views and interests of the world scientific and engineering community. This step is necessary for future joint work to make humanity an interplanetary species. Solving such a large-scale task requires the united work of the intellectual forces of all people involved in this. Unification and a single standard for projection will allow people to communicate more easily and find the core of the essence, as well as unite the scientific community and reduce material and time costs in the interaction of scientists from different countries.

The experiment carried out can hardly be called unambiguous; due to the fact that the level of knowledge of the “American” projection system by the teachers who taught the students is unclear.

References


