

Features of projection surface locations in construction engineering in different countries

Ekaterina Golikova^{1*}

¹Moscow Aviation Institute (National Research University), 4, Volokolamskoe Shosse, Moscow, 125993, Russian Federation

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

* Corresponding author: gxtl@mail.ru

United States of America (USA), Holland, England, Australia, Japan. Engineers of all the remaining countries, including Russia, draw according to the “European” system.

Drawing not only depicts objects and bodies, but also shows their dynamics and movement [2]. Engineering graphics is a real language that allows people from different countries to talk to each other, but today it is not universal [3]. The language of engineers is unique, it allows you to create grandiose things, to fly into space to study the depths of the ocean [4]. Structures, when working in such aggressive conditions, have a hard time. It is necessary to make complex calculations and simulate different scenarios for the development of events [5-10]. Today it is impossible to define any one material that would have all the necessary functions of both metal and non-metallic composite materials [11, 12]. The ongoing studies of materials using digital processing prove this [13]. It is not known for certain why the creation of the drawing went in two different directions. There is not much information on the formation of this view of object projection on the Internet. However, it can be assumed why this happened and why a common system has not been introduced in the world to this day.

The aim of article to identify differences in techniques and approaches to projecting objects onto different surfaces.

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 [14]. 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 of America. 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 of America, 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 [15] 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 re-publication 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 [16]. Moving on to the second question, it is worth noting the power of “habit”. Engineers and designers who are accustomed to one projection system will work more efficiently with the system to which they are accustomed, but there are still times when they have to read or create a drawing using a different method. The key points in the

differences of the drawings are described below, after which it is shown how the problem described by the proposal above is solved.

In an experiment 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.

3 Results and discussion

Let's start with the “European” system. The idea of projecting an object from the world according to the system which is considering is that it is placed in the first octant of the projection planes. This means that if the observer looks at the object from the front, the frontal (P2) projection plane is located behind the object, and the lines and planes perceived by his eyes will also be displayed in the frontal view [17]. Same process with top and left views; they will be displayed on the horizontal (P1) and profile (P3) planes, respectively.

This process can also be explained through a light source located in front of the displayed object, where the projection is a shadow cast by all illuminated faces, and the “in the shadow” faces are displayed with dash-dotted lines (Fig. 1).

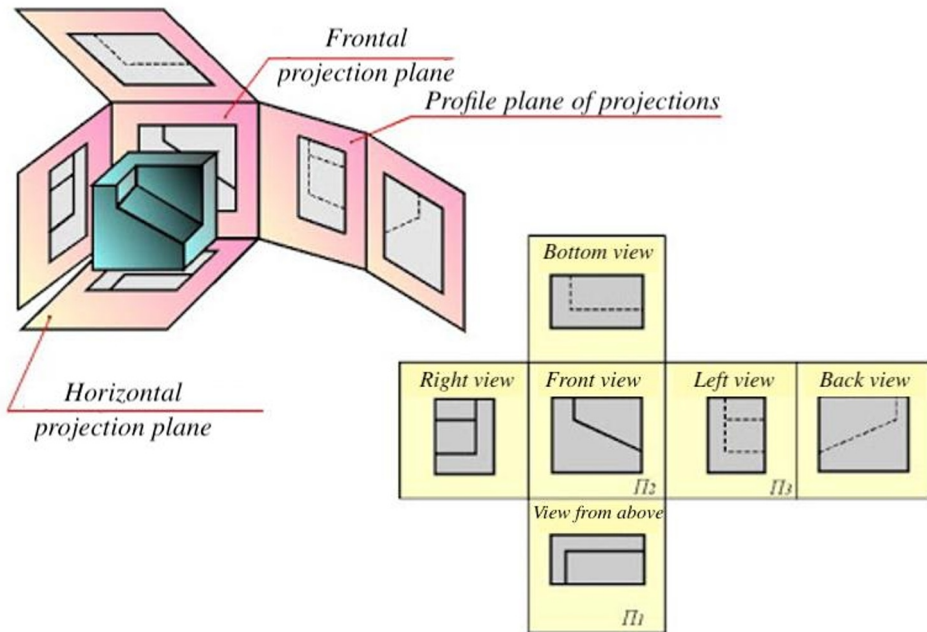


Fig. 1. Light location.

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

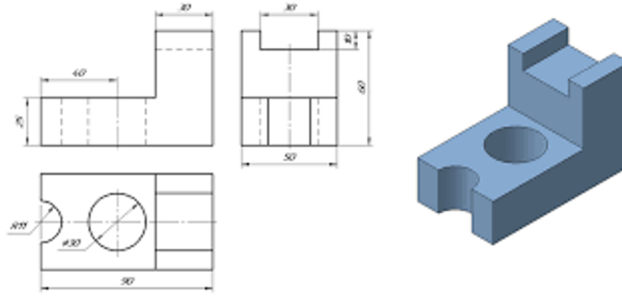


Fig. 2. Detail in the “European” style.

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.

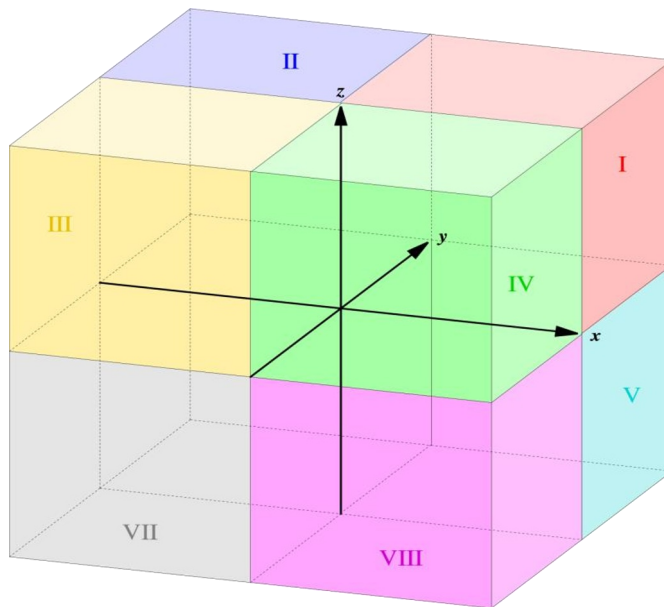


Fig. 3. Positioning of projection surfaces.

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.

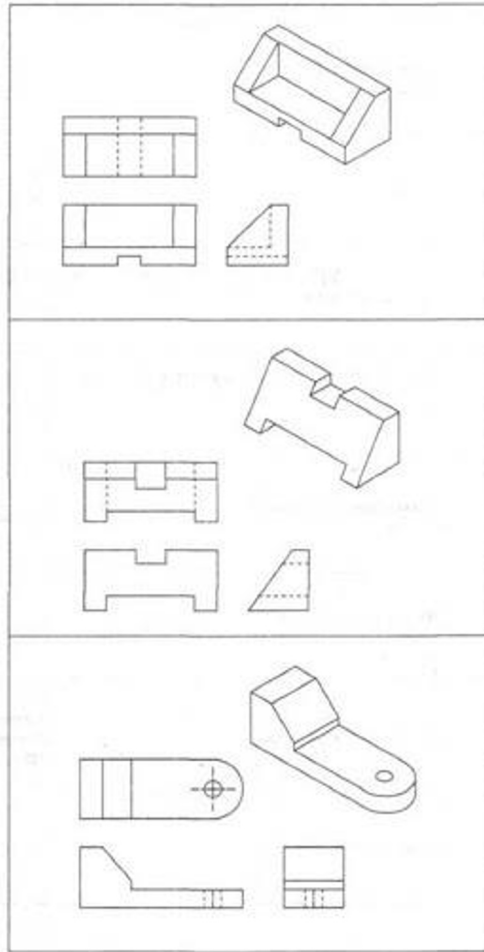


Fig. 4. Detail in the “American” style.

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 [18]. 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 leader 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.

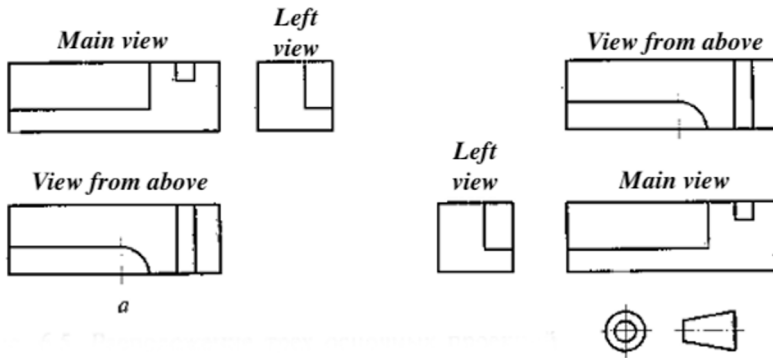


Fig. 5. Comparison.

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]. In the “American” system, the reversal is towards the observer under the same conditions. If you talk about the complete picture of

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” method, the reversal is relative to the far frontal plane [21-35].

4 Conclusions

At the moment, there are both options for projection, both of them have the right to life, since they have enough tools and techniques to reliably display real objects. However, analyzing all of the above, it can be talked about the greater efficiency of the “European” standard 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 not clear.

References

1. Vorotnikov, I.A. 1990. *Entertaining drawing*. Moscow: Prosveshcheniye.
2. Babaytsev, A.V. Orekhov, A. Rabinskiy, L.N. 2020. Properties and microstructure of AlSi10Mg samples obtained by selective laser melting. *Nanoscience and Technology: An International Journal*, 11(3), 213-222.
3. Babaytsev, A.V., Rabinskiy, L.N., Thu Aung, K. 2020. Investigation of the contact zone of a cylindrical shell located between two parallel rigid plates with a gap. *INCAS Bulletin*, 12, 43-52.
4. Babaytsev, A.V., Kuznetsova, E.L., Rabinskiy, L.N., Tushavina, O.V. 2020. Investigation of permanent strains in nanomodified composites after molding at elevated temperatures. *Periodico Tche Quimica*, 17(34), 1055-1065.
5. Vahterova, Y.A., Fedotenkov, G.V. 2020. The inverse problem of recovering an unsteady linear load for an elastic rod of finite length. *Journal of Applied Engineering Science*, 18(4), 687-692.
6. Amosov, A. G. (2021). Classification indicators of maintainability of technical systems. Paper presented at the AIP Conference Proceedings, 2402 doi:10.1063/5.0071519
7. O.A. Butusova. Adsorption Behaviour of Ethylhydroxyethyl Cellulose on the Surface of Microparticles of Titanium and Ferrous Oxides, *International Journal of Pharmaceutical Research*, 2020, Vol. 12, Supplementary Issue 2, pp. 1156-1159.

8. Y. Solyaev, A. Babaytsev. Direct observation of plastic shear strain concentration in the thick GLARE laminates under bending loading. *Composites Part B: Engineering*, Vol. 224, 2021. Proceedings, 2402.
9. Kapitonov, M. V. (2022). Evaluation and analysis of risks in automotive industry. Paper presented at the Transportation Research Procedia, 61, 556-560. doi:10.1016/j.trpro.2022.01.090
10. Babaytsev A.V., Zotov A.A. Designing and Calculation of Extruded Sections of an Inhomogeneous Composition. *Russian Metallurgy (Metally)*. Volume 2019, Issue 13, 1 December 2019, Pages 1452-1455, DOI: 10.1134/S0036029519130020
11. Amosov, A. G. (2022). Comparative analysis of materials of loading devices of machine building. Paper presented at the AIP Conference Proceedings, , 2467 doi:10.1063/5.0092787
12. A.Y. Burova. Concept of multistage discrete fourier transform without performing multiplications, *Journal of Physics: Conference Series*, 2021, vol. 1889, no. 2, 022003.
13. Kapitonov, M. V. (2021). Mathematical model of the kinematics of turning of wheeled construction equipment with real and ideal control systems for steering the wheels of a semi-trailer. Paper presented at the AIP Conference Proceedings, 2402 doi:10.1063/5.0071308.
14. B.A. Garibyan. Mechanical Properties of Electroconductive Ceramics, *International Journal of Pharmaceutical Research*, 2020, Vol. 12, Supplementary Issue 2, pp. 1825-1828.
15. Sun, Y., Kolesnik, S.A., Kuznetsova, E.L. 2020. Mathematical modeling of coupled heat transfer on cooled gas turbine blades. *INCAS Bulletin*, 12, 193-200.
16. O.A. Butusova. Surface Modification of Titanium Dioxide Microparticles under Ultrasonic Treatment, *International Journal of Pharmaceutical Research*, 2020, Vol. 12, I. 4, pp. 2292-2296.
17. A.N. Tarasova. Vibration-based Method for Mechanochemical Coating Metallic Surfaces, *International Journal of Pharmaceutical Research*, 2020, Vol. 12, Supplementary Issue 2, pp. 1160-1168.
18. Amosov, A. G. (2021). Curvilinear trajectory of track machines. Paper presented at the AIP Conference Proceedings, 2402 doi:10.1063/5.0071513
19. Kapitonov, M. V. (2021). Course-keeping ability of heavy transport units with an arbitrary number of links. Paper presented at the AIP Conference Proceedings, 2402 doi:10.1063/5.0071336
20. N.A. Bulychev. Synthesis of Gaseous Hydrogen and Nanoparticles of Silicon and Silica by Pyrolysis of Tetraethoxysilane in an Electric Discharge under the Ultrasonic Action, *International Journal of Hydrogen Energy*, 2022, Vol. 47, I. 84, pp. 35581-35587.
21. O.A. Butusova. Stabilization of Carbon Microparticles by High-Molecular Surfactants, *International Journal of Pharmaceutical Research*, 2020, Vol. 12, Supplementary Issue 2, pp. 1147-1151.
22. M.O. Kaptakov. Catalytic Desulfuration of Oil Products under Ultrasonic Treatment, *International Journal of Pharmaceutical Research*, 2020, Vol. 12, Supplementary Issue 2, pp. 1838-1843.
23. A.N. Tarasova. Effect of Reagent Concentrations on Equilibria in Water-Soluble Complexes, *International Journal of Pharmaceutical Research*, 2020, Vol. 12, Supplementary Issue 2, pp. 1169-1172.

24. Babaytsev, A., Nikitin A., Ripetskiy A. VHCF of the 3D-Printed Aluminum Alloy AlSi10Mg. *Inventions* 8(1):33, DOI:10.3390/inventions8010033
25. Thant Zin Hein, Arseniy V. Babaytsev, A.V. Ripetskiy. Effect of build atmosphere on the surface roughness of AlSi10Mg samples produced by selective laser melting. *Nanoscience and Technology: An International Journal*, 2022, Vol. 13, Issue 1, pp. 1-9.
26. A.N. Tarasova. Effect of Vibration on Physical Properties of Polymeric Latexes, *International Journal of Pharmaceutical Research*, 2020, Vol. 12, Supplementary Issue 2, pp. 1173-1180.
27. M.O. Kaptakov. Enhancement of Quality of Oil Products under Ultrasonic Treatment, *International Journal of Pharmaceutical Research*, 2020, Vol. 12, Supplementary Issue 2, pp. 1851-1855.
28. O.A. Butusova. Vinyl Ether Copolymers as Stabilizers of Carbon Black Suspensions, *International Journal of Pharmaceutical Research*, 2020, Vol. 12, Supplementary Issue 2, pp. 1152-1155.
29. N.A. Bulychev. Obtaining of Gaseous Hydrogen and Silver Nanoparticles by Decomposition of Hydrocarbons in Ultrasonically Stimulated Low-Temperature Plasma, *International Journal of Hydrogen Energy*, 2022, Vol. 47, I. 50, pp. 21323-21328.
30. A.V. Perchenok, E.V. Suvorova, A.A. Farmakovskaya, V. Kohlert. Application of vinyl ether copolymers for surface modification of carbon black, *International Journal of Circuits, Systems and Signal Processing*, 2021, Vol. 15, pp. 1414-1420.
31. Vladimir Goncharenko, Yury Mikhaylov, Natalya Kartushina. Pattern recognition techniques for classifying aeroballistic flying vehicle paths. *Neural Computing and Applications*, 2022, Vol. 34, I. 5, pp. 4033-4045.
32. Pogodin V.A., Astapov A.N., Eremkina M.S., Babaytsev A.V., Rabinskiy L.N. Investigation of the low-temperature oxidation effect on the structure and mechanical properties of c/c composite. *Nanoscience and Technology*, Vol. 12, Issue 3, pp. 29 – 46, 2021, DOI: 10.1615/NanoSciTechnolIntJ.2021037997
33. N.A. Bulychev, L.N. Rabinskiy, O.V. Tushavina. Effect of Intensive Mechanic Vibration of Ultrasonic Frequency on Thermal Instable Low-Temperature Plasma, *Nanoscience and Technology. An International Journal*, 2020, Vol. 11, I. 1, pp. 15-21.
34. N.A. Bulychev, S.A. Kolesnik. Reinforcement of Polymer Composite Materials by Titanium Dioxide Nanoparticles Synthesized in Plasma Discharge under Ultrasonic Cavitation. *IOP Conference Proceedings*, 2022, Vol. 2231, article number 012012.
35. Amosov, A. G. (2021). Comparative analysis of requirements for industrial cleanliness in mechanical engineering. Paper presented at the *Journal of Physics: Conference Series*, , 1889(4) doi:10.1088/1742-6596/1889/4/042033