VISUALIZATION OF GEOMETRICAL TRANSFORMATIONS IN PROJECTIONS WITH ELEVATIONS

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Abstract. This paper describes how 3-D views, drawn by AutoCAD, can be helpful in visualization of geometrical transformations in projections with elevations. Example of solving tasks for the intersection between a line and a plane by using the method of auxiliary projection is given.

Key Words: geometrical transformations, projections with elevations (coted projections), visualization by using AutoCAD.

1. Introduction

Spatial visualization ability is one of the main factors of human intelligence. Drawing is the language of engineers and Descriptive Geometry is the grammar of this language. Most of the students come to the university without spatial visualization skills, because Drawing, as compulsory subject, is eliminated from the Lithuanian secondary schools curriculum. If students have poorly developed spatial skills, they have difficulty in performing a variety of spatial tasks [1].

2. Geometrical transformations in projections with elevations

Computer technology has changed the teaching philosophy of engineering graphics significantly [2]. The World Wide Web is the biggest "library" of the engineering graphics problems solutions. But the adequate readiness is necessary for the use of this tremendous amount of material. Furthermore, I want to add that not all branches of engineering graphics are covered equally. For example, it is little or no material about the method of projections with elevations (or coted projection with an application [1]). This method is used in the topographic drawings. The largest difficulty for students in learning this method is to see the objects in the three dimensions space from a two-dimensional plan view.

Some methods of geometrical transformations by solving problems in projections with elevations are used:
1) method of vertical planes or cross-section method;
2) imaginary plane method;
3) method of rotation about horizontal axis or method of superposition;
4) method of auxiliary projection.

Students learn in a variety of ways. Most of them learn by following the succession in scratching parallel, perpendicular or other direction lines without thinking why it is necessary to do so. Those, who rarely or never attended lectures must learn by themselves.

3-dimensional representations of models, drawn by AutoCAD, can be helpful in more clear understanding of geometrical transformations of primary projections. For example, by solving tasks for the intersection between a line and a plane, we can use either cross-section, or imaginary plane, or auxiliary projection methods. In any way, we know that the intersection between a line and a plane in space is a single point, at which the line pierces the plane. The ways to solve the problem graphically, using different methods of geometrical transformations are different.

Isometric view (Fig. 1), drawn by AutoCAD, illustrates the main point for using the method of auxiliary projection to solve this problem. Auxiliary projection – similar to orthographic projections, however the directions of viewing are other than those for orthographic projections [3]. Direction of projectors *s* is chosen freely - parallel to segment *AC*.
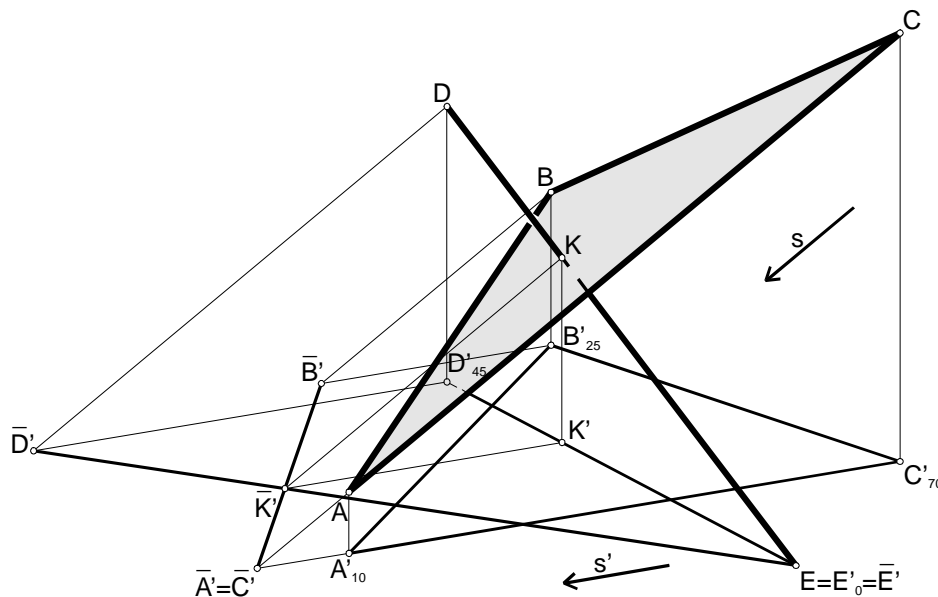

Figure1: Intersection of a line and a plane

Using command of AutoCAD View => 3-D Orbit, we can rotate our model in any direction we want. The plane ABC in direction s is seen as an edge $\overline{A'}\ \overline{B'}$ where it intersects with auxiliary projection of the line $\overline{D'}\ \overline{E'}$ at the point $\overline{K'}$. By projecting back into the primary views, we designate the point at which the line pierces the plane.

Analogous to this simple and informative example, many different 3-D models in the teaching of the Descriptive Geometry can be used .

References

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WIZUALIZACJA TRANSFORMACJI GEOMETRYCZNYCH W RZUCIE CECHOWANYM

W pracy opisano jak trójwymiarowe widoki, wykonane w programie AutoCAD, mogą być pomocne w wizualizacji transformacji geometrycznych w rzucie cechowanym. Zaprezentowano przykład rozwiązania zadania konstrukcji punktu wspólnego prostej z płaszczyzną z użyciem metody rzutu pomocniczego.