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CONSIDERATIONS CONCERNING THE REPRESENTATION OF THE INTERSECTIONS OF POLYHEDRA IN VARIOUS SYSTEMS OF REPRESENTATION

Abstract: *This paper presents the intersection between two polyhedra in various systems of representation: the orthogonal projection on two planes of projection, the axonometric projection and the projection with elevations. A comparative analysis of the advantages and disadvantages produced by the representation in the three mentioned systems of representation is also performed. Then, suggestions as to the selection of one or another system of representation are also made, in view of finding a clearer spatial visual perception of the unit.*

Keywords: *intersections of polyhedra, axonometry, projection with elevations, orthogonal projection on two planes of projection.*

1. INTRODUCTION

Descriptive geometry, together with other engineering subjects, plays an important role in developing the space sight of the would-be specialists in the engineering field. In today's conditions when information technology rapidly develops, one should consider the basic criteria that train and structure the thought of a future specialist in the engineering field.

Usually, in the intersection of two solids, in descriptive geometry, one makes use of the orthogonal projection on two or three planes of projection. To help the future expert to have more diverse representation manners, the unit chosen can also be represented in the projection with elevations and in the axonometric projection, as well. At the end of this paper, the intersection of the two polyhedral was solved with the help of a CAD application, its purpose being to simplify the selection of the optimal system of representation, as the drawing is much clearer and the solution is made more rapidly.

2. INTERSECTION OF TWO POLYHEDRA IN ORTHOGONAL PROJECTION

Figure 1 shows the intersection between an oblique pyramid and an oblique prism, solved in the orthogonal projection on two planes of projection. To solve the intersection and to find the intersection polygon respectively, auxiliary planes cutting through the pyramid vertex and parallel to the prism edges were used. The intersection of the two bodies is a breaking type intersection.

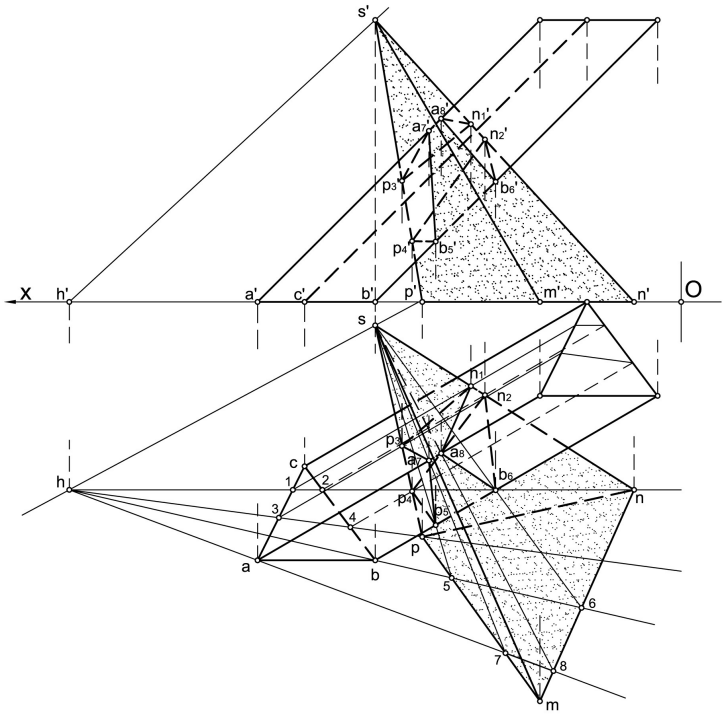

Fig. 1 Intersection of two polyhedral in the orthogonal projection on two planes of projection.

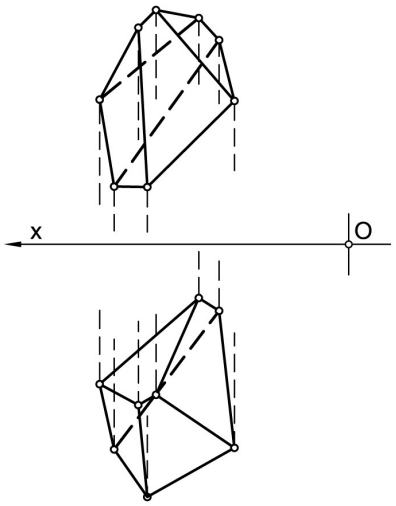

Fig. 2 Representation of the common solid in the orthogonal projection on two planes of projection.

The analysis of the results reached – the common solid, in the orthogonal projection on two planes of projection (Fig. 2) highlights that it is much more difficult to be understood by a beginner in this field. Consequently, it is considered necessary to make a representation of the common solid in axonometric projection, besides that in the orthogonal projection on two planes of projection.

In order to develop the three dimensional thinking of a beginner, to help the learner transpose bodies in plane and to make the inverse operation, it is necessary a sustained effort and high energy consumption on behalf of the teacher. Experience, expertise, skill to find the right pace and to organise the information so that it becomes the basis for further data are required.

3. INTERSECTION OF POLYHEDRA IN AXONOMETRIC PROJECTION

In order to get a more impressive representation, to have a space visualisation of the intersection between the two polyhedra, we made appeal to the isometric orthogonal projection for the intersection of the oblique pyramid with the oblique prism.

The isometric axonometric orthogonal projection of the two polyhedra after being intersected was found by representing with the help of coordinates of each and every point found in the orthogonal projection on two planes of projection, including the intersecting polygon. The outcome was more figurative, easier to read as one can see in the representation in Figure 3.

It is assumed that the representation in axonometric projection parallel to the orthogonal projection on two (or three) planes of projection of the intersect ion of the solids can lead to better and easier comprehension of problems. It also conducts to understanding the connection between solids in space and their representation in a plane [3].

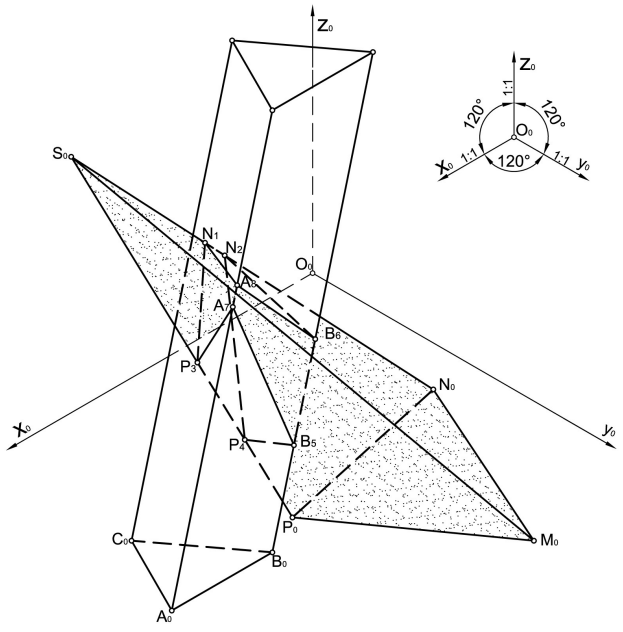

Fig. 3 Intersection of two polyhedra in axonometric projection.

4. SOLVING THE INTERSECTION OF POLYHEDRA IN THE PROJECTION WITH ELEVATIONS

Figure 4 presents the representation in projection with elevation of the intersection of the two irregular polyhedral, previously presented in orthogonal projection on two planes of projection and in axonometric projection. The intersection was solved with the help of planes drawn through every face of the polyhedral. Horizontal lines of the same elevation were used and

intersected one by one until the intersection polygon was obtained.

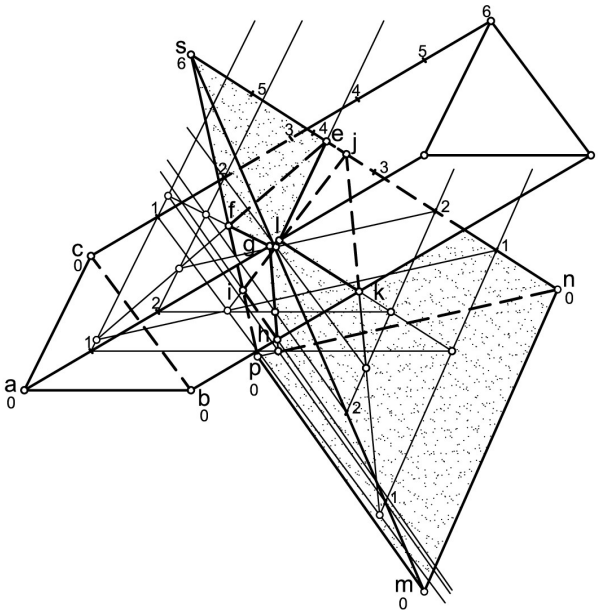

Fig. 4 Intersection of two polyhedra in the projection with elevations.

Comparing this representation to the two previous representations, it was found that the representation of the projection with elevations is more painstaking and more difficult to comprehend, in the case of beginners.

5. THE INTERSECTION OF TWO POLYHEDRA SOLVED WITH A CAD APPLICATION

The intersection between the two polyhedral is also solved with the help of a CAD application, as shown in Figure 5. The solving of the intersection with the computer rand respectively with the computer application is faster, more interesting and more advantageous, in the sense that it can be visualised from any side. Data on the two polyhedra before and after the intersection can be very easily found. The common solid can also be easily extracted, as shown in Figure 6.

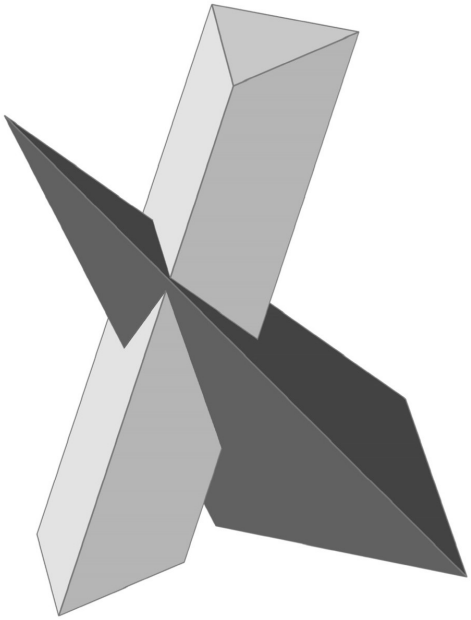

Fig. 5 Representation of the intersection between two polyhedral with the help of a CAD application CAD.

Today, the engineering and technical field is unconceivable without a computer. The computer represents the most adequate tool for the engineers to express the way they think in their professional field [1].

In general, many persons are reluctant to using new approaches and consequently think that abandoning the study of traditional subjects and suddenly replacing them with new subjects that are better adapted to present-day realities is a dangerous aspect for education [2].

But the computer is an invention of genius, a tool for the humans, the results of its use depending only on the strong connection between the human and the instrument [1].

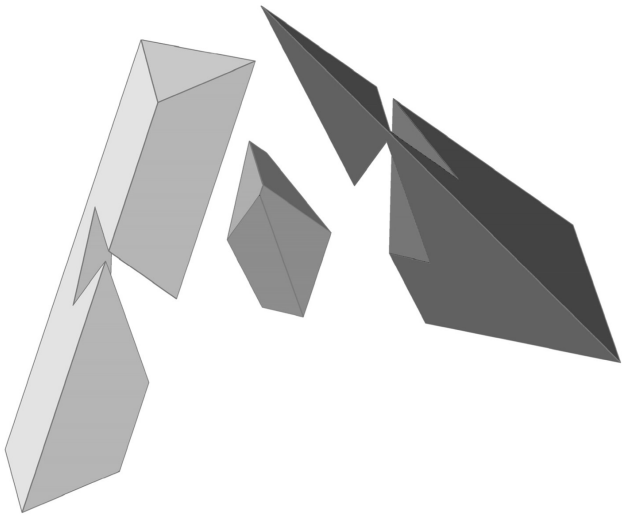

Fig. 6 The common solid as represented with the CAD application.

6. CONCLUSIONS

The main objective in teaching Descriptive Geometry to would-be specialists in an engineering field lies in entraining and practising with the three dimensional thought so as to make simple the conversion of one's mind from the 3D to the 2D representation and viceversa. Descriptive Geometry contributes to the education and development of the ability of seeing in space [4].

The representation in the orthogonal projection on two planes of projection of the intersection between two polyhedral requires theoretical knowledge of descriptive geometry, based on logical argumentation.

The axonometric projection is based upon the representation in the orthogonal projection on two planes of projection, to be able to represent each and every point with its coordinates.

The representation in projection with elevations is heavier as a representation manner, but it has good application where one of the dimensions is much different from the other two dimensions (such as the representation of the ground in topography, mapping, embankment works, communication ways, etc.).

Making use of the CAD application to solve the intersection issue is easier and faster, though it is also based upon elementary notions of plane representation from descriptive geometry.

Comparing the results for the intersection representation in the various systems of representation used we can state that the representation in the orthogonal projection on two planes of projection , though heavier, is based on logical arguments and leads to a more accurate and clearer outcome. Then, the axonometric representation has the advantage of a more figurative quality compared to the orthogonal projection on two planes of projection; however, the representation is also based upon the orthogonal projection on two planes of projection. The projection with elevations is quite suggestive, easy to understand, but the solution is heavy as compared to the previous two types of representation.

The conventional methods of representation continue to be competitive, in spite of the applications which occurred and showed their capacity to solve problems in short time. All these applications are based on elementary concepts from descriptive geometry. It is for this reason that it is thought that to get the best solutions in developing spatial sight is necessary to mix together modern and conventional approaches.

In other words, besides using new technology, it is important to have a wide comprehension of the outcomes of the respective technology. All these technologies are instruments facilitating activities and also developing the habit of dependence.

Any software application used to solve graphical problems can be useful, can be easier to understand and apply for a problem, but it cannot replace the fundamental and classical part of descriptive geometry, that is it can only come to complete it [1].

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