COMMON MISTAKE IN THE REPRESENTATION IN TRIPLE ORTHOGONAL PROJECTION OF CYLINDRICAL-CONICAL AND METHODS FOR THEIR ELIMINATION

GREŞELI FRECVENTE LA REPREZENTAREA ÎN TRIPLĂ PROIECŢIE ORTOGONALĂ A CILINDRO-CONICELOR ŞI METODE PENTRU ELIMINAREA ACESTORA

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Abstract. *In many elements of street furniture (pergolas, terraces, benches, etc.) the straight cylinder (elliptical or circular) is found as a constructive element. In the execution drawings (plans, main or side views) of these elements, the correct representations in triple orthogonal projection in the clearance of the bodies are necessary. The paper shows the frequent mistakes of the representation in triple orthogonal projection in the shape of the straight cylinder (cylindrical or elliptical that has the base located in various planes (general position, vertical, parallel, or intersecting the OX axis) and propose a solution for avoiding misrepresentations.*

Keywords: Descriptive Geometry, Cylindrical-conical, Technical Drawing

Rezumat. *În multe elemente de mobilier urban (pergole, terase, bănci, etc.) se regăseşte cilindrul drept (eliptic sau circular) ca element constructiv. În desenele de execuţie (planuri, vederi principale sau laterale) ale acestor elemente sunt necesare reprezentările corecte în triplă proiecţie ortogonală în epură ale acestor cuadrice. Lucrarea pune în evidenţă greşelile frecvente de reprezentare în triplă proiecţie ortogonală în epură ale cilindrului drept (cilindric sau eliptic) ce are baza amplasată în diverse planuri (de poziţie generală, vertical, de capăt, paralel sau ce intersectează axa OX) şi propune soluţii pentru evitarea reprezentărilor greşite.*

Cuvinte cheie: Geometrie Descriptivă, Cilindro-conice, Desen Tehnic

INTRODUCTION

Following the design activities, there is a need to transmit, through graphic representations, all the information so that the final form of the obtained elements fully reflects the project details. From the practical experience mainly based on the study of numerous drawings, the authors noticed many errors of representation, in the treble orthogonal projection, of the shape of the circular cylinder because were not respected the rules of the Descriptive Geometry.

Following the study, the authors proposed solutions to avoid misrepresentations.

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MATERIAL AND METHOD

It is known that any plane representation of an object can results from a combination of simple geometric shapes: straight lines, rectangles, circles, arcs, ellipses, ellipse arcs.

At the same time, complex three-dimensional geometric bodies can contain polyhedral (prisms, pyramids), conical and cylindrical surfaces (cone, cylinder), spheres, or combinations thereof.

The understanding, on the building site, of the three-dimensional shapes of the designed elements depends on how were drawn the principal views on the execution drawings, such as the front view, the top view, or the left view.

To be correctly drawn, in the treble orthogonal projections, the representation model of the three-dimensional geometric bodies listed above must be well known. Thus, must be taken into account: the bases of the bodies, the direction of the edges in the case of prisms, the direction of the generators in the case of cylinders, the positions of pyramids or cones, body heights.

Theoretically, all the representations in the treble orthogonal projections are relatively simple to make with the following conditions:

- the simple geometric shapes must be located in the horizontal [H] or vertical [V] projection plane or planes parallel to them (fig. 1 and fig. 2);
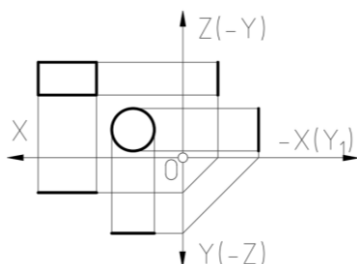

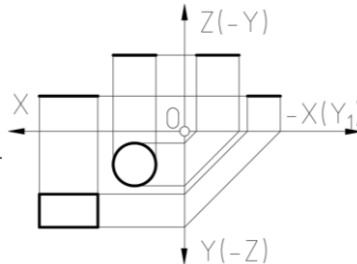**Fig. 1** The geometric shape is located in a plane parallel to the vertical projection plane [V].   **Fig. 2** The geometric shape is located in a plane parallel to the horizontal projection plane [H].

- the bases of the bodies are in their turn located in the horizontal [H], vertical [V], or lateral [L] projection planes or in planes parallel to them, and the edges or generators are perpendicular to the planes listed above.

The two conditions are simultaneously met extremely rare because, as a rule, simple geometric shapes or the bases of bodies are not located in the projection planes. On the other hand, the directions of the edges, in the case of prisms and of the generators in the case of cylinders are not perpendicular to the planes [H [, [V] or [L], they can be straight lines of general, horizontal, front or profile position.

From their experience, the authors considered that between the prism, pyramid, circular cylinder, or circular cone, only the cylinder presents the most problems of representation. That's way, it was chosen, for this study.

For the study, 45 students were chosen, divided into two groups, first of 22 and second of 23 students. Starting from the property of a square to be inscribed or circumscribed into a circle, the students were required to represent the projections of circle, on the three projection planes.

Starting from the earlier representations, in the second part of the study, the students were requested to represent in the three projections the circular cylinder as having the lower base represented in the first part of the study.

RESULTS AND DISCUSSIONS

The results showed that despite the fact the students know Descriptive Geometry if the stages of representing the circular cylinder in treble orthogonal projection are not explained, the cylinder representations will be inaccurate in almost all cases.

Thus, the following mistakes were observed:

- the lower and upper projections of the bases, on the projection planes [H] and [V], was made incorrectly; this was observed at all students (100%);

- the direction of the cylinder generator is incorrectly positioned (28 students, rate 62.2%);

- the height of the cylinder is not correctly determined; this was observed at all students (100%).

To help and understand the reasons why the students misrepresent the three views, the authors asked them to complete a questionnaire containing the following questions:

1). in the treble orthogonal projection, is the base of the cylinder drawn following the drawing steps of an ellipse? YES/NO;

2). in the treble orthogonal projection, the base of the cylinder is drawn, by following the same steps from isometric axonometry, respecting the stages of representations according to the working plane? YES/NO;

3). starting from the real size and shape of the cylinder base, in treble orthogonal projection, the base of the cylinder is determined by the method of replacing the projection planes, rotation, folding, or by lifting from folding?

4). is the height of the right circular cylinder perpendicular only to the horizontal trace of the plane (Ph)? YES/NO;

5). is the height of the right circular cylinder perpendicular only to the vertical trace of the plane (Pv)? YES/NO;

6). is the height of the right circular cylinder perpendicular simultaneously to both traces of the plane (Ph and Pv)? YES/NO;

7). the height of the cylinder is determined by measuring only on the horizontal projection plane [H]? YES/NO;

8). is the size of the cylinder height determined by measurement only on the vertical projection plane [V]? YES/NO;

9). the height of the cylinder can be determined by measuring both the horizontal plane [H] and the vertical projection plane [V]? YES/NO;

10). the determination of the real size of the cylinder height is done using one of the Descriptive Geometry Methods? YES/NO;

11). if you answered YES to the previous question which, in your opinion, of the Descriptive Geometry Methods allows the determination of the real size of the cylinder height?

The results of the questionnaire are presented in the next table (tab. 1):

Table 1

Synthesis of students answers

Questions / Students	1	2	3	4	5	6	7	8	9	10	11
1	yes	yes	no	yes	no	no	yes	no	no	yes	a
2	yes	yes	no	yes	no	no	yes	no	no	yes	b
3	yes	yes	no	no	yes	no	no	yes	no	no	a
…	…	…	…	…	…	…	…	…	…	…	…
43	yes	yes	no	yes	no	no	yes	no	no	yes	c
44	yes	yes	no	yes	no	no	yes	no	no	yes	b
45	yes	yes	no	yes	no	no	yes	no	no	yes	c

Starting from the students' answers for each issue, the authors have presented the steps leading to the correct solutions.

Finally, the students were requested to construct the main views on the projection planes [H], [V], and [L] of a circular cylinder as a base in a general position plane, which has different coordinates from the first example.

Studying the works done, it is observed that:

- 39 students (86.67%) correctly represented all three views;

- 4 students (8.89%) accurately drawn, in the three views, the two bases of the right circular cylinder but did not correctly determine the height of the cylinder;

- 2 students (4.44%) incorrectly drawn all three projections.

CONCLUSIONS

1. The circular cylinder is one of the surfaces that is frequently meet in the composition of urban furniture elements;

2. Representation of views on the projection planes of the cylinder that does not have the base located in the projection planes poses problems for students because they do not understand the correct way of representing the base and of determining the direction and length of its generator;

3. The study conducted on a group of 45 students aimed to highlight and eliminate the ambiguities that led to incorrect representations of the cylinder;

4. Studying the percentages obtained after this study can be observed a considerable improvement in the percentage of students who correctly solved the proposed topic.

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