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Designing a Quasicircular Pool Using Descriptive Geometry

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Abstract: the paper presents a solution for a practical problem concerning the design of a pool for model-ship using descriptive geometry.

Keywords: quasicircular pool, icosagon, rotation, rebating

1. INTRODUCTION

Within an institution in the city of Cluj-Napoca, a kids-group for model-ship sailing wanted an enclosure (pool) for testing different radio-controlled model boats.

2. DESIGN REQUIREMENTS

In response to the project requirements several variants of pools were studied, of which two solutions approaching the beneficiary requests were chosen. These are illustrated in figures 1, 2, 3 and 4.

We worked on the pool variant shown in Fig. 5 for which the unfolded surface from the corners of the basin was calculated, as shown in Fig. 6. Because the classic pool variant shown in Fig. 5 didn't give the expected results, the design requirements were changed, requiring the construction of the pool's walls using plates having the shape of isosceles trapezoids inclined at 30^0 to the horizontal plane.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

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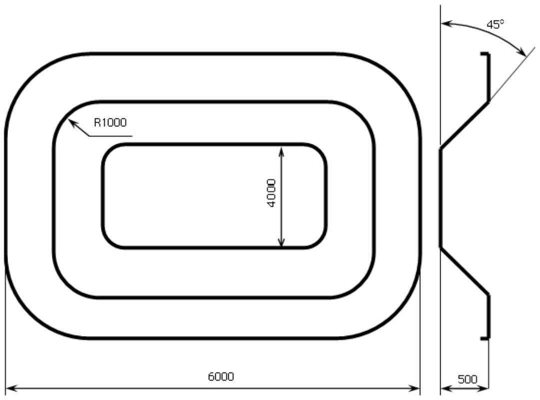

Fig. 5

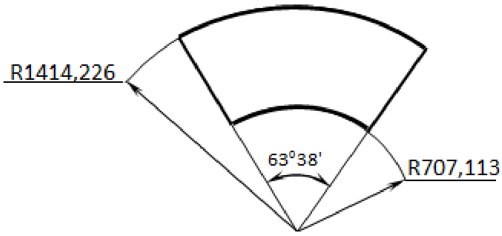

Fig. 6

This solution was asked because of technological and practical reasons.

More technological considerations were taken into account when examining the possibility of making the trapezoidal plates from fiberglass with many advantages arising from this. This solution can also prevent water leakage from the basin.

In the initial version (Fig. 5) because of the long side walls, at the model-boats' approach to the pool's contour, especially at high speeds, waves of considerable length were created, and sometimes the ships would be overturned.

By adopting the variant with walls inclined at 30^0, built of trapezoidal plates, these inconveniences were removed because the icosagon shaped contour fragmented the length of the waves. As a result it was possible to test the model-ships at higher speeds without the danger overturning.

The height of one trapezoidal plate was required to be 250 mm.

Since the pool size was relatively large (a requested diameter of 6000 mm), the author adopted as a solution a quasicircular enclosure design.

A circle of 6000 mm diameter was considered and then it was divided into 20 equal parts, obtaining an icosagon as the base of the pool.

Each of the icosagon's sides represents the small base of a trapezoidal plate.

Two classical methods of descriptive geometry were used to find the large base of the isosceles trapezoid: rotation, rabating and drawing up the rabating, as shown in Fig. 8.

In Fig. 8 of this paper, because of the editing restrictions and because of the large dimensions of the construction, in order to ensure a high quality of the picture the author didn't work at scale, but instead a theoretical solution of the problem was explained. All the steps of the solution were taken as if working at scale.

3. THE GRAPHIC SOLVE

The circumference of the given circle was divided into 20 equal parts, obtaining the base of the enclosure: an icosagon (Fig 7).

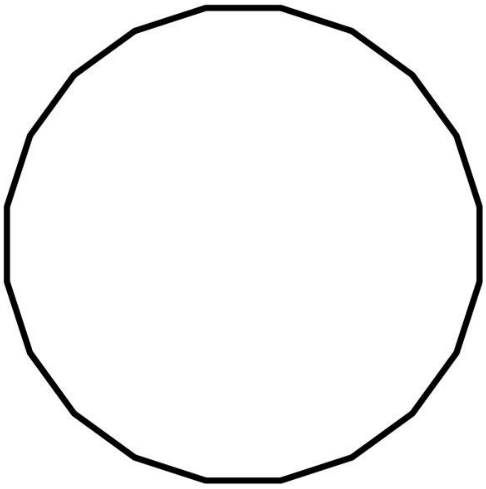

Fig. 7

The icosagon's sides are small bases of the isosceles trapezoids that form the pool's walls: side *cd* on the Fig. 8.

Taking the diameter of the circle perpendicular to *cd*, the point "*a"* was obtained on the symmetry axis of the trapezoid. On this symmetry we can measure the height of the trapezoid.

On this symmetry axis the point *P* is taken and rotated around the axis of rotation which is a vertical line passing through point *A*. Thus the point *P* reaches on the frontal line (*APr*) that forms a 30^0 angle with the horizontal plane. We obtain the projections p'_r and *p'* both on the vertical trash N'_1 of the level plan $[N_1]$.

On $a'p'_r$ line we can measure h'_i, the size required by the project beneficiary: 250 mm. We obtain the points b'_r and *b'*. By point *b'* will pass N'_2 the trace of the level plan $[N_2]$.

By order line will be obtained the projection *b* on *ap*. Through the point *b* a parallel is leading to cd and we get the point *n*. By order line we get the projection *n'* ($N\varepsilon$ $[N_2]$). By rabating the point *N* about the axis *cd* on the projection plane *[H]*, we get n_0 one of the trapezoids' vertices. Similary will be obtained the other three vertices of the trapezoid: c_0, d_0, n_{0s}.

4. DRAWING AT THE SCALE

The problem was practically solved using the graphical method, as shown in Fig. 8 and the dimensions of one trapezoidal plate were obtained as shown in Fig. 9.

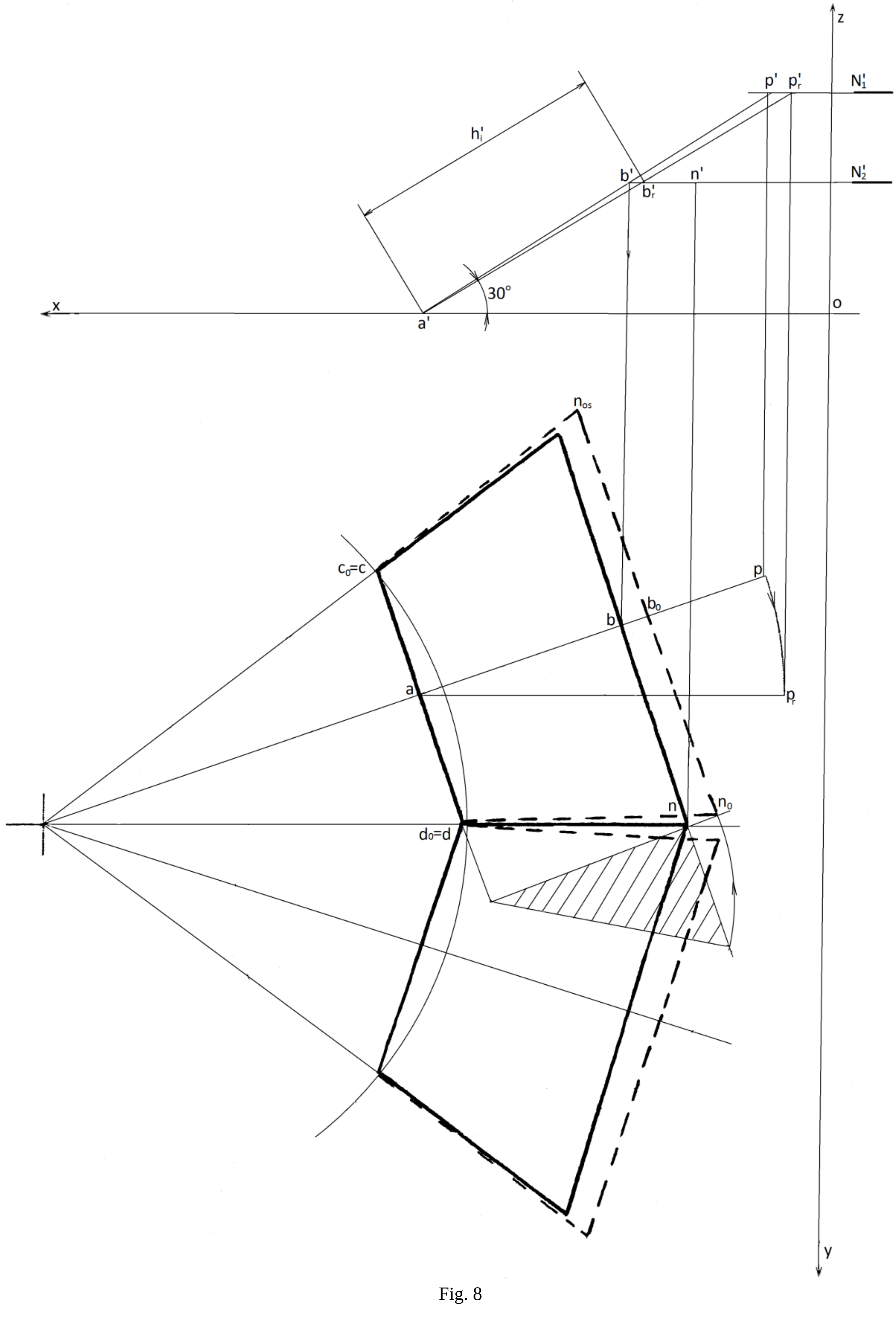

Fig. 8

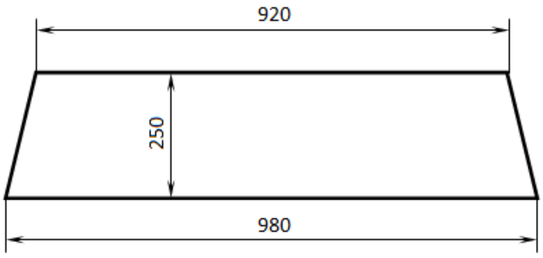

Fig. 9

Considering the large initial data, a scale of 1:10 was chosen because of technical restrictions: tools and paper format.

Work on this scale required a very neat graphical construction to avoid the errors. Ideal would be to work in 1:1.

The problem could be solved using other methods, perhaps faster, but the author adopted the graphical version that highlights the beauty and utility of descriptive geometry.

Through this work, the author also wants to emphasize the importance of having accurate construction graphics, especially when we are dealing with very large constructions the solution being a decrease in scale (1: 20 or 1:50).

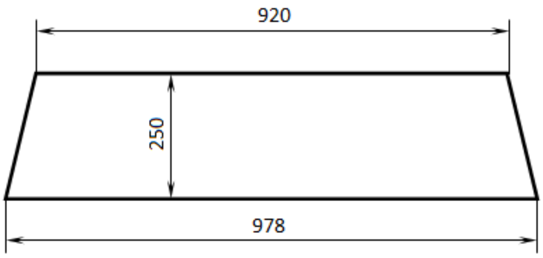

Fig. 10

To demonstrate this, we calculated the trapezoid’s sides and values using mathematical relationships, geometric and trigonometric formulae the result being represented in Fig. 10.

From the above, it can be seen that by graphic solving at a scale of 1:10, we obtained a 0.2 mm deviation due to the imperfections of the instruments and the human factor. Therefore, in such situations, it is advisable to work at 1:1 scale to avoid errors.

5. CONCLUSIONS

This paper brings one more argument in emphasizing the importance of descriptive geometry in solving practical problems.

Using descriptive geometry methods, one can solve a lot of problems that appear during the design of the various architectonic, mechanical and industrial structures.

Also, this paper aims to underline the importance of this fact: when practical problems are solved using graphical methods, if the elements represented in the drawing have very large dimensions (meters or tens of meters - a scale as close to the natural possible), there is a possibility of significant errors.

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