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Constructing Ellipse Points as an Isometry of a Circle Using the Graphical Method

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Abstract

Creating ellipses dots from graphic method is offered in this article. In this case, the graphical method for constructing an ellipse is described in detail, and it is recommended to use it in modern architecture of buildings, since ellipsoids provide structural strength and have an excellent appearance.

Keywords: ellipsoid; thin-walled shells; the axis of rotation of the cone; bisector; foci of an ellipse; tangent to the plane; isometry of a circle; circle radius

Introduction

In architectural design, it is often necessary to build a configuration of ellipsoidal structures, since the ellipsoid provides the rigidity of structures.

The sketch of thin-walled shells of many architectural structures is carried out in the form of an ellipse (Fig. 1)

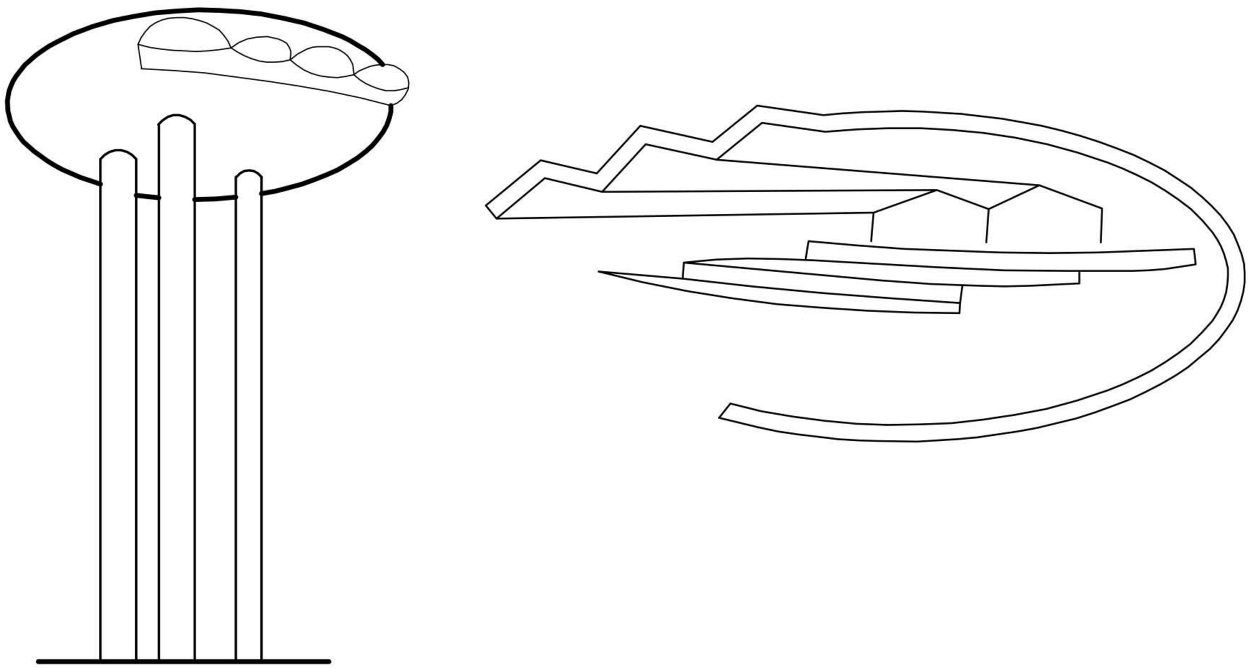

Fig.1.

Ellipse - a flat curve, which is formed as a result of the intersection of all generators of a right circular cone with the plane G (Fig. 2).

The parameters of an ellipse as a section of a cone are defined as follows [1]-[5] :

1. At the points of intersection of the outline of the generatrix of the cone with the plane G, points A and B are determined. The distance between points A and B determines the magnitude of the major axis of the ellipse 2a.
2. The foci of the ellipse F1 and F2 are determined at the intersection of the axis of rotation of the cone with the bisectors F1A and F2B. These points are the centers of the tangents to the plane G

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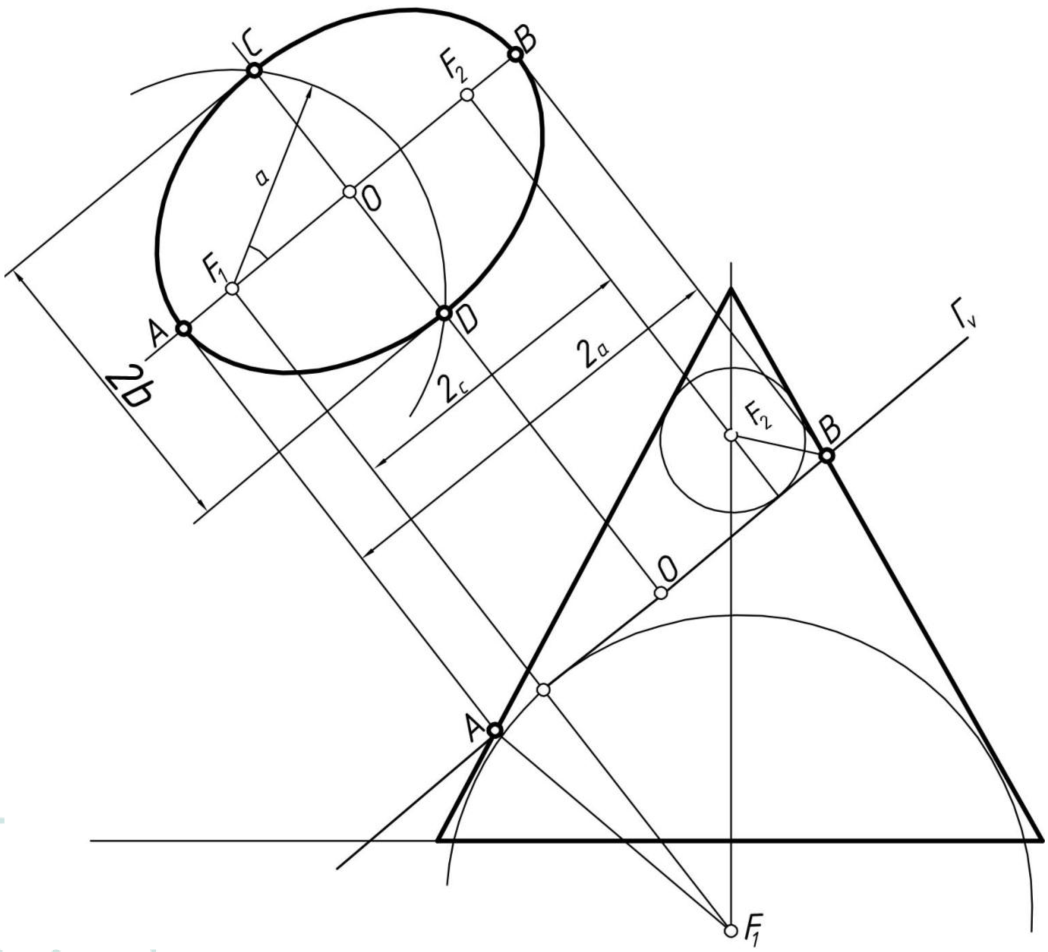

Fig.2.

3. By drawing from the middle O of the segment AB, the perpendicular to the plane G is determined by the direction of the minor axis CD
4. An arc drawn from the center F1 with radius a intersects with the direction of the minor axis at points C and D. The distance between points C and D determines the magnitude of the minor axis of the ellipse 2b [2], [6]:.

As is known in the existing literature, an ellipse as an isometry of a circle is constructed from several points (Fig. 3). If the plane of the circle is parallel to the horizontal plane of projections, then from the center of the circle in the direction of the axes ox and oy, the values of the radius of the circle 01=02=03=04=R are plotted and points 1,2,3, and 4 are determined

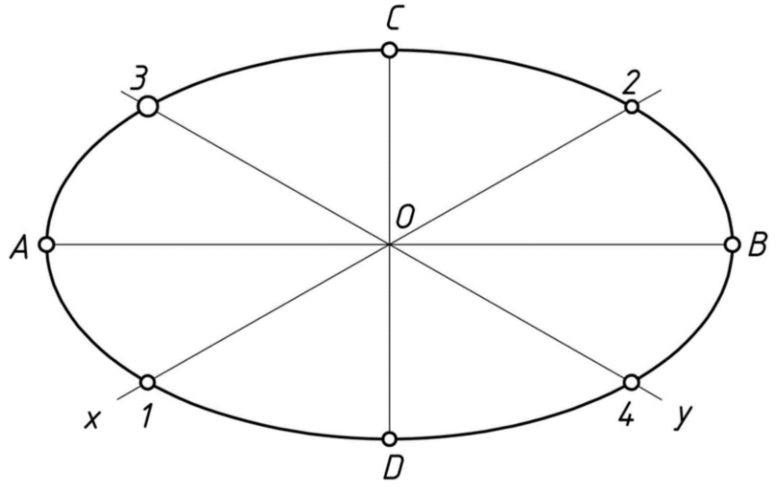

Fig.3.

In the direction of the major axis of the ellipse, the values OA=OB=1.22·R are plotted, and in the direction of the minor axis, the quantities

OC=OD=0.7·R,

those. in a mathematical way.

The subject of descriptive geometry, in its essence, solves all the problems of geometry in a graphical way.

Therefore, this paper proposes a graphical method for determining the points of an ellipse.

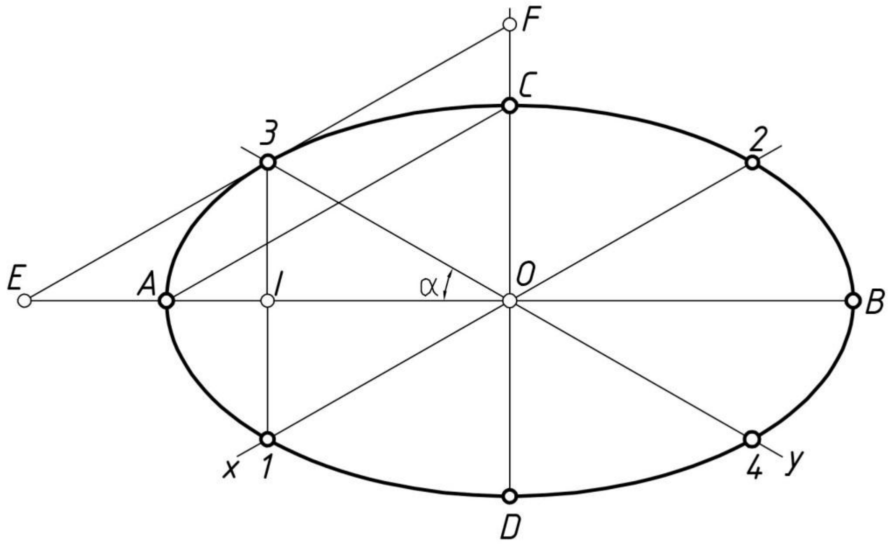

Рис.4.

The point of the ellipse is defined in the following sequence:

1. If the circle is on a horizontal plane, then its points are on a plane parallel to the xoy plane. Therefore, from the center 0 of the ellipse, segments 01=02=03=04=R are plotted along the axes ox and oy and points 1,2,3 and 4 are determined (Fig. 4).
2. A straight line parallel to the ox axis is drawn through point 3 and points E and F are determined [3], [7-8]:.
3. From points E towards the center of the ellipse, setting aside the segment EA, equal to half the radius of the circle, point A is determined:

EA=05·R

The proof of such a statement is carried out as follows: for $\alpha=30^0$,

segment I3=0.5·R=sinα, and OI=cosα.

OE=2· OI; OE=2 cosα. At R=1, sinα=0,5.

Coṡα=0,866.

2 cosα=1,72.   2 cosα – sinα = OE-EA-OA.

OA=1,72-0,5=1,22,

Q.E.D

4. A parallel line EF is drawn from point A and at its intersection with the line OF defines points C. From the similarity of triangles:

ΔEFO~ΔACO,

$\frac{OF}{OE} = \frac{OC}{OA}$; from here $OC = \frac{OA \cdot OF}{OC}$.

At K=1 OA=1,22; OF=1; OE=1,72, then $OC = \frac{1{,}22 \cdot 1}{1{,}72} = 0{,}71$, , which was required to be proved.

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