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DEVELOPMENT OF SOME REVOLUTION SURFACES

Abstract: *The paper work proposes practical graphic methods provided by Descriptive Geometry to plot the development of two revolution surfaces: the revolution surface having an oval as median section and the revolution surface having an ordinary curve as median section. The two surfaces were selected because their developments have similarities when plotted.*

Key words: *Revolution, surface, oval, median, section, ordinary curve.*

INTRODUCTION

Revolution surfaces unable to be developed are frequently met in practice. Their developments cannot be accurately drawn because when processed the initial material is subjected to plastic distortions on two directions. Therefore the developments are just approximate, hence the necessity to rectify the developments after obtaining the test element [3].

The paper work presents two examples of such surfaces, the revolution surface having the median section an oval and the revolution surface having the median section an ordinary curve [1].

2. APPROXIMATE DEVELOPMENT OF A REVOLUTION SURFACE HAVING THE MEDIAN SECTION AN OVAL

As the revolution surface is a symmetrical one, in figure 1 is plotted the projection on horizontal plane and the projection on vertical plane of a half of this surface.

The vertical projection of the surface is half of an oval obtained with the help of two arcs of circle of radius *(R)* (arc *0'3'*) and of radius *(r)* (arc *3'c'*). Arc *0'3'* is divided into a convenient number of equal parts (three) and through division points *0'*, *1'*, *2'*, *3'* horizontal lines are drawn. Through each adjoining division points (*0'* and *1'*, *1'*and *2'*, *2'* and *3'*) lines are drawn and they are lengthened until they intersect ovalĝs vertical axis in points i_0', i_1', i_2'.

The horizontal projection of the surface is a semicircle divided into a convenient number of equal parts (four) with the help of meridian sections. The division points of the vertical projection *0'*, *1'*, *2'*, *3'* are projected on horizontal projection in *0, 1, 2, 3*. With the centre in point *c* arcs of circle are drawn of radii *(c0)*, *(c1)*, *(c2)*, *(c3)* intersecting the adjoining meridian section in points 0_1, 1_1, 2_1, 3_1.

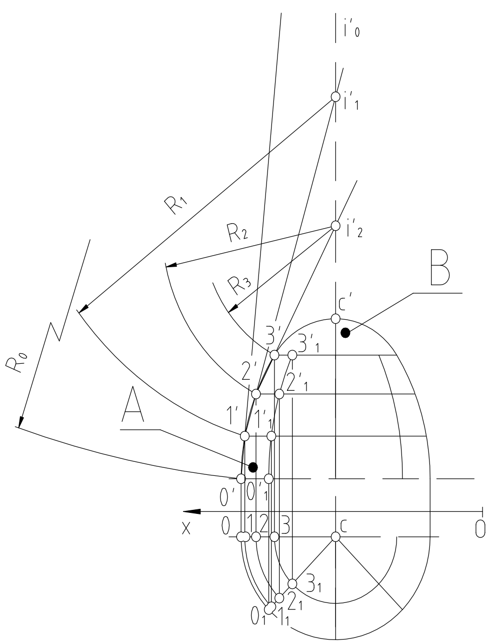

Fig. 1 Projections of the revolution surface 1.

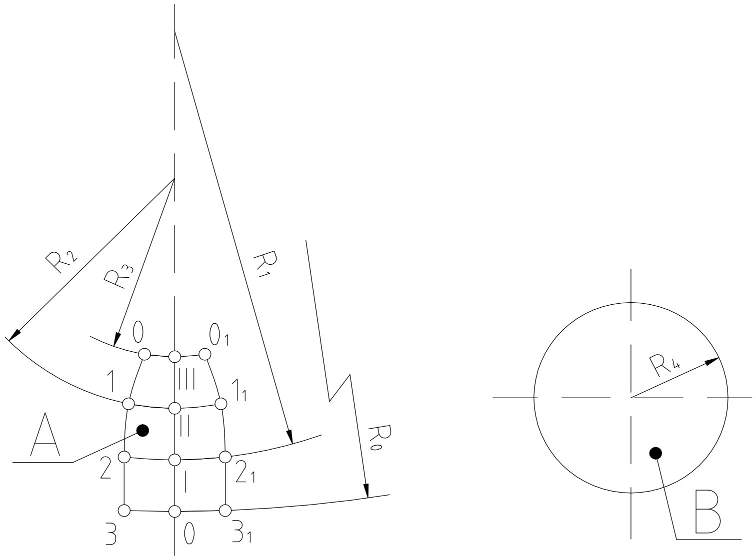

Fig. 2a, b Development of elements A and B.

The development of the surface is drawn with the help of the developments of elements *A* and *B* (fig. 2a, b) [5].

In order to obtain the development of element *A* (fig. 2a) a vertical symmetry axis is drawn and on the axis are measured segments *(0 I)*, *(I II)*, *(II III)* equal to each other and also equal to the length of arcs *0'1'*, *1'2'*, *2'3'* (fig. 1). Through the obtained points arcs of circles are drawn of radii $R_0 = (0'\ i_0')$, $R_1 = (1'\ i_1')$, $R_2 = (2'\ i_2')$, $R_3 = (3'\ i_3')$ (fig. 1). On the obtained circles the lengths of arcs 00_1, 11_1, 22_1, 33_1, are measured having the vertical axis as symmetry axis. The obtained points are joined by continuous curves.

The development of element *B* (fig. 2b) is a circle of radius R_4 equal to the length of arc *3'c'*.

3. APPROXIMATE DEVELOPMENT OF A REVOLUTION SURFACE HAVING THE MEDIAN SECTION AN ORDINARY CURVE

As the revolution surface is a symmetrical one, in figure 3 is plotted the projection on horizontal plane and the projection on vertical plane of a half of this surface.

The horizontal projection of the surface is a semicircle divided into even number of parts (six) with the help of meridian sections.

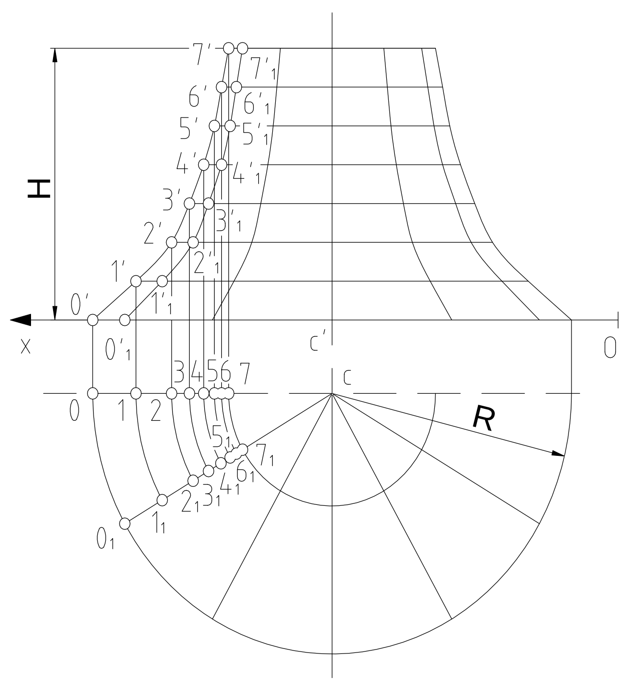

Fig. 3 Projections of the revolution surface 2.

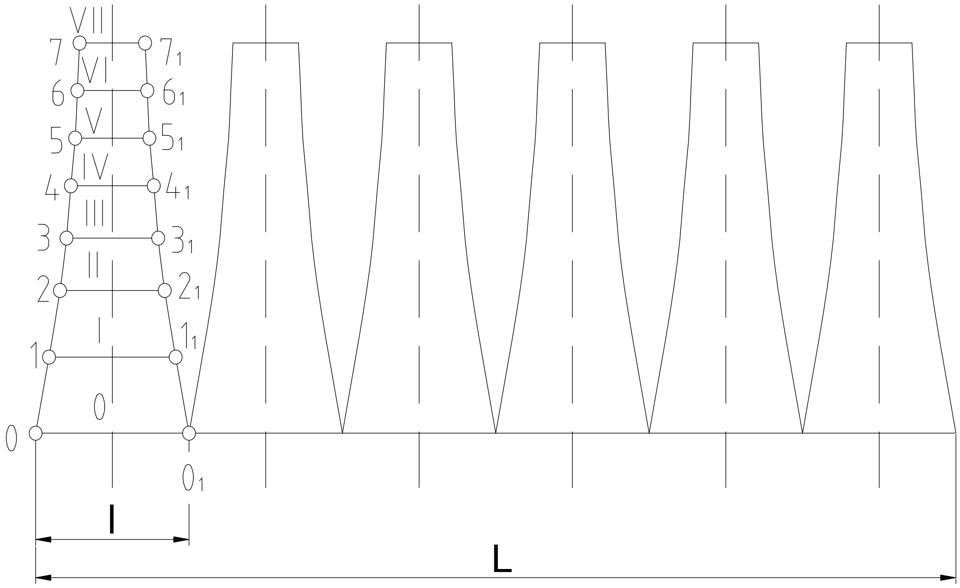

Fig. 4 Development of the revolution surface 2

The vertical projection of the surface is divided into equal parts on the height direction *(H)* with the help of horizontal lines resulting points *0'*, *1'*, *2'*, é , *7'*. The division points on the vertical projection *0'*, *1'*, *2'*, é , *7'* are projected on horizontal projection in *0*, *1*, *2*, é , *7*. With the centre in point *c* arcs of circles are drawn of radii *(c0)*, *(c1)*, *(c2)*, é ., *(c7)* intersecting the adjoining meridian section in points 0_1, 1_1, 2_1, é , 7_1.

The development of the surface consists of six identical elements, such an element being the development of the part situated between two adjoining meridian sections [7].

The length of the whole development equals the length of the semicircle *(L)* (fig. 4).

The length of an elementøs development equals the sixth part of the whole development *(l)* (fig. 4).

The length of the development written down a development drawing refers to the intermediate layer of the material. The intermediate layer represents the neutral one, situated between the external layer (stressed to stretching) and the internal layer (stressed to compression). The intermediate layer maintains itself to the initial length [6].

Dimensioning development drawings must consider all possible additions that can come out in practice.

Technical literature provides values for the coefficient to adjust the dimensioning length according to the selected processing method.

$$L = \pi R \quad (1)$$

$$l = \pi R / 6 \quad (2)$$

In order to obtain the development of an element (fig. 4) a vertical symmetry axis is drawn and on this axis are measured segments *(0 I)*, *(I II)*, *(II III)*, é *(VI VII)* adequately equal to the length of arcs *0'1'*, *1'2'*, *2'3'*, é , *6'7'*. Through points *0*, *I*, *II*, é , *VII* horizontal lines are drawn. On each of these lines the adequate lengths of arcs 00_1, 11_1, 22_1, é , 77_1 are symmetrically measured in report to vertical axis. Thus obtained points are joined by a continuous curve.

4. CONCLUSION

The approximate development of the revolution surfaces are based on general methods of development, provided by Descriptive Geometry. Applying these methods is not enough to obtain in practice an accurate development because the surfaces are complicated enough to be manufactured. Therefore a test element is recommended to be firstly processed and after analyzing materialøs distortions the development can be rectified [4].

The approximate developments are successfully obtained if the required dimensions are exactly measured on the draught and these dimensions are accurately transposed on the development [2].

The practical methods to develop the two selected surfaces have similarities to each other, as previously presented, and they also have similarities to the development of a sphere [1]:

- The selected surfaces are symmetrical ones.
- The horizontal projections are circles or semicircles.
- The horizontal projections are divided into even number of equal parts. As the number of equal parts increases, the accuracy of the developments increases too, as the developments are approximate ones.
- The vertical projections are divided into a convenient number of meridian sections. The method to divide the surface into a number of meridian sections is a general

one; it may be applied no only to the sphere but also other surfaces, even to a surface having as median section an ordinary curve.

- The vertical projections are divided on height direction into a convenient number of arcs, using level planes parallel to equatorial plane.
- The developments of the whole surfaces consist of a certain number of identical development elements.
- When practically assembling the identical development elements the thickness of the material (plate) must be considered because it has technological consequences on the precision of the whole ensemble.
- According to the selected assembling method of the identical elements (welding, flange assembling, rivets assembling etc.) the length of the display must be proportionally increased or diminished as required by the manufacturing technology, in order to avoid deviations from the required position.

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