UNFOLDINGS OF THE CYLINDRICAL SURFACES USED IN THE INDUSTRIAL INSTALLATIONS

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Abstract: *The connections in the construction of the various industrial installations: pipes, boilers, joints elements and fittings have a cylindrical configuration, or similar cylindrical shape. The execution and their installation require knowledge of the unfolding and intersection curves, which compose them. The graphical solving of the problems of technical representation has enabled the formation of abstract geometric of the pieces forms and the ability to see into space. The paper proposes to establish the unfolding of a connection, used in the industrial equipments, by the classical method of the descriptive geometry and mathematics, using appropriate software.*

Keywords: cylinder, intersection curve, unfolding, methods.

1. THEORETICAL CONSIDERATIONS

This paper addresses a theme met in technical design of the connections in which the knowledge of the unfolding of the geometric elements, which compose them, is the basis of making, required in installation. The design, the execution and their installation requires tracing of the unfolding of the geometric elements of the respective connection[1]. The intersection of three cylinders of equal diameter $D = 30mm$ and axis concurrent, inclined at an angle of 60^0 is considered (Figure 1). This paper aims to resolve in two ways, by methods of the descriptive geometry and mathematics, such an application.

2. DESCRIPTIVE GEOMETRY METHOD

The problem can be reduced to an intersection of cylinders with equal diameters and axis concurrent inclined at a known angle. Because of the symmetry of the case only unfoldings of the middle cylinder and only one side are determined. To determine the curve of intersection between the cylinders, we use the method of the auxiliary planes. The number of auxiliary planes is bigger, obvious the accuracy of the intersection curve is higher. The intersection of the outer cylinders on the common section can be considered simplier as an intersection of a cylinder with a plan. The angle that the plane makes with the horizontal axis of the cylinder is of 60^o .

To determine the intersection points that define the curve, the cylinder base is divided into 8 equal parts, that horizontal (lateral) with the points $1,2,...8$ and the middle with the points $m,n,...,v$. Through these points, the limit planes $f_1, f_2, ..., f_5, l_1, ...l_5$ are constructed. At the intersection of the corresponding planes the $m5, n4 = v6, p3 = u7,$ intersection points of the curve are obtained and the $p1 \equiv u1$ point. It is obvious that the true sizes of the generators are measured in the vertical plane. The unfolding will be a rectangle, with a side length equal to the base circle and the other side equal with the $l_1, l_2, ..., l_5$ lengths generators, respectively l_6, l_7, l_8.

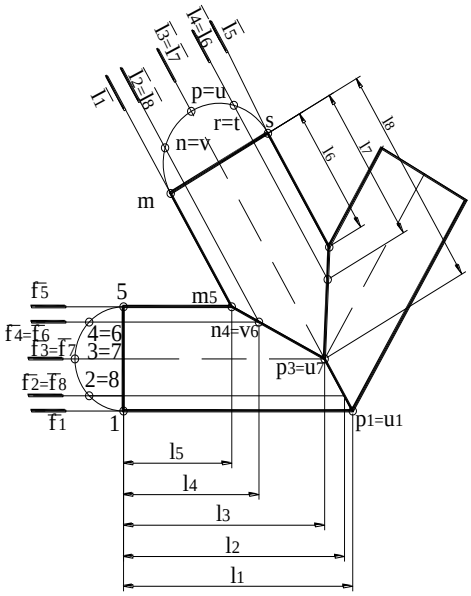

Fig. 1. *Connections intersection*

The Figure 2 shows the unfolding of the horizontal cylinder, where the length of the segment is $\overline{1_0 1_0} = 2\pi 30$, and the other dimension is $\overline{1_0 P1_0} = l_1, ..., \overline{5_0 M5_0} = l_5$. The points of the intersection curve will be: $P1_0, ..., M5_0, ..., P1_0$.

The Figure 3 presents the unfolding of the middle cylinder, where the segment length is $\overline{M_0 M_0} = 2\pi 30$, and the other dimension is $\overline{M_0 M5_0} = l_6, ..., \overline{P_0 P3_0} = l_8$. The points of the intersection curve will be: $M5_0, N4_0, P3_0, ..., M5_0$.

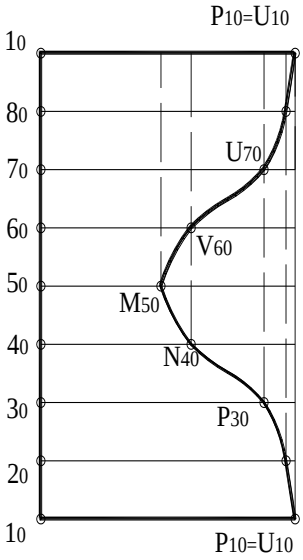

Fig. 2. *Unfolding of the horizontal cylinder*

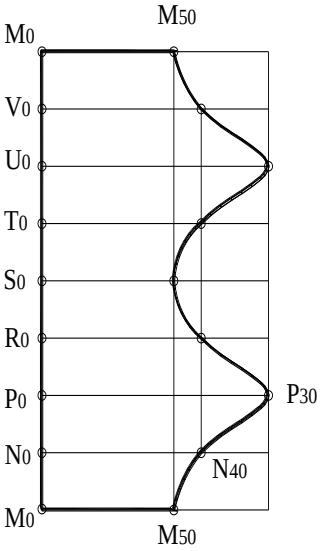

Fig. 2. *Unfolding of the middle cylinder*

3. MATHEMATICAL METHOD

In the Figure 4 is presented the setting way of the cylinders.

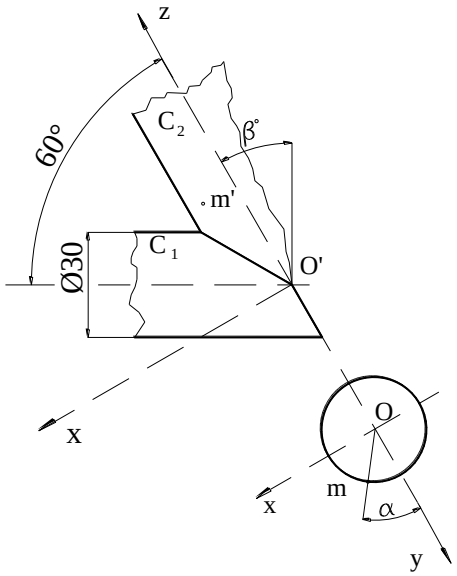

Fig. 3.*The geometrical elements of cylinders*

For the C_2 cylinder, the equation of the transformation curve, is obtain by applying the transformation (2), (3) to the equation (1), [2-7].

$$z = (x - x_0)\, tg\beta,\ x \in [-\pi R,\ \pi R] \tag{1}$$

$$x = R \sin\alpha \tag{2}$$

$$z = z_d,\ \alpha \in [0,\ 2\pi] \tag{3}$$

In this case:

$$x_d = R\alpha$$

$$x = R \sin(\frac{x_d}{R})$$

$$z = z_d$$

Those we obtain:

$$z_d = tg\ \beta\ (R \sin\frac{x_d}{R}),\ x_d \in [0,\ 2\pi R] \tag{4}$$

For an angle $\beta = 60^0$ and a cylinder radius $R = 15\text{mm}$, we obtain the Figure 5, by introducing the relation (4) into the Mathematica program. The Figure 5 show the unfolding for the C_2 cylinder.

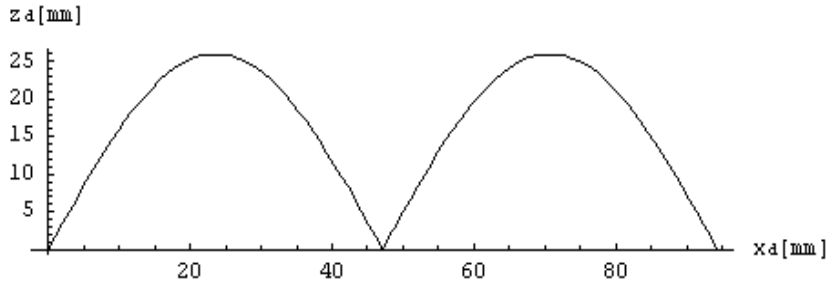

Fig. 4. *Unfolding of the middle cylinder*

For the horizontal cylinder we consider a reunion between definition domains, and the same method, but the C_1 cylinder is cutting with tho oblique plane (Figure 6).

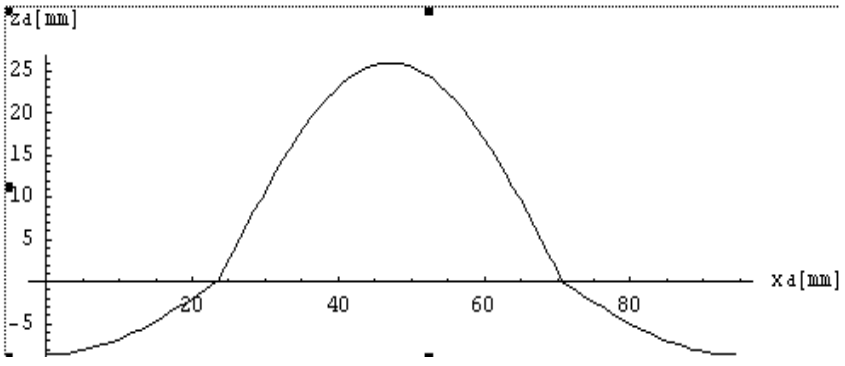

Fig. 5. *Unfolding of the horizontal cylinder*

4.CONCLUSIONS

For the correct execution of some pieces or subassemblies with complex form, which meet the requirements, the methods of descriptive geometry are absolutely necessary. Resolve the difficulties of producing patterns, by determining the types of surfaces that are part of that is very necessary.The presented method is very speedy and exactly and using the program we can obtain the cylinders unfoldings for any other dimensions. The two methods have the same results.

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