Buletinul Ştiinţific al Universităţii "POLITEHNICA" din Timişoara

Seria HIDROTEHNICA

TRANSACTIONS on HYDROTECHNICS

Tom 58(72), Fascicola 2, 2013

Method to develop a bend consisting of cylindrical elements with axes laying in different planes

Vanda – Ligia Dănăilă[1] Alina – Angelica Anghel[1]

Abstract: The paper presents a graphical method to develop the bends consisting of several cylindrical parts, the axis of each cylinder being situated in a different plane. The method can also be extended to bends consisting of conical elements.

Keywords: bend, cylinder, development, projection, planes.

1. INTRODUCTION

The bends are elements usually made of iron plates, using electric welding method for joining. The joining method is a simple one and also provides good mechanical strength.

The presented graphical method was selected because it allows to quickly and accurate enough develop the elements the bend consists of.

The development can also be obtained with the help of analytical methods, but they imply complicate enough reckonings which don't necessarily improve the precision of the development. The analytical methods are recommended for large elements and for points difficult to be found applying other method than the presented one.

2. DEVELOPMENT OF BEND

Fig. 1 represents a bend consisting of three cylindrical elements having the same diameter *(D)* and axes laying in different planes: cylinders *1* and *2* have the axes laying in the vertical projection plane and cylinder *3* has the axis laying in a common plane.

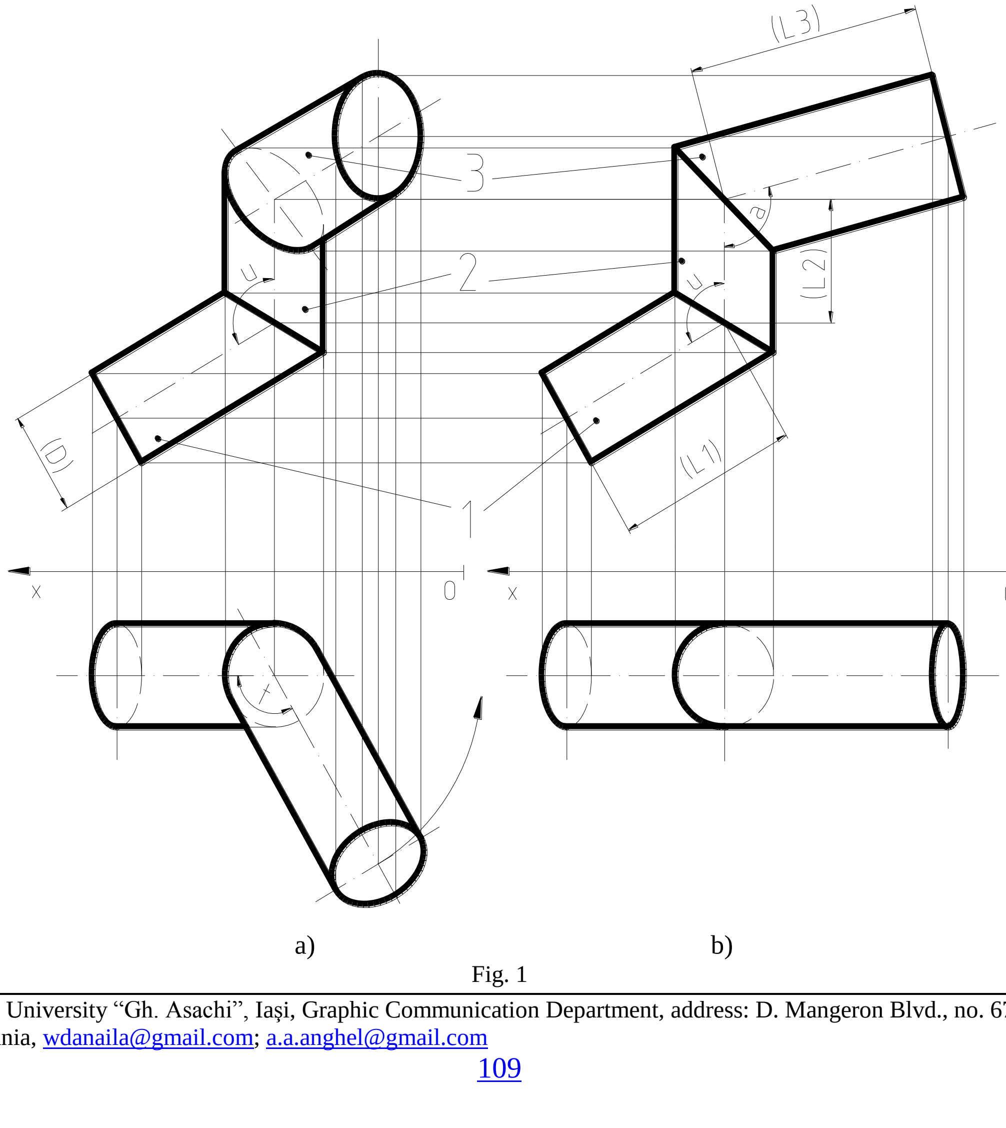

Fig. 1

[1]Technical University “Gh. Asachi”, Iaşi, Graphic Communication Department, address: D. Mangeron Blvd., no. 67, 70050, Iaşi, Romania, wdanaila@gmail.com; a.a.anghel@gmail.com

In order to develop the three cylinders, the true sizes of their geometric elements are requested. The true size of the angle *u* between the axes of cylinders *1* and *2* comes out in the projection on the vertical plane (fig. 1a) [1]. The true size of the angle *a* between the axes of cylinders 2 and *3* comes out in fig. 1b, where cylinder *3* is rotated on indicated direction until it reaches a convenient position for plotting (cylinder's axis becomes horizontal) [1]. Diameter *(D)* of the cylinders along with the lengths of cylinders' axes *(L1)*, *(L2)*, *(L3)* come out in the projection on vertical plane (fig. 1).

Cylinders *1* and *3* are similar to right circular cylinders cut by ending planes *[P]* bent under an angle equal to *u/2* respectively *a/2* in report to horizontal projection plane. In order to develop their lateral surfaces proceed as follows (fig. 2) [4]:

- plot the projections on horizontal and vertical projection planes of the cylinder cut by the ending plane;
- divide the base circle of diameter *(D)* into an even number (12) of equal parts;
- from division points *1*, *2*, …, *12* draw lines of recall intersecting the cutting in points $1_1'$, $2_1'$, …, $12_1'$;
- draw a line segment equal to the circumference of the base circle $(L_c) = \pi(D)$;
- divide the line segment into the same number of equal parts (12);
- draw lines of recall from each division point;
- the lines of recall intersect the adequate horizontal lines in points I_1, II_1, …, XII_1;
- join thus resulted points by a continuous curve.

Cylinder *2* is similar to a right circular cylinder cut by two ending planes, one plane bent under angle *u/2* and the other plane bent under angle *a/2* in report to the horizontal projection plane [6]. Cylinder *2* may also be assimilated to two right circular cylinders having one base in common, one cylinder cut by an ending plane bent under angle *u/2* and the second cylinder cut by an ending plane bent under angle *a/2* in report to horizontal projection plane [2].

In order to develop the lateral surface of cylinder *2* proceed analogously with the development of cylinders *1* and *3* (fig. 3) [1], [5]:

- plot the projections on horizontal and vertical projection planes of the cylinder cut by two ending planes;
- divide the base circle of diameter *(D)* into an even number (12) of equal parts;
- from division points *1*, *2*, …, *12* draw lines of recall intersecting the cuttings in points $1_1'$, $2_1'$, …, $12_1'$ and $1_2'$, $2_2'$, …, $12_2'$;
- draw a line segment equal to the circumference of the base circle $(L_c) = \pi(D)$;
- divide the line segment into the same number of equal parts (12);
- draw lines of recall from each division point;
- the lines of recall intersect the adequate horizontal lines in points I_1, II_1, …, XII_1 and I_2, II_2, …, XII_2
- join thus resulted points by continuous curves

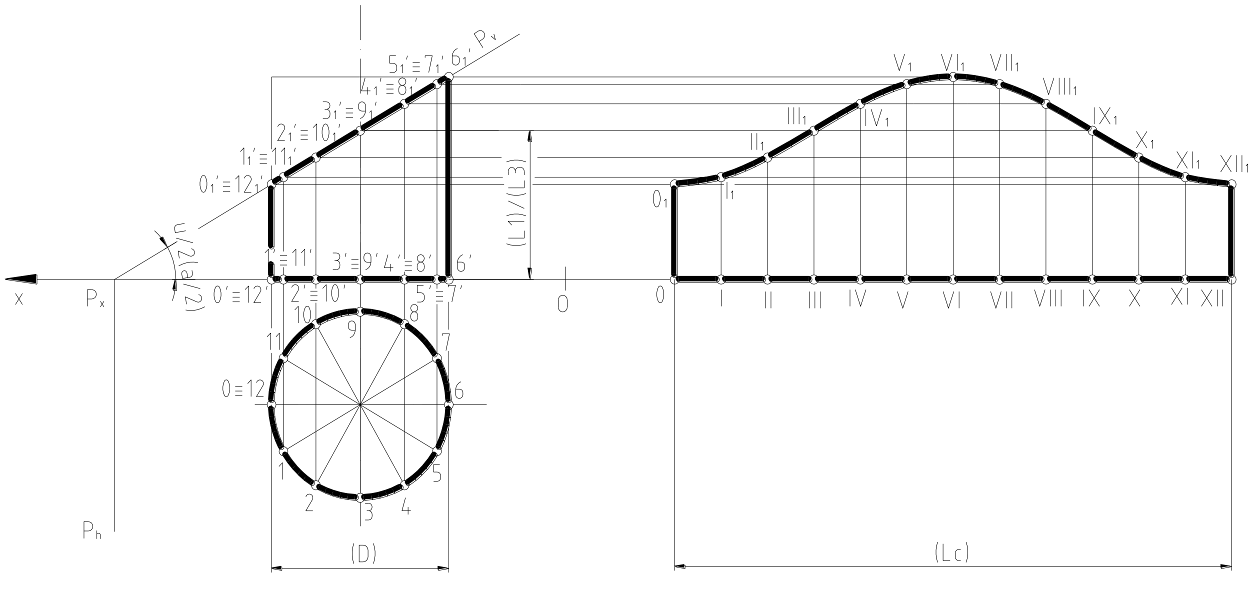

Fig. 2

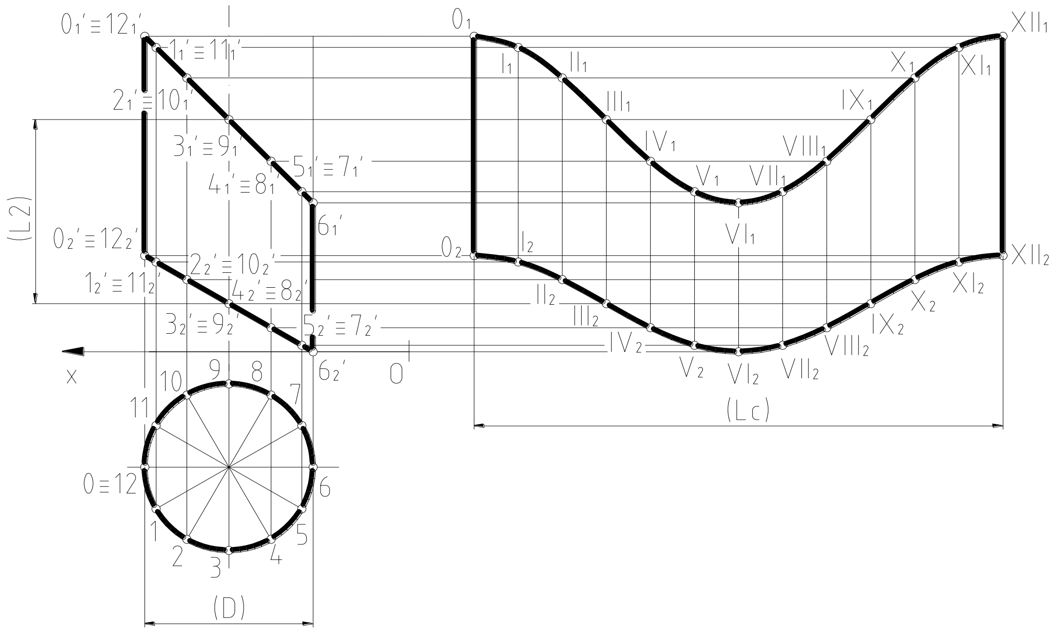

Fig. 3

CONCLUSIONS

The example presented in this paper work is a current one; it may come out in common practical cases of machines, equipments, industrial installations etc.

The proposed development of the bend applies the methods of classic descriptive geometry.

Plotting the development of the bend requires it to be separated into simple geometric elements (cylinders) cut by one ending plane (cylinders *1* and *3*) or by two ending planes (cylinder *2*). The graphic method to develop such elements is simple enough and it can be easily applied.

The method may be extended; it may be used to plot the development of other types of bends, consisting of several cylindrical elements with axes laying in different planes (projection or common planes). When applying the method, the user has to accurately measure the angles between cylinders' axes in order to transpose them on the projections. These angles represent the angles the ending planes are bent in report to horizontal projection plane [3].

Even the bend has more cylinders with the axes laying in several different planes the problem comes to a case similar to the described one. This thing is possible because the cylinders with axes situated in common planes are rotated until they reach a convenient position for plotting (axes belonging to projection planes or laying in planes parallel to projection planes).

The proposed method is a general one; it can be used for any value of cylinders' diameter or angle between cylinders' axes.

The developed elements plotted as previously described can be used as templates for other cases of bends having various diameters and angles between cylinders' axes.

As the joining method of the cylindrical elements is usually electric welding, during technological process some deformations may occur. Therefore adjustment of the final product is recommended in order to obtain a bend according to the designed one.

REFERENCES

[1] *V. L., Dănăilă,* Practical Geometry, 2013, LAP Lambert Academic Publishing, ISBN 978-3-659-19362-0, Saarbrücken, Germany

[2] *V. L., Dănăilă, A. A. Anghel,* Considerations on Some Characteristic Cases of Surfaces Able to be Developed, Proceedings of the 3rd International Conference on Engineering Graphics and Design, Technical University of Cluj-Napoca, 2009, Acta Tchnica Napocensis Publishing, ISSN 1221-5872, Cluj-Napoca, Romania, pp. 51-55

[3] *V. L., Dănăilă,* Dimensioning of the Development Drawings, Proceedings of the 2nd International Conference on Engineering Graphics and Design, Dunărea de Jos University, Galaţi, 2007, Cermi Publishing, ISBN 978-973-7-252-1, Iași, Romania, pp. 41-45

[4] *V. L., Dănăilă, A. A. Anghel,* Descriptive Geometry, 2006, Tehnopress Publishing, ISBN 973-702-345-5, Iași, Romania

[5] *V. L., Dănăilă, M. Baran, I. Antonescu* Technological Observations about the Display of the Iron Plate Machine Parts, Proceedings of the 1st International Conference on Engineering Graphics and Design, "Politehnica" University, Bucureşti, 2005, Politehnica University Publishing, ISBN 973-685-217-5, Bucureşti, pp. 56-57

[6] *V. L., Dănăilă,* Desfăşurarea coturilor alcătuite din elemente cilindrice, Proceedings of Al VIII-lea Simpozion Naţional, cu participare internaţională de Grafică Tehnică şi Design, "Transilvania" University, Braşov, 2003, Transilvania University Publishing ISBN 973-635-195-5, 973-635-196-3, Braşov, Romania, pp. 49-50