

## STUDY ON THE PROJECTION WITH ELEVATIONS OF HELICOID-TYPE SURFACES

**Abstract:** This paper presents right helicoid surfaces in various systems of representation. Emphasis was put on the representation of helicoid surfaces in the projection with elevations, where both the right helicoid with a perpendicular axis on the elevated plan and the right helicoid with the axis inclined at a certain angle to the elevated plan.

**Keywords:** helicoid surfaces, projection with elevations, ruled surfaces.

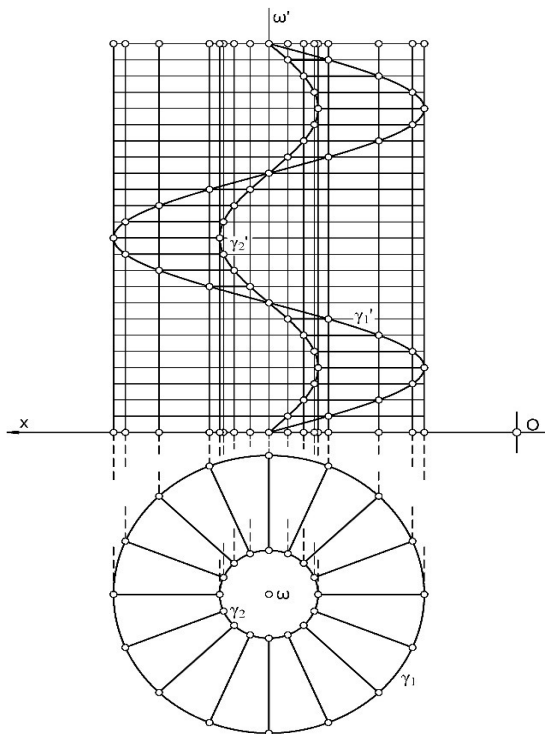
### 1. INTRODUCTION

Helicoids are surfaces with a considerable range of technical application. Due to their remarkable aesthetic appearance, these surfaces are very frequently used in constructions, mainly in the design of helicoid staircases.

In general, a helicoid surface can be defined as generated by a generatrix recording a helix motion. The generatrix curve can turn into a straight line parallel to a directing plane, when a right helicoid is born. In case the generating straight line forms an oblique angle to the directing plane, the helicoid is skew [1].

### 2. MANNERS FOR REPRESENTING HELICOID SURFACES

Usually, in the constructions field, the representation of the helicoid surfaces is made with the orthogonal projection on two planes of projection.

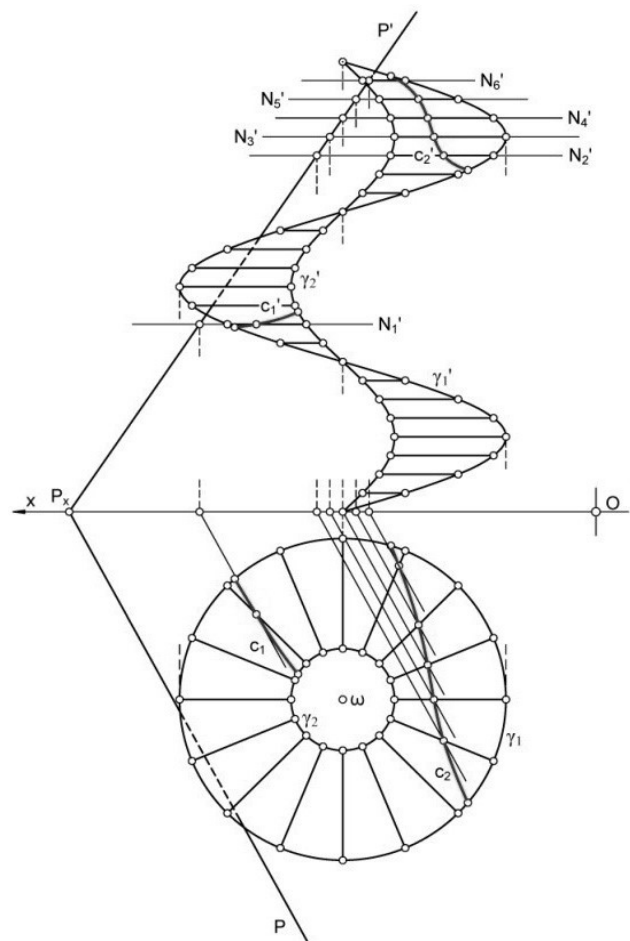


**Fig. 1** Right ruled helicoid surface. Orthogonal projection on two planes of projection.

The surface represented in Fig. 1 is a right helicoid surface represented in orthogonal projection on two planes of projection.

The surface generatrix is a horizontal straight line supported at both ends on a cylindrical helix (directrix curves). In this case, all the generatrices are parallel to plane [H] which consequently becomes the directrix plane.

In Fig. 2, Fig. 3 and Fig. 4, plane sections in the helicoid are represented as resulting from the intersection with an oblique plane (Fig. 2), vertical projecting plane (Fig. 3) or vertical plane (Fig. 4).



**Fig. 2** Oblique plane section in the right helicoid.

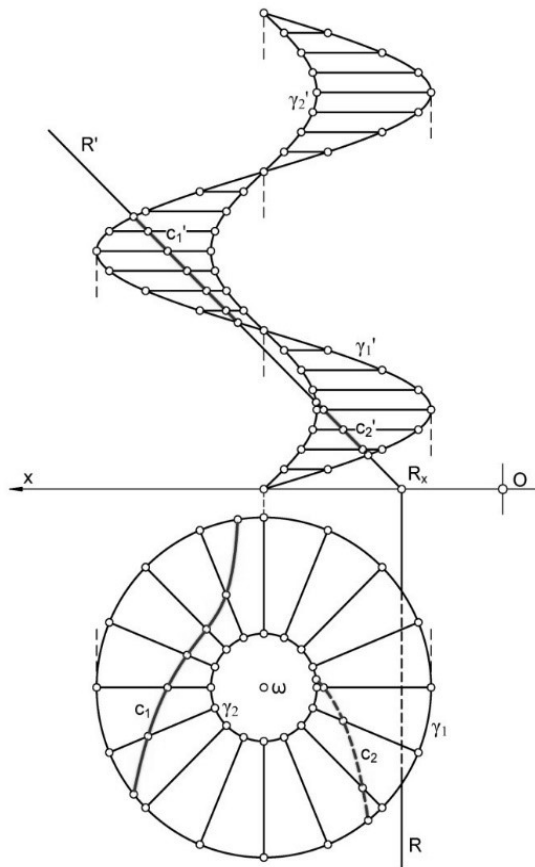


Fig. 3 Vertical projecting plane section in the right helicoid.

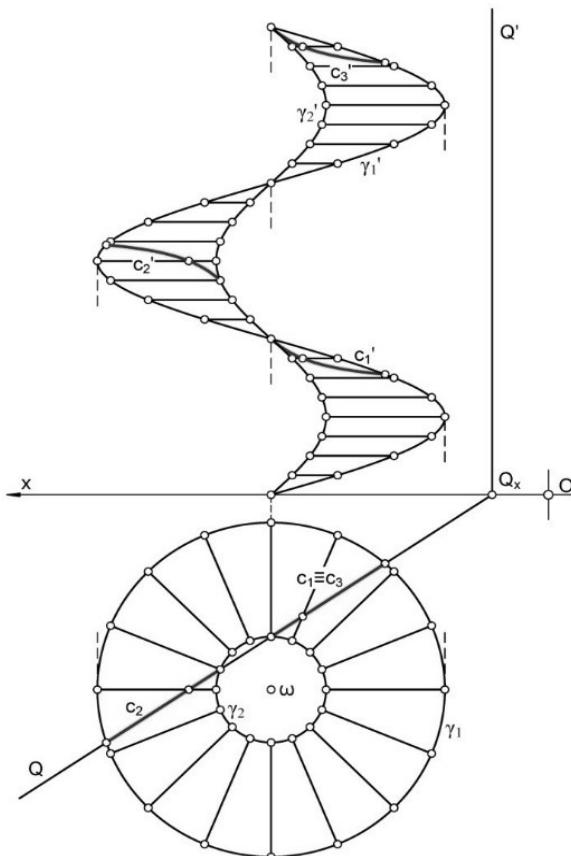


Fig. 4 Vertical plane section in the right helicoid.

In Fig. 5 a right helicoid surface is represented in isometric orthogonal axonometric projection. The construction of the axonometric projection was made on the basis of data taken from the orthogonal projection on two planes of projection.

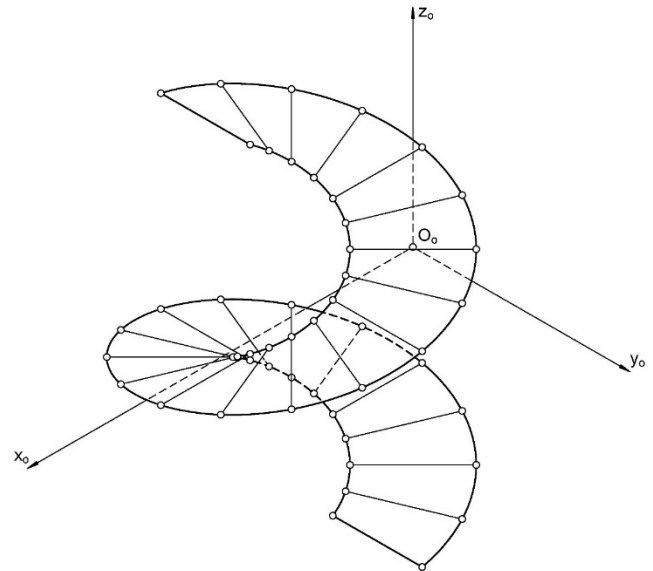


Fig. 5 Right ruled helicoid surface. Isometric axonometric orthogonal projection.

### 3. THE REPRESENTATION IN PROJECTION WITH ELEVATIONS OF HELICOID SURFACE WITH VERTICAL AXIS

In paper [2], we discussed how the projection with elevations for the surface mentioned earlier was found. In Fig. 6, Fig. 7 and Fig. 8, there is given the way in which sections with various cutting planes are made, in the projection with elevations.

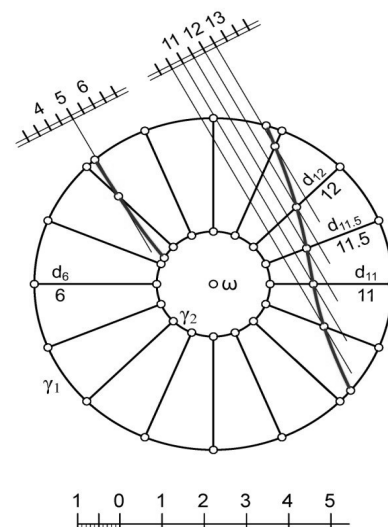
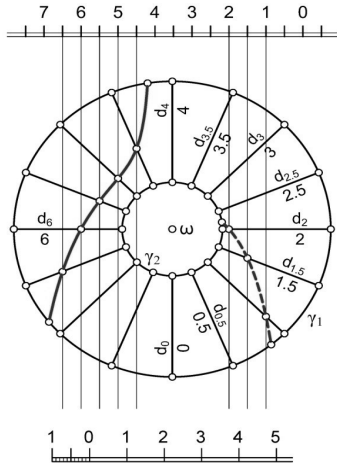


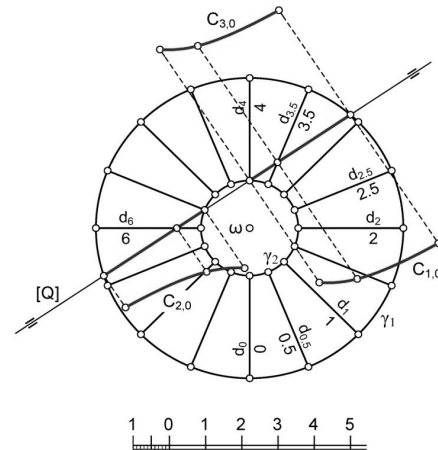
Fig. 6 Oblique plane section in the right helicoid. Projection with elevations.

Thus, in Fig. 6, the section made with an oblique plane [Q] is shown, while in Fig. 7, the section with a vertical projecting plane [R] is presented. The same surface is represented in Fig. 8, when cut with a vertical plane [Q]. In the latter case, the cutting curve overlaps the plane trace, the true size of the cutting curves ( $C_1$ ), ( $C_2$ ), ( $C_3$ ) resulting from bringing the cutting plane into coincidence.



**Fig. 7** Vertical projecting plane section in the right helicoid. Projection with elevations.

The cases presented in Fig. 6, 7 and 8 lead to the conclusion that when the projection with elevations of the surface is defined, it is much easier to solve issues related to the intersections of the surface with planes or straight lines.

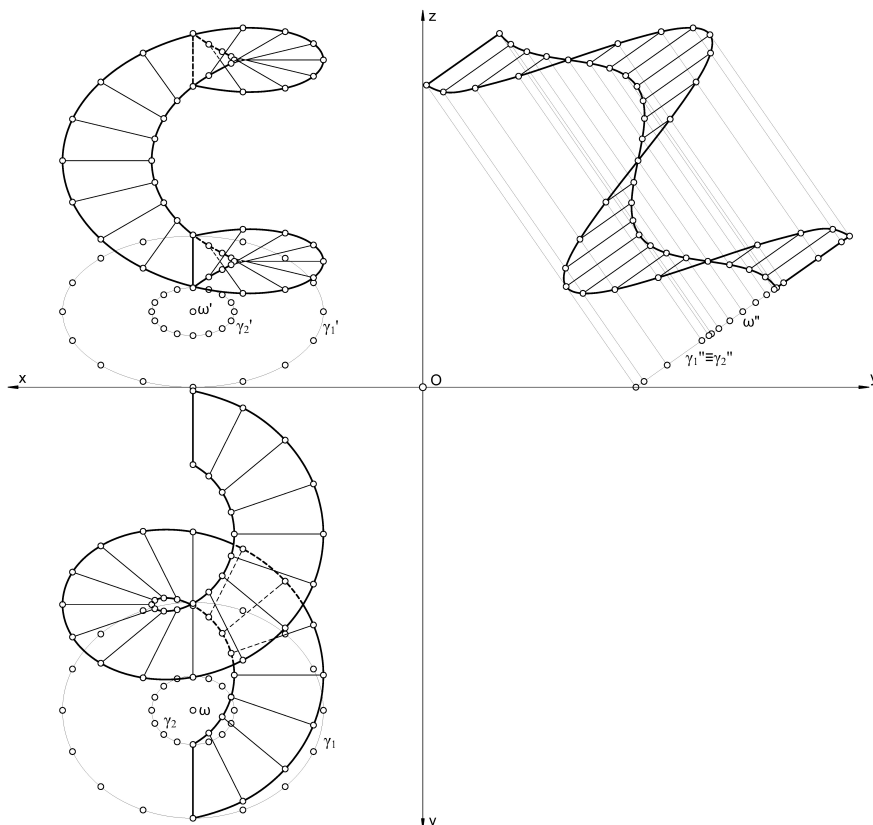


**Fig. 8** Vertical plane section in the right helicoid. Projection with elevations.

#### 4. THE REPRESENTATION OF A HELICOID SURFACE WHOSE AXIS IS INCLINED RELATIVE TO THE PROJECTION PLANE

In Fig. 9, a right helicoid whose axis is inclined at  $55^\circ$  relative to plane [H] is represented. The right helicoid was generated as usually, with the generating straight lines parallel to the horizontal projection plane [H] and inclined after the generation.

To find the projection with elevations of the helicoid surface in this new position, equidistant to [H] planes cutting the surface were used (Fig. 10).



**Fig. 9** Right helicoid with axis inclined relative to [H]. Orthogonal projection on three planes of projection.

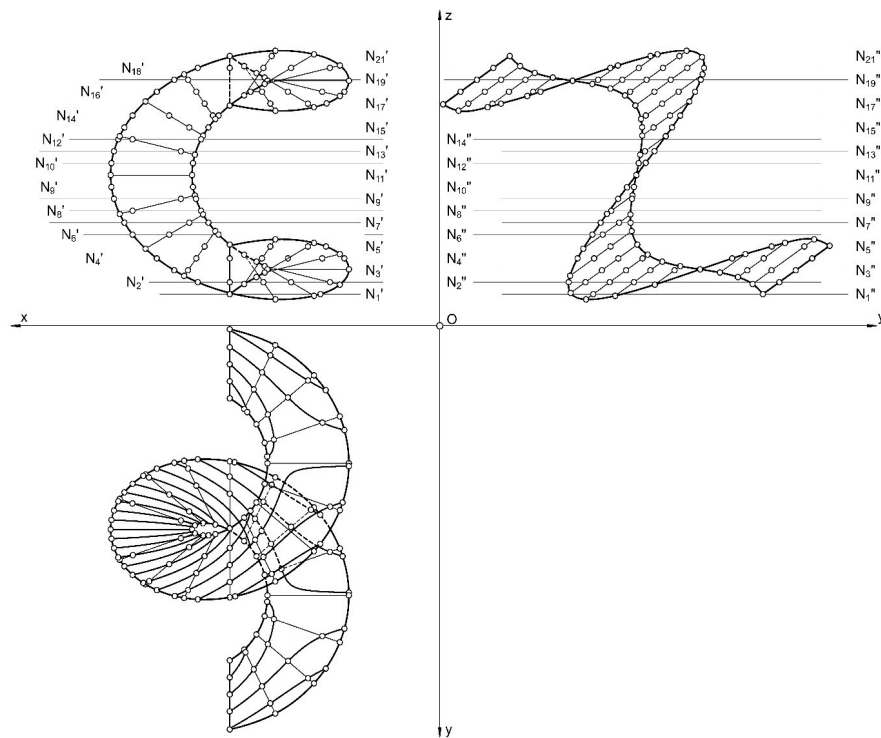


Fig. 10 Right helicoid with axis inclined relative to [H]. Finding the Projection with elevations.

The surface of the right helicoid whose axis related to the elevated plane is inclined is represented in the projection with elevations in Fig. 11.

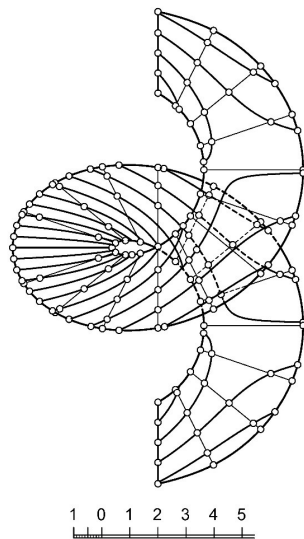


Fig. 11 Right helicoid with axis inclined relative to [H]. Projection with elevations.

## 5. CONCLUSION

The selection of the most accurate and suggestive system of representation is an action that needs to be based upon an in-depth knowledge of the types and norms of representation.

The study carried out here points out to the fact that insome cases the representation in the projection with

elevations simplifies both the study of the concerned surface and the solution of problems related to the intersection of the surface with straight lines or planes.

In the case of helicoids with an inclined axis relative to the elevated plane, there is no justification to use the projection with elevations as the representation has a too high representation complexity. In this case, it is advisable to use the orthogonal projection on three planes of projection or the three-dimensional modelling representation performed with special software. Among the software of interest, one can use Autodesk AutoCad, Arhicad, Google Sketchup or MOI3D.

## REFERENCES

- [1] Iancau V., Zetea E., Barbat V., Rosa S., Rusu I. (1982). *Reprezentari geometrice si desen tehnic*, EDP, Bucuresti.
- [2] Dragan D., Tudoreanu A., (2013). *Study on the Representation of Helicoid Surfaces*, Proceedings of the C60 International Conference, pp. 273-280, ISBN 978-973-662-903-7, Cluj-Napoca, 7-9 November 2013, U.T.Press, Cluj-Napoca.

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