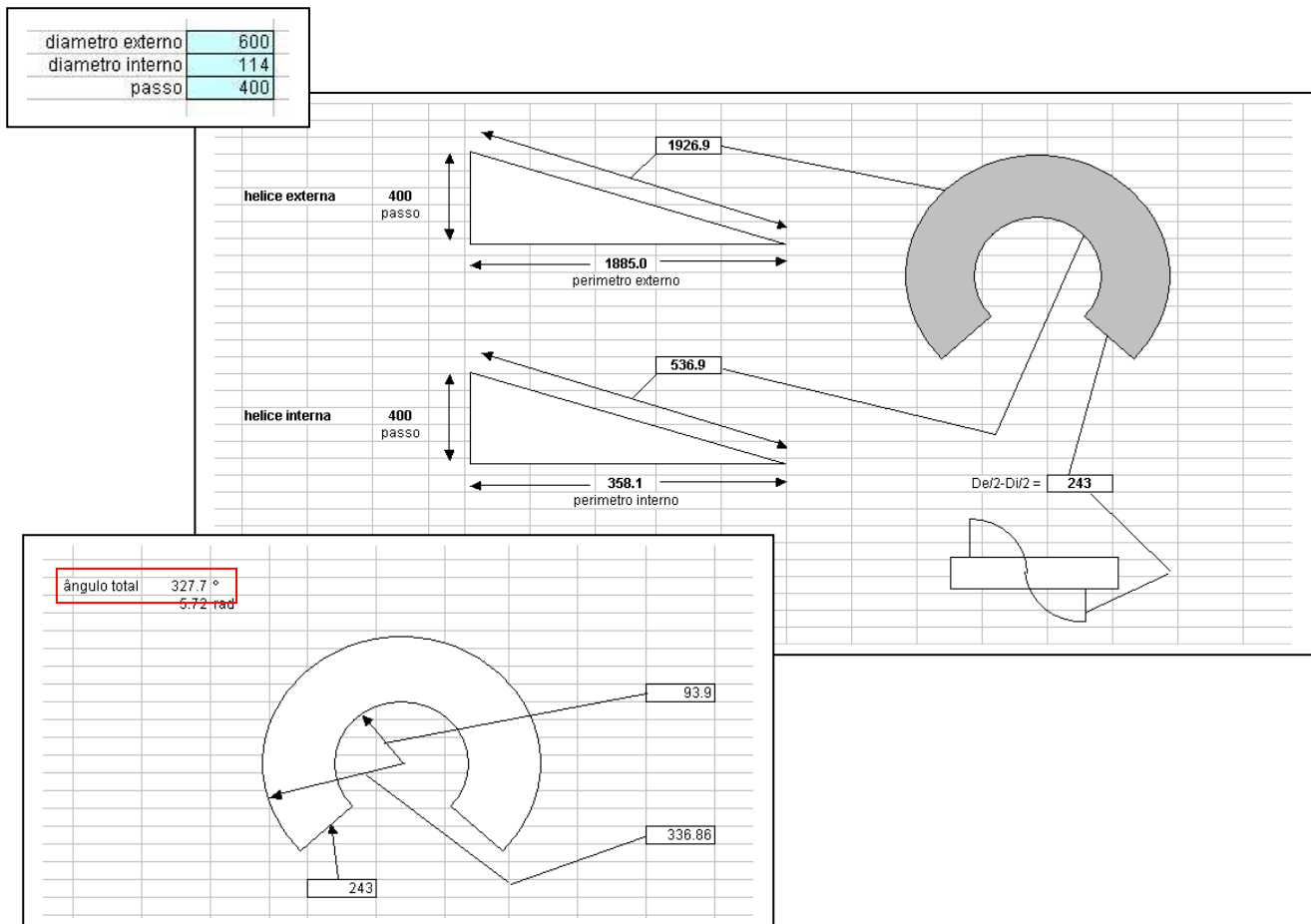


Helicoids' Project

The helicoid calculation is very simple and can be easily guessed using simple trigonometry, however, manufacturing does not follow the same trend.

The unfold calculation of the helicoid made using the classic and trigonometric method is shown in the figure below using the following data as an example:



All the mathematics of the solution is based on the following geometric conditions:

- 1- There are two lengths which are the hypotenuses of the triangles formed by the pitch and the perimeters of the helix (both the internal and external helix). In the example, these two lengths are 1926.9mm and 536.9mm.
- 2- These two lengths must be traced on the plate in a concentric way and kept apart from each other by the distance of the height of the helix, in the example, 243mm. To make this possible, an external radius of the unfolded part is calculated to meet this condition. In the example, 93.9mm. The external radius will then be the sum of the internal radius and the height of the helix: $939 + 243 = 336.9\text{mm}$
- 3- With the external radius = 336.9mm and the perimeter = 1926.9mm, using the classic trigonometric formula: $\text{Angle} = \text{perimeter}/\text{radius}$, that is, $1926.9/336.9 = 5.719$ radial or 327.7 degrees.

What normally happens when manufacturing the auger (mainly using thicker plates) are the following problems:

a) Difficulty in conforming which usually results in a great distortion in the original geometry and frequently it is necessary to use a flame (heating with fire) to help in the deformation. This very much compromises the fidelity of the unfold calculation with the final result.

b) Difficulty in reaching the perfect positioning of the internal hélice of the auger with the hypothetical hélice external to the tube forcing thus, the axial growth of the auger (apparent increase of the pitch) and a decrease of the external diameter (little perceptible). For this problem it is convenient to leave a good gap between the external of the tube and the internal of the calculated auger (5 mm, for example, for a plate 1/4). This prevents a forced assembly on the tube.

c) The total unfold angle must be respected (usually this angle is above 300°) because if the part is cut with an angle greater than that which is specified, folgas will appear between the internal of the screw thread and the tube. The cut through the angles is usually inaccurate thus, we suggest the use of the strings to mark the cutting angle. It is a common practice to cut the disk formed by the 2 radius completely to reduce the waste of material, as seen on the drawing below:

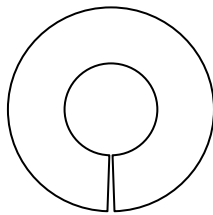


Figure 1 - Normal way
Tracing of the complete circles so as to reduce the consumption of material

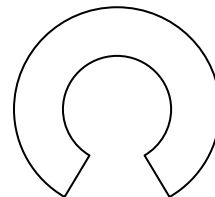
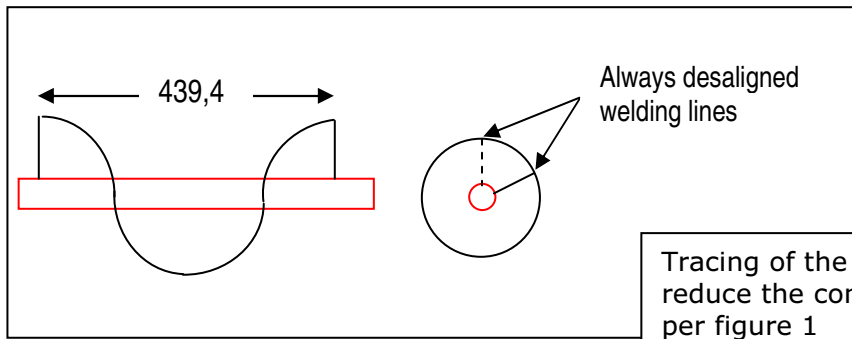
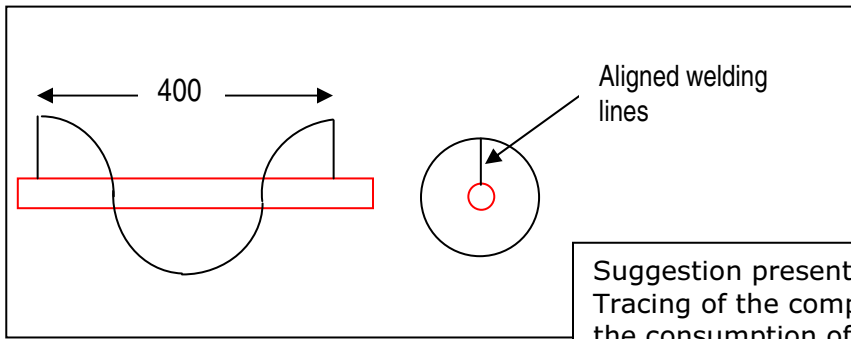


Figure 2 - Suggestion presented by CALDsoft
Tracing of the complete circles so as to reduce the consumption of material

In this case, it is important to observe that the traced part with complete circles (figure 1) will have a length exceeding the pitch originally given for the calculation, whereas the segmented figure presented by the CALDsoft calculation (figure 2) will have the exact length to reach the given pitch. In the example given in the beginning of this document, the result is a segmented figure (as seen on figure 2) which comprehends 327.7 degrees (and not 360 degrees as it would be in figure 1). This complete tracing could be used however, when the first hélice is assembled on the base tube, the extremities of the hélice will not be at 400 mm (given pitch) but, at 439.4mm which is the simple result of $400 \times 360 / 327.7$.



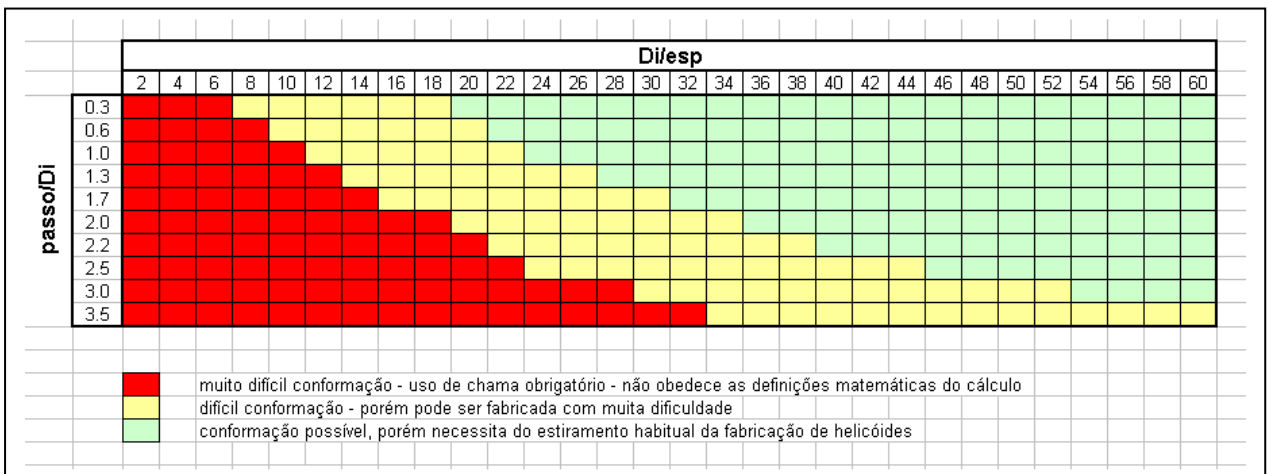
Tracing of the complete circles so as to reduce the consumption of material as per figure 1



Suggestion presented by CALDsoft:
Tracing of the complete circles so as to reduce the consumption of material as per figure 2

Below is a practical and reference table to try to show the level of difficulty in manufacturing an helicoid due to its dimensions for low carbon steel. (In cases of less tenacious steel, the region in red on the chart will move even more to the right. That is, more difficulty in conforming and less adherence to the linear mathematical model).

Obs: This table is valid only for the $D_e/D_i=2$ relation. For larger relations, the difficulties in conforming are even greater.

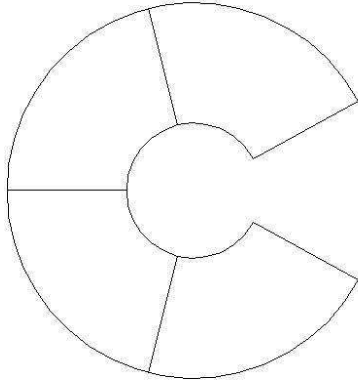


Tips to diminish the difficulty of conforming (stretching) of the helicoids:

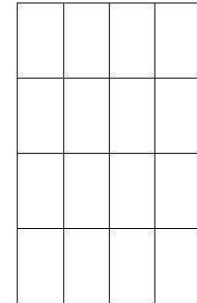
Two good tips to reduce the difficulty of conforming are:

First tip: Trace supporting lines as seen on the example below.

Unfolded Helicóide (with the divisions)

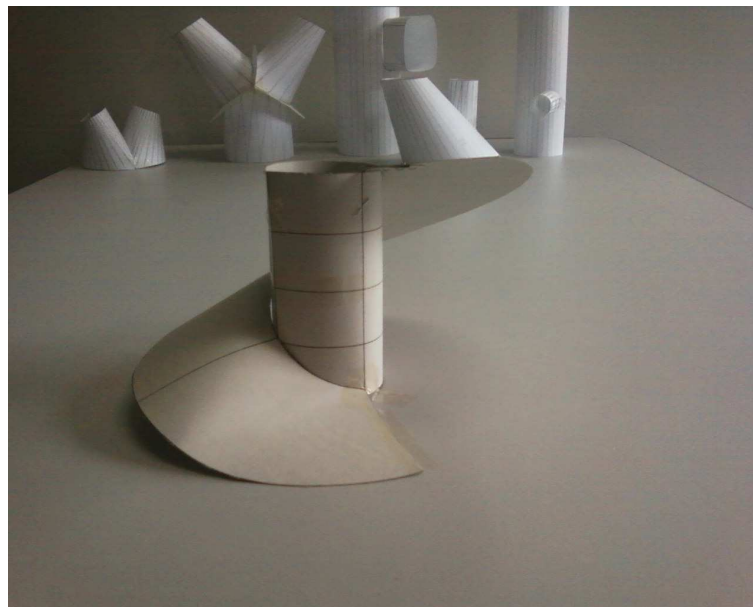


Unfolded Tube (with the divisions)



On the helicoid, 4 radial lines equally spaced and on the tube, axial lines in the 0°, 90°, 180° and 270° positions and transversal lines every 1/4 pitch.

The purpose of these lines is to make both of them meet during the difficult process of stretching avoiding very large final differences (see images below).





Second tip: Always calculate the helicoid with an internal diameter a few millimeters larger than the tube where the helicoid is to be welded. This will make the stretching process easier because as the helicoid begins to get close to the base tube, the difficulty in the stretching increases. This small gap will disappear when the helicoid is finished and welded.

Obs.: Because it is easier to stretch the external periphery than the internal one (mainly if there isn't a reasonable gap between the tube and the internal diameter) the helicoid is likely not to be perfectly perpendicular to the axial plan of the tube which causes an effect of inclination/toppling.