5.4. Detail design phase

After the Conceptual Design phase is finished, the project enters progressively in the detail design phase. The limit between those two phases is not always clear, and it is also influenced by the type of product, the degree of innovation, etc. In general, the detail design is connected with the design of the sub-assemblies and elements that form the assembly.

All the products are formed with elements that, to a greater or lesser extent, are defined in the conceptual design phase, but that can vary depending on the different manufacturing processes, materials or shapes.

In this phase of detail design the designer deals with generalities, unless he or she focuses on a specific product. The contrary, a more concrete vision, would imply a deep knowledge of all the technologies applicable to each component of the product.

It is estimated that 70-80% of the activity in the design of an industry belongs to the detail design phase. Nevertheless, this important dedication is useless if the previous work is not performed systematically and methodically.

When the detail design phase is reached, it is necessary to call upon all the knowledge about material, production processes, analysis techniques, new technologies in the sector, component environment, appearance, etc. Basically, it is about subsequent restrictions that the designer must take into account to achieve a good design of the component, so that it fits perfectly in the global product, both physically and functionally.

During the detail design phase all the components of the product must be completely defined. Subsystem and components design must take into account all factors affecting the product, as in the conceptual design phase.

While in the conceptual design phase the product was considered in a global manner, with the necessary subsystems to ensure all functions, in this detail phase all the characteristics of each part must be defined, so that they make possible the functionality of all subsystems.

The factors, through specifications, fix limits to the solutions field. Usually, the most important factors in a given product will determine the design characteristics and then, those characteristics will be adjusted to fit the rest of the specifications.

Focusing only on the mechanic study, its objective is to design all the components of the product that are needed to fulfil its different functions. To make the mechanical study, we start from the global product, determining the different subsystems. This way, we can tackle the specific problems of each subsystem in a independent way.

We are talking now about a pure detail design, when each part integrated in a subsystem must be defined, calculated, dimensioned, permitting that the assembly works. Of course, the complexity of this study goes hand in hand with the complexity of the assembly. If the product has systems or components with relative movements, it is convenient to model its behaviour, an aspect that can be performed using Compute Aided Design. CAD work permits to verify the movement of the parts, the existence of interferences, and even to analyze the behaviour with different charges.

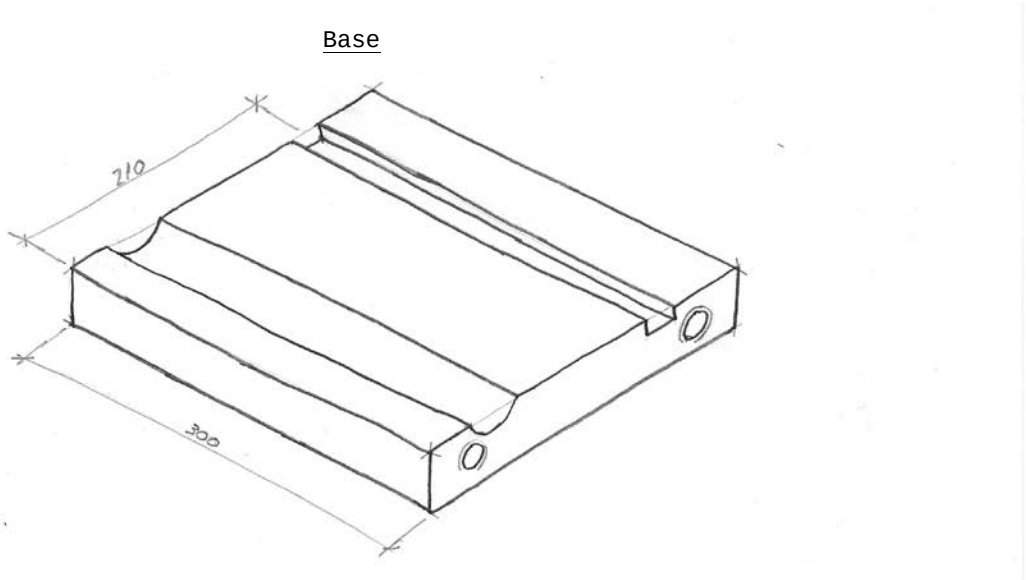
As a result, the definitive planes of the product must be generated, with the necessary specifications for its manufacturing. By the end of this phase we need detailed planes, with dimensions and with all the necessary indications. The documents in this phase are:

- General plane of the assembly, with at least maximum dimensions, and with references to each of the parts
- Planes of the parts usually exploded. If some of the parts are not visible in the general plane, or if you want to make that plane simpler, you can use the part plane to refer other parts. In the part plane there is no need to give dimensions, and usually, indications are given to explain how to assembly some elements (if necessary).
- Individual planes for each part of the assembly, except for the standardized ones. Dimensions must be given in those planes, and, if necessary, manufacturing tolerances.
- Analysis. Conceptual design phase also implies a bunch of calculations, as discussed earlier. In this phase, the technological knowledge of the designer is employed to resolve the technical problems of the design. All calculations concerning the design must be expressed in a document, so that they can be consulted at any moment.

This phase is necessarily made using CAD, and its later integrated with the rest of the applications.

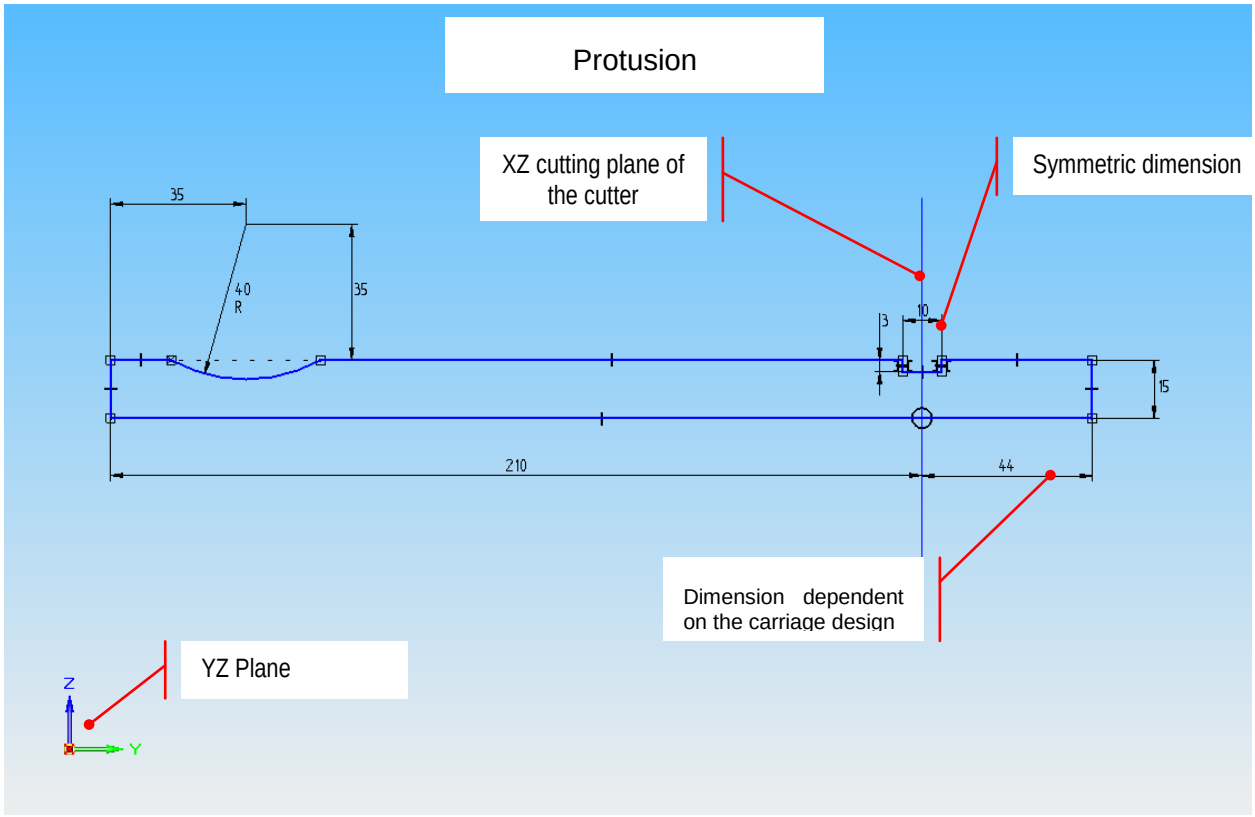
5.4.1. Modelling

Board

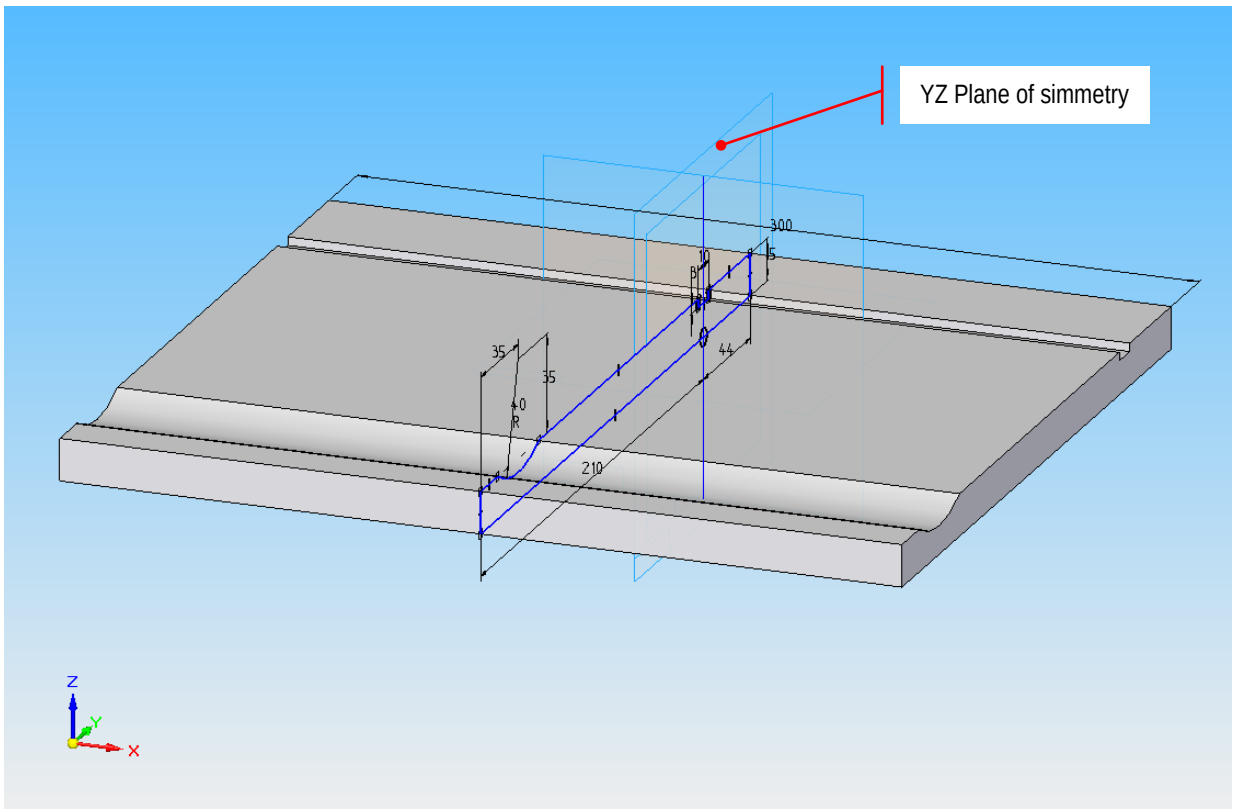


5.13.Image: Board

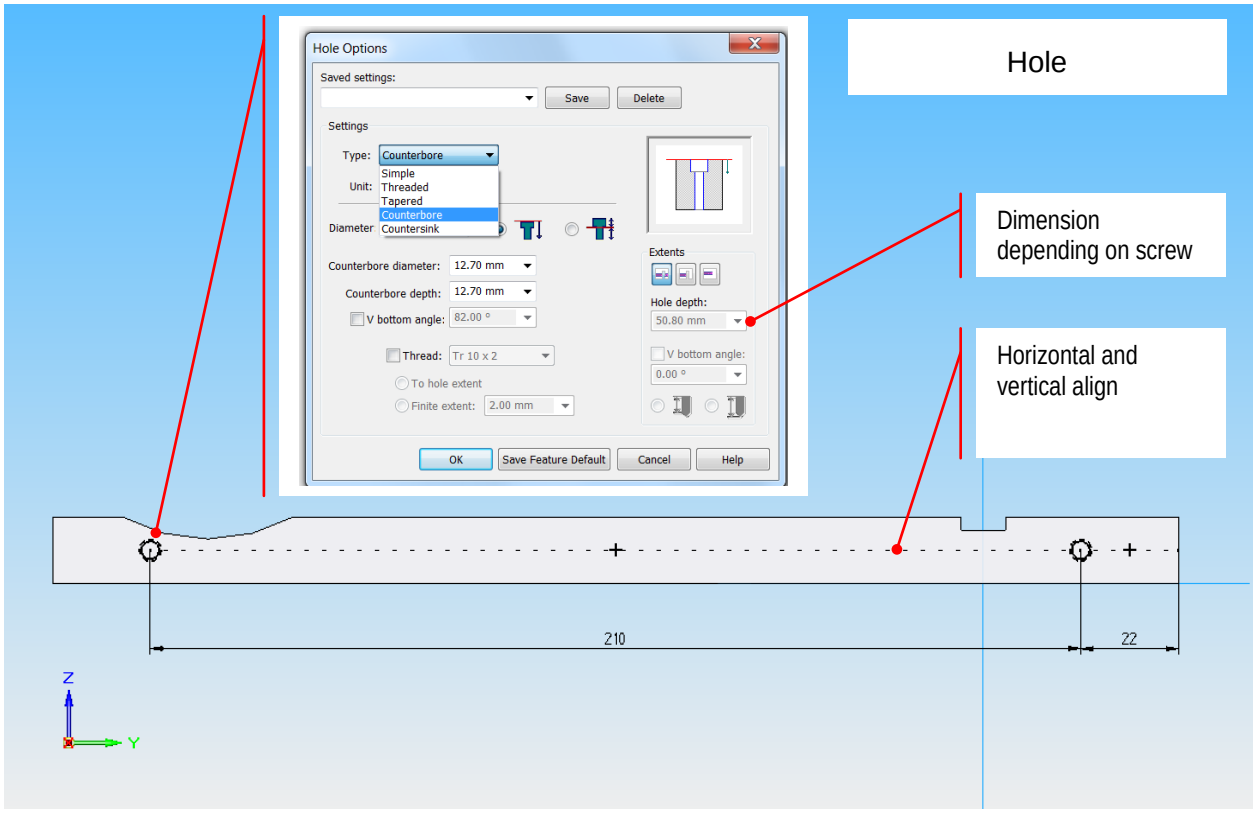
The first operation is a Protusion. Then, it is completed with the threaded holes on the sides.



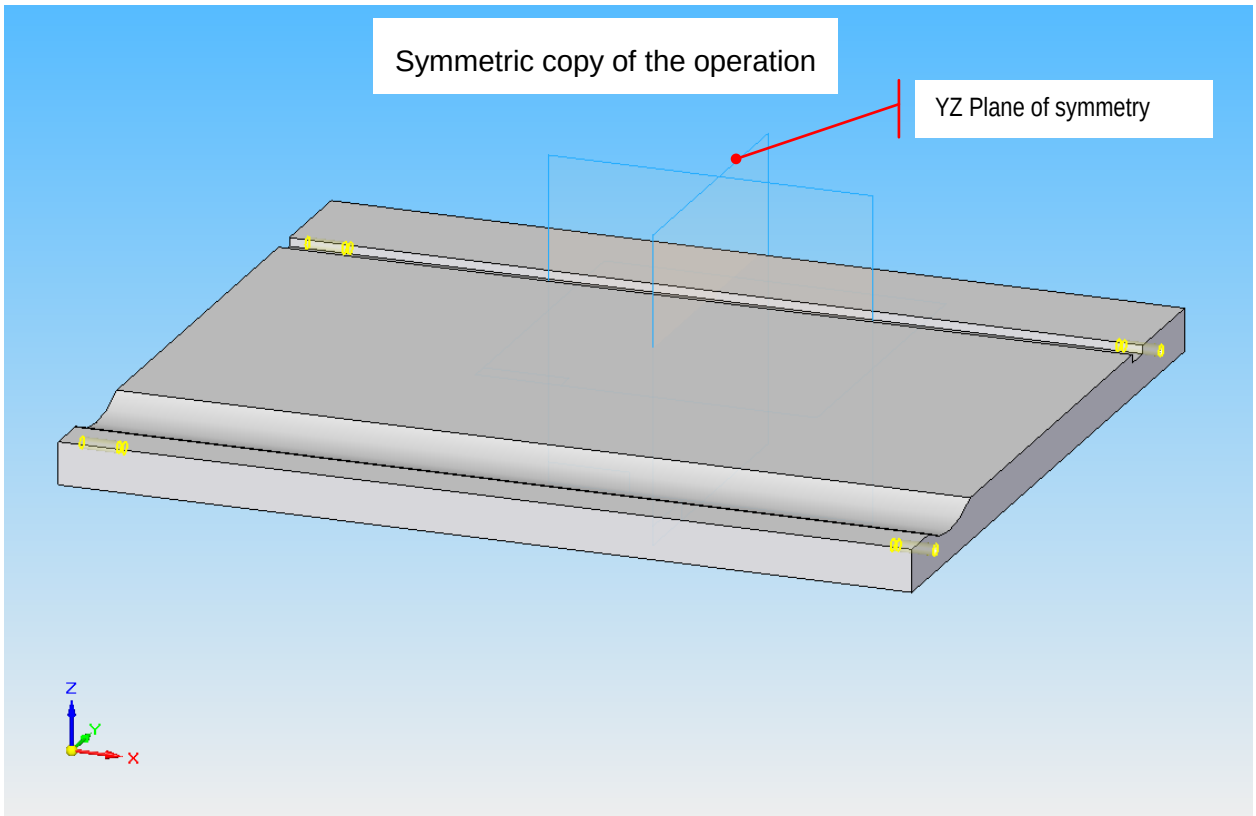
5.14.Image: : Profile of the Protusion 1 (Image made with Solid Edge)



5.15. Image. Board: 1 Response of the Protusion 1 (Solid Image made with Solid Edge)

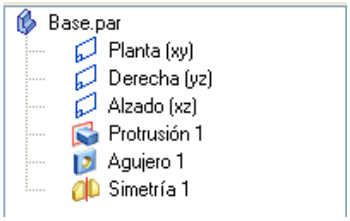


5.16. Image. Board: Profile of the hole 1 (Image made with Solid Edge)



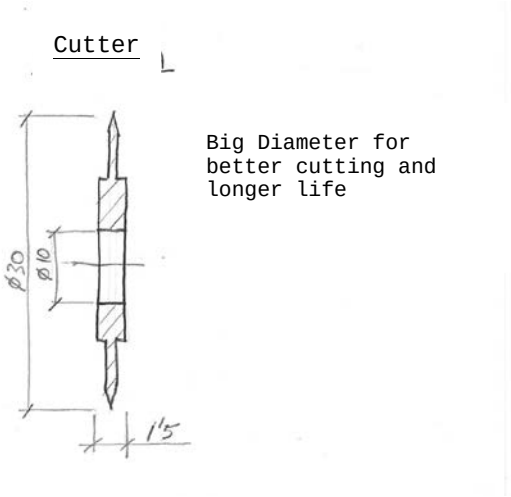
5.17. Image. Board: symmetry 1 (Image made with Solid Edge)

PathFinder of the operations for the board:



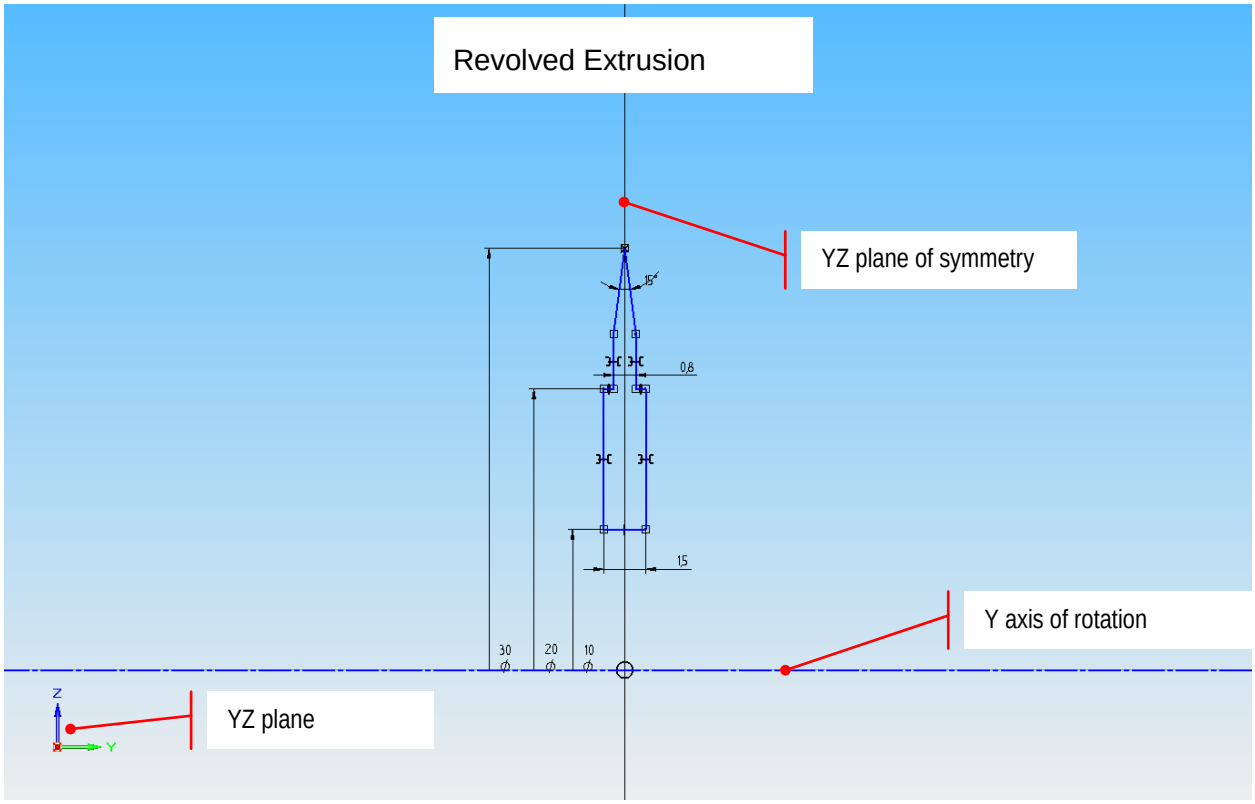
5.18. Image. PathFinder of the operations for the board (Image made with Solid Edge)

Cutter

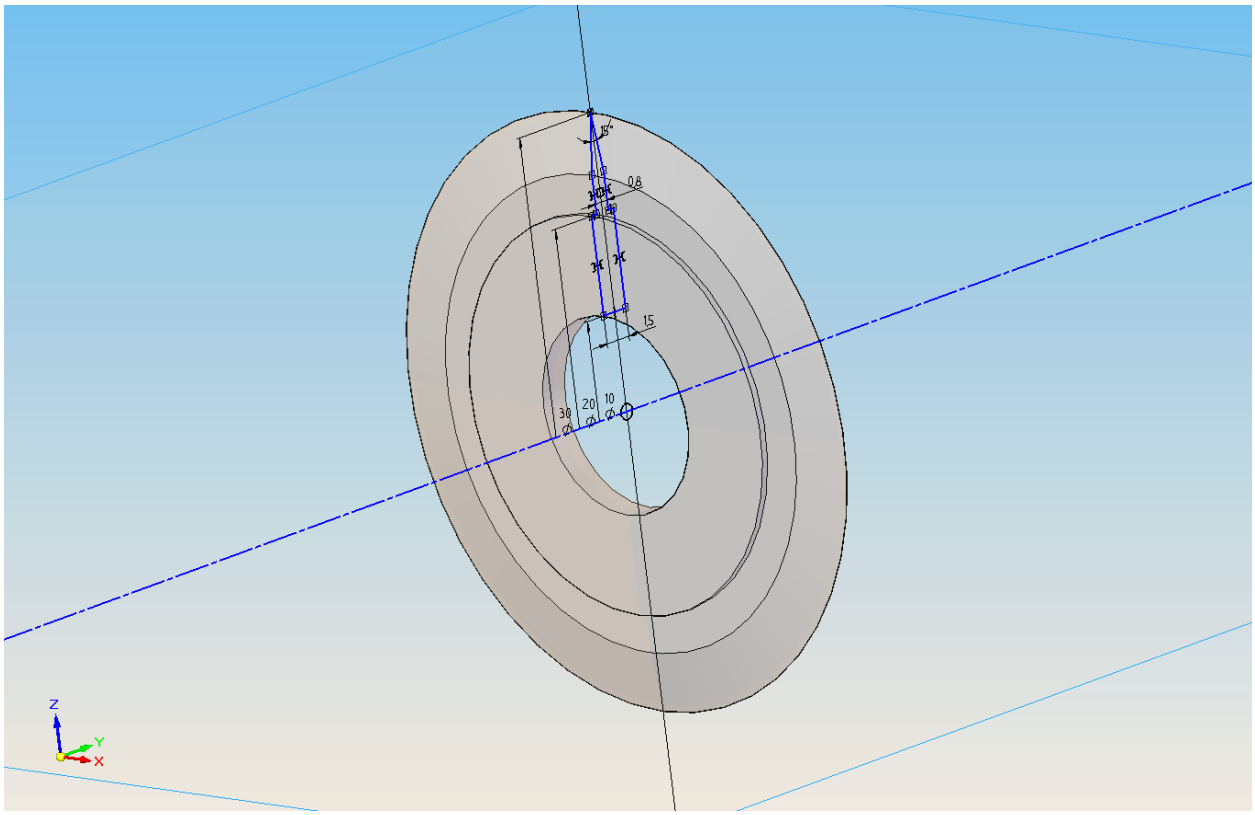


5.19. Image. Cutter

It can be made with an unique operation, Revolved Extrusion.

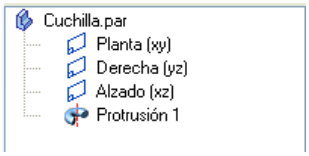


5.20. Image. Cutter: Protrusion 1 Profile (Image made with Solid Edge)



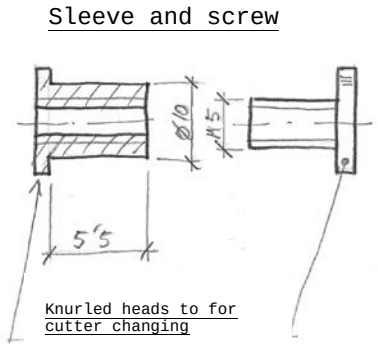
5.21. Image. Cutter: Protrusion 1 response (Image made with Solid Edge)

PathFinder of the operations for the cutter:



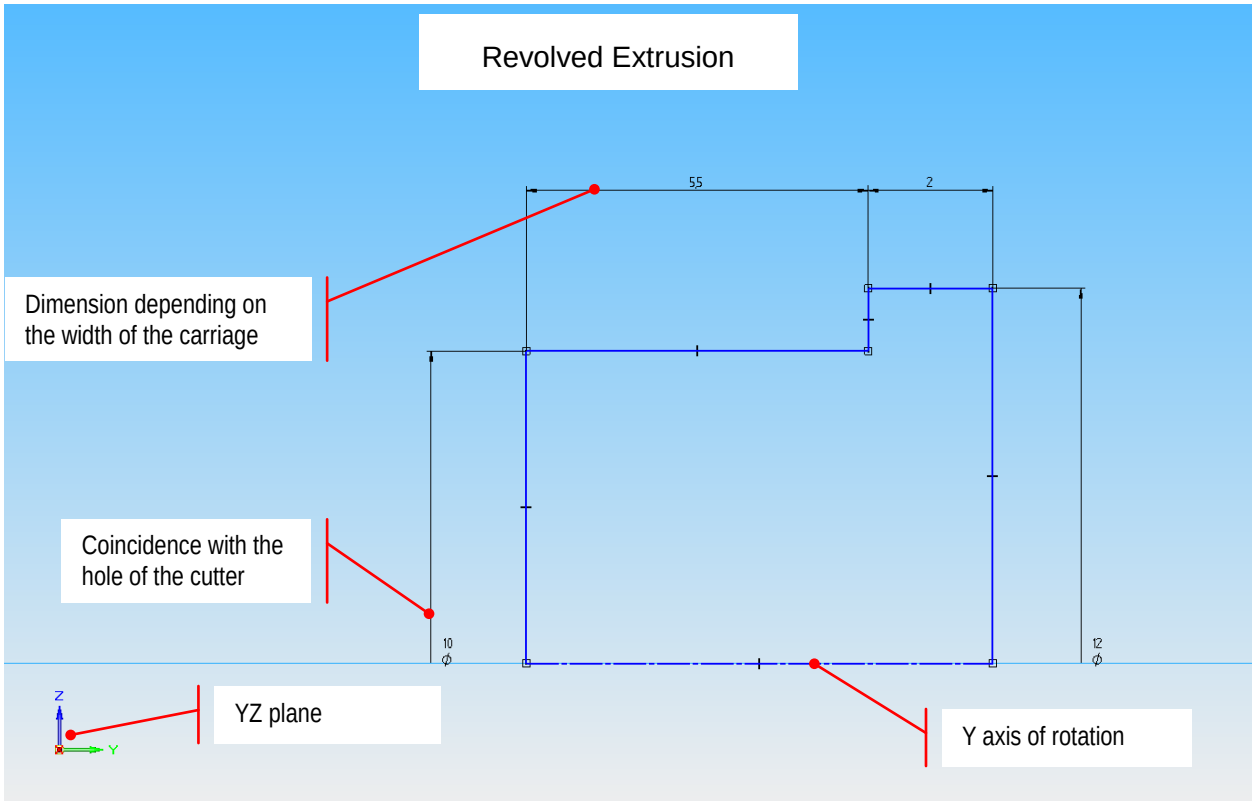
5.22. Image. Cutter: PathFinder of the operations

Sleeve and knurled screw

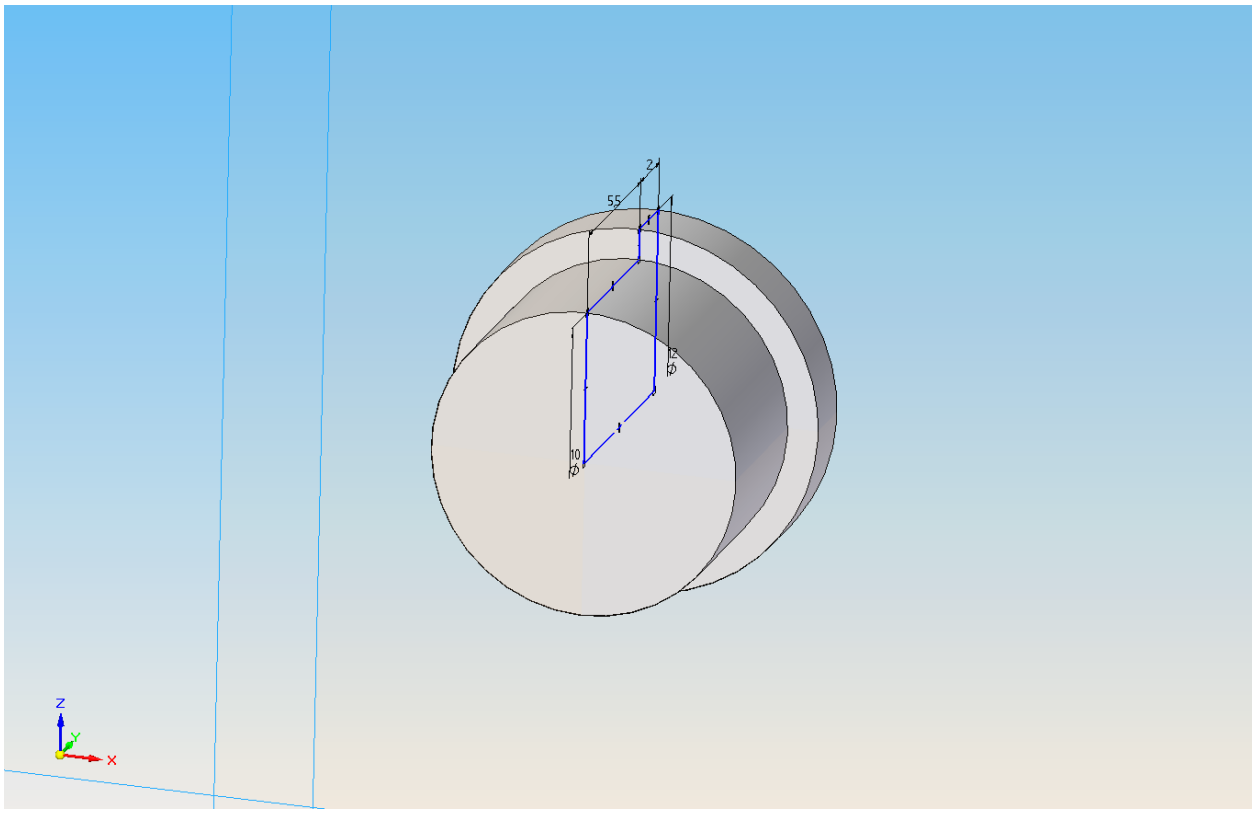


5.23. Image. Sleeve and knurled screw

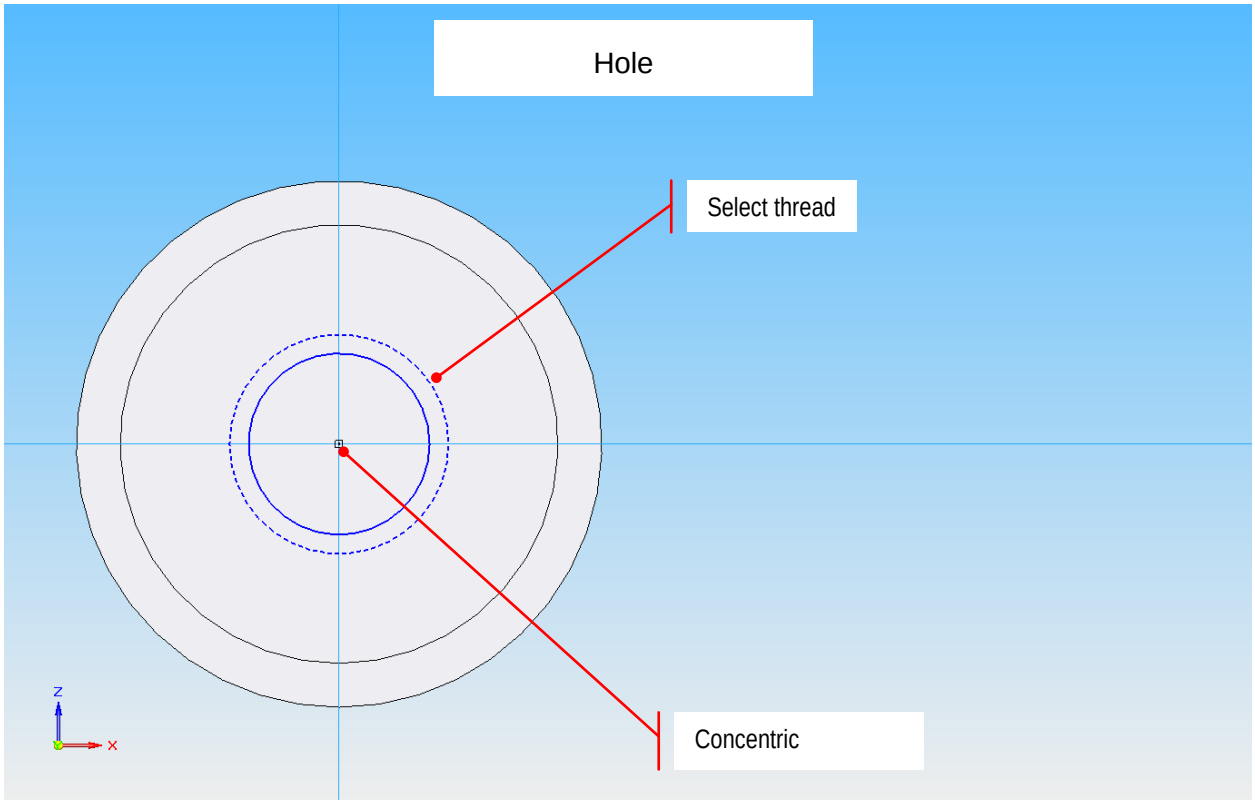
In the case of the sleeve, the first operation is a Revolved Extrusion, which is completed with two through threaded holes.



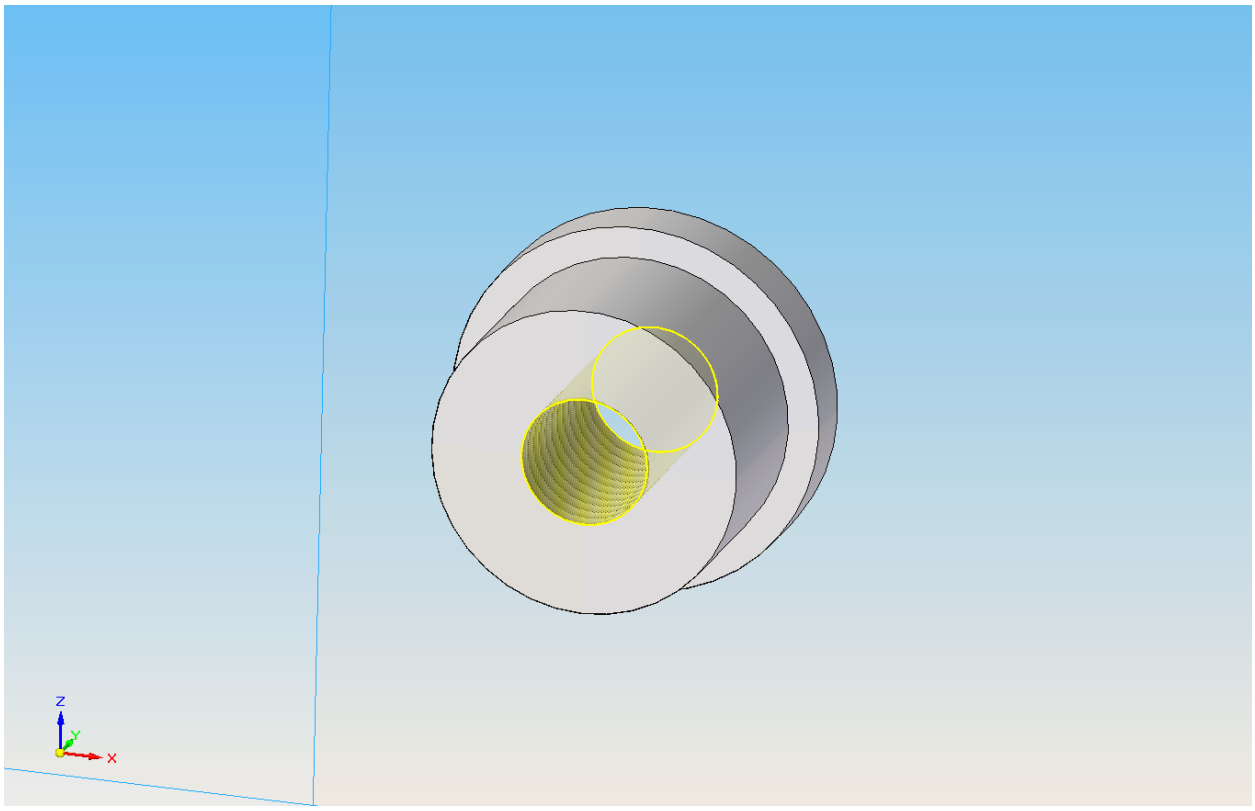
5.24. Image. Sleeve: Protusion 1 Profile (Solid Image made with Solid Edge)



5.25. Image. Sleeve: Protusion 1 response (Image made with Solid Edge)

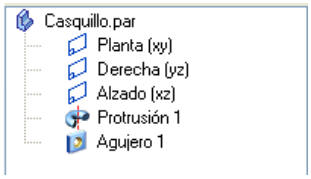


5.26. Image. Sleeve: hole 1 profile (Image made with Solid Edge)



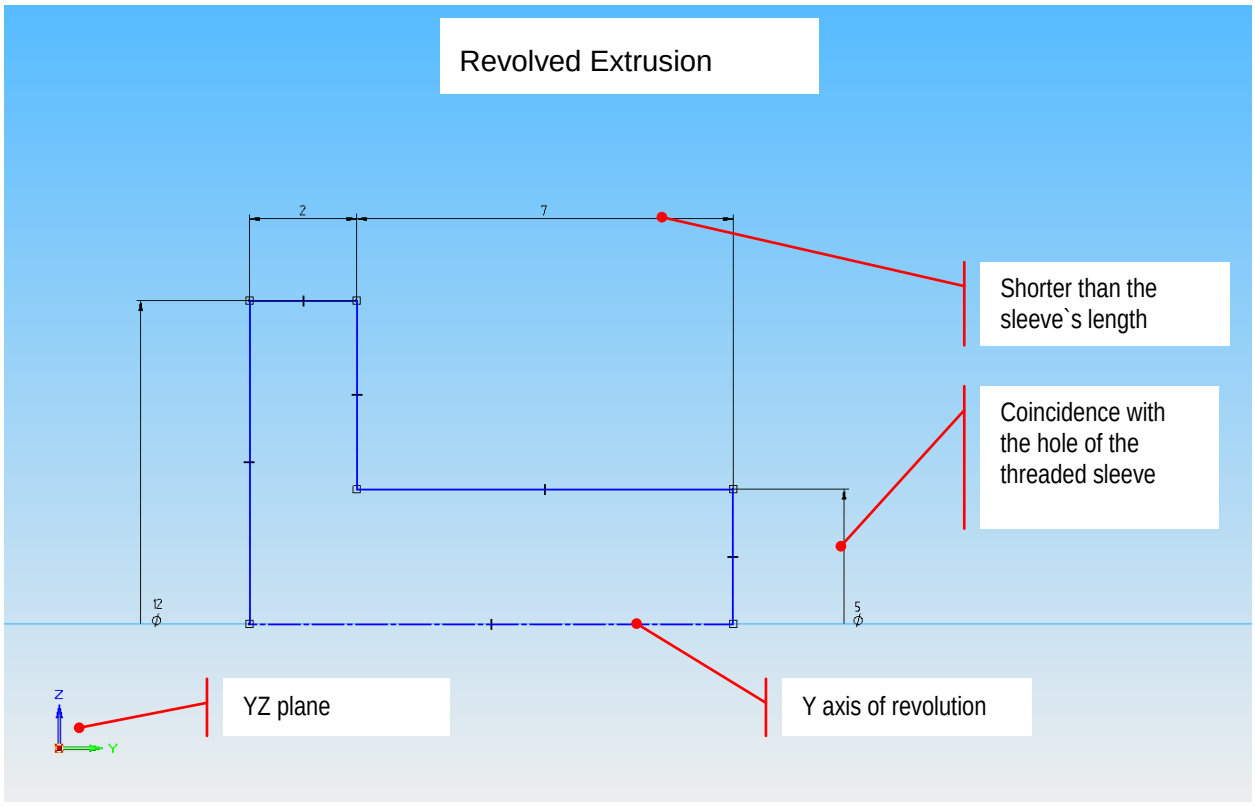
5.27. Image. Sleeve: hole 1 response (Image made with Solid Edge)

PathFinder of the operations for the sleeve:

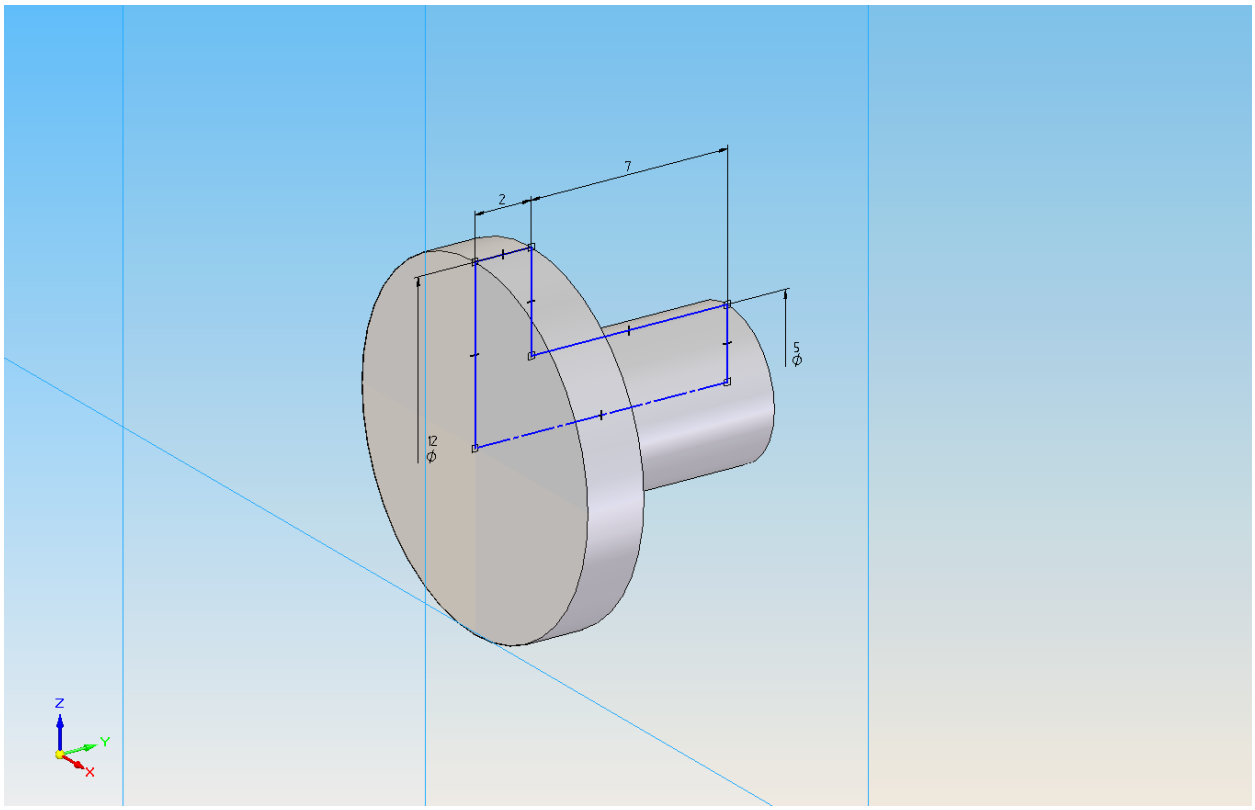


5.28. Image. Sleeve: PathFinder of Operations (Solid Image made with Solid Edge)

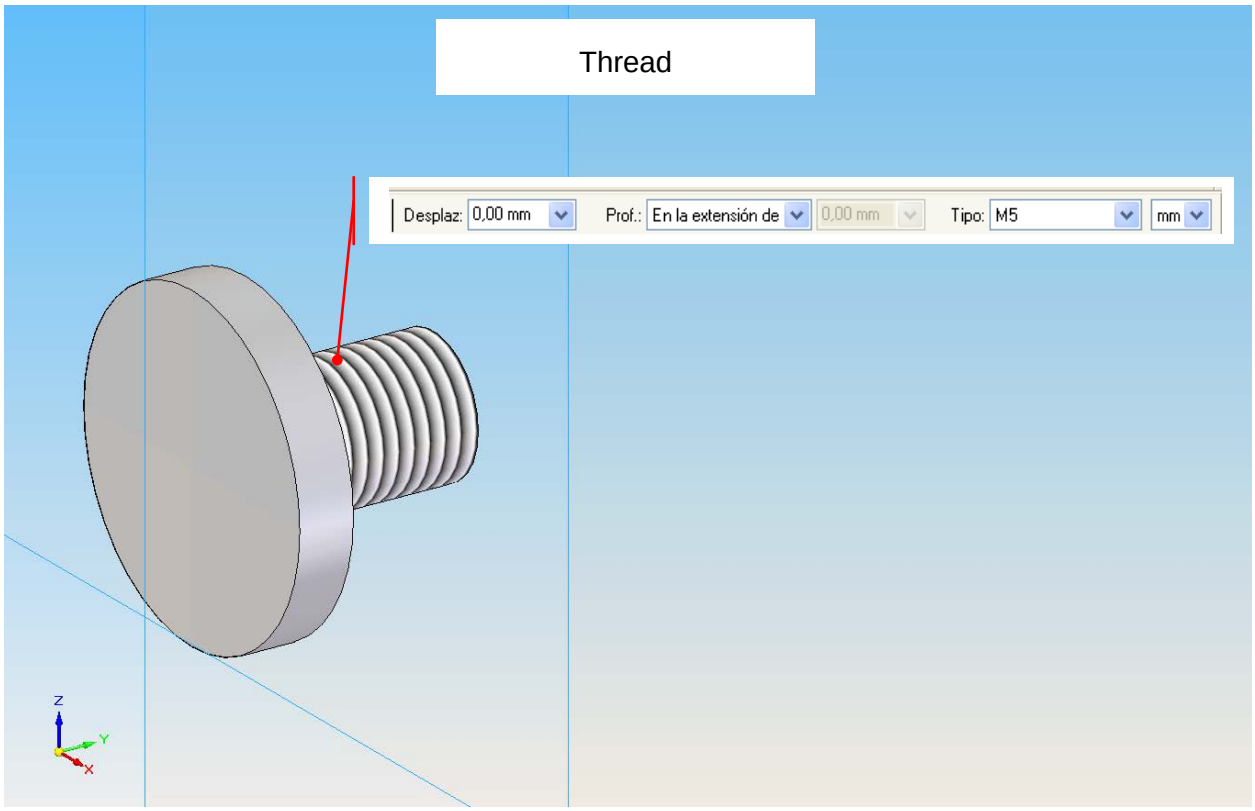
The first operation for the knurled screw is a Revolved Extrusion, and it is completed with an external thread and a chamfer.



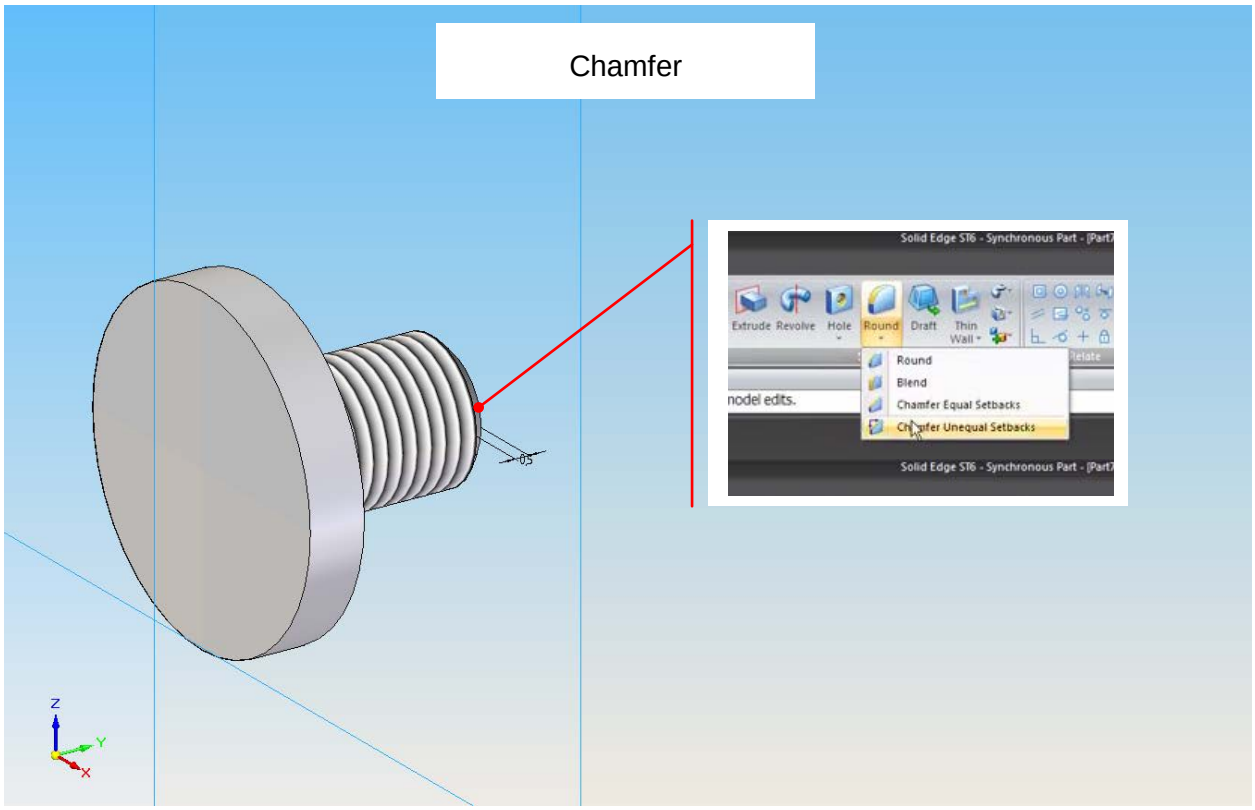
5.29. Image. Knurled screw: Protusion 1 profile (Solid Image made with Solid Edge)



5.30. Image. Knurled screw: Protusion 1 response (Image made with Solid Edge)

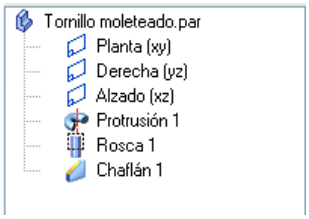


5.31. Image. Knurled screw: Options in thread 1 (Image made with Solid Edge)



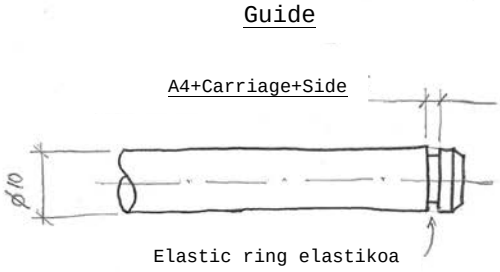
5.32. Image. Knurled screw: Options in chamfer 1 (Image made with Solid Edge)

PathFinder of operations of the knurled screw:



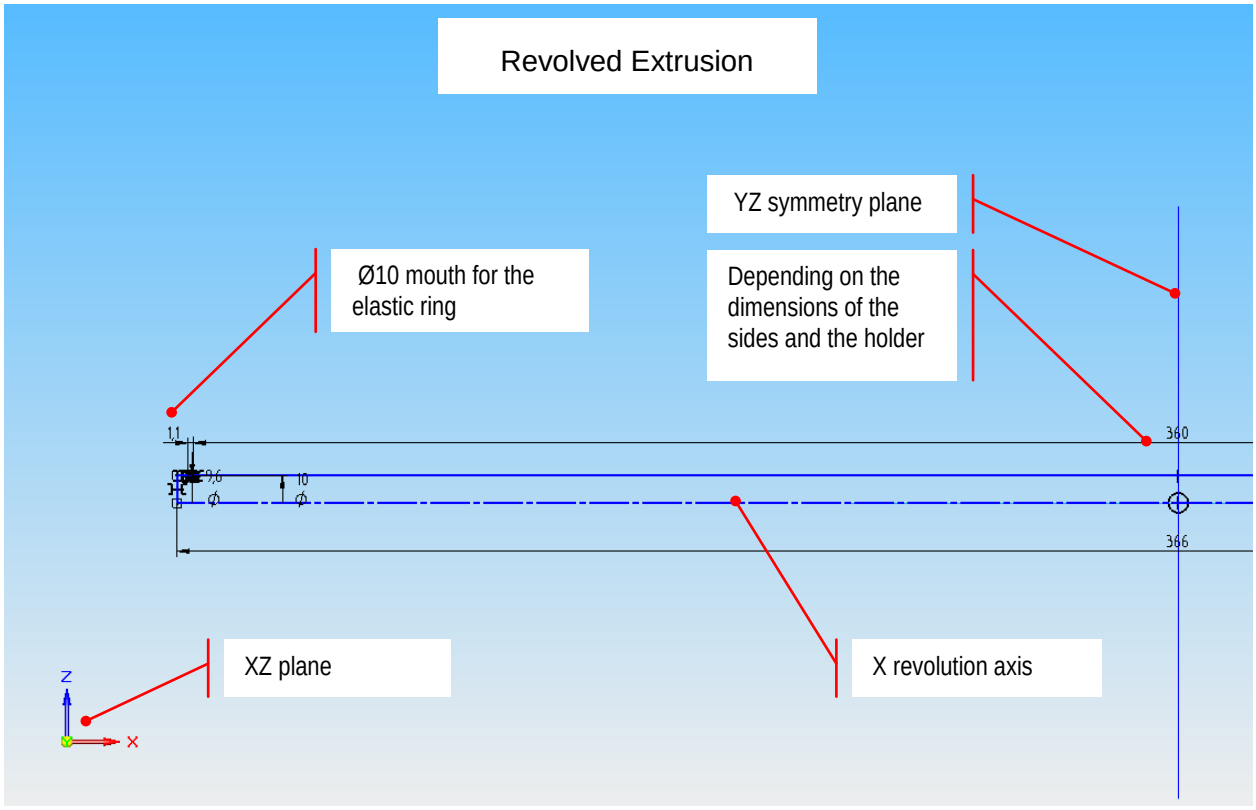
5.33. Image. Knurled screw: PathFinder of Operations (Image made with Solid Edge)

Guide

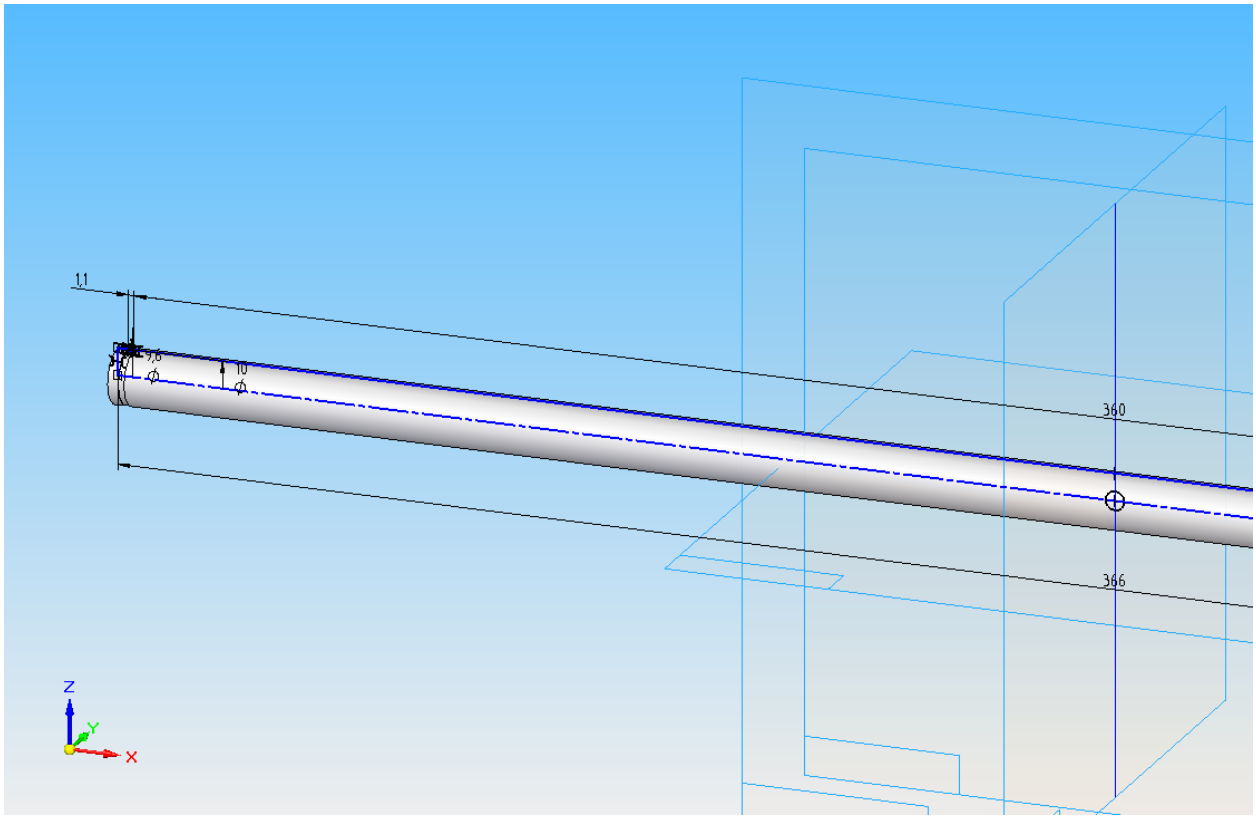


5.34. Image. Guide

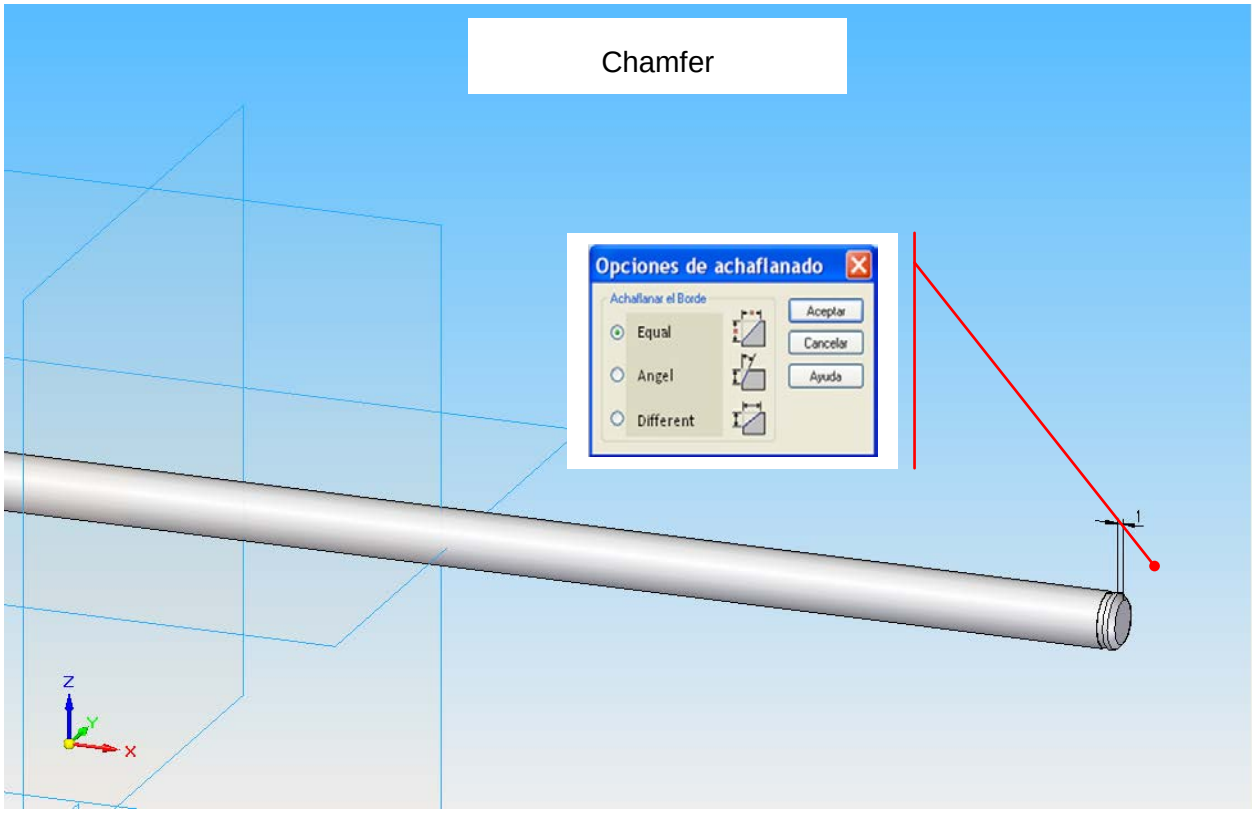
The first operation for the guide is a Revolved Extrusion, and it is completed with chamfers on the sides.



5.35. Image. Guide: Profile of Protrusion 1 (Image made with Solid Edge)

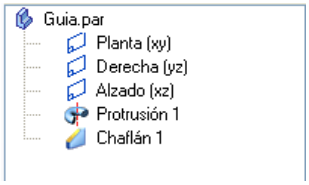


5.36. Image. Guide: Response of Protusion (Image made with Solid Edge irudia)



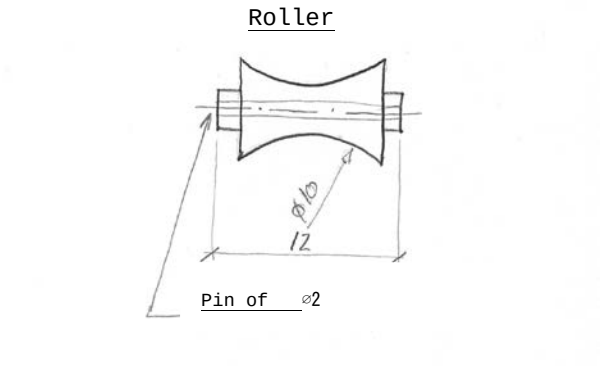
5.37. Image. Guide: Options of chamfer 1 (Image made with Solid Edge irudia)

PathFinder of operations of the guide:



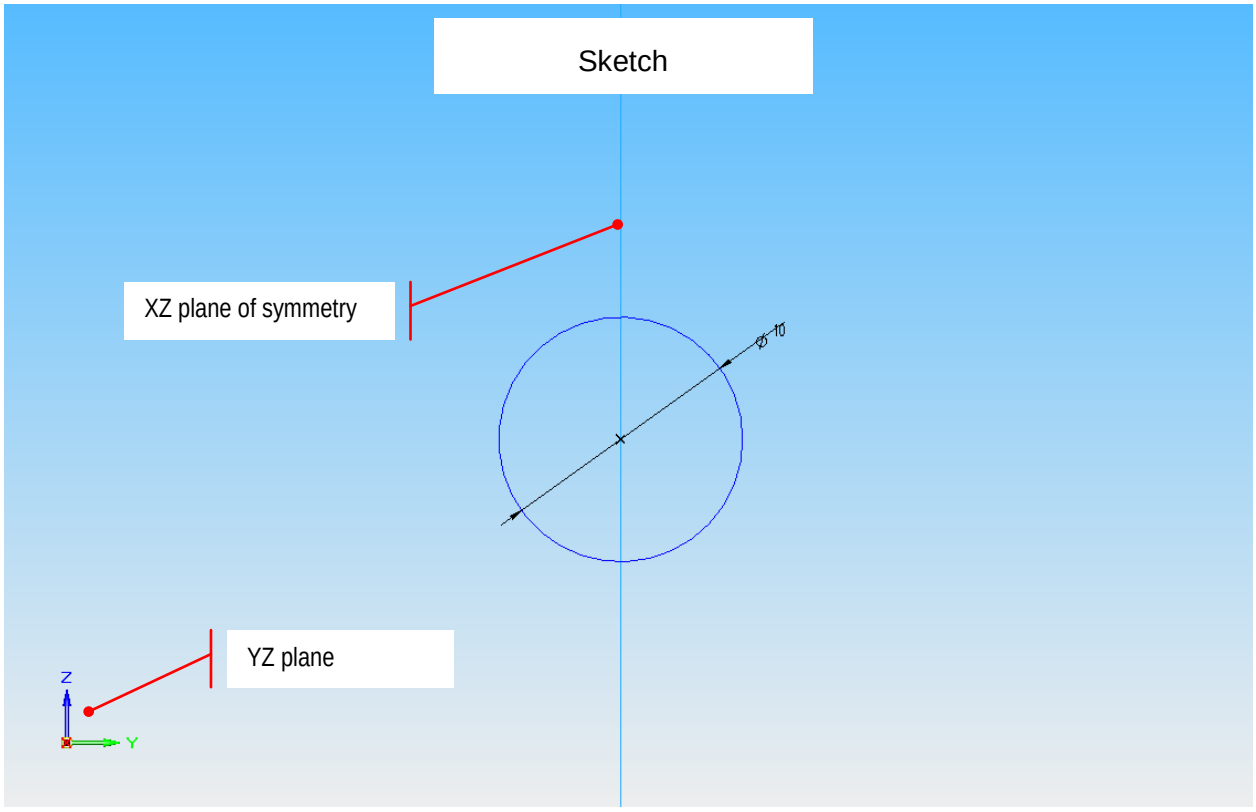
5.38. Image. PathFinder of Operations (Image made with Solid Edge irudia)

Roller

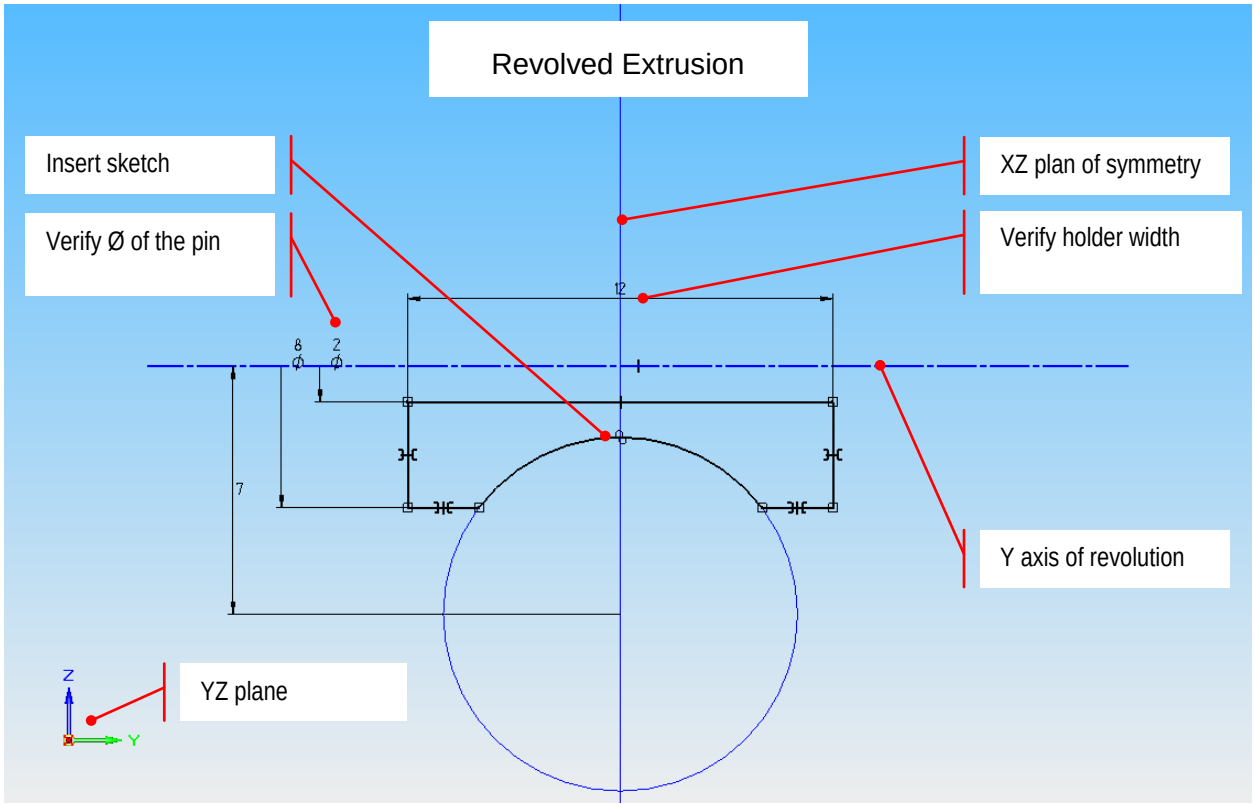


5.39. Image. Roller

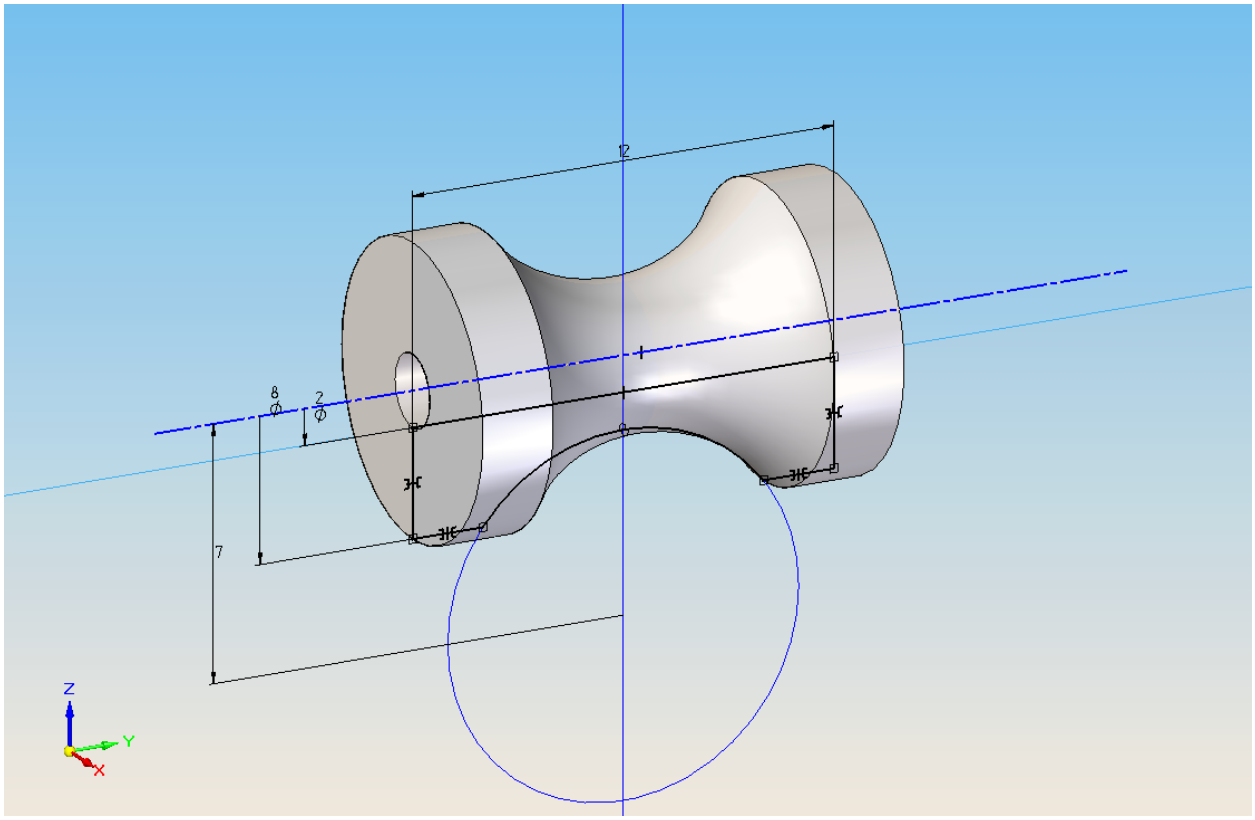
The first operation for the roller is a Profile of the Guide´s section, and it is completed with a Revolved Extrusion.



5.40. Image. Roller: Sketch 1 (Image made with Solid Edge)

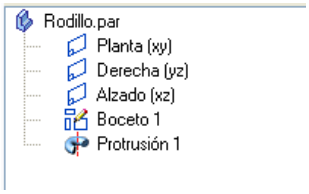


5.41. Image. Roller: Profil 1 of Protusion (Image made with Solid Edge)



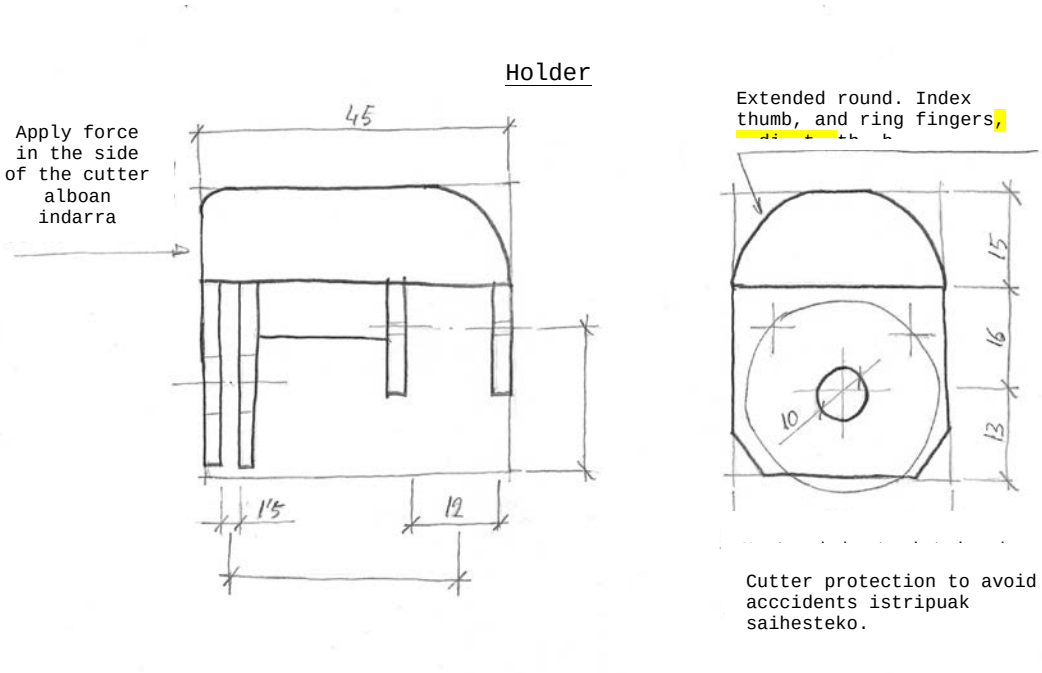
5.42. Image. Roller: Protusion 1 response (Image made with Solid Edge)

PathFinder of operations of the roller:



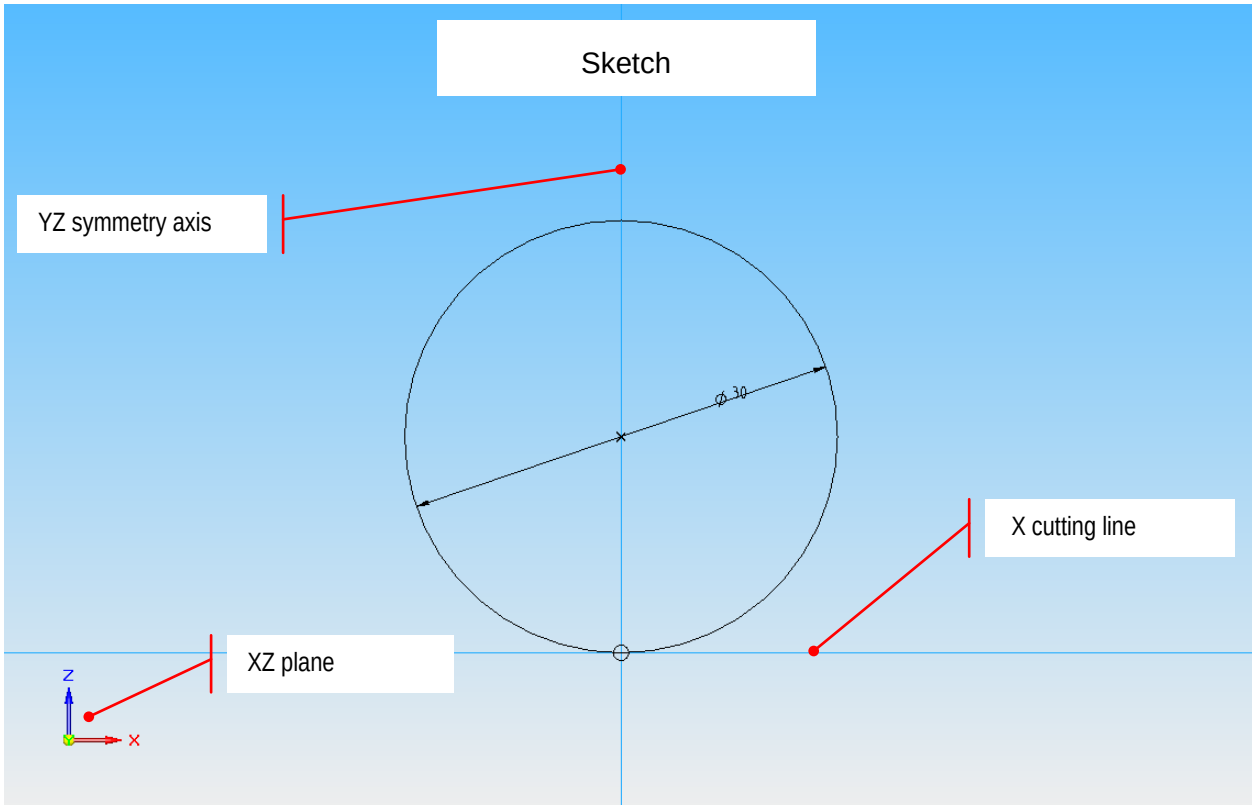
5.43. Image. Roller: PathFinder of operations (Image made with Solid Edge)

Holder

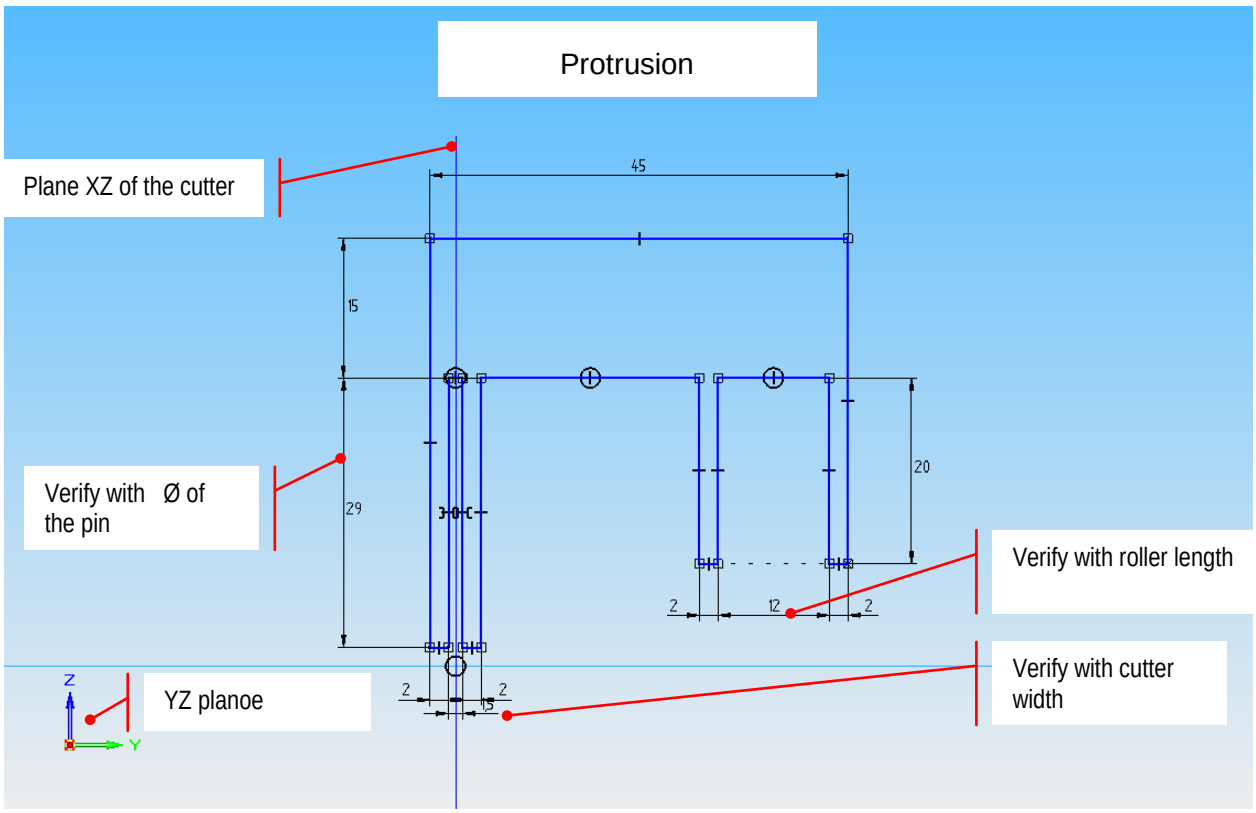


5.44. Image. Holder.

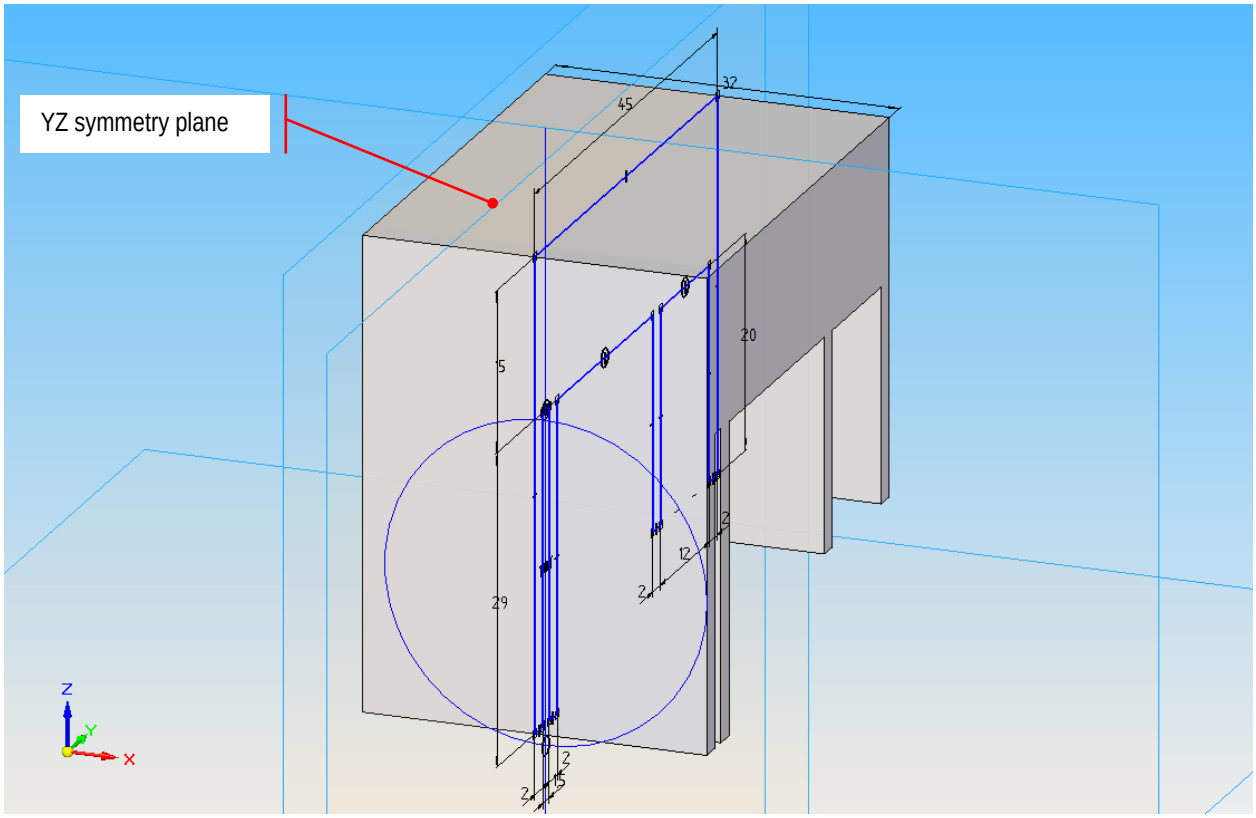
The first operation for the holder is a Sketch, and next go, the operations to add material: a Protrusion and a Reinforcement. Finally, material is removed with roundings, holes and removing.



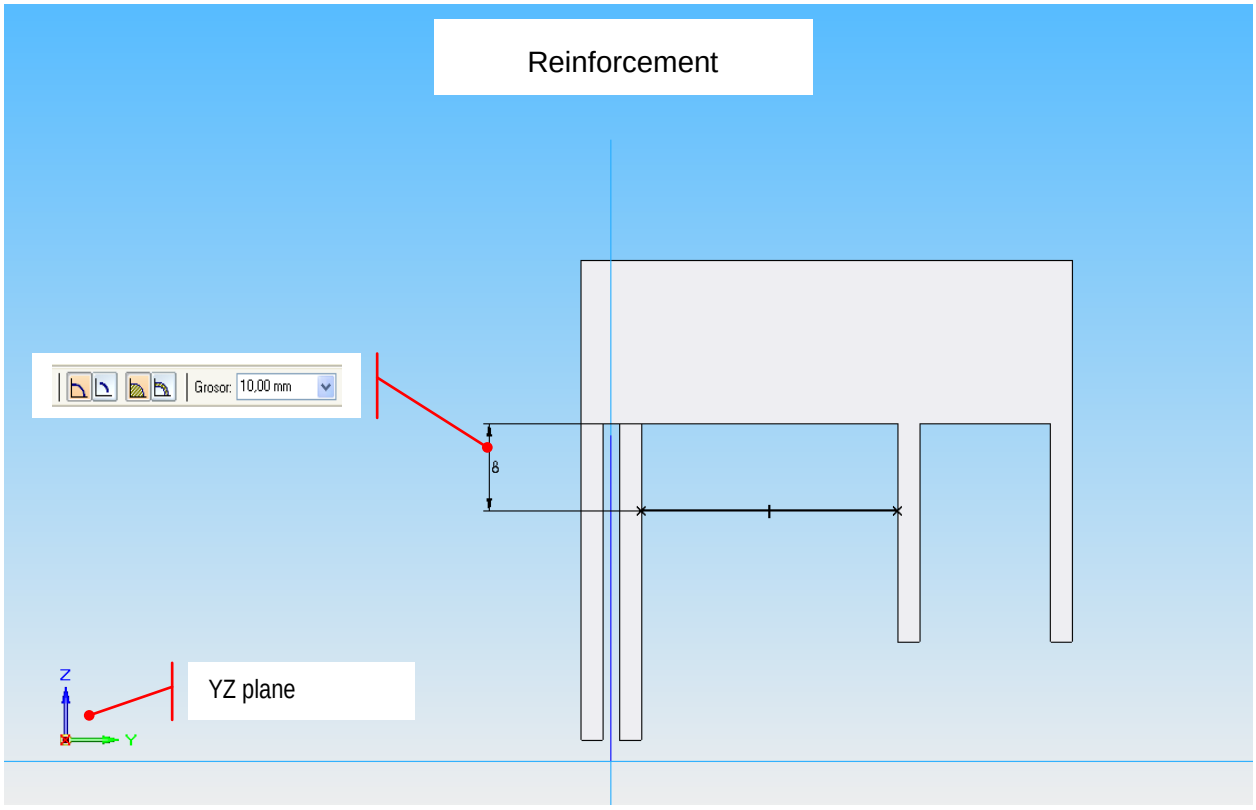
5.45. Image. Holder: Sketch 1 (Solid Image made with Solid Edge)



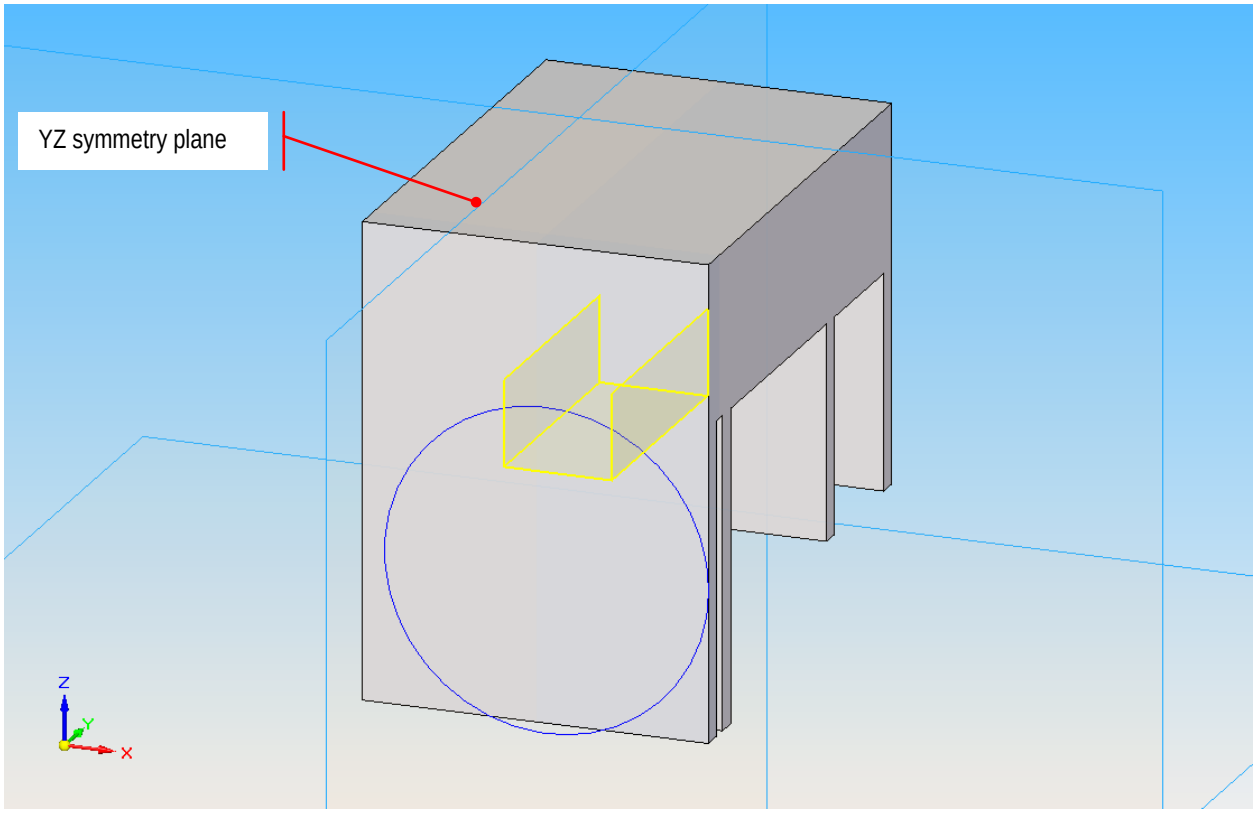
5.46. Image. Holder: Profile of Protrusion 1 (Image made with Solid Edge)



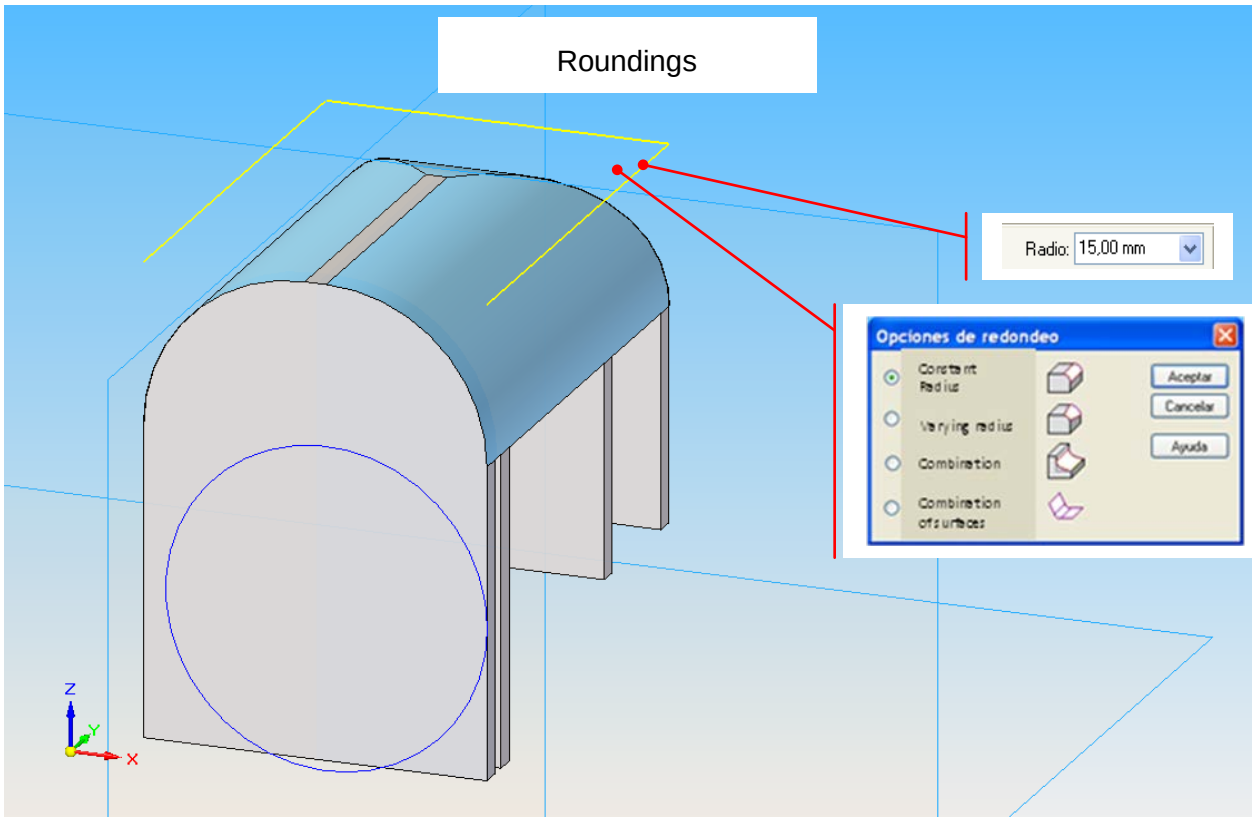
5.47. Image. Holder: Response of Protrusion 1 (Image made with Solid Edge)



5.48. Image. Holder: Profile and options of Reinforcement 1 (Image made with Solid Edge)



5.49. Image. Holder : Response of Renforcement 1 (Image made with Solid Edge)



5.50. Image. Options of roundings 1 (Image made with Solid Edge)