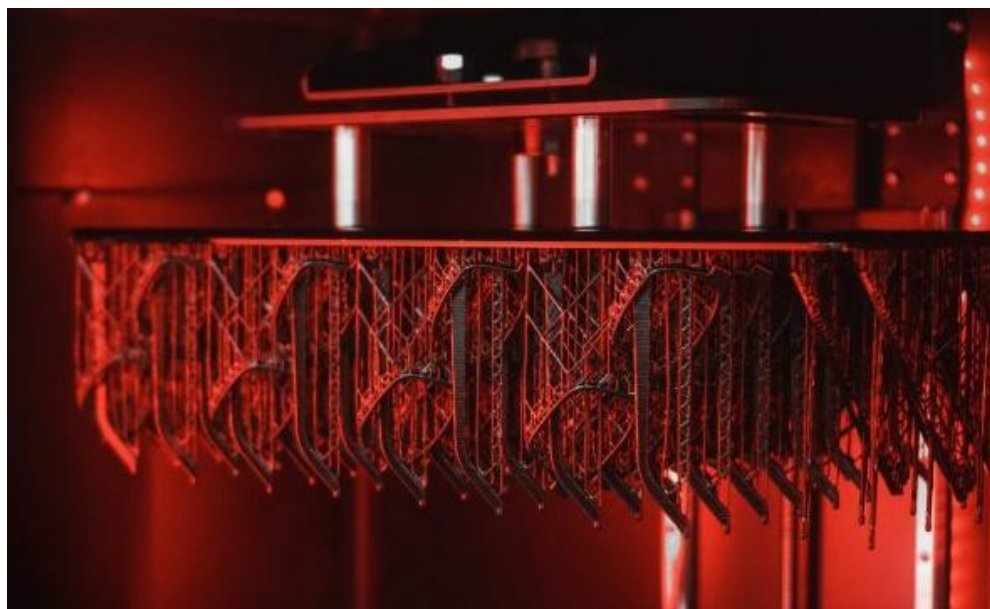




Remote workshop for additive manufacturing



Practice 1 - Orientation and arrangement of a piece in the Slicer of LCD technology additive manufacturing equipment

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Student Name:

Delivery Date:



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OBJECTIVE

The objective of this task is to familiarize the user with basic commands of the PHOCENTRIC STUDIO slicer interface of an additive manufacturing equipment using LCD technology.

1. PREVIOUS KNOWLEDGE.

In order to carry out the practice, the student must have prior knowledge such as:

- Basic notions of industrial design or 3D drawing.
- Behavior of the materials to be manufactured with the 3D printing technology used.
- Operation of LCD technology
- Characteristics of the part to be manufactured.

2. THEORETICAL RESOURCES.

- Teaching Guide
- Remote Workshop Manual
- Annexes: Additive manufacturing equipment interface user manual
- Glossary

3. DESCRIPTION OF THE PRACTICE.

The practice aims to teach the student how to configure an OBJ/STL file (format generally used for 3D printing) within the slicer that allows correct manufacturing in an 3D Printer through the use of LCD technology.

Its orientation, layout and the way it has been designed are crucial for the piece to be successfully generated and to meet the desired technical specifications.

The arrangement of completely flat faces in the XY plane of the manufacturing tray will be avoided. In this way, deformations due to thermal contractions or expansions in the file will be avoided.

To avoid this problem, the pieces will be arranged so that when each of the layers is created, the layer surface is as small as possible, avoiding any extensive flat face in the XY plane.

4. SAFE USE OF THE EQUIPMENT IN THE LABORATORIES.

The activities proposed in this workshop do not require physical or online monitoring by a teacher.

5. ACTIVITIES

Activity 1: Previous Knowledge test.

Activity 2: Orientation of the piece.

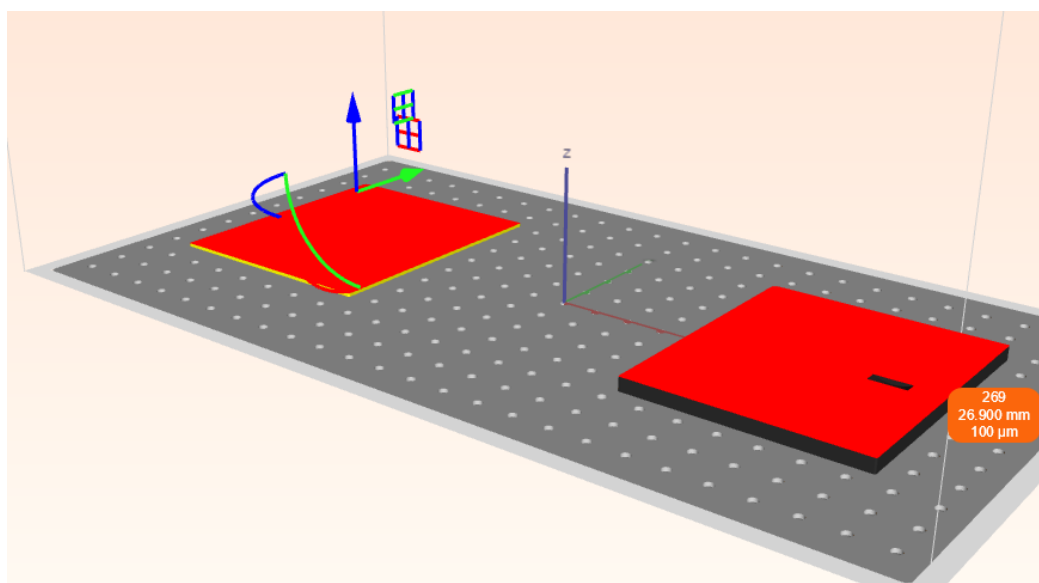
Avoid placing excessively large flat faces on the XY plane. Rotate and reorient a few degrees.

The SLT or OBJ file is introduced with the software once it is open, or alternatively we can grab and drag the STL file to the interface software.

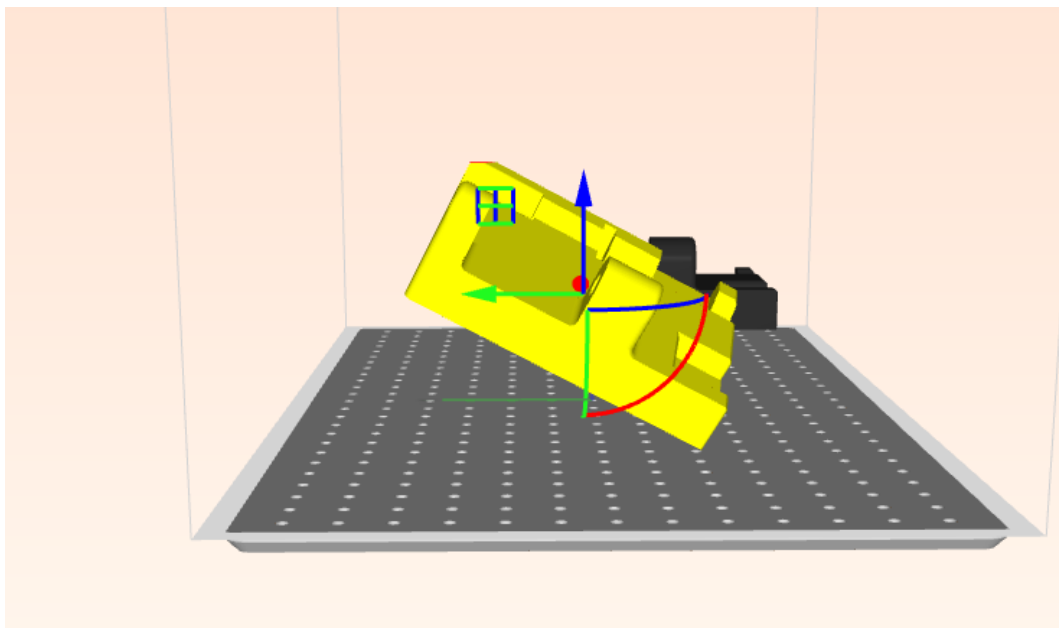
Once inside, click on the piece, at that moment it will appear in yellow and the axes that allow us to reorient the piece will be shown.

When reorienting the piece, the following considerations must be taken into account:

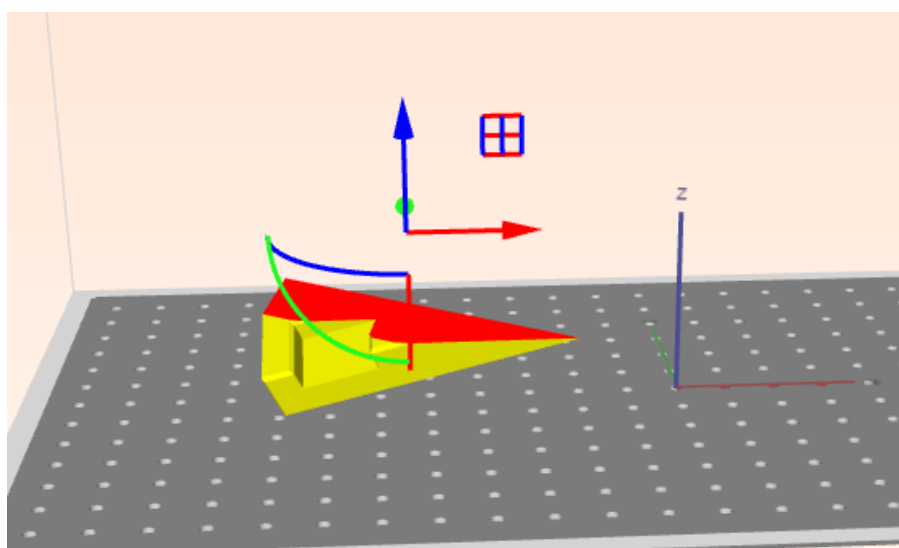
- a) Avoid the creation of large flat layers in parallel with the manufacturing platform. If our piece to be manufactured contains flat plates during its creation with this manufacturing technology, they may tend to lose flatness due to the appearance of thermal expansions.



Creation of flat plates parallel to the manufacturing platform

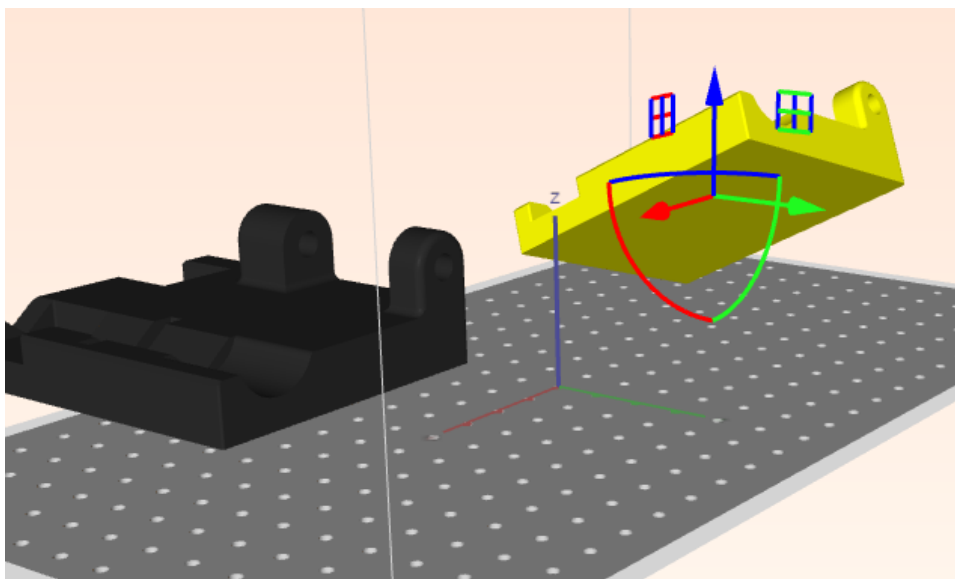


Reorientación de la pieza para evitar que cada capa creada huya de una disposición coplanar con la cama de fabricación



With the new orientation the created layer loses surface parallel to the bed in each layer created

- b) Reorientation of the part to prevent each layer created from escaping a coplanar arrangement with the build bed



The lower face does not have the same importance as the upper face, where there is a greater demand for tolerance.

Activity 3: Lightening parts.

Additive manufacturing allows the removal of material from the inside of parts to lighten them and reduce their weight. This feature is much more complicated in other manufacturing processes and conditions the process. With additive manufacturing, a part can be lightened in two ways: Either by just pouring, or by adding an internal mesh that gives the part more strength while reducing the amount of material added.

The pouring will make the part to be manufactured hollow by inserting an offset. With the precision parameter you can control the size of the sampling grid and therefore the size of the triangles in the offset mesh.

Internal meshes. The filling function can be used to generate an internal mesh in a previously poured object. This makes the object more robust during printing.

Activity 4: Supports.

Automatic creation. Having previously selected the piece, an auxiliary support structure can be created so as not to compromise manufacturing and to be able to manufacture those parts that are cantilevered.

Recommendations: Modify the diameter of the tip and the thickness of the support itself. Creating predetermined supports will make the generated pieces offer resistance when removing them and obtaining our piece.

Activity 5 : Outcome evaluation questionnaire.

Complete the “LCD additive manufacturing” questionnaire from the data filled in the tables above. which will be published as an annex

6. Learning Outcomes.

1. Establish knowledge of the minimum commands required to prepare a manufacturing process with this technology.
2. Recognize the different possible configurations of the piece within the slicer.
3. Prepare the manufacturing process for this 3D manufacturing technology

7. Evaluation Criteria

1. Well-oriented parts: avoiding their arrangement parallel to the manufacturing tray.
2. Design of the part in accordance with this additive manufacturing technology.

8. Evaluation tools.

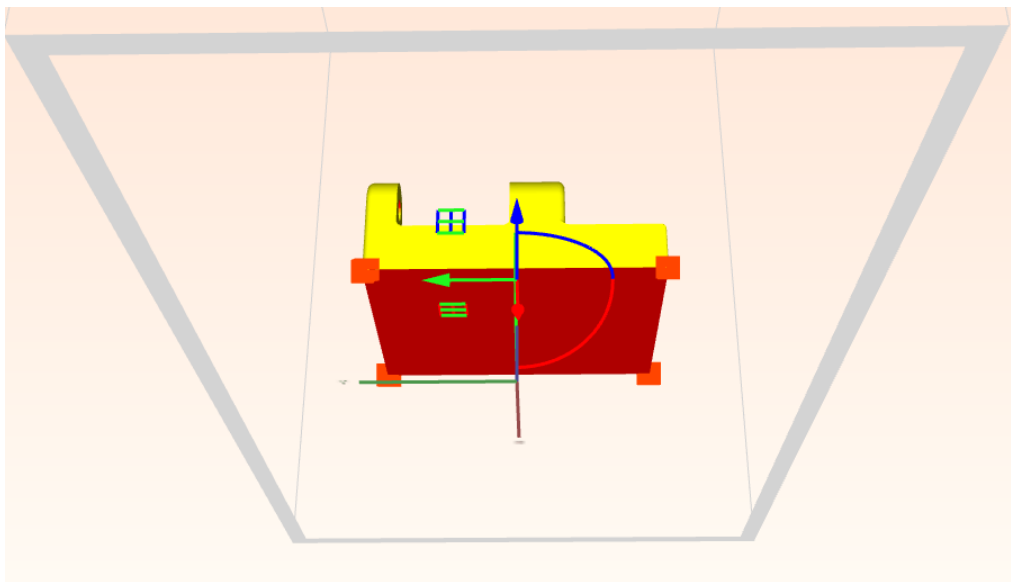
- Connection time to the remote workshop
- Completion of questionnaires that allow the user to carry out: Kanban Box Methodology + Active Recall
- Check by the teacher helped by FEMPA's workshop technician document on the geometric layout of the piece, design, to see if the design of that piece is suitable or not for LCD additive manufacturing, creation of supports.
 - Check 1 ☐
 - Check 2 ☐
 - Bonus ☐
 - Check 3 ☐
 - Check 4 ☐
 - Bonus ☐
 - Check 5 ☐

*To pass test is necessary to have 3 points correct.

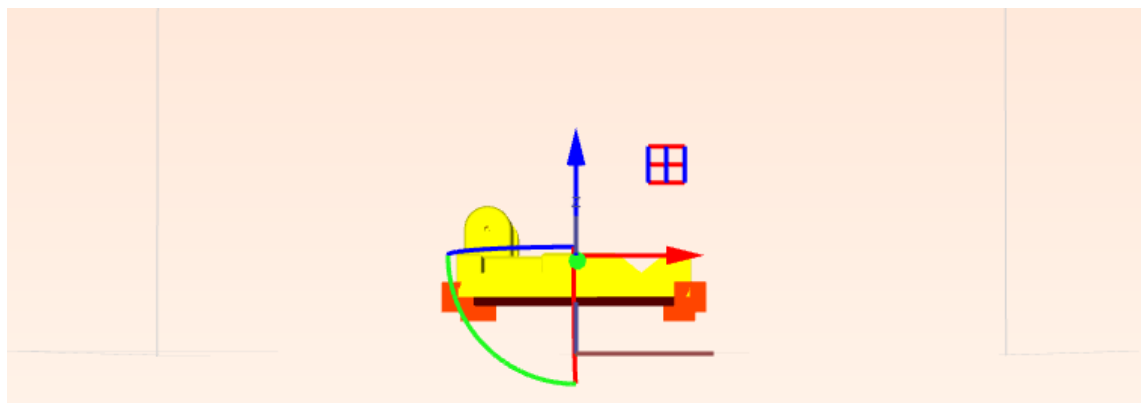
FEMPA's document workshop for additive manufacturing

Check 1: Identify the face with the least demands:

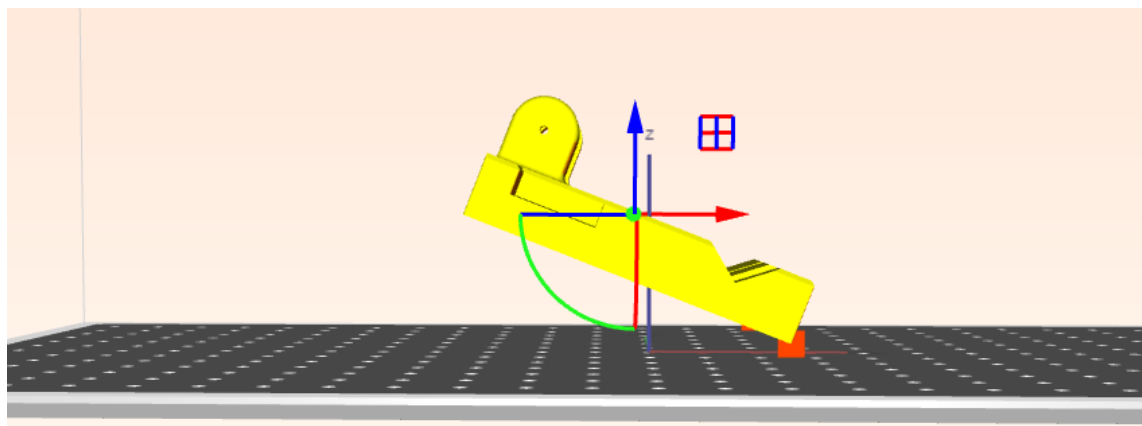
Solution: Bottom face of the piece, flat face. Face selected in red.



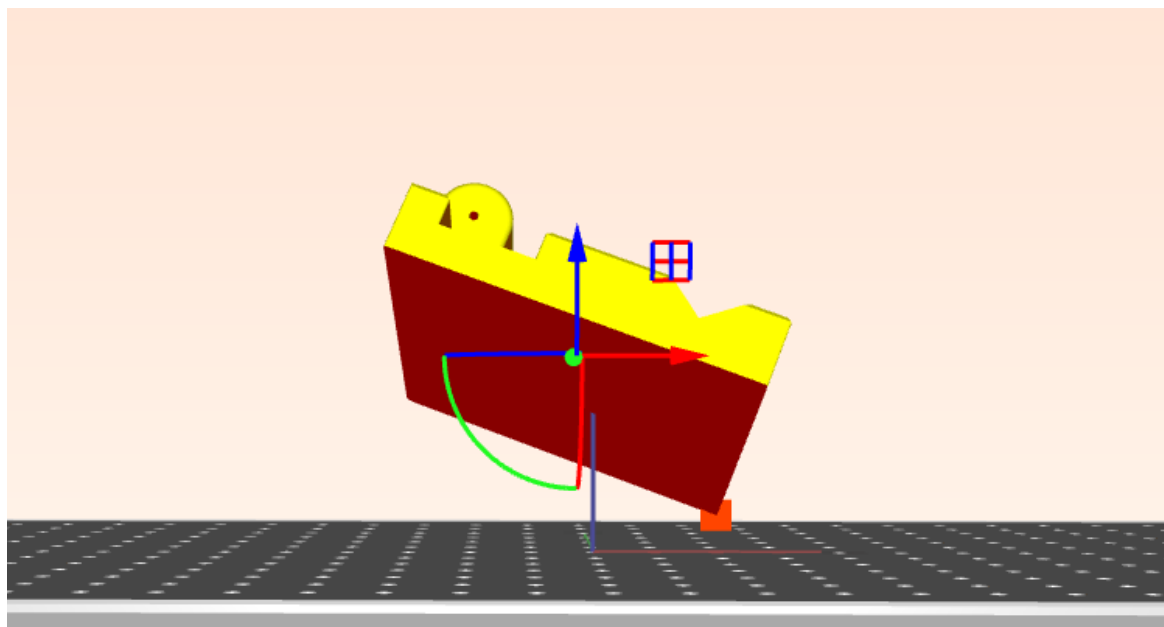
Check 2: X axis. The part had to be prevented from being parallel to the manufacturing platform:



Example of proper position:

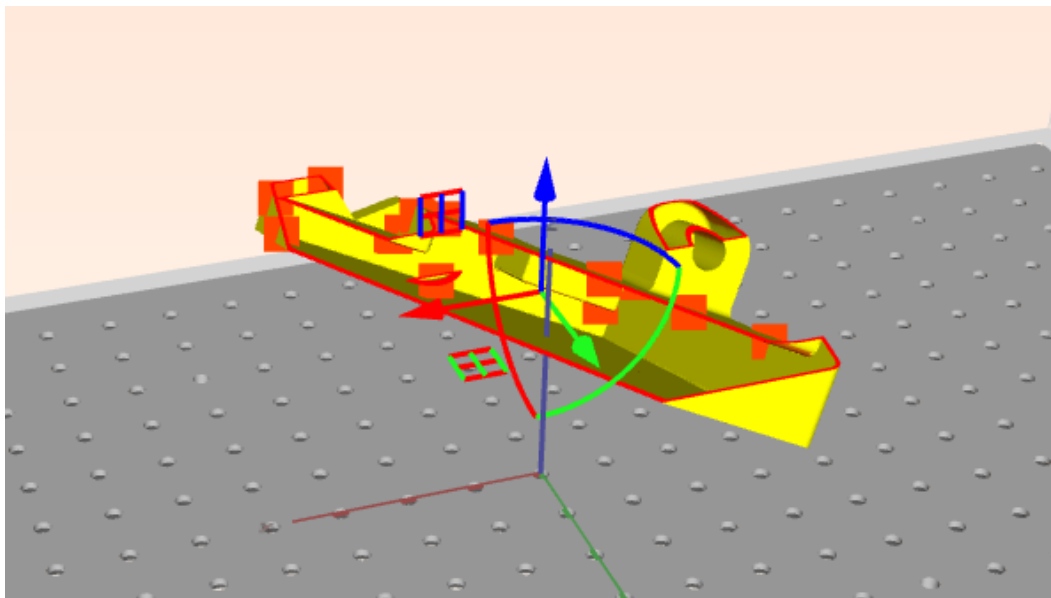


Bonus: If the piece is tilted on both its X and Y axis, an additional point may be awarded to the student. Example.

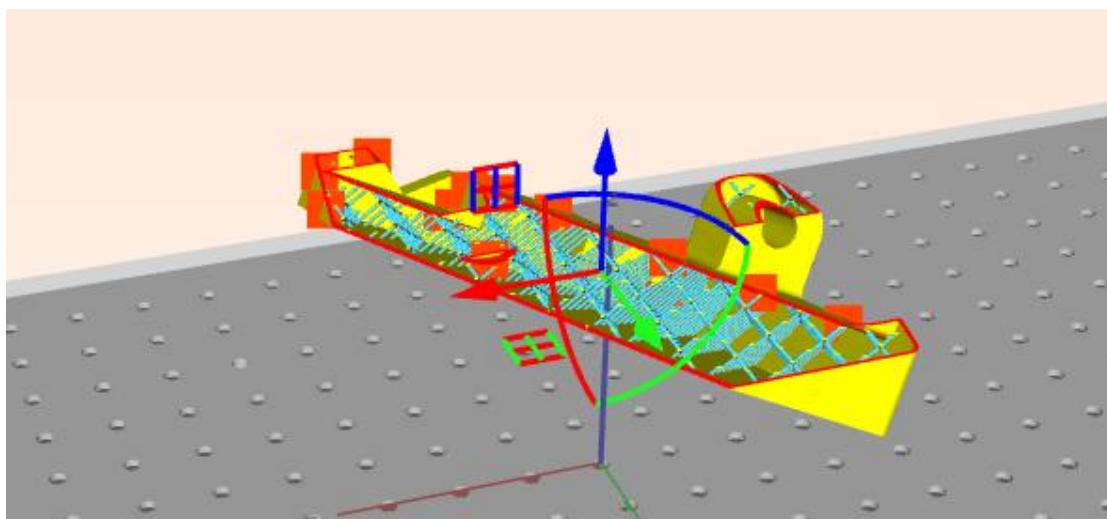


Check 3: Lightening the parts

Use the sidebar to observe the evolution of the layers. Observe whether the student has emptied the layers properly.

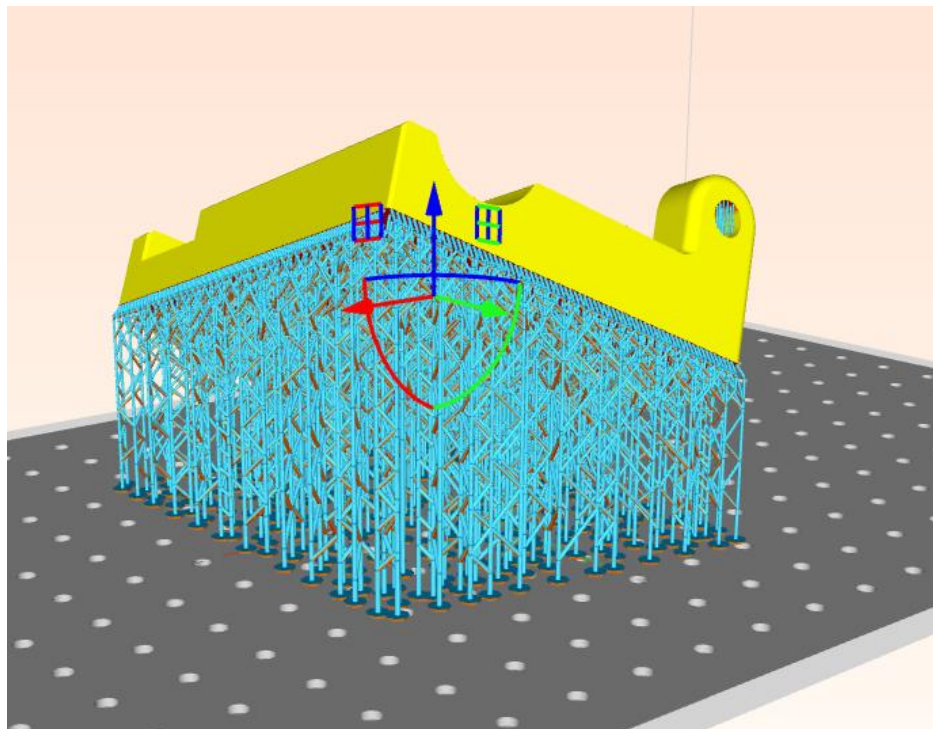


Using the sidebar, see if the casting has been filled with an internal mesh structure to maintain the rigidity of the part.



Check 4: Support generation.

Check that the supports have been generated on the faces of the part that have the lowest surface demand (bottom flat part):



Bonus: If the student has considered adjusting the diameter of the tip and the support below 1mm and above 40mm, this will be assessed by giving him/her another additional point.

Densidad	100	[%]
Diámetro de la punta	0.40	[mm]
Diámetro del soporte	0.70	[mm]
Altura del pie	0.80	[mm]
Ángulo crítico para construir soportes	47	[°]
☐ Añadir base		

Final check. Ask the student to indicate the manufacturing hours and the amount of material needed.

