Task for the summer semester 2025

Design and construction of an autonomous vehicle that can follow a line, detect and avoid obstacles

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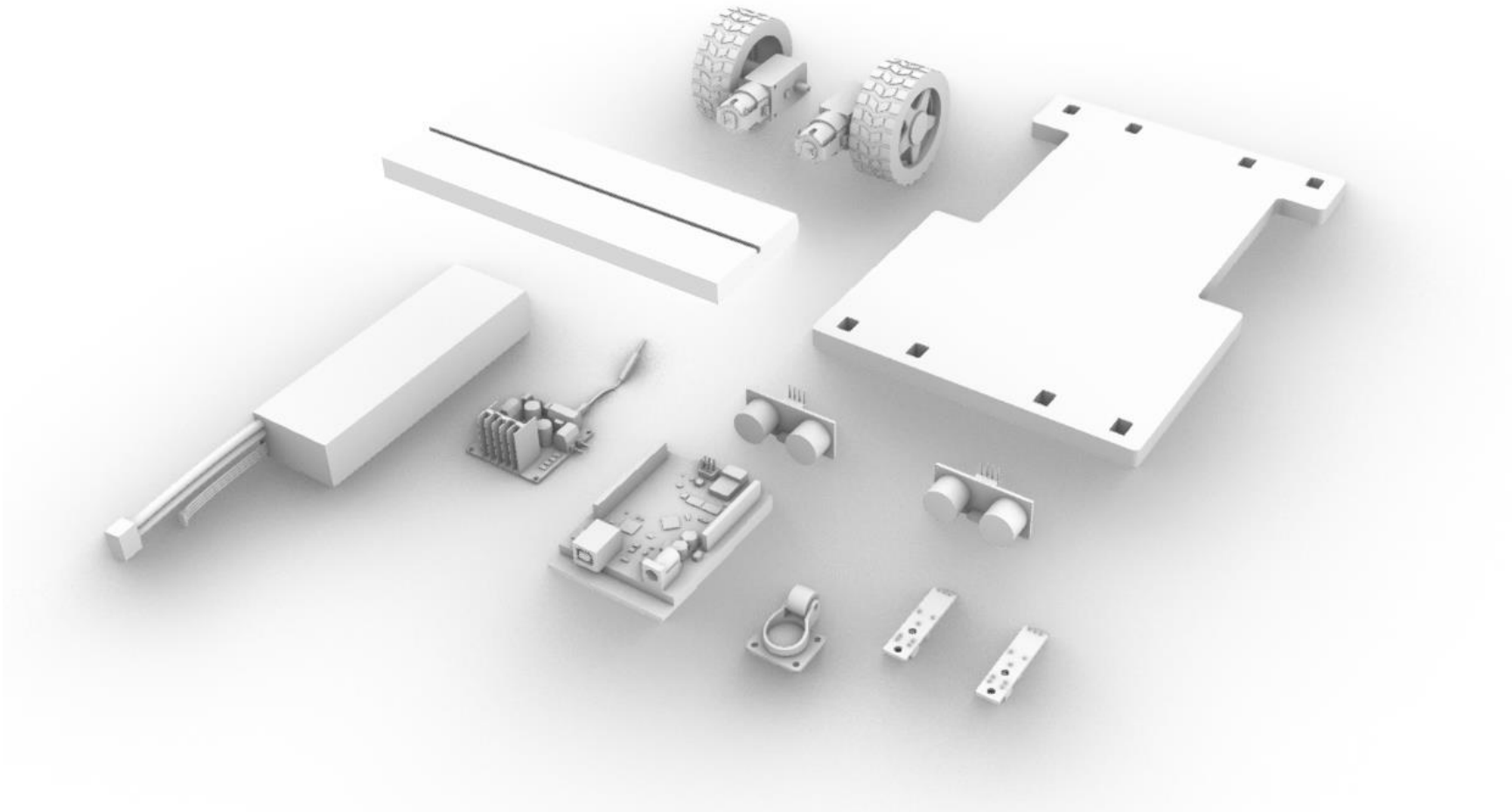

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Topics during the semester

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Microcontroller
Mr. Henkler

Physical prototyping
Mr. Wahrmann

Programming
Ms. Pasandideh

Prototyping schedule for the semester project

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7th and **9th** of April Kick-off

14th and **16th** of April first parts 3d modelled. Discussion and Feedback.

Revise or new modelling of 3d parts until the **22nd of April submission by mail until 0 o´clock for monday groups. Submission for wednesday groups 24th until 0 o´clock.**

Name the parts with your team number before you mail them ! Use the file format .stl. If it is to big send it to me via WE-transfer. Send the data or link to the following adress: gido.wahrmann@hshl.de

Printing the parts by Mr. Wahrmann.

28th and **30th** of April handover of the 3d printed parts to you. Start the assembly of the vehicle.

Guidlines for the prototyping project

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Design with the provided parts an autonomous vehicle

1. You have to use the provided parts.

   Each group has to design their own components to connect the parts to the chassis. The parts has to be watertight for 3d printing (description follows)

   Only mechanical connectíons are allowed. No hot glue / glue or tape or zip ties.

2. Arange the parts with a CAD tool. You can chose in which direction you want to drive.

3. 3d modelling of geometries to fix the parts to the chassis. The parts will be 3d printed. Each team has a maximum printing time of max. 190 min. (we will tallk about that point some slides later)

Prototyping grading

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Modelling the following 3d parts within the time period and submit them as described:

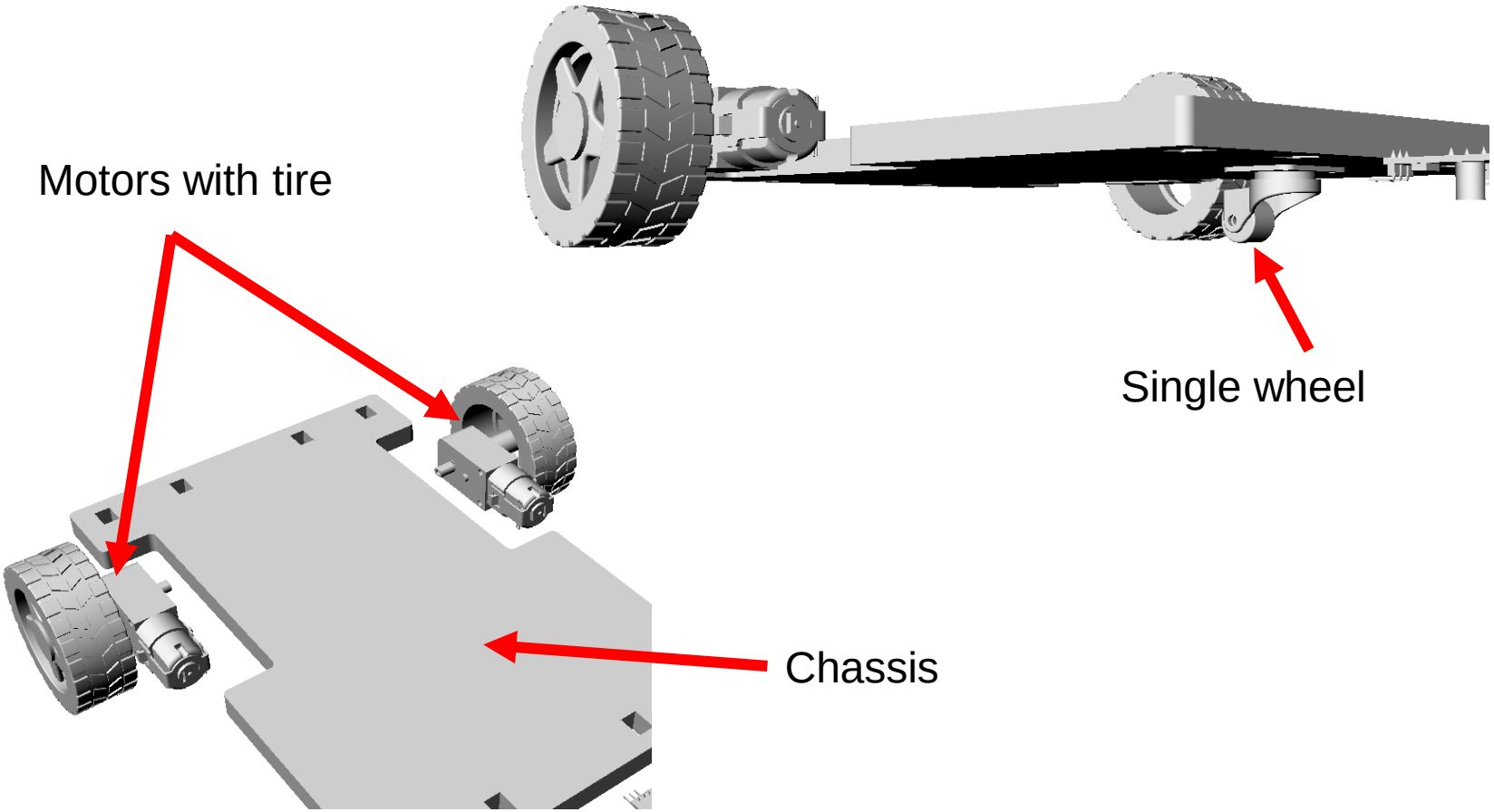
Motor holder, IR-Sensor holder and the combined breadboard/battery holder the other parts are graded as a bonus. I will grade the originality of your parts and how you meet the reqirements. Each team has to submit the parts by mail or download. Name the parts with your team number.

Stay within the time limit for 3D-printing. The over all printing time should not be more than **190 min.**

If you cant make it until the 22nd (Monday groups) and 24th (Wednesday groups) you will fail the prototyping part. (we will provide spareparts for you so that you can go on with the project)

Guidlines for the prototyping project

Start with the component to attach the motors to the chassis



Guidlines for the prototyping project

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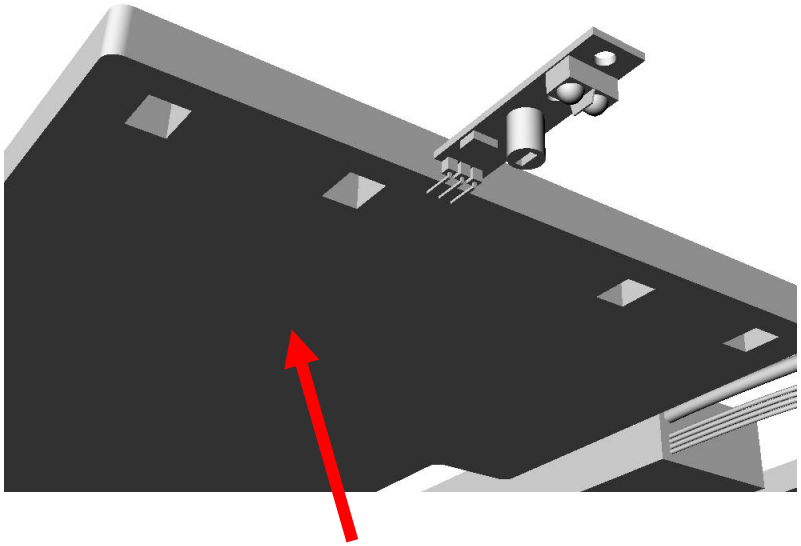
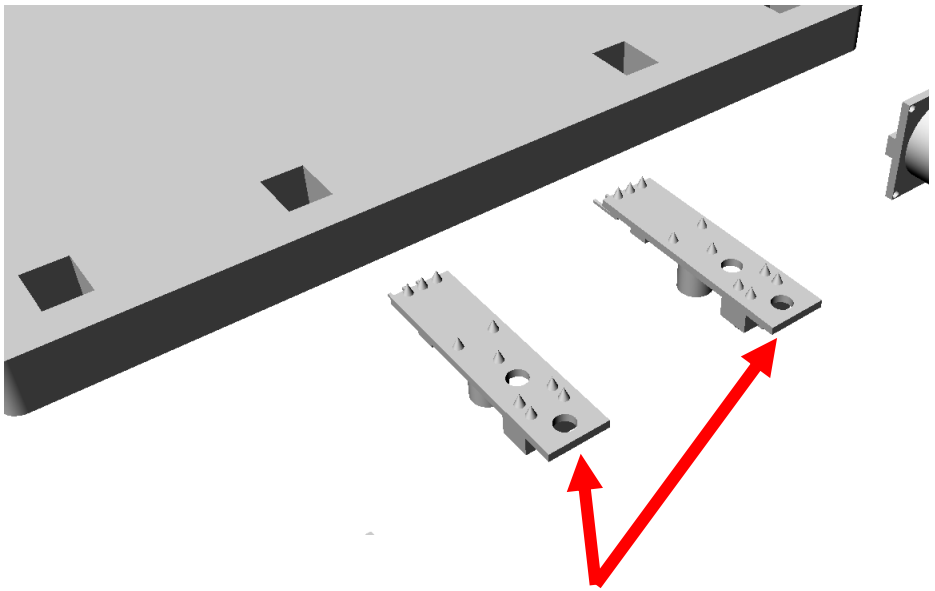
Go on with the component to attach the IR-Sensors to the chassis.

We recommend to construct them as modular as possible to get the best distance between them and to adjust the hight to dectect a line.



Chassis



IR Sensors

Guidlines for the prototyping project

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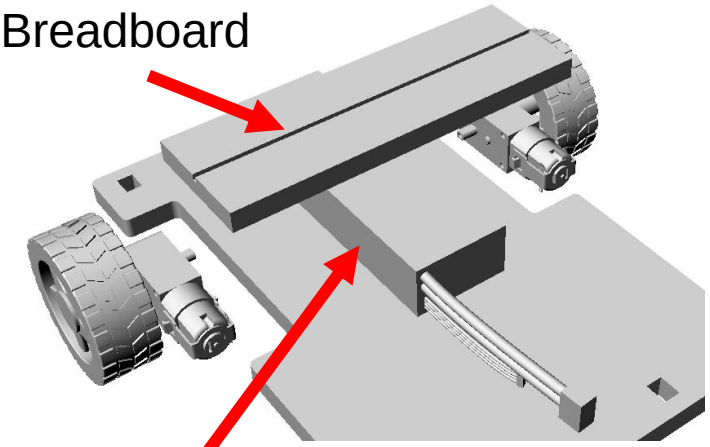
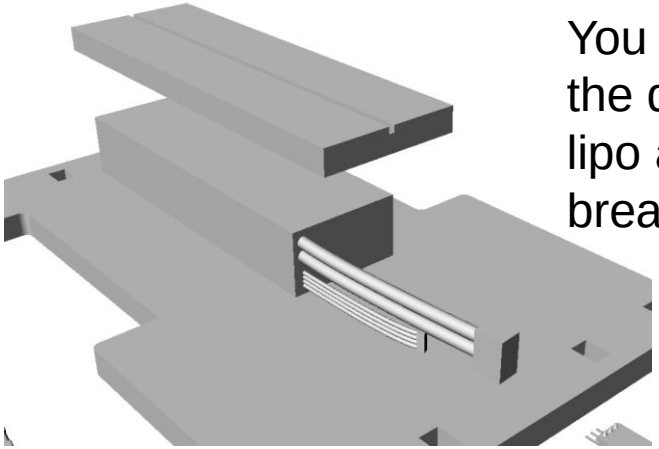
Next part are the components to fix the breadbord and hold the battery in place

Last part should be the holder for the ultrasonic sensor.

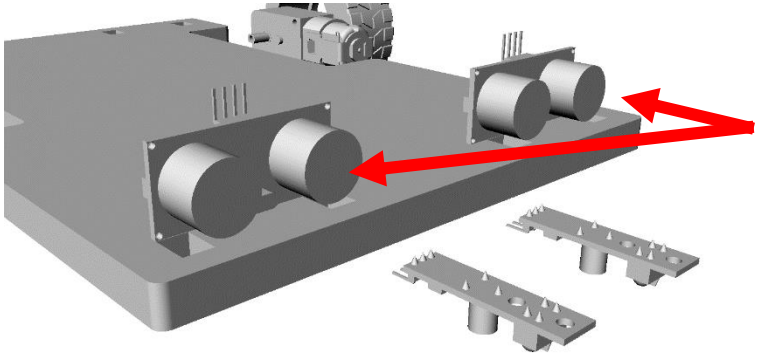
Breadboard



Lipo Battery



You can chose the direction of lipo and breadboard



Ultrasonicsensors

Introduction

- Additive manufacturing (AM)
  How does 3d-printing works

Additive manufacturing (AM)

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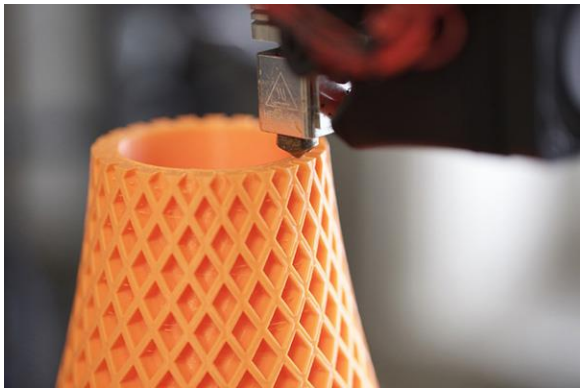
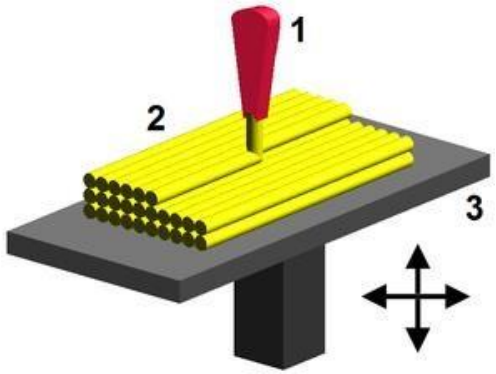
Fused Deposition Modeling (FDM)

FDM printers use a thermoplastic filament to create 3D objects. The filament is melted inside the barrel of a printing nozzle. Once it becomes hot liquid resin, it is laid down layer-by-layer. Before an object can be printed, it has to be converted into a format the 3D printer can comprehend, which is typically an .STL format.





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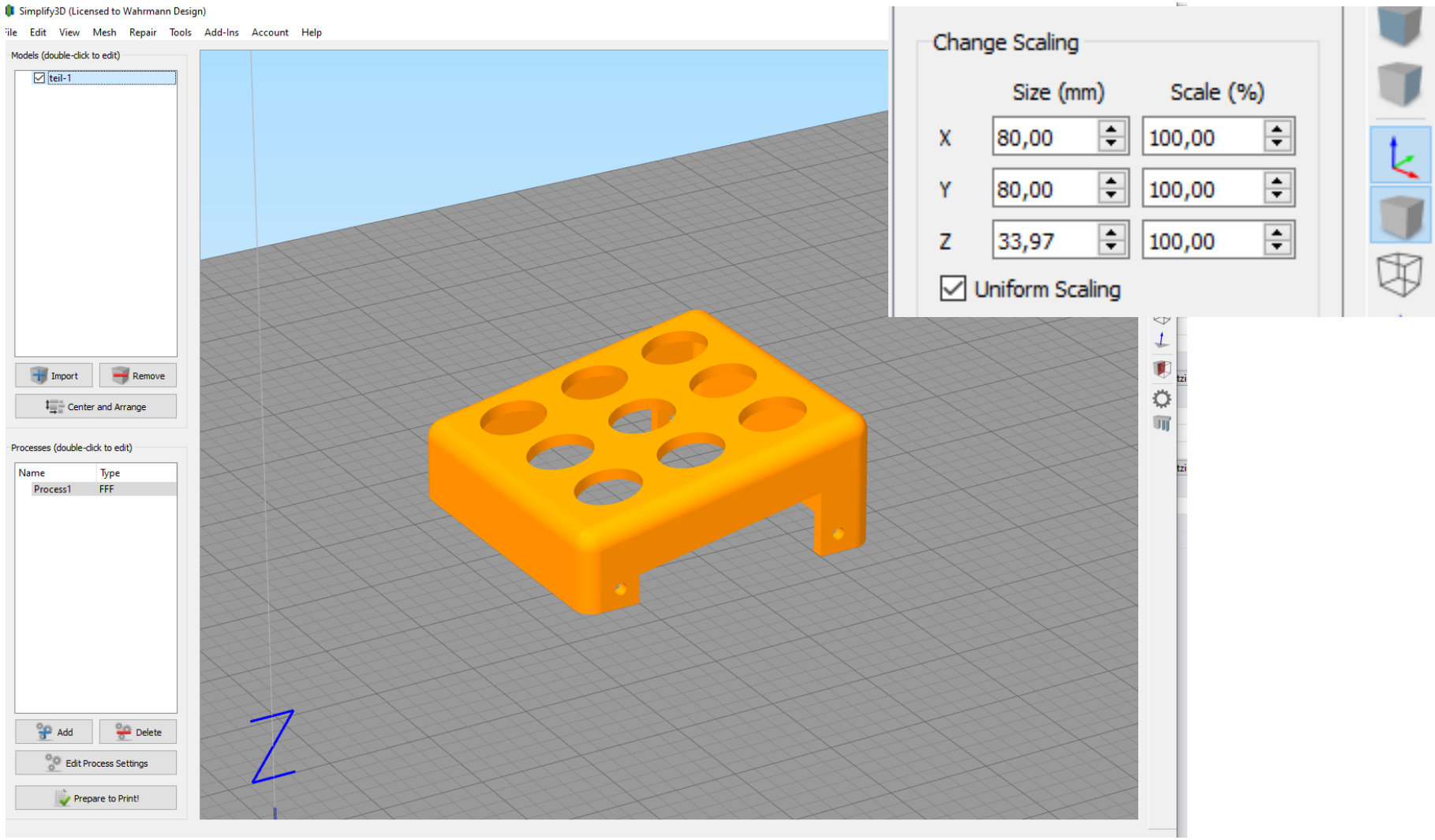

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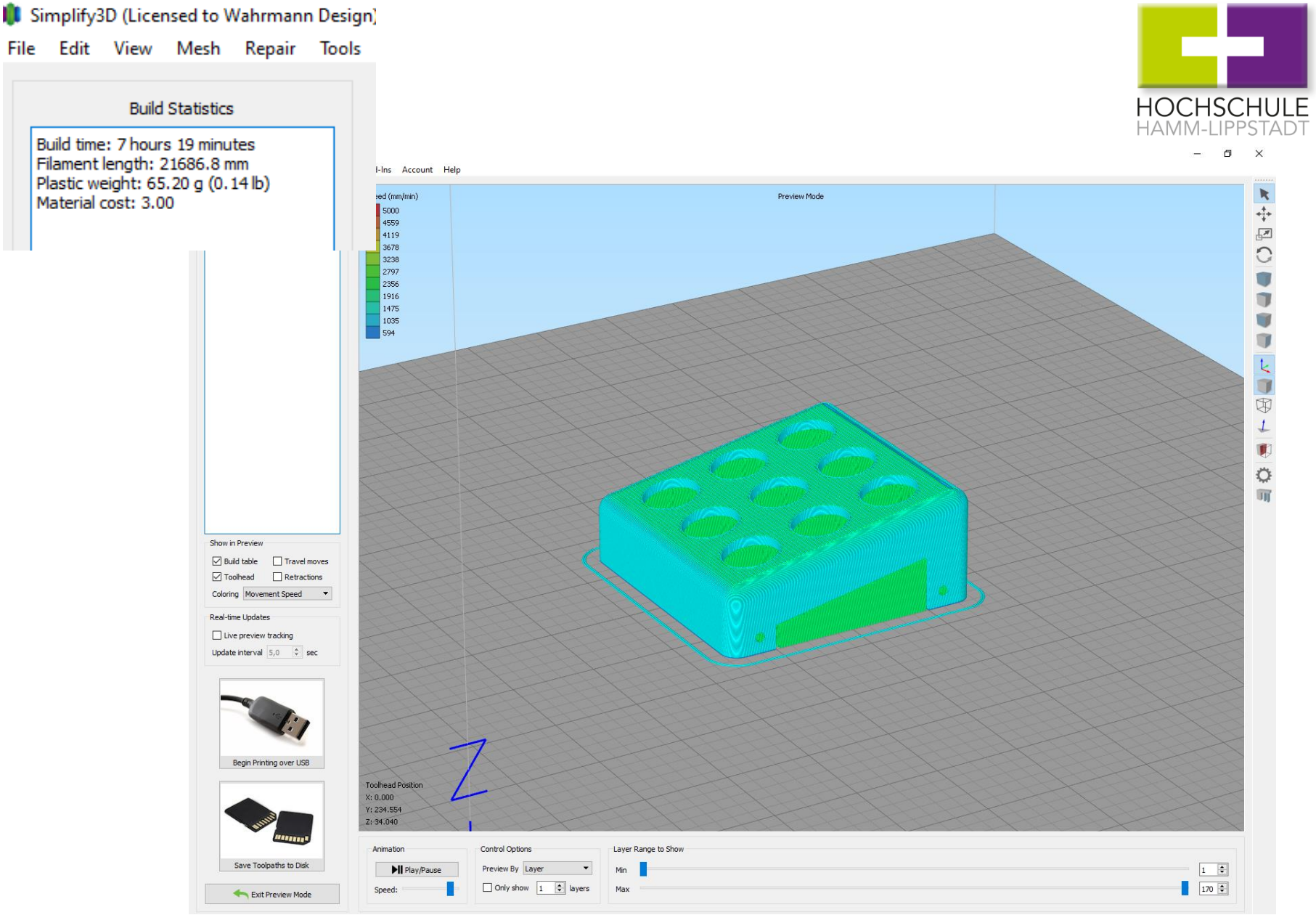

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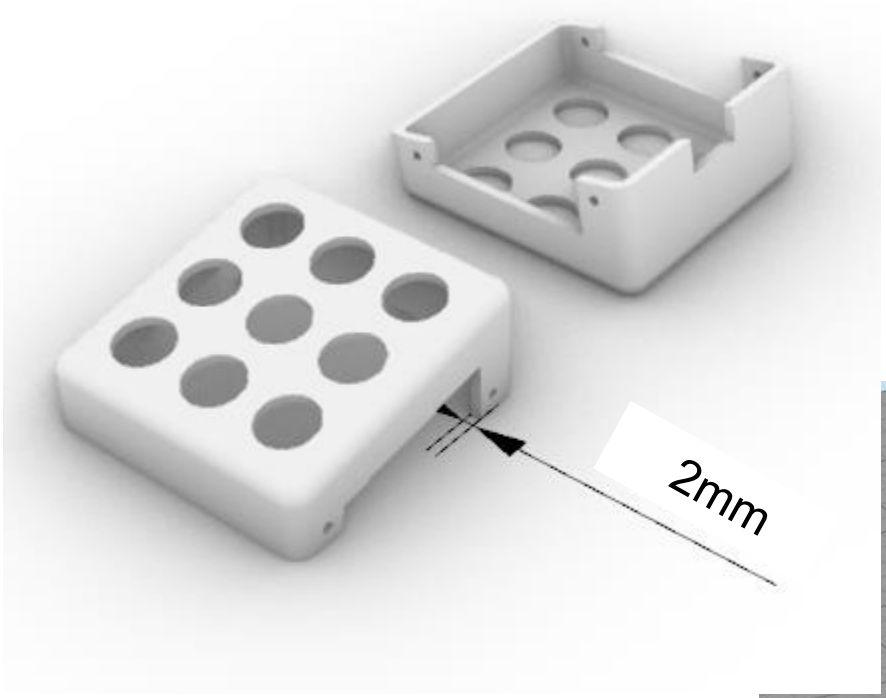
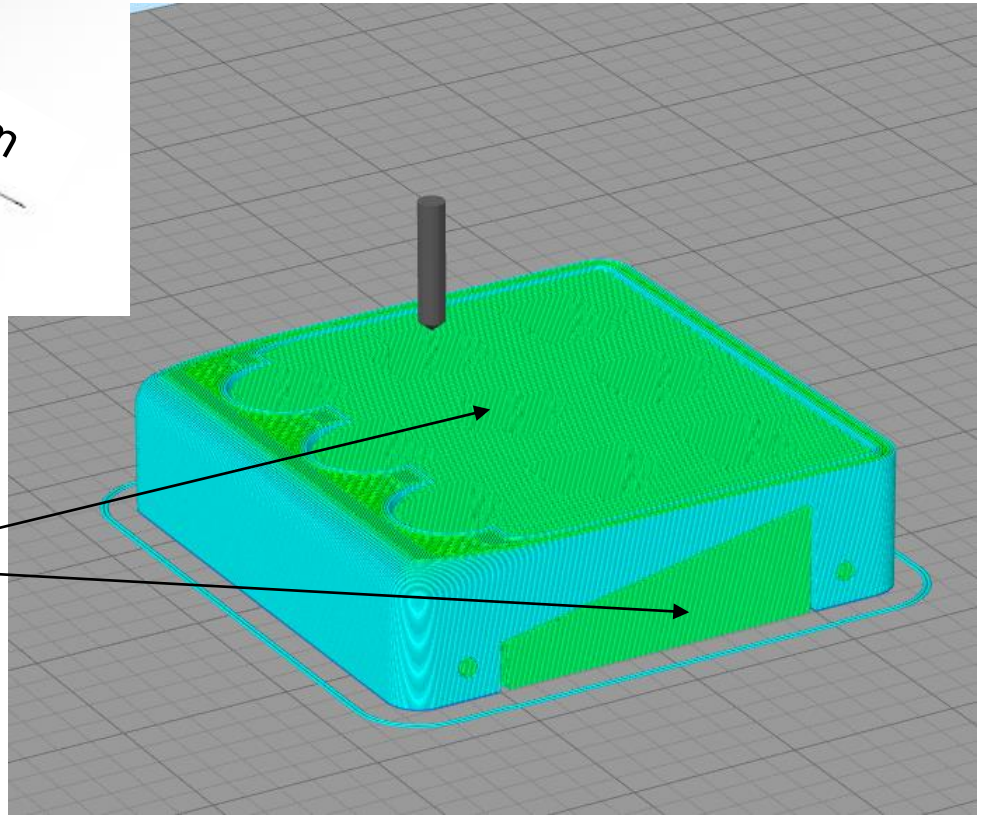
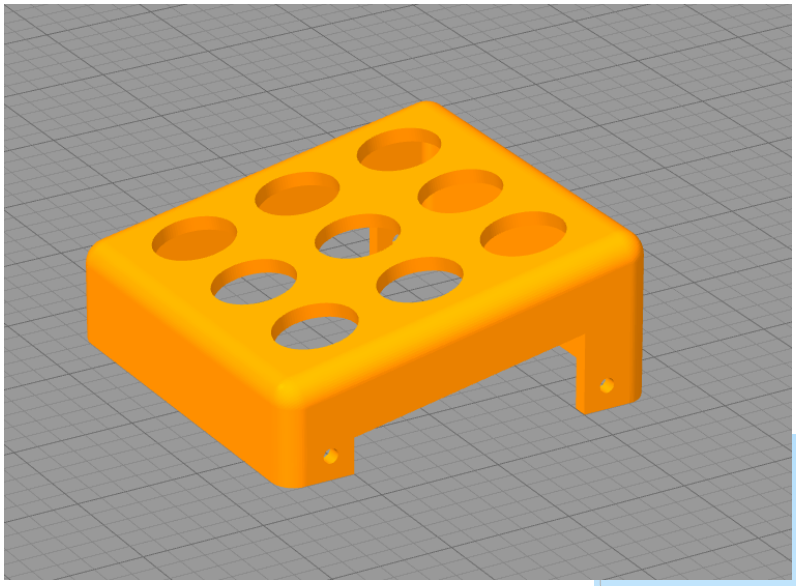
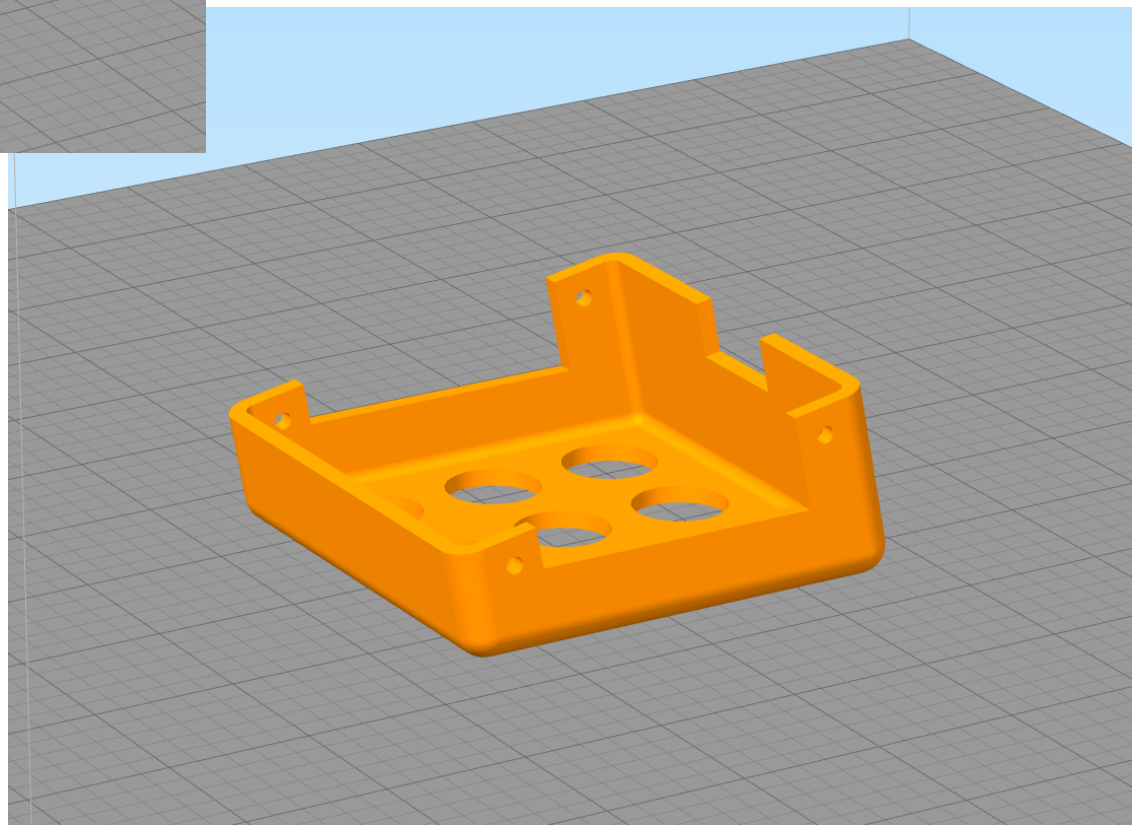




Support structures





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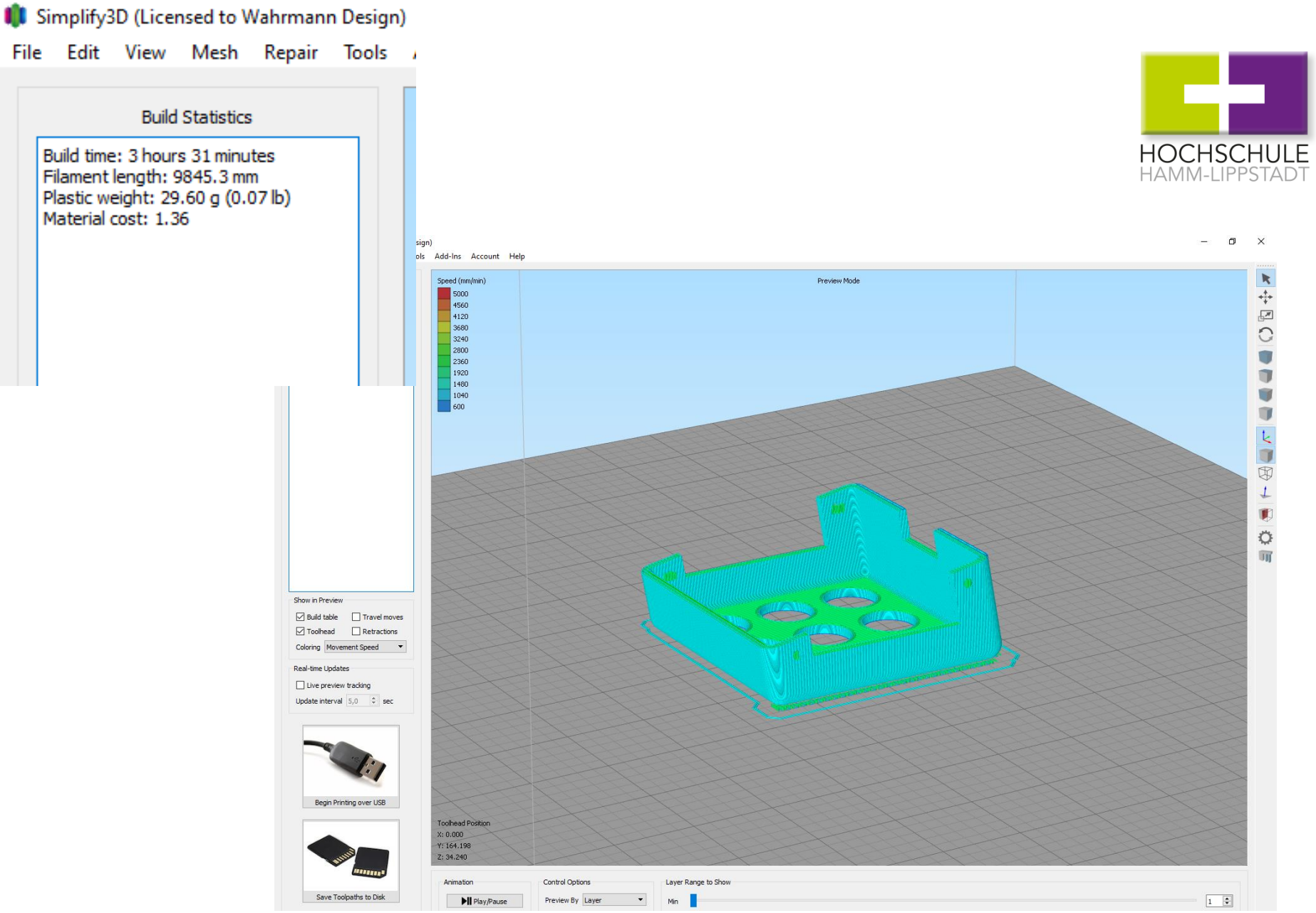

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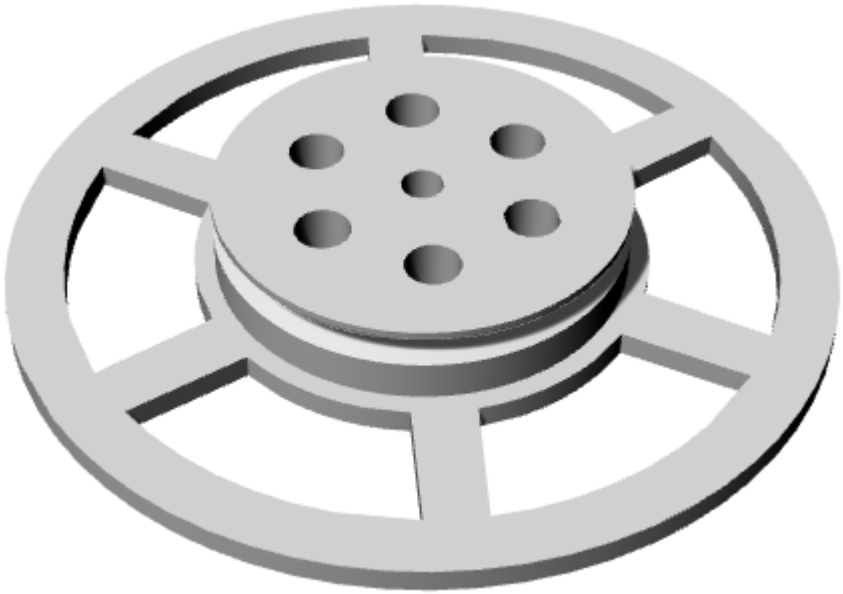

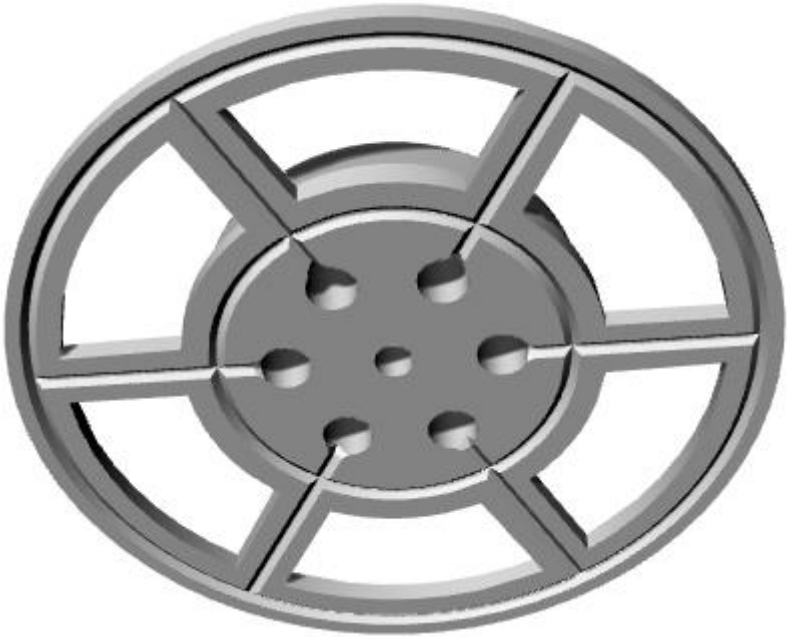

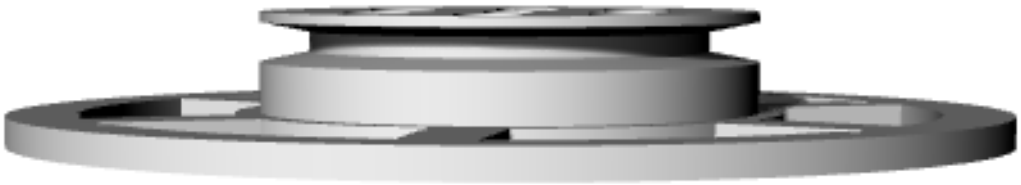

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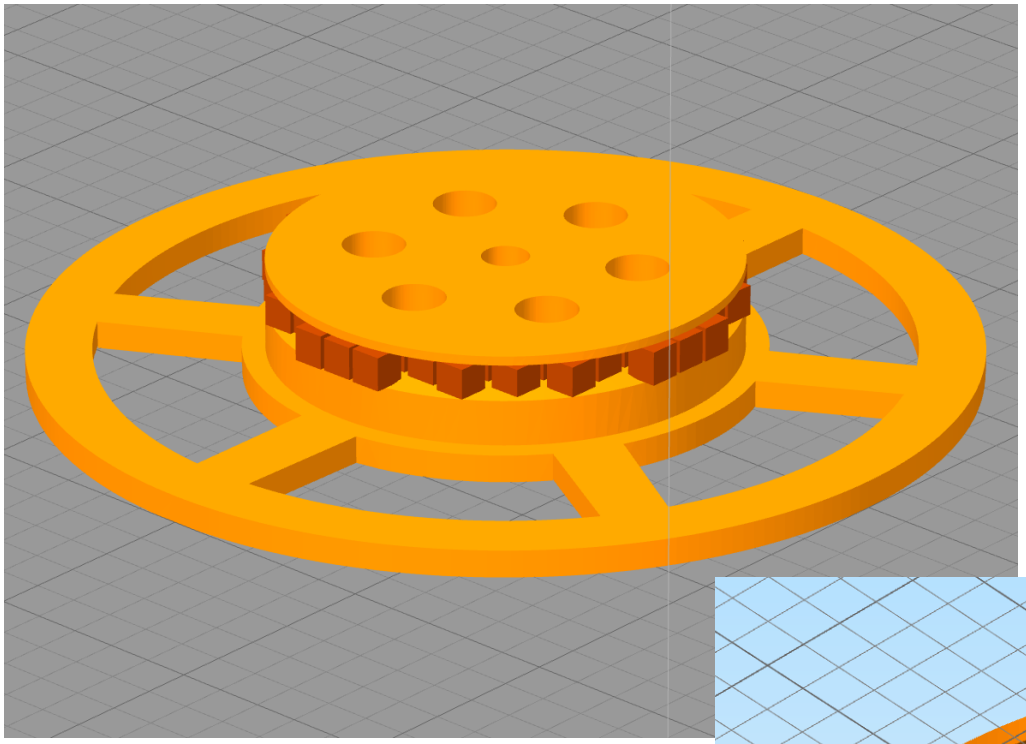

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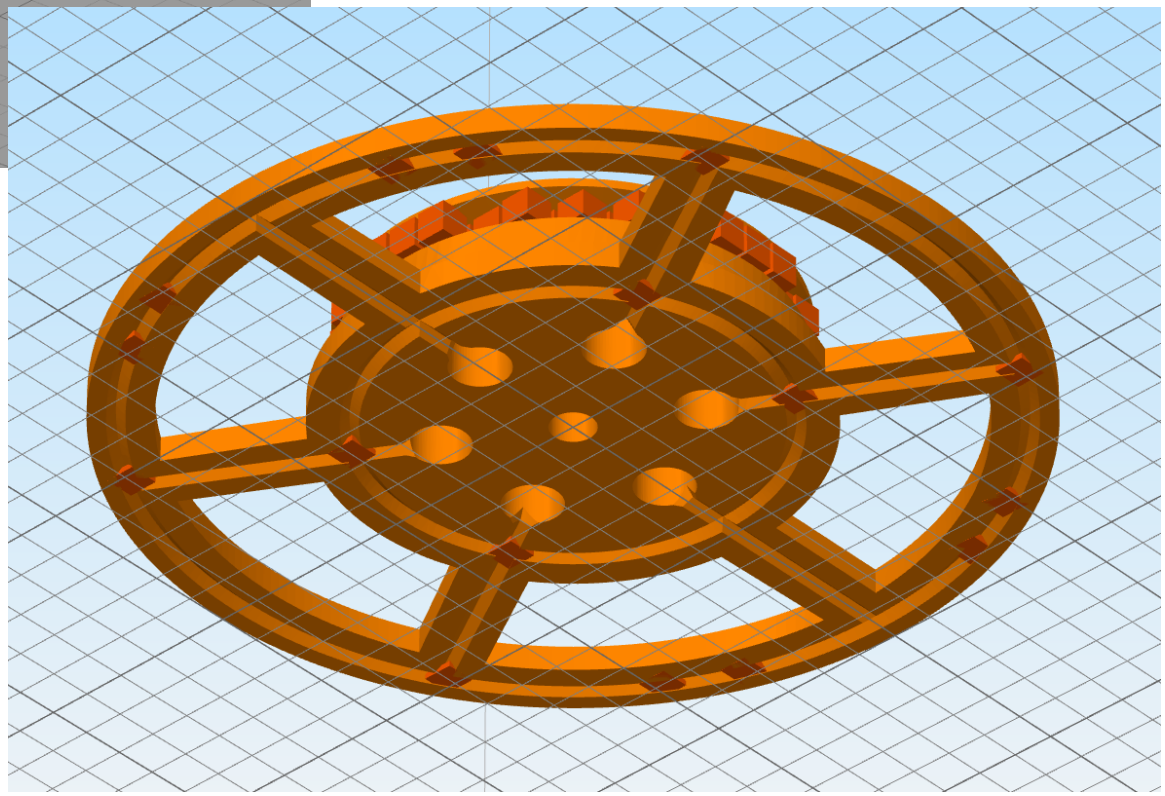

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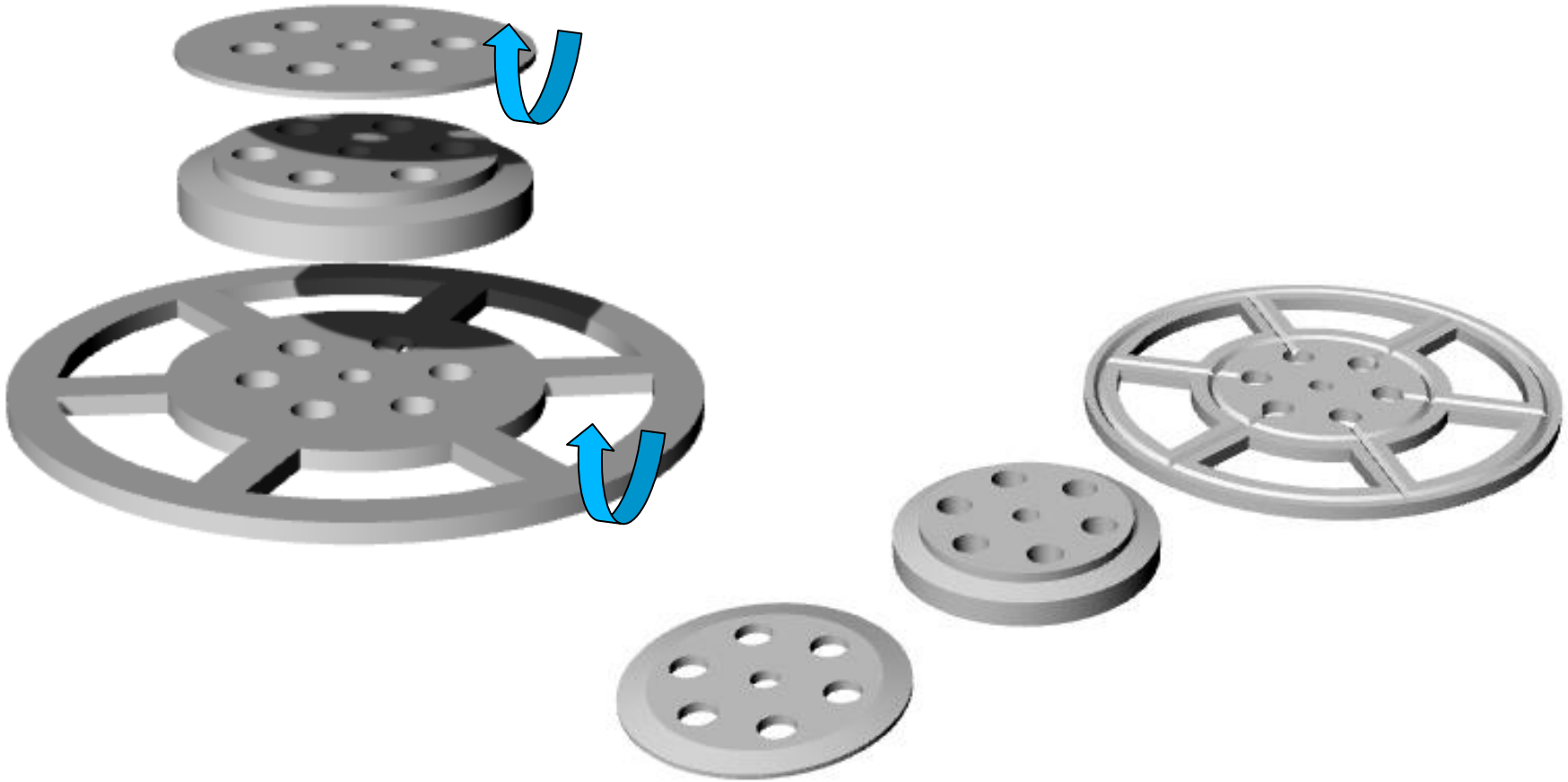

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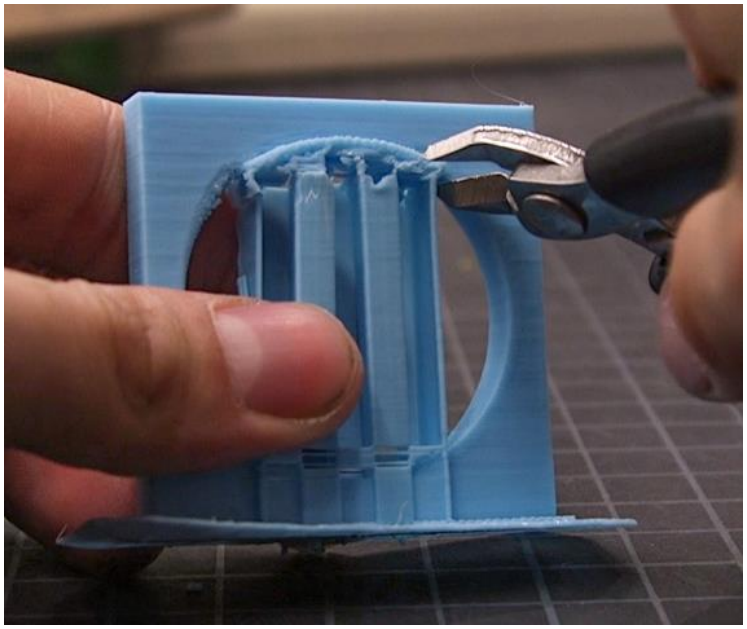

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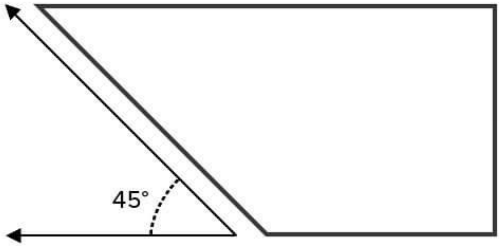
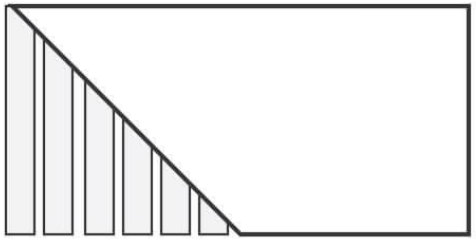


Overhang of less than 45 degrees
No support is needed



Overhang of more than 45 degrees
Support is needed

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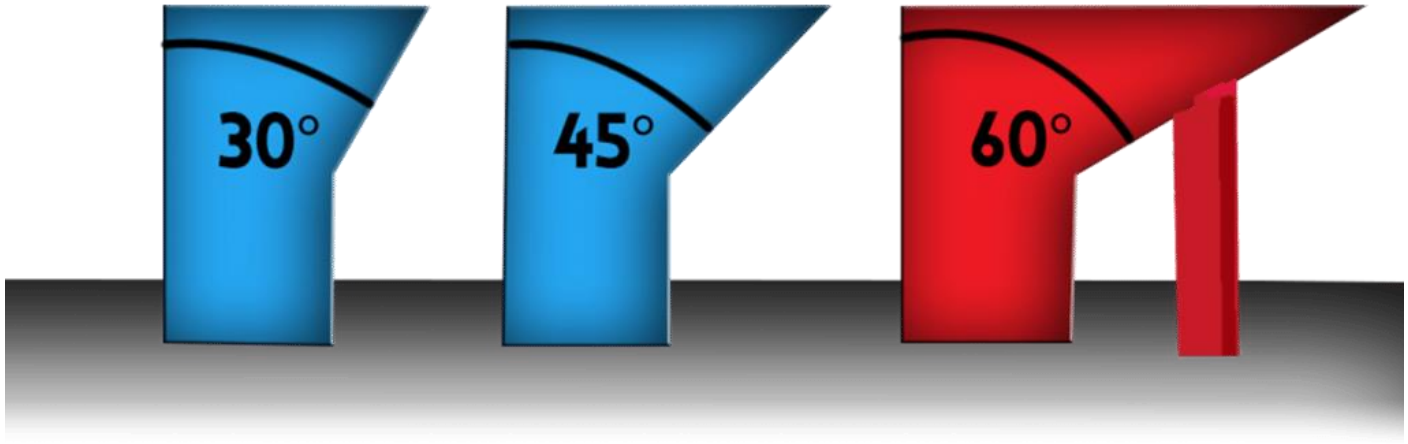

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Introduction

- Calculate the printing time

5. Printing time for each team 190 min

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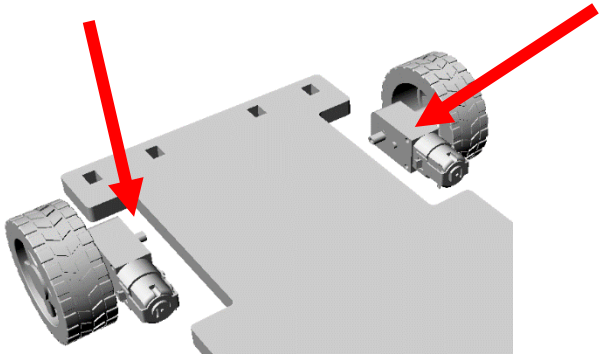
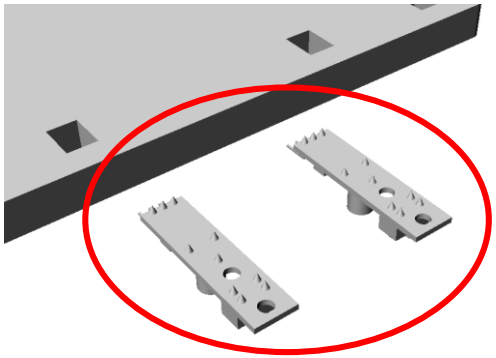
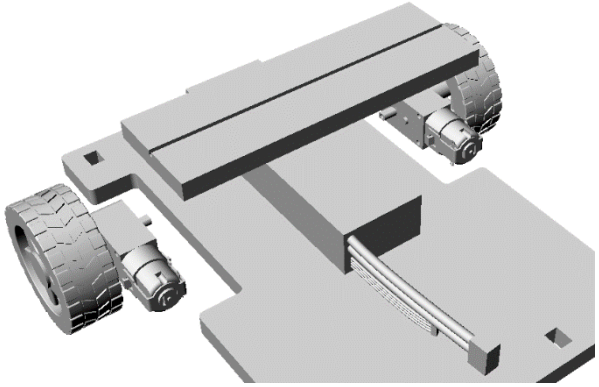
Motorholder left 40min **Motorholder right 40min**



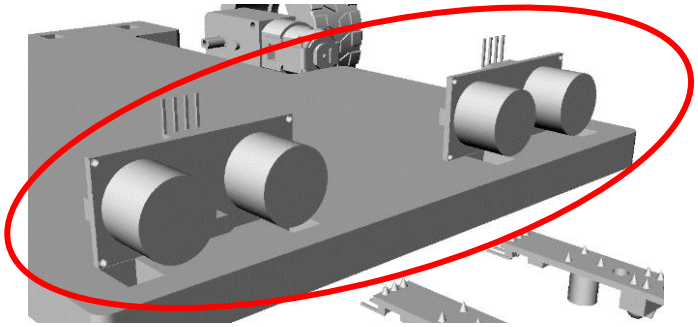
IR holder together 40min



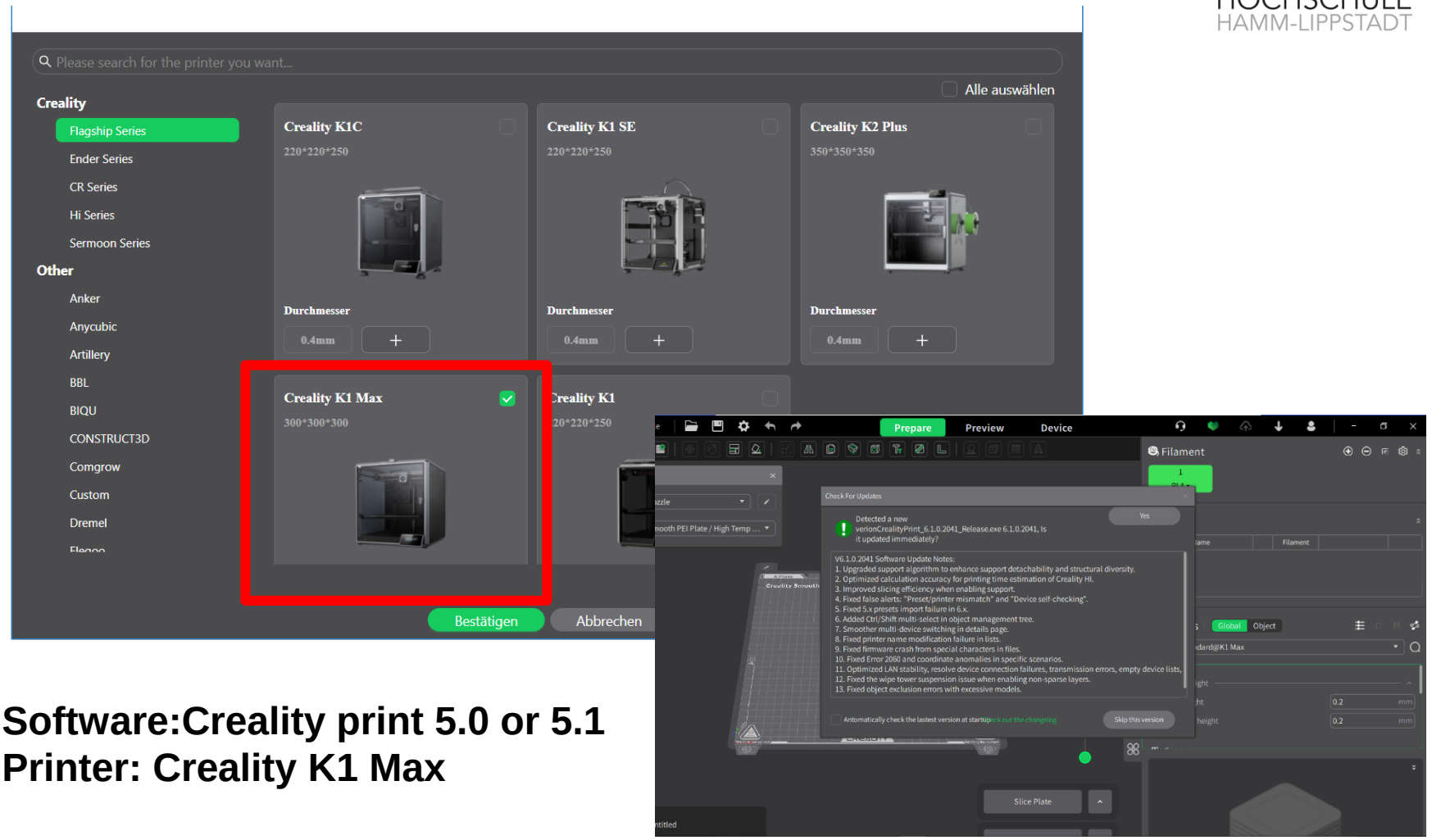
Breadboard / battery holder 30min



Ultrasonic holder together 40min.
This part is optional



Slicer software to calculate the printing time



Software:Creality print 5.0 or 5.1
Printer: Creality K1 Max

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1. **Install the software (link provided via moodle) Import your 3d modell (.stl file)**

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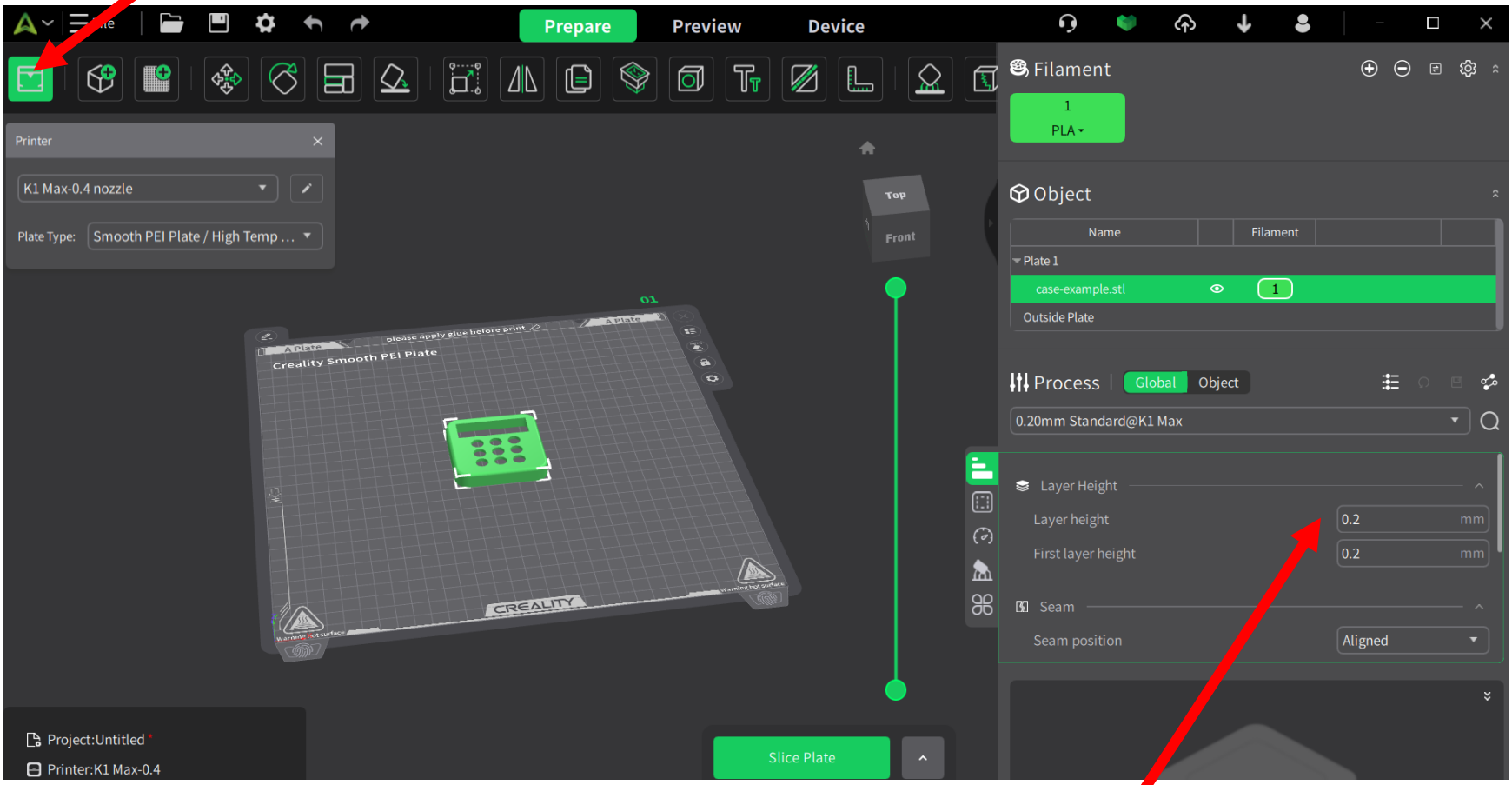
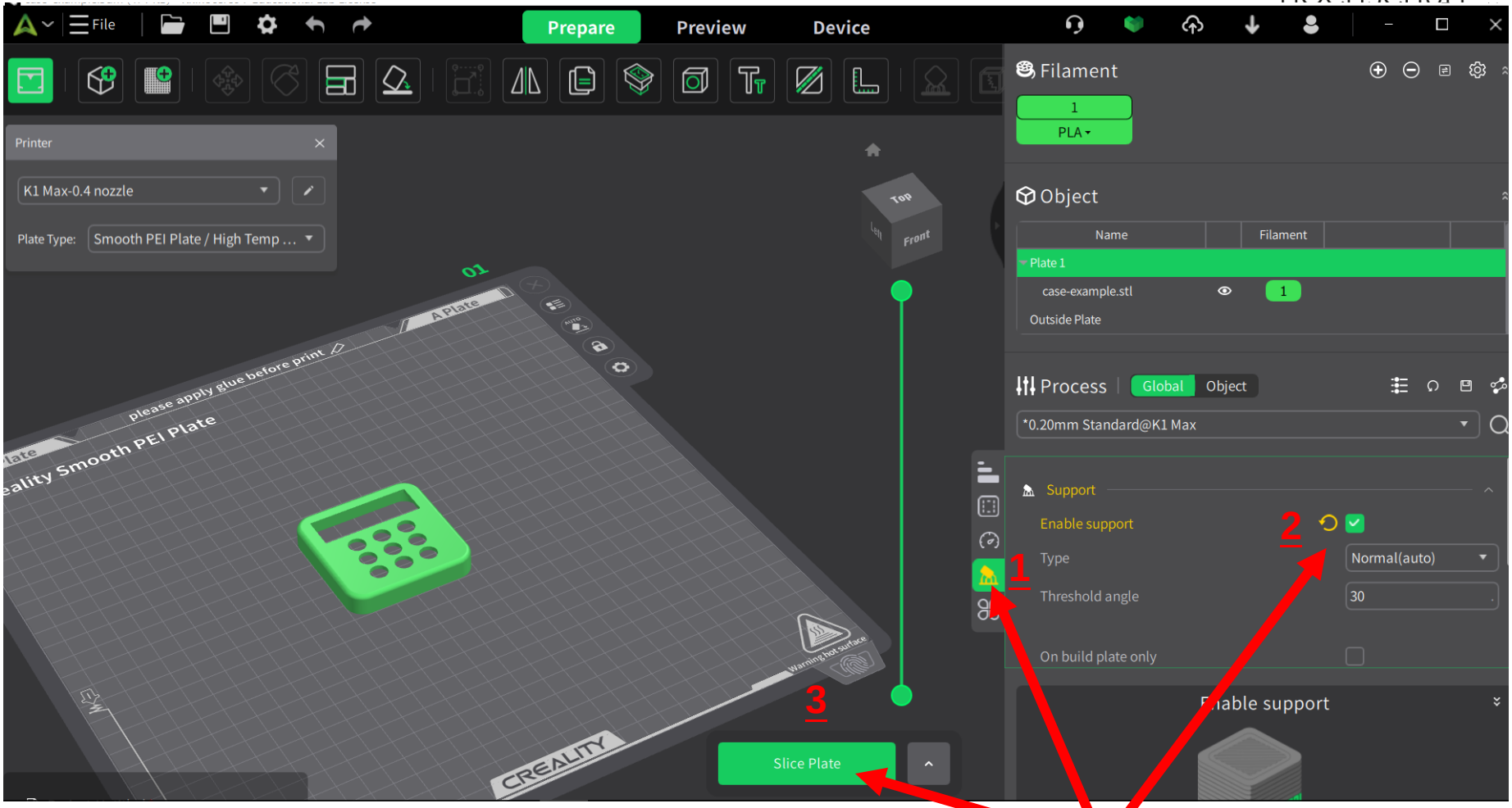


Use the provide parameters. Layer height 0.2, Infill 15%
Please do not change any other parameters in the software

2. Check the parameter



Enabel the support function and slice the plate

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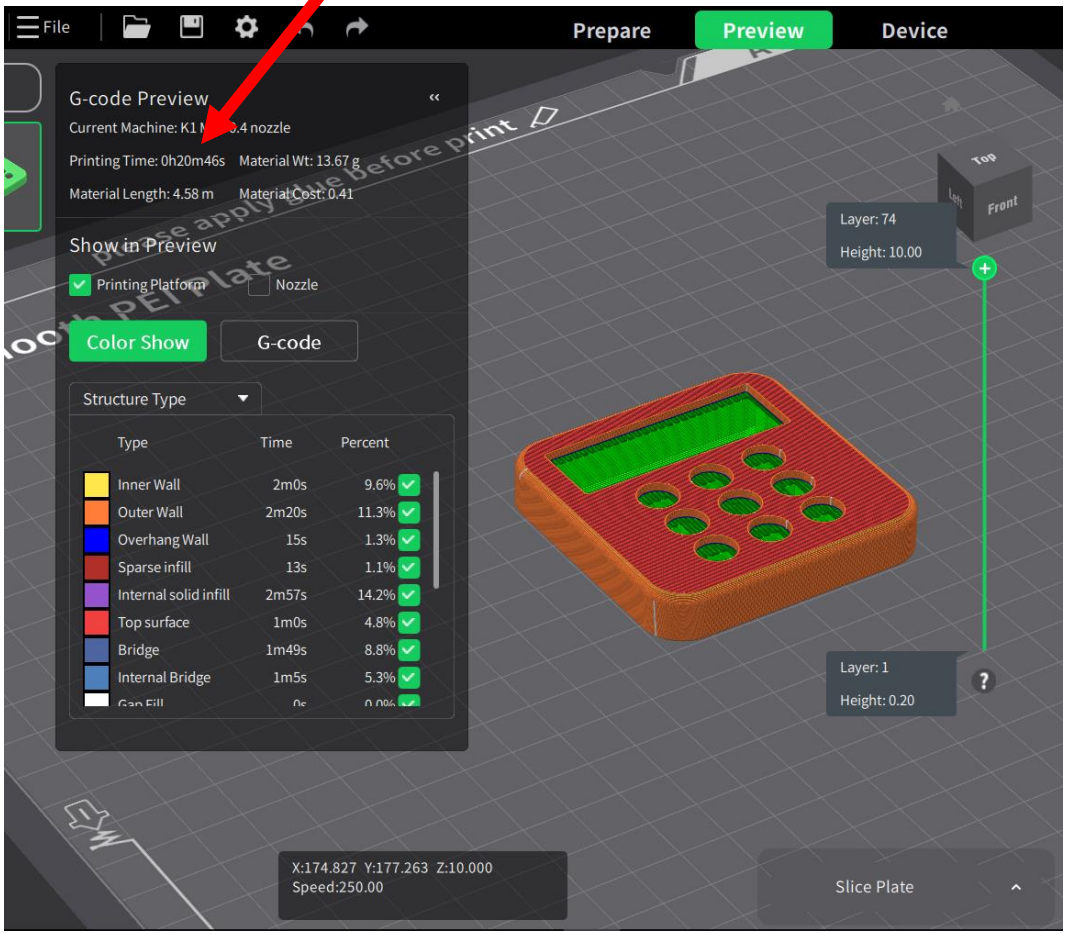
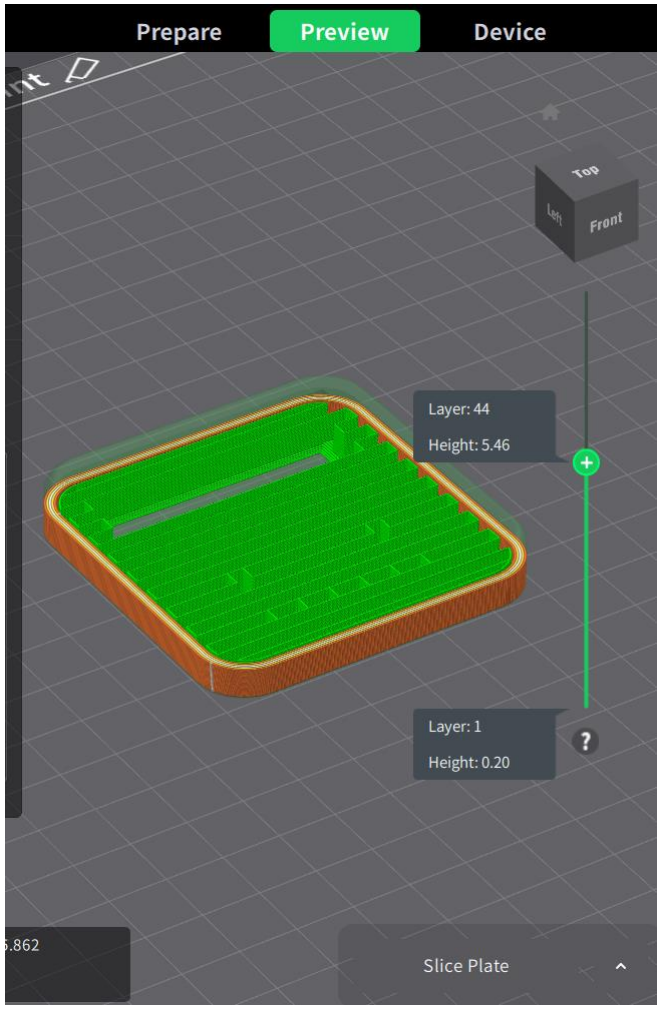
3. Check the printing time its 20min 45s with support





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4. Try different orientations of your part to check the influence of the printing time

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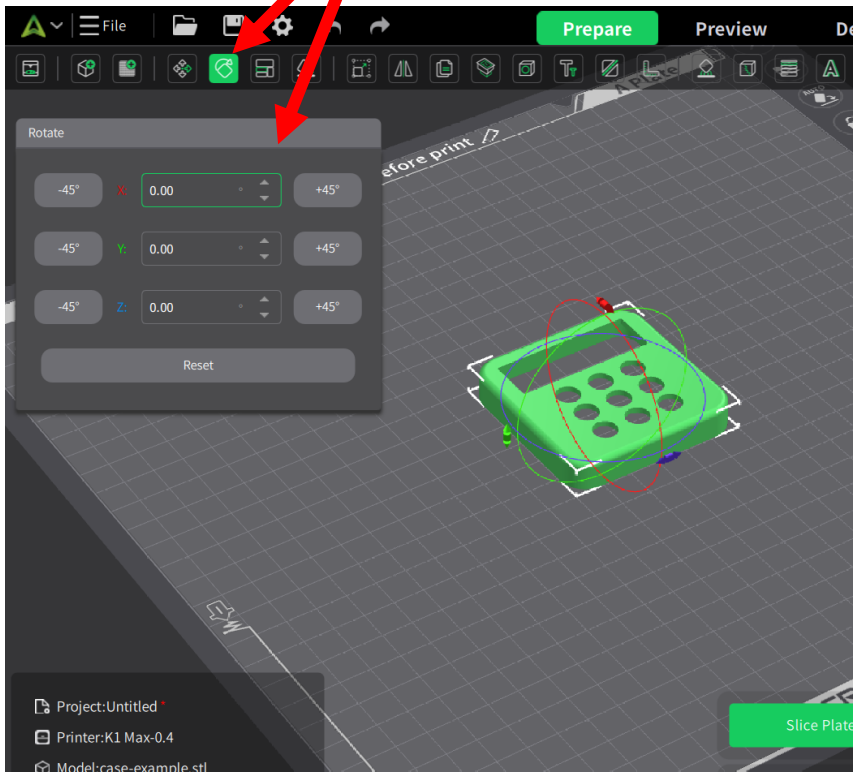

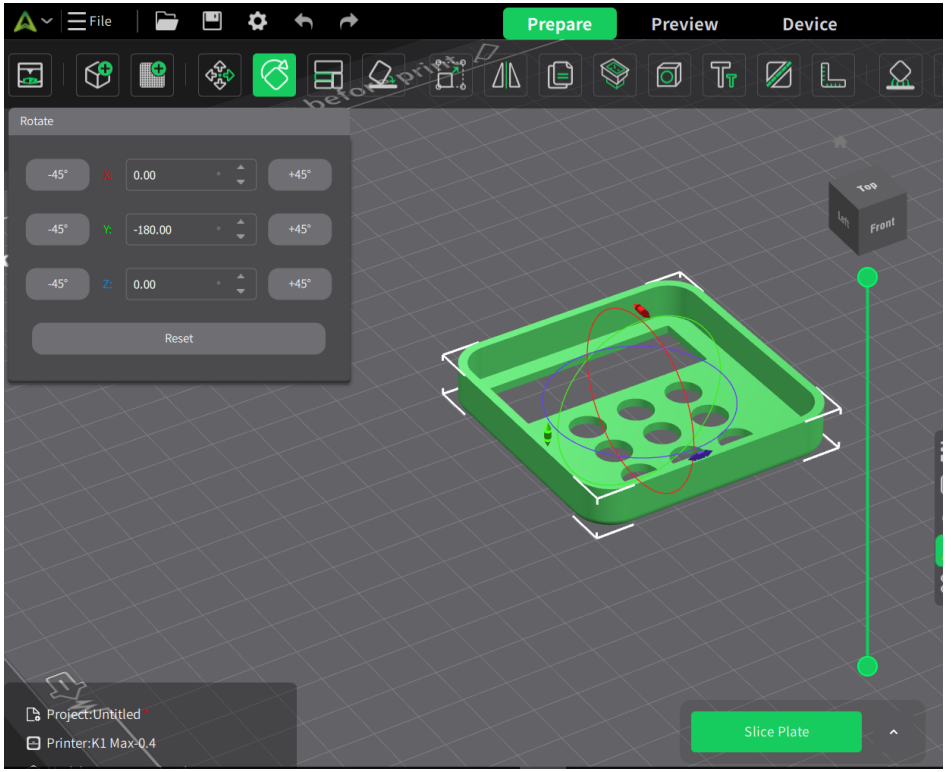

The part is flipped 180° degree.
No need for support structure.

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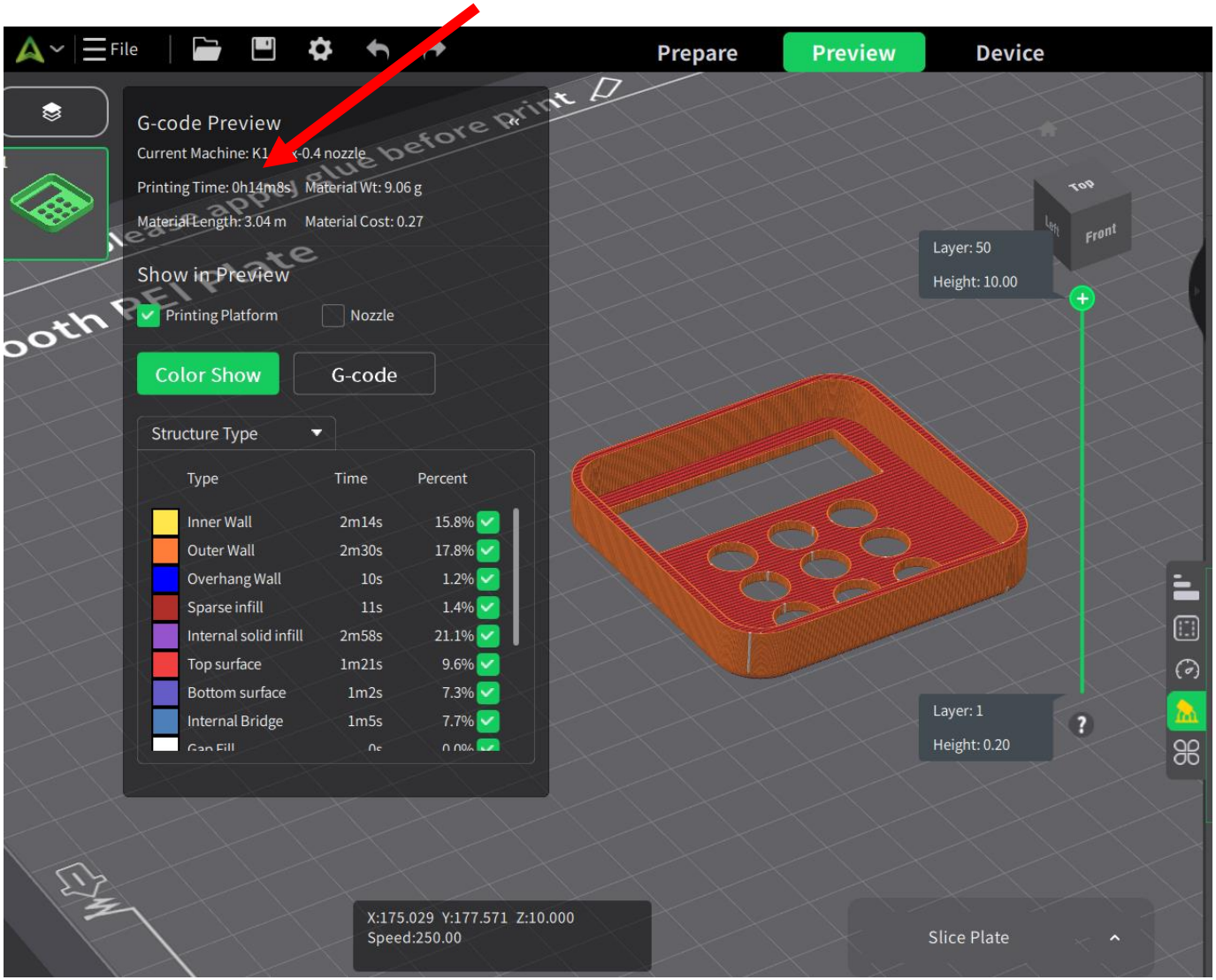
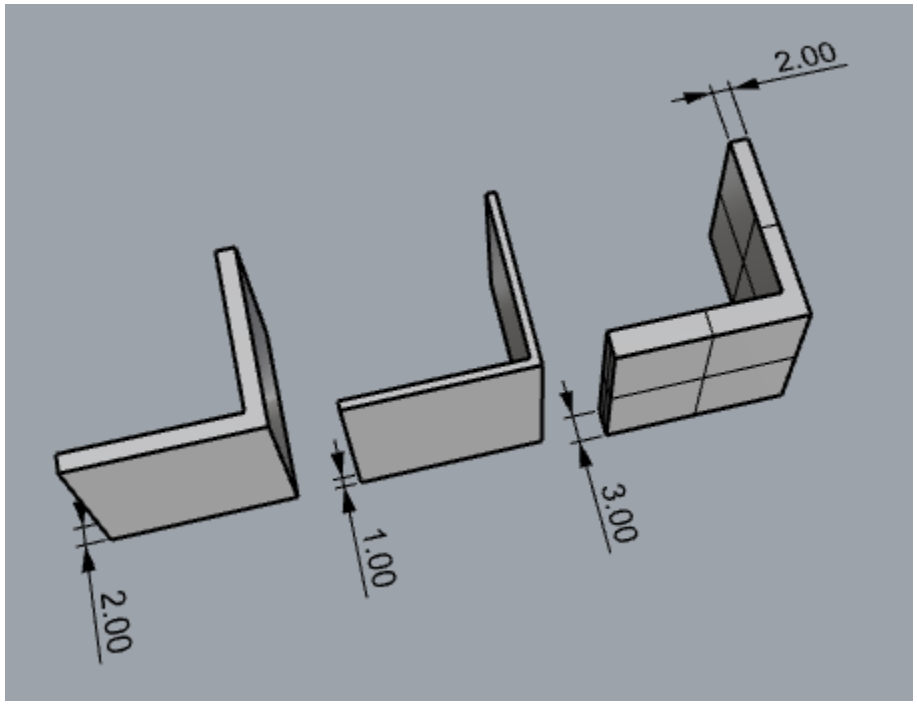
5. Check the printing time its 14min 8s



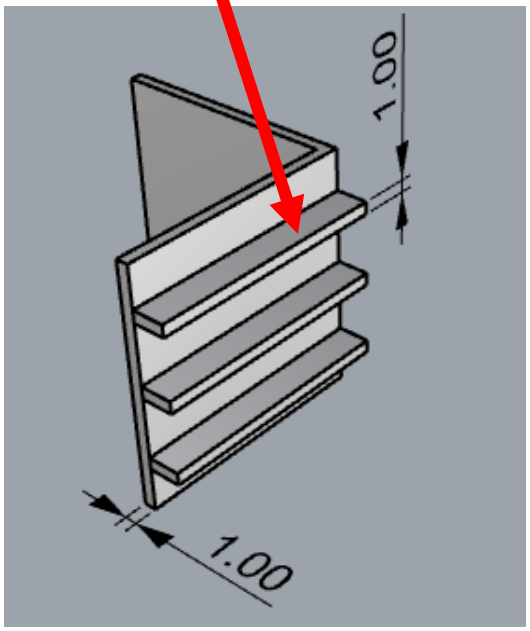
6. Construction guidelines: Material thickness for FDM 3D-printing

You can decide which thickness you need

For parts that only hold light components you can take 1mm 1.5mm or 2mm wallthickness. If you need more stability you can choose up to 3mm or combine it with other wallthickness dimensions.



It can also be a good idea to model support brackets to make the part more stiff



6. Construction guidelines: Tolerances for FDM 3D-printing

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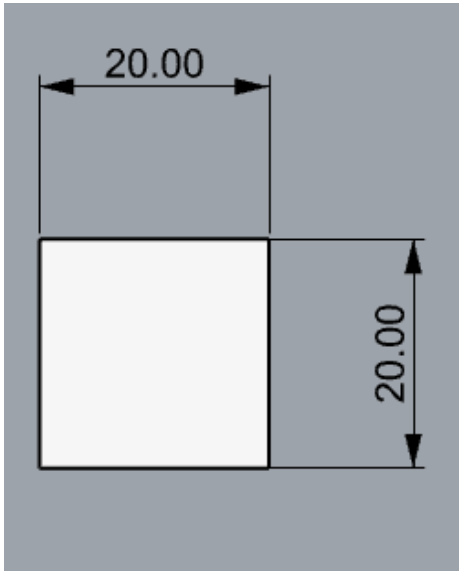
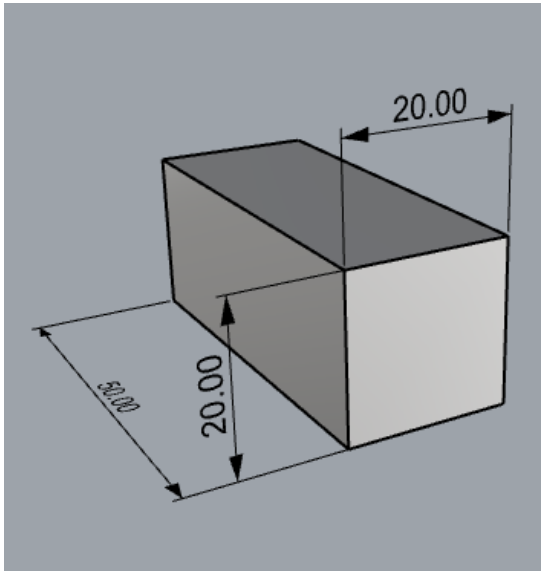
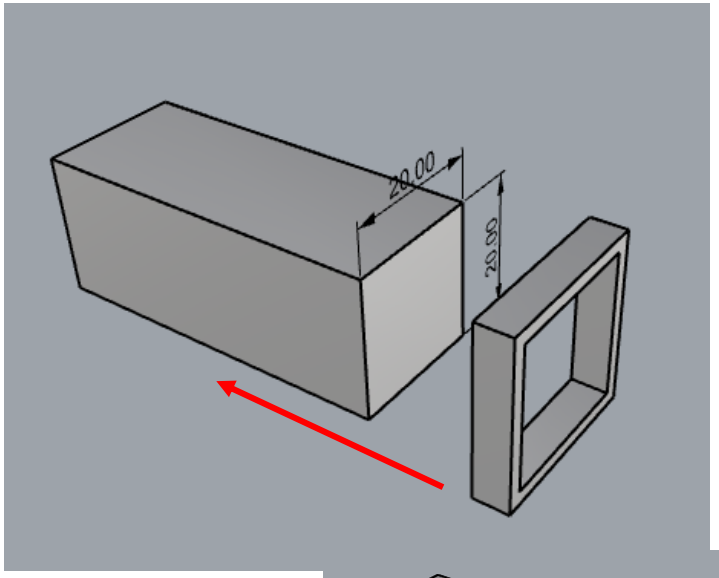
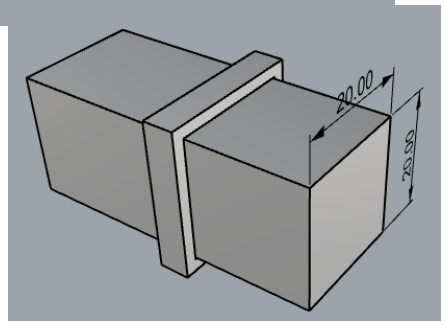
Block with the dimensions 20mm x 20mm x 50mm





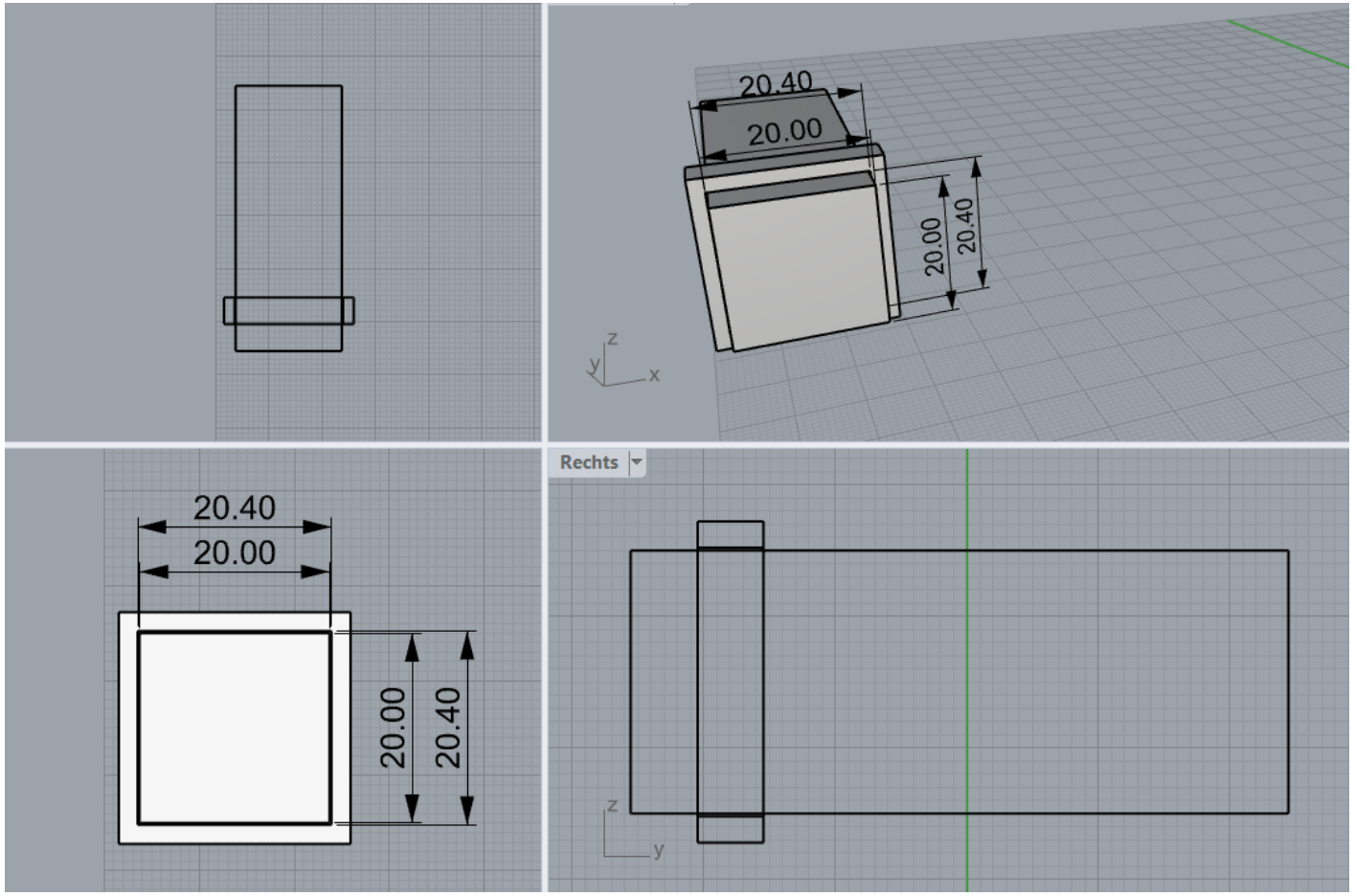
You want that another part fits to the block 20mmx20mmx50mm





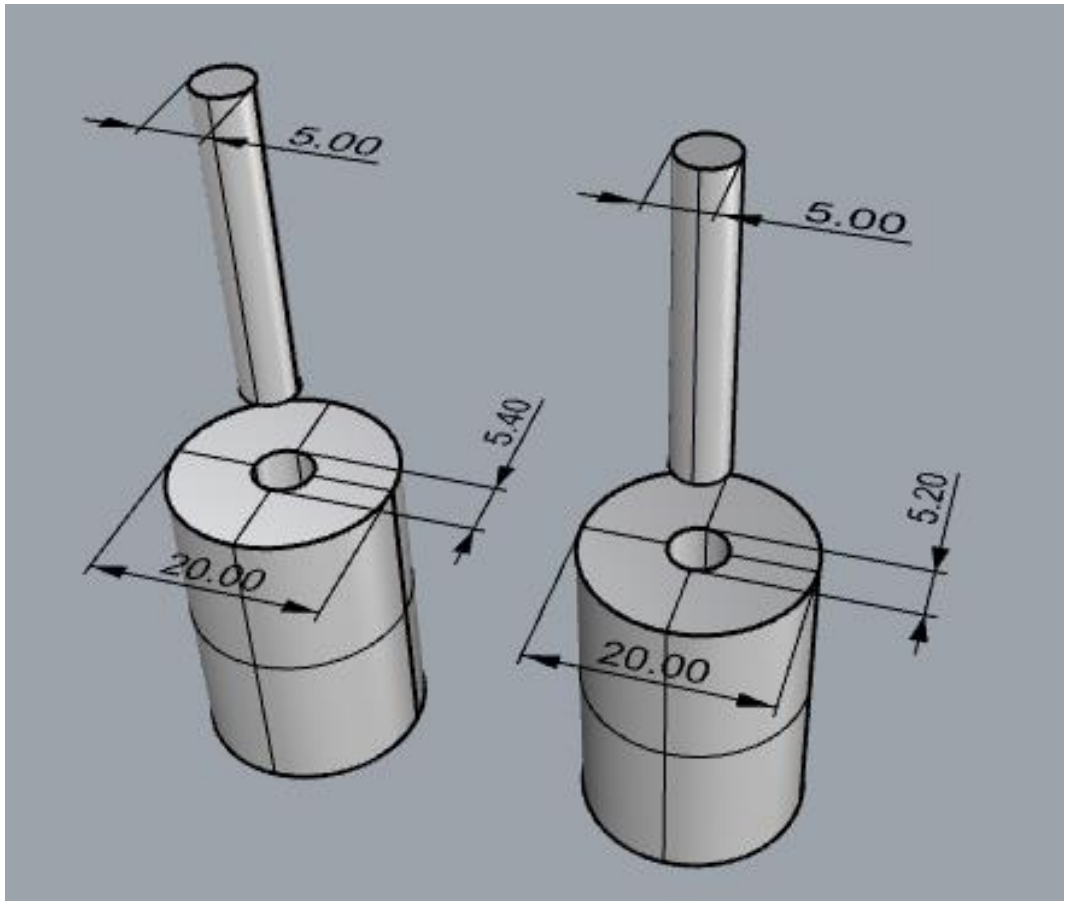
7. Construction guidelines: Tolerances for FDM 3D-printing

The dimensions for the part that has to fit to the block has to be 2 tenth of a millimeter all around



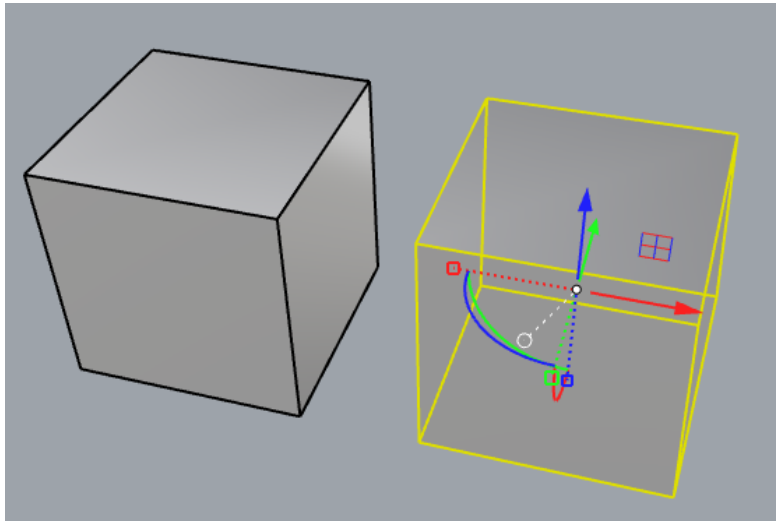
8. Construction guidelines: Tolerances for FDM 3D-printing

The dimensions for the part that has to fit to the cylinder has to be 2 tenth of a millimeter all around. If you want friction so that you need some force to combine the parts has to be 1 tenth of a millimeter all around

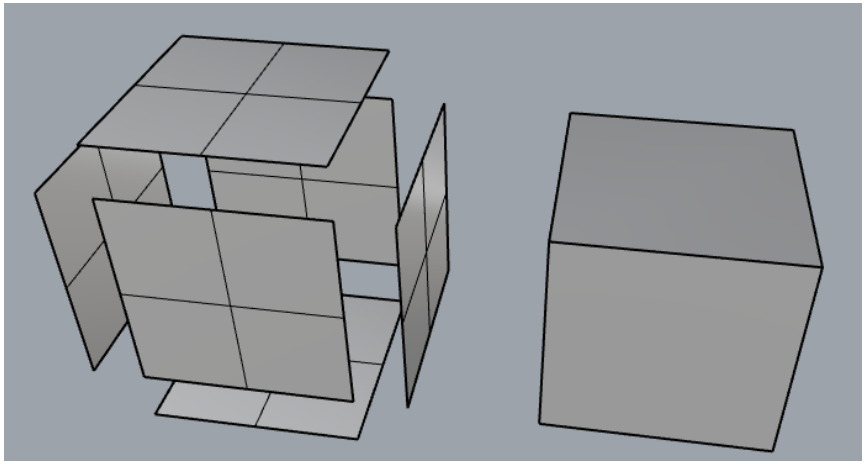


8. Construction guidelines: What does watertight mean?

All parts that you want to print should consist of closed geometries

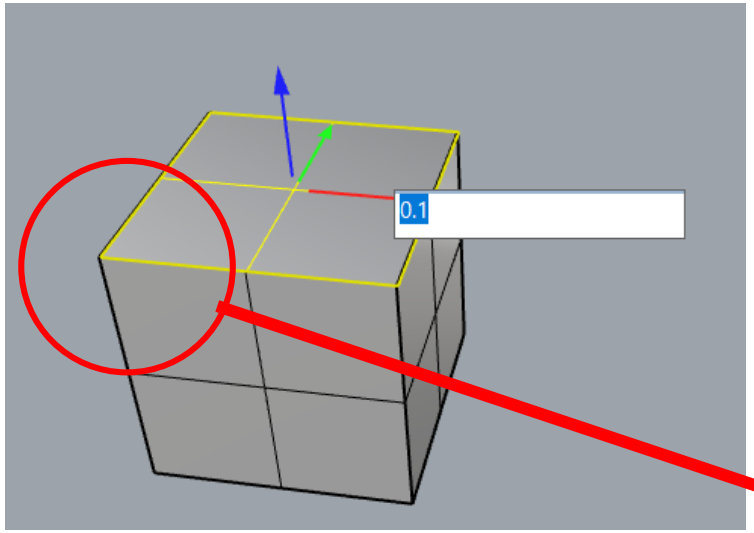


A dice has six single sides. If you combine them and connect you have a volume.

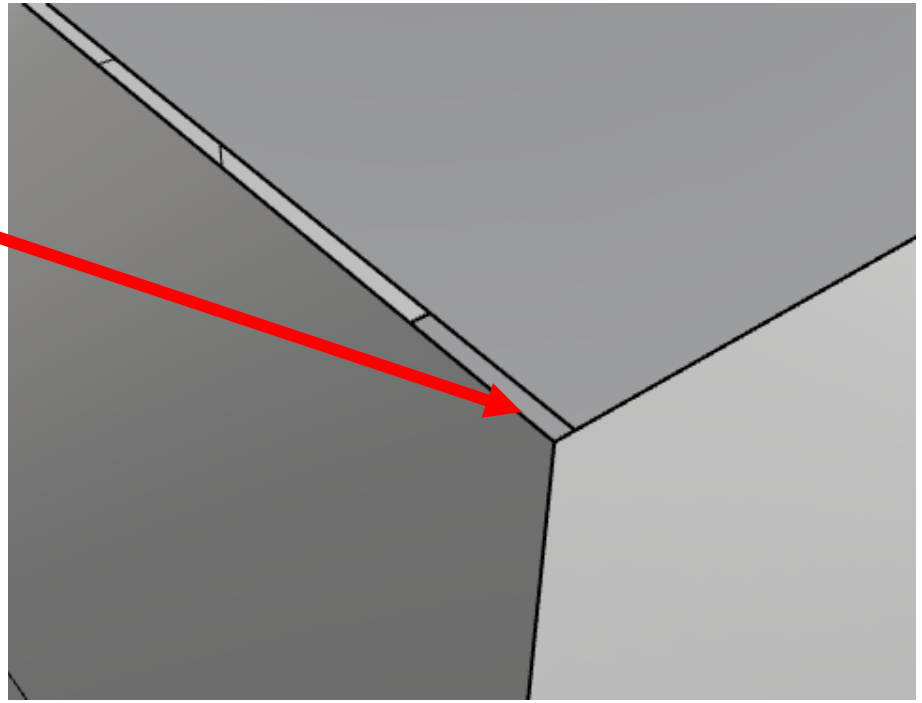


8. Construction guidelines: What does watertight mean?

If one side is only 1 tenth of a millimeter not alligned the geometry is not watertight./closed.

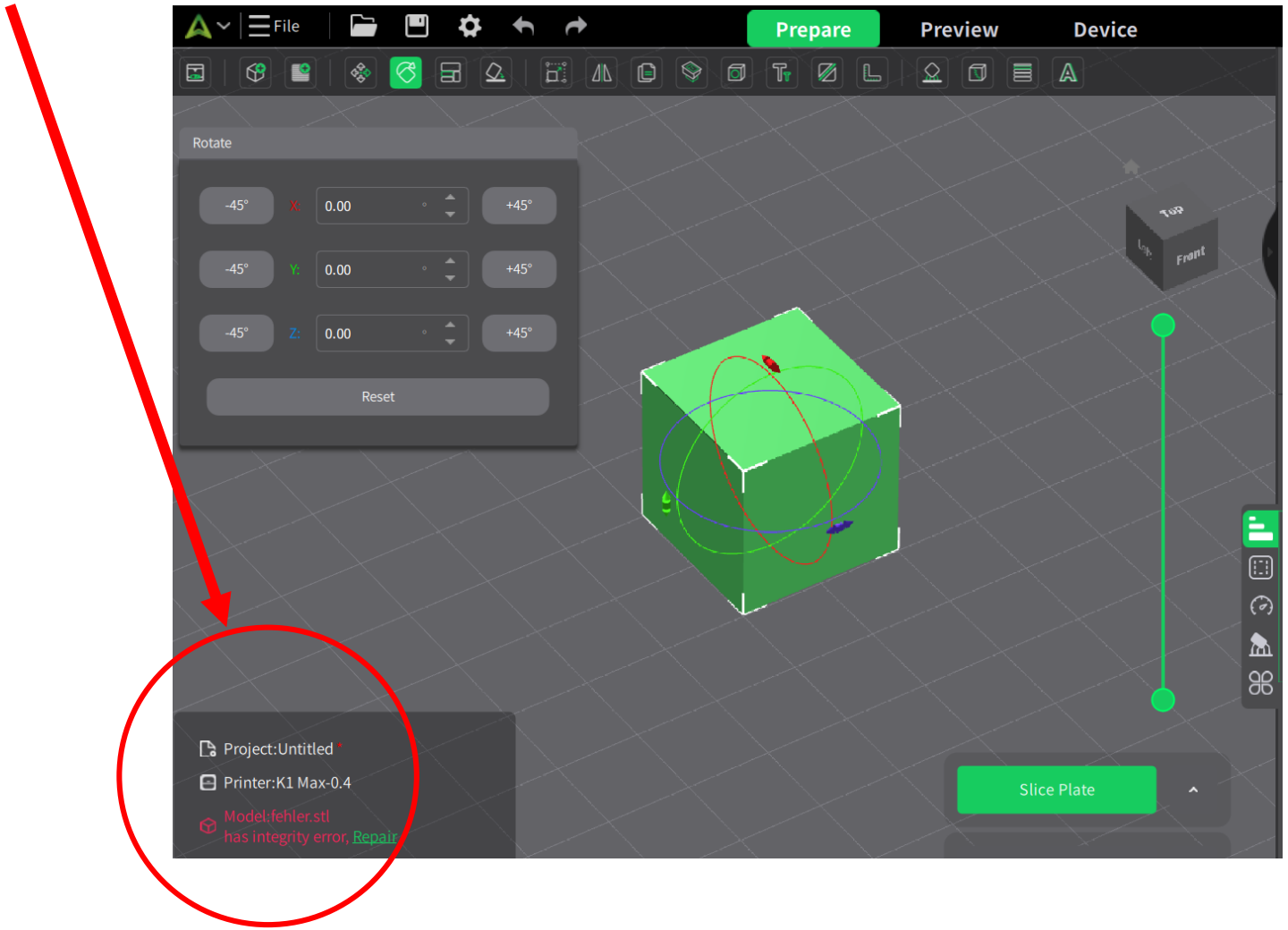


Trough the gap you can look into the geometrie.



8. Construction guidelines: What does watertight mean?

When you upload it to the slicing software it shows a mistake in your model



HOCHSCHULE
HAMM-LIPPSTADT

How you can start

- Demonstration with Rhino

The caliper (Messschieber or Schieblehre in german)

A Nonius (after Pedro Nunes) is a device for reading intermediate values on a scale, e.g. on the length scale of a sliding caliper. The vernier scale usually has ten parts, which together are as long as nine parts on the main scale. The measured value, determined by the zero point of the vernier, is then read to one decimal place by finding the line on the Nonius that corresponds exactly to a line on the main scale.