HEI MAKERS

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Technical creativity in 3D printing module

Co-funded by the Erasmus+ Programme of the European Union
2017-1-LT01-KA203-035231

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WORKSHOP #4

3D printing of a technical product

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TECHNICAL CREATIVITY IN 3D PRINTING MODULE

3D PRINTING OF A PCB VICE

- Aim of the workshop is equip makers with the practical knowledge needed to develop a technical product suitable for 3D printing
- Resources / Tools needed: computer, Internet, CAD software, 3D Slicer Software, FDM 3D printer, filament, basic tools
- Safety first: observe all the safety rules applicable in the workshop; use safety glasses and gloves during post-processing; exercise caution when using cleaning tools; Never touch hot parts of the machine (extruders, motors and heated bed); Don't touch moving parts of the machine; Do not interact with turned on fans; Keep your loose hair and clothes out of reach of moving belts, screws and fan.

Duration	2 academic hrs
Author / Lecturer	Doru Cantemir, Ludor Engineering
Delivery methods	Team work
Evaluation methods	Test / Report / Feedback / Exam etc.

PROBLEM STATEMENT

- Design and make a device able to secure a PCB to allow work to be performed on it.

Figure 11.1. PCBs. Source: Pixabay

NEED ANALYSIS AND SPECIFICATION LIST

- Discuss with your maker fellows, do an Internet search and make a list of needs relevant for the device and specifications required. Include maximum PCB size, the ability to rotate PCB in a range of positions, etc.

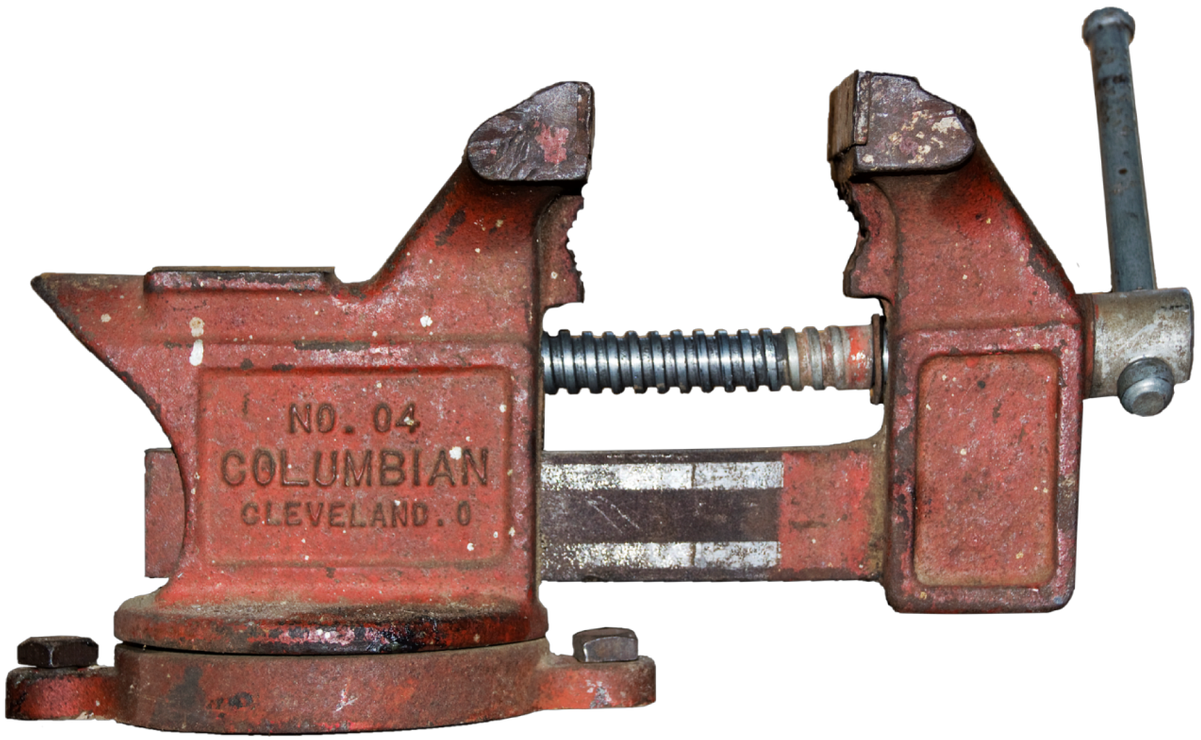


Figure 11.2. Vice. Source: Pixabay

CONCEPT DRAWINGS

- Make a list of possible design ideas, based on discussions and Internet research. Make concept drawings to communicate and analyze these ideas.

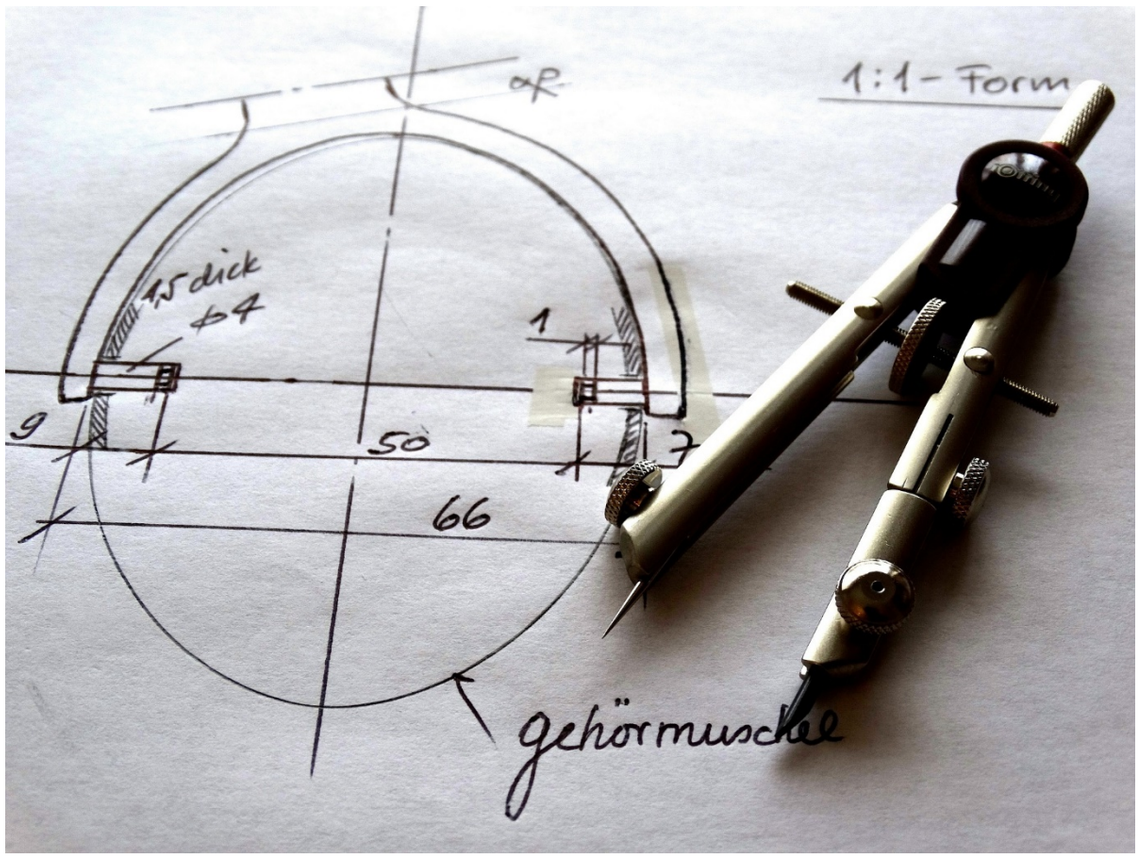


Figure 11.3. Concept drawing. Source: Pixabay

3D MODELING

- Select the best idea and start modelling it in a CAD software.

Figure 11.4. 3D model. Source: Ludor Engineering

3D PRINTING THE COMPONENTS

- 3D print, finish and ensemble the components

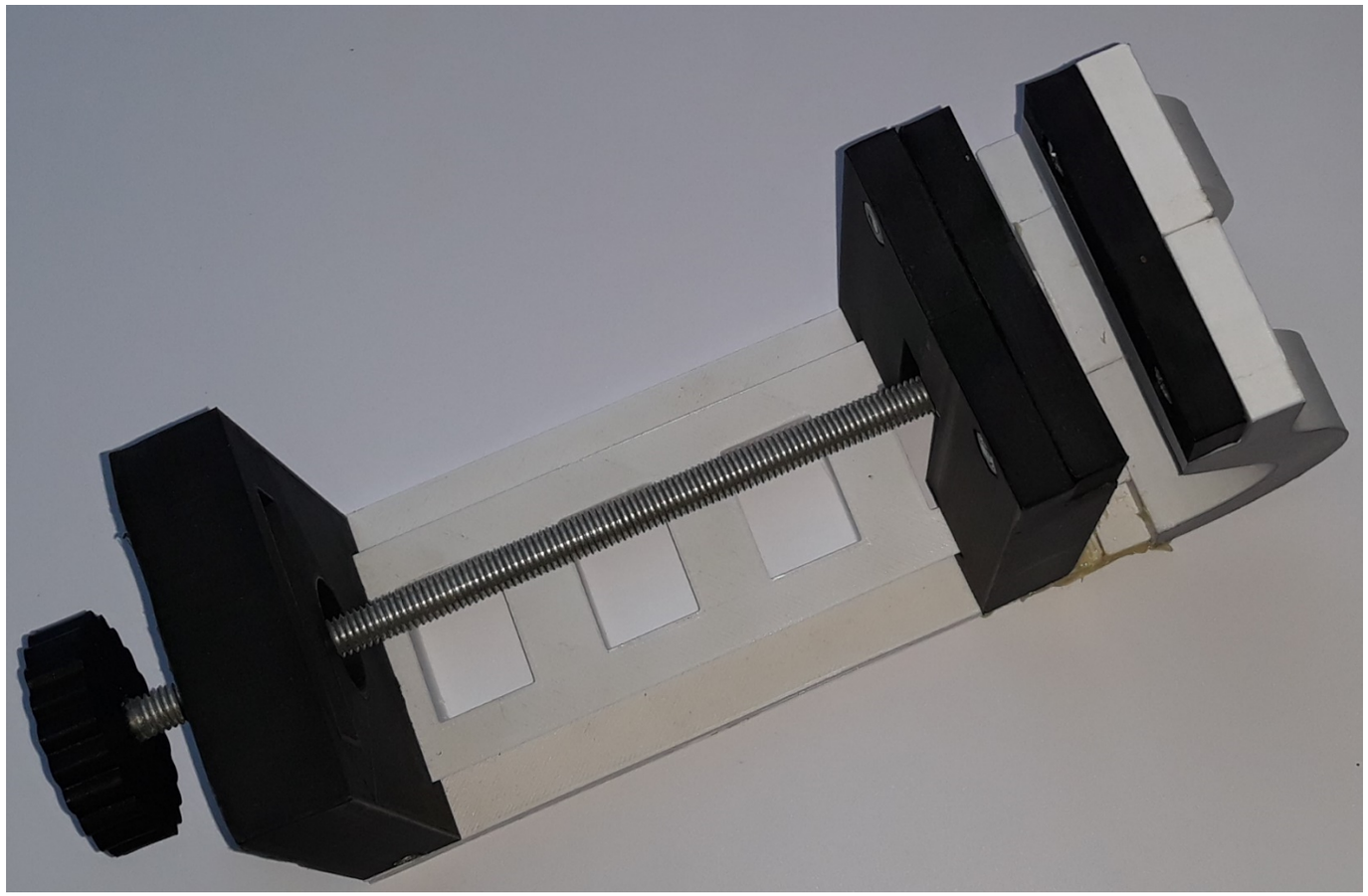


Figure 11.5. 3D printed vise. Source: Ludor Engineering

3D PRINTING OF A BEARING PRESS

- Aim of the workshop is equip makers with the practical knowledge needed to develop a technical product suitable for 3D printing
- Resources / Tools needed: computer, Internet, CAD software, 3D Slicer Software, FDM 3D printer, filament, basic tools
- Safety first: observe all the safety rules applicable in the workshop; use safety glasses and gloves during post-processing; exercise caution when using cleaning tools; Never touch hot parts of the machine (extruders, motors and heated bed); Don't touch moving parts of the machine; Do not interact with turned on fans; Keep your loose hair and clothes out of reach of moving belts, screws and fan.

Duration	2 academic hrs
Author / Lecturer	Rihards Rieka, RTU
Delivery methods	Team work
Evaluation methods	Test / Report / Feedback / Exam etc.

PROBLEM STATEMENT

Design and develop a tool that can be used to press bearings into their housing.

Figure 11.6. A bearing in its housing. Source: http://www.diyouware.com/node/151 [2019]

In many fields of engineering there is a need for pressfit bearings which can be put in their housing only with a significant pressure. Examples are bicycles, cars, robots etc.

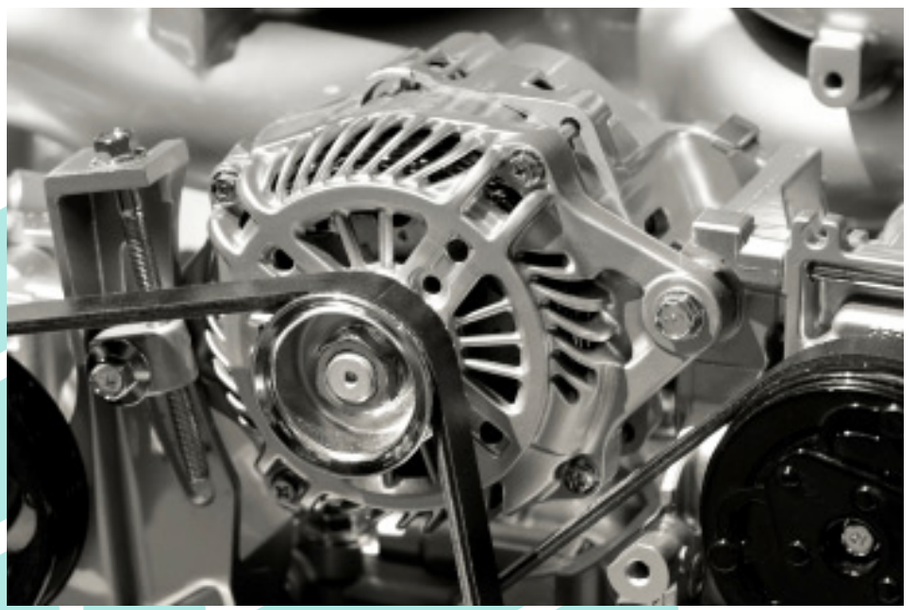


Figure 11.7. Car engine and a crankshaft bearing . Source: HTTPS://AUTO.HOWSTUFFWORKS.COM/UNDER-THE-HOOD/CAR-PART-LONGEVITY/CRANKSHAFT-BEARINGS-LAST.HTM [2019]

Figure 11.8. Bicycle bottom bracket with pressfit bearings . Source: HTTPS://WWW.PARKTOOL.COM/BLOG/REPAIR-HELP/BOTTOM-BRACKET-SERVICE-BB30 [2019]

There are tools out there to press these bearings, but in most cases they are very expensive. Develop an tool, that can press bearings in their housing **with good pressure** and **very precisely.**

Figure 11.9. A bearing press. Source: HTTPS://ROAD.CC/CONTENT/FEATURE/172698-HOW-FIT-CHRIS-KING-PRESS-FIT-BOTTOM-BRACKET [2019]

NEED ANALYSIS AND SPECIFICATION LIST

First of all, choose what type of bearing tool you are going to make – doublesided (suited for bicycles- see Figure 4.3) or singlesided (suited for car engines – see Figure 4.2). Also, decide on size of a bearing to do the press for – you can easily find standart sizes of car or bicycle bearings on internet.
Next, discuss with your team and do a research about parts and tools you need to make your product. Keep in mind two main needs – precision and pressure.

CONCEPT DRAWINGS

Make a list of possible design ideas, based on discussions and Internet research. Make concept drawings to communicate and analyze these ideas.

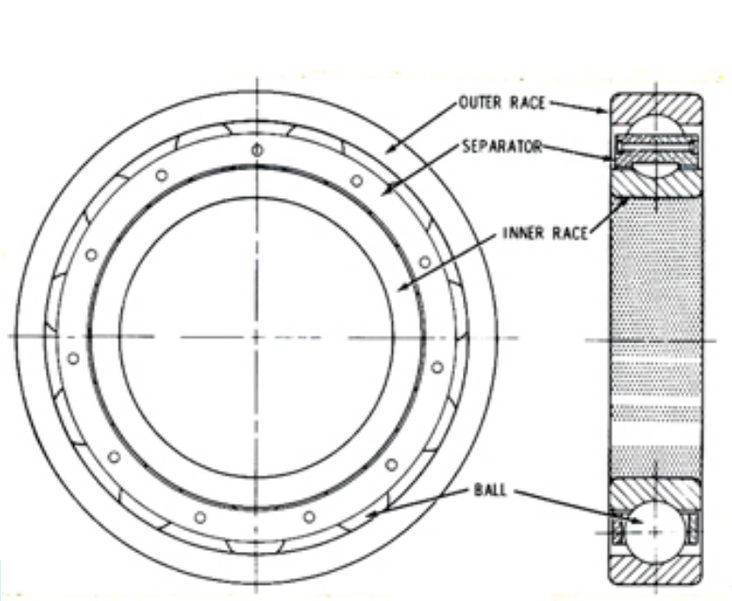


Figure 1 Typical High-Speed Ball Bearing

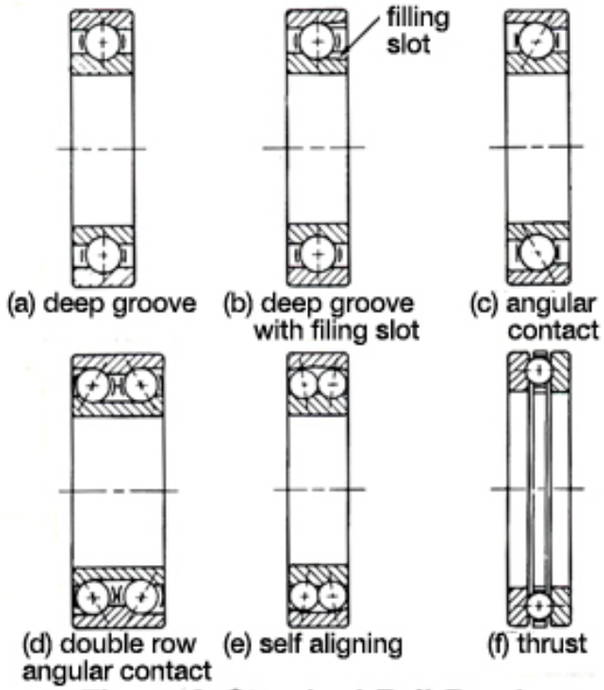


Figure 2 Standard Ball Bearing

Figure 11.10. Concept drawing of a bearing. Source: HTTP://WWW.SDP-SI.COM/DESIGN-DATA/BALL-BEARINGS.PHP [2019]

3D MODELING

Select the best idea and start modelling it in a CAD software. Pay particular attention to precision of the parts that you are 3D printing. If they turn out a bit too big, you can always take some material off, however too small and you will have to make a new print.

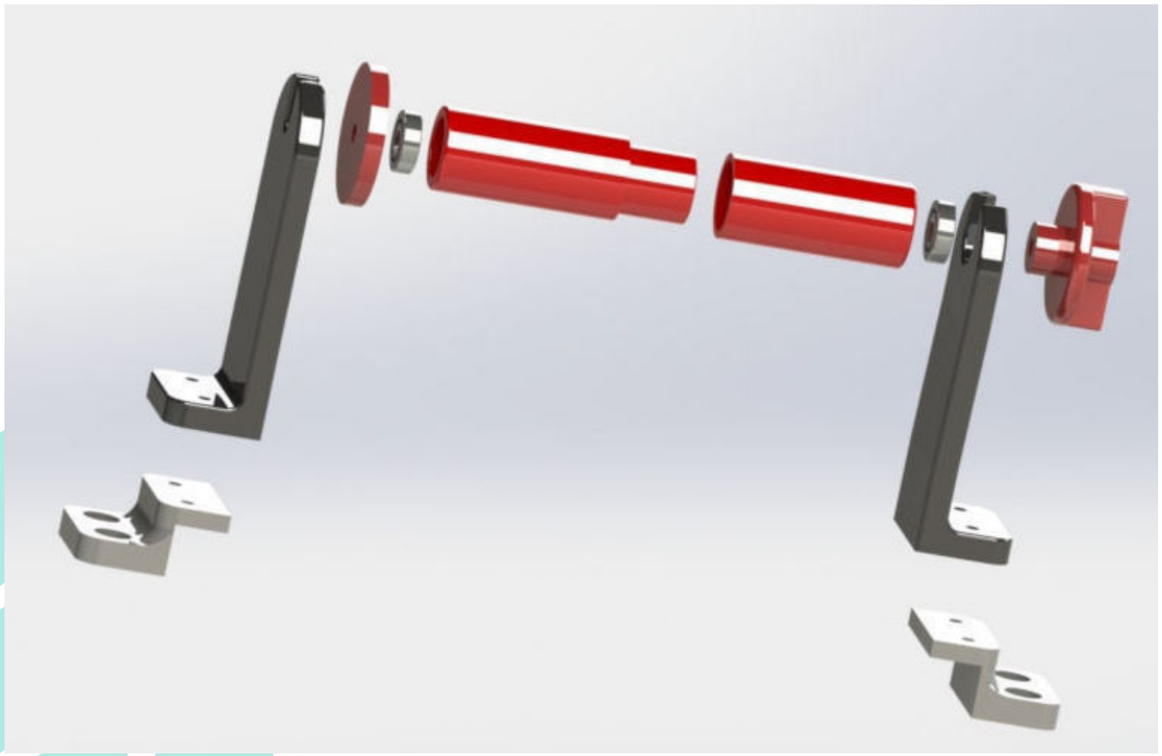


Figure 11.11. 3D model. Source: HTTPS://PINSHAPE.COM/ITEMS/11631-3D-PRINTED-ANOTHER-UNIVERSAL-SPOOL-HOLDER [2019]

3D PRINTING THE COMPONENTS

3D print, finish and ensemble the components. If you dont have access to real bearings and their housings, a good idea could be to 3D print them too for the test – you can easely find ready 3D models on the internet.

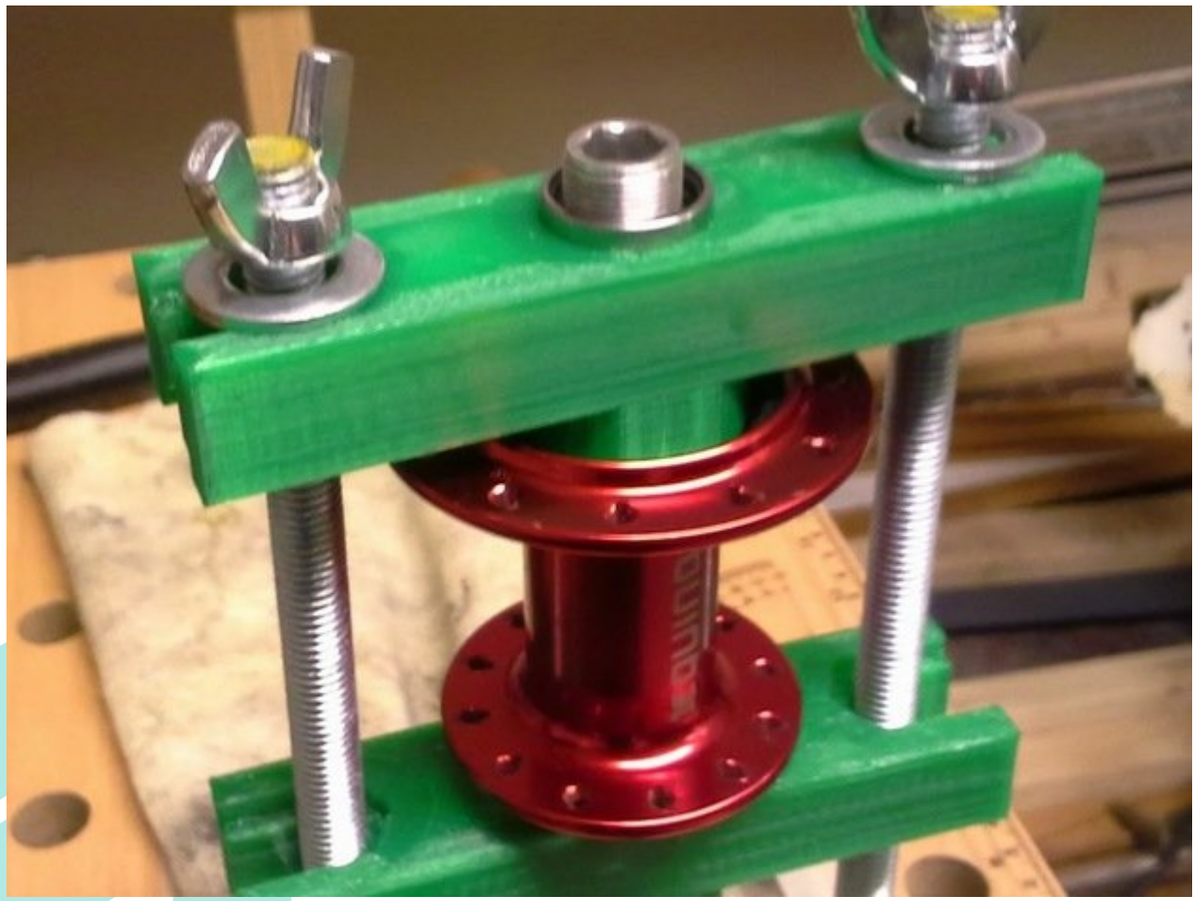


Figure 11.12. 3D printed bicycle hub bearing press. Source: HTTPS://WWW.THINGIVERSE.COM/THING:155520 [2019]

3D PRINTING OF AN ERGONOMIC HANDLE

- Aim of this workshop is to present makers the practical knowledge needed to develop a technical product suitable for 3D printing
- Resources / Tools needed: computer, Internet, CAD software, 3D Slicer Software, FDM 3D printer, filament, basic tools
- Safety first: observe all the safety rules applicable in the workshop; use safety glasses and gloves during post-processing; exercise caution when using cleaning tools; Never touch hot parts of the machine (extruders, motors and heated bed); Don't touch moving parts of the machine; Do not interact with turned on fans; Keep your loose hair and clothes out of reach of moving belts, screws and fan.

Duration	2 academic hrs
Author / Lecturer	Diana Popescu, UPB-CAMIS
Delivery methods	Team work
Evaluation methods	Test / Report / Feedback / Exam etc.

PROBLEM STATEMENT

Design and 3D print an ergonomic handle that can be used as adapter for sticks.

Figure 11.13. Ergonomic handle.

Ergonomically enhanced tools are needed in all types of daily activities for ensuring an efficient and safe use, for preventing injury, to minimize fatigue and to allow force control.

Handles can require **a power grip**, i.e. the object is clamped between the partly flexed fingers and palm with the thumb opposing the grip.

Figure 11.14 Left-Handed Ergonomic Handle Orthopedic Walking Stick **. Source: https://www.walkingsticks.co.uk/left-handed-ergonomic-handle-orthopaedic-walking-stick.htmL**

Figure 11.15. Left Handed Palm Grip Ergonomic Handled . Source: Https://www.Forestmobility.Com/aidapt-black-ergo-left-handed-palm-grip-ergonomic-handled-height-adjustable-walking-stick/

NEED ANALYSIS AND SPECIFICATION LIST

User requirements:

- Ergonomic grip
- Adaptable for different types of sticks with cylindrical shape

Producer requirements:

- Cost efficient
- 3D printing time as small as possible

Steps:

1. Search the internet for different handles shape and modalities to adapt the handles to the stick (press-fit, screw, etc.)

2. Sketch different models of handles

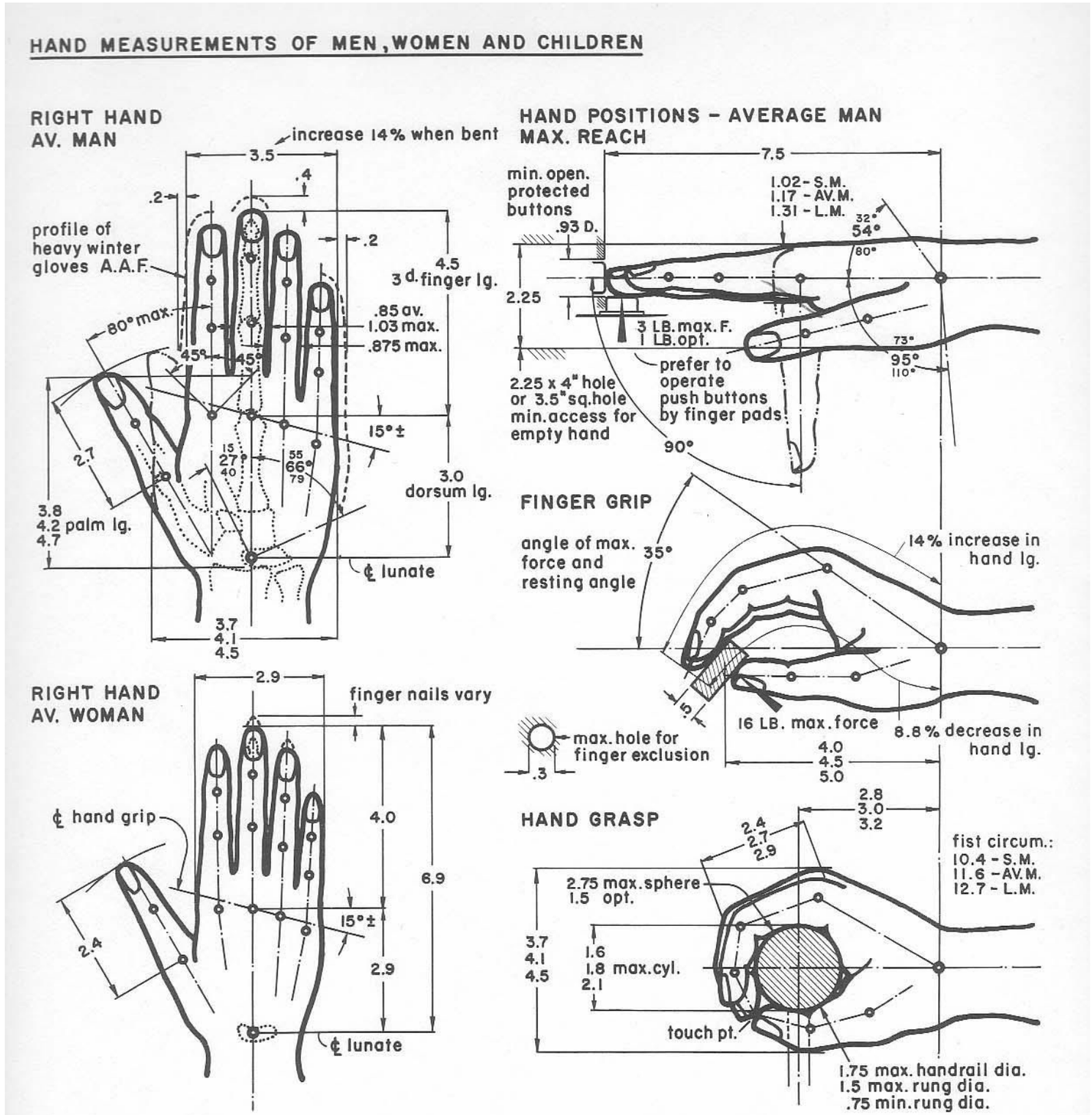
3. Dimension the handle based on anthropometrical hand data or by measuring your own hand

OR

4. Use a piece of clay and shape it according to your ergonomic grip. Then 3D scan the clay and obtain the 3D virtual model of the grip

Figure 11.16. EXAMPLE OF ANTHROPOMETRICAL HAND DATA FOUND IN LITERATURE

Source: www.pininterest.com



HAND DATA	MEN			WOMEN			CHILDREN			
	2.5% tile	50.% tile	97.5% tile	2.5% tile	50.% tile	97.5% tile	6 yr.	8 yr.	11 yr.	14 yr.
hand length	6.8	7.5	8.2	6.2	6.9	7.5	5.1	5.6	6.3	7.0
hand breadth	3.2	3.5	3.8	2.6	2.9	3.1	2.3	2.5	2.8	—
3d. finger lg.	4.0	4.5	5.0	3.6	4.0	4.4	2.9	3.2	3.5	4.0
dorsum lg.	2.8	3.0	3.2	2.6	2.9	3.1	2.2	2.4	2.8	3.0
thumb length	2.4	2.7	3.0	2.2	2.4	2.6	1.8	2.0	2.2	2.4

CONCEPT DRAWINGS

Bellow one can find an example of a handle.

Feel free to design your own model.

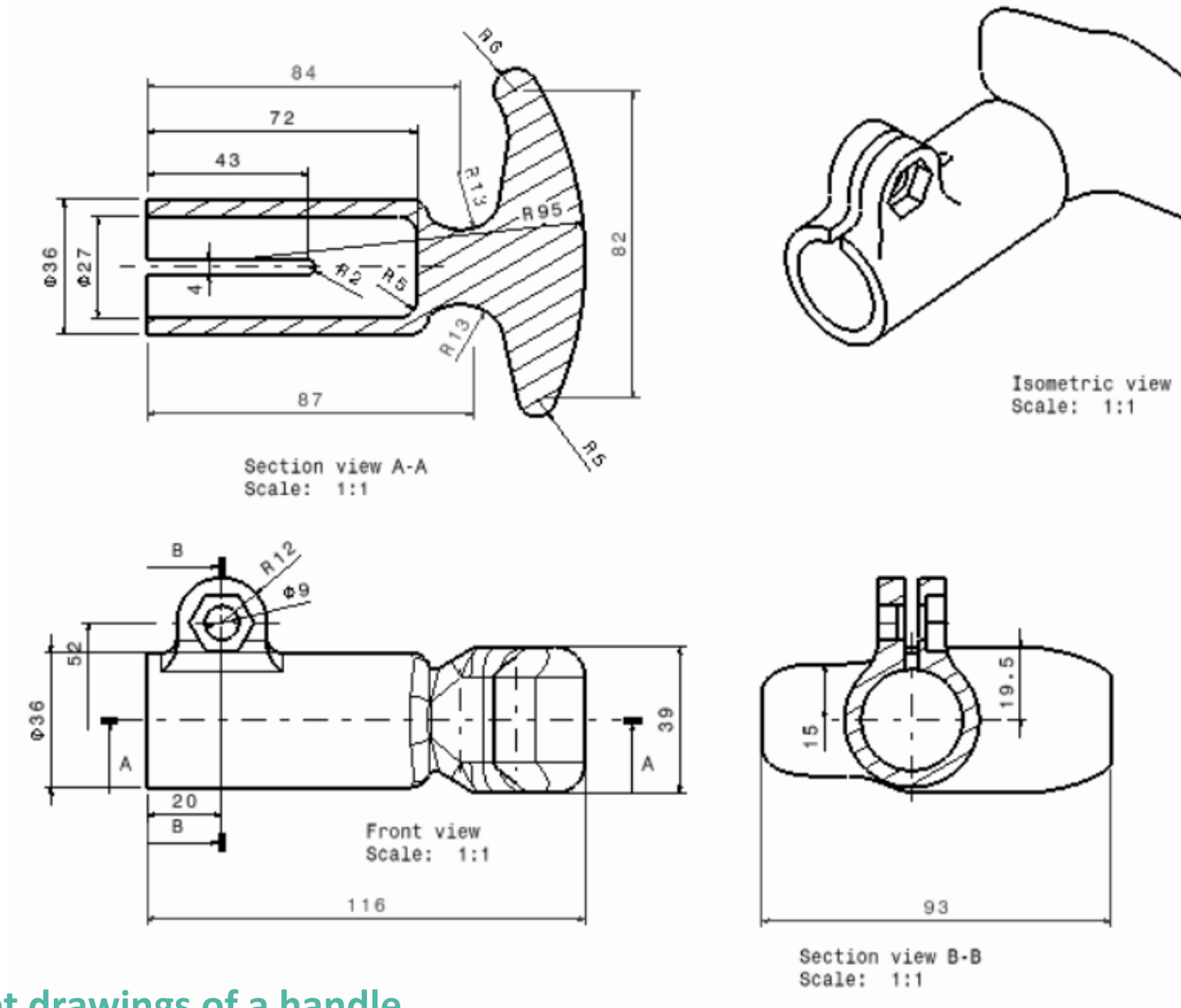


Figure 11.17. 2D concept drawings of a handle.

3D MODELING

Use a 3D CAD software for designing your handle.

CATIA V5 model in presented bellow.

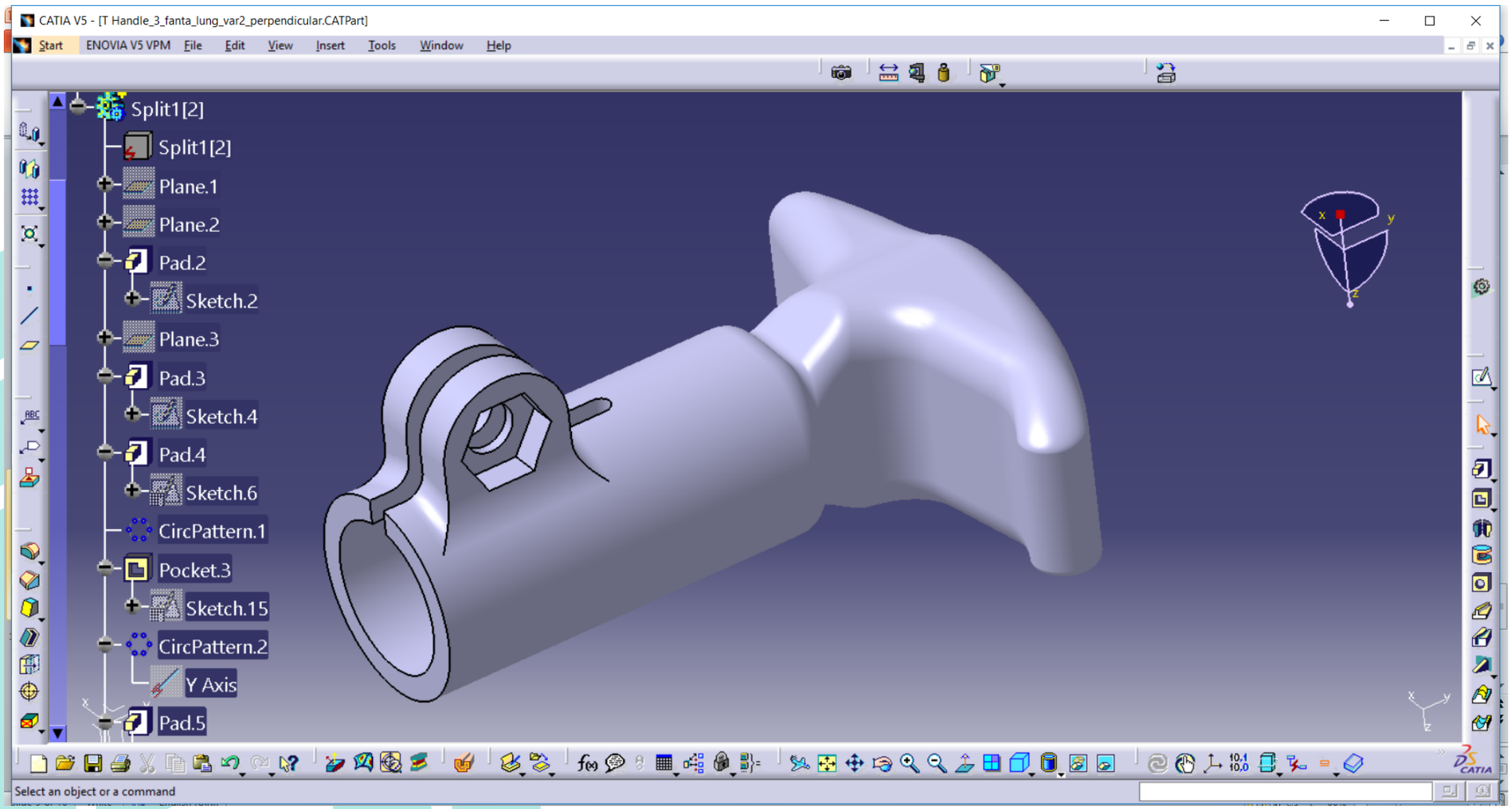


Figure 11.18. 3D model.

3D MODELING

- Save your 3D virtual model in STL file format.

- Pay attention to the parameters defining STL accuracy. Each 3D CAD software has its own modality to set these parameters. Check this aspect using information from software tutorial.

- Verify that the STL model is correctly generated using a dedicated app, such as Netfabb Autodesk.

3D PRINTING THE HANDLE

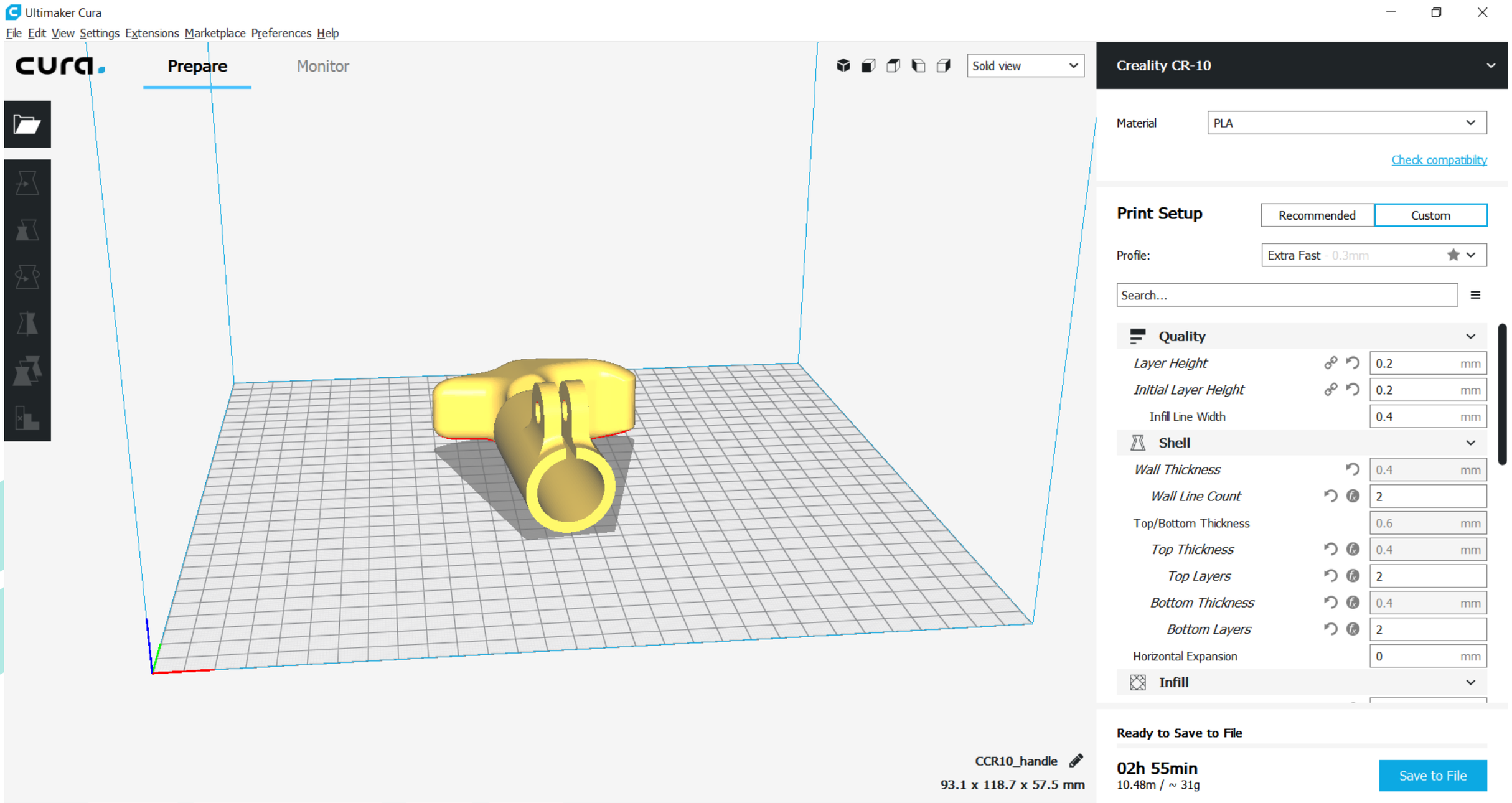
- Import the STL file of the handle in Cura Ultimaker software.

- Choose a material (PLA, for instance) you can use with your 3D printer

- Set the 3D printing parameters: layer thickness, nozzle diameter, printing temperature, bed temperature, infill, etc.

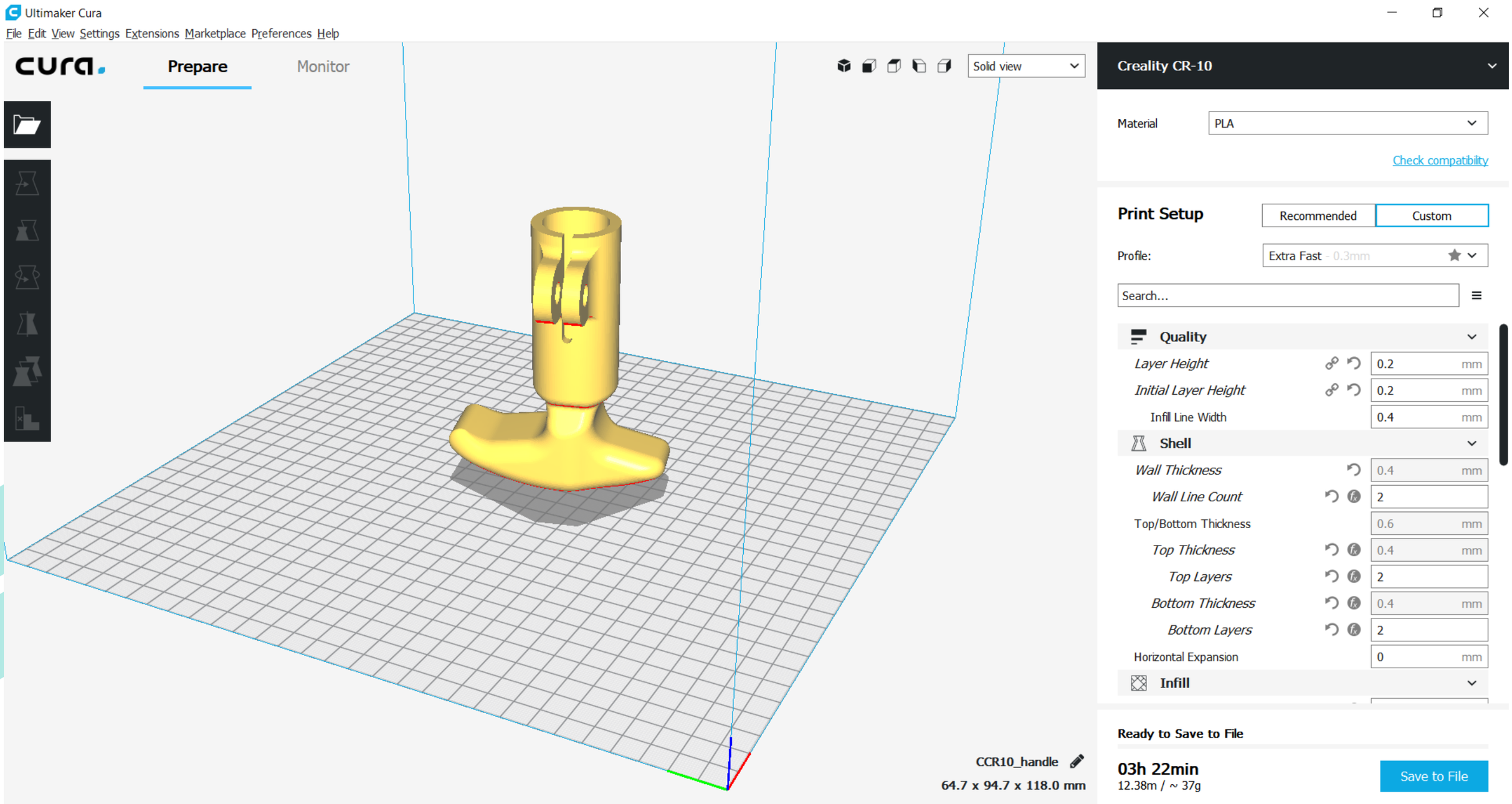
- Choose a building orientation that minimizes the printing time.

3D PRINTING THE HANDLE



One possible building orientation. Pay attention to printing time and material consumption.

3D PRINTING THE HANDLE



Another possible building orientation. Compare printing time and material consumption.

TECHNICAL CREATIVITY IN 3D PRINTING MODULE

3D PRINTING OF A TECHNICAL PRODUCT – ENTREPRENEURSHIP DEVELOPMENT

Aim of the workshop is to equip makers with the technical entrepreneurial knowledge needed to successfully develop their ideas

Students will improve their organisational, leadership, presentation, creative, time management and team working skills

Duration	2 academic hrs
Author / Lecturer	Inventya
Delivery methods	Team work
Evaluation methods	Test / Report / Feedback / Exam etc.

ACTIVITY OVERVIEW

Students will form into business units and the task is to design and market a product related to the 3D printing industry. You will then pitch your business ideas to the judges.

COMPANY INFORMATION

1. Split into teams of 4-6 students to represent your company
2. Assign a team member as the leader. The leader will be in charge of making sure all the decisions are based on consensus, all members contribute and ensure the smooth and effective operation of the team.
3. Working as a team, come up with the following information related to your company:

    - Company name
    - Company logo
    - Company structure
    - Company goals and objectives

PRODUCTS AND SERVICES

Discuss within your groups the type of products and services your company will offer and think about the following questions:

- What is your product/service?
- Why did you come up with this idea?
- What unmet needs is your product/service satisfying?
- What makes your product stand out from the other companies? i.e. what is your selling point?
- How will you produce the product?
- How much will it cost?

BUSINESS STRATEGIES

By referring to the content in the entrepreneurship lecture, devise business strategies:

- What industry or market segment do you want to sell into?
- Where will you get your funding?
- How will you develop and protect your product?
- How does your business have a global potential?
- What are the risks regarding your business and how will you manage them?
- What other strategies will you employ to further develop your business?

PRESENTATION

Once you have gathered all the information, you will then present your ideas to the panel of judges. Each team will have **10 minutes** to present their ideas.

When presenting, the judges will be looking for the following things:

- Ability to combine everyone's ideas and be able to utilize the team talents
- Creativity when addressing the product/service
- Organizational skills and the ability to keep to time
- Confidence when presenting
- Clarity of strategy and presentation

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