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13, 14 y 15
de octubre
2022



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MINISTERIO DE EDUCACIÓN
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Año Europeo de la Juventud

3D printing support service for innovative citizens

Servicio de apoyo a la impresión 3D para ciudadanos innovadores (INNO3D)

Dr. Santiago Ferrandiz
Dr. Juan López
Dr. Octavio Fenollar
Dra. M^o Dolores Samper

UPV – Team/equipo

13 de octubre del 2022

UPV



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Compartiendo nuestros valores europeos con la juventud de hoy y de mañana: por estos 35 años y los que vendrán



INDICE

- Descripción del proyecto
- Instalaciones disponibles
- Material de formación

INDEX

- Project description
- Facilities available
- Training material



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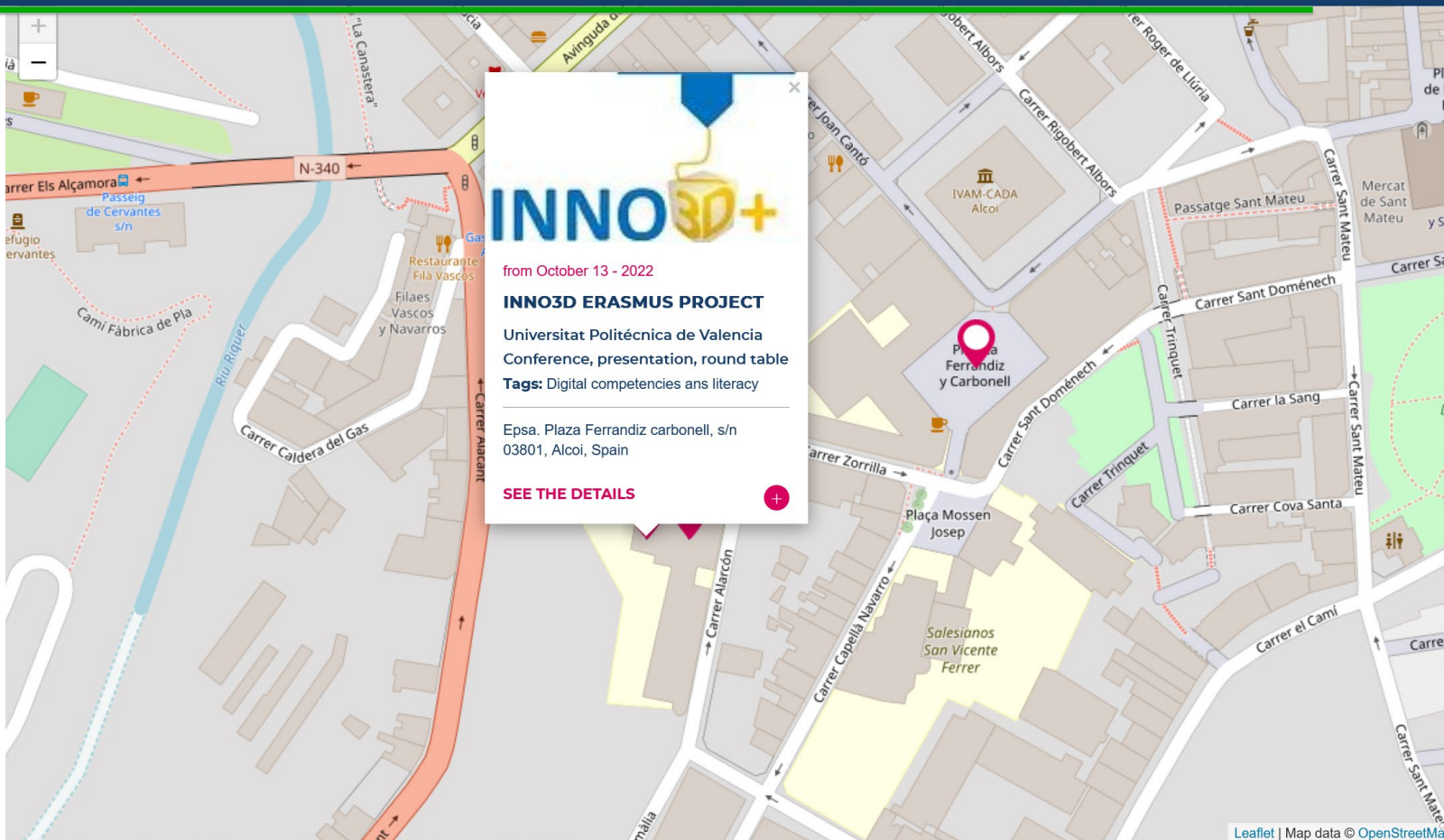


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The 3D printing support service for innovative citizens (INNO3D) project

El proyecto mejorará la calidad y relevancia de los conocimientos y habilidades de los bibliotecarios en el área de la impresión 3D.

Objetivos del Proyecto: El proyecto está diseñado para mejorar y diversificar los servicios ofrecidos a los usuarios de las bibliotecas universitarias y de otro tipo al ofrecer a estos usuarios de bibliotecas habilidades clave y la oportunidad de desarrollar competencias de impresión 3D. Esto se logrará capacitando a los bibliotecarios que luego capacitarán a los usuarios de la biblioteca, estudiantes, personal y ciudadanos en general en el uso de los servicios de impresión 3D.

The project will improve the quality and relevance of librarians' knowledge and skills in the area of 3D printing.

Project Objectives: The project is designed to improve and diversify the services offered to users of academic and other libraries by offering these library users key skills and the opportunity to develop 3D printing competencies. This will be achieved by training librarians who will then train library users, students, staff and general citizens in the use of 3D printing services.



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INNO3D Project Partners:

Technological University of the Shannon: Midlands Midwest (TUS) (formerly LIT), Limerick,
IRELAND (Grant-holder)

Transilvania University of Brasov (UTBV), Brasov, ROMANIA

University of Crete (UOC), Rethymno, Crete, GREECE

Constantine the Philosopher University of Nitra (UKF), Nitra, SLOVAKIA

Polytechnic University of Timisoara, Timisoara (UPT), ROMANIA

Polytechnic University of Valencia (UPV), Valencia, SPAIN

MBTHINKTANK SRL, Brasov, ROMANIA

Universidade NOVA de Lisboa, Lisbon (UNL), PORTUGAL

University of Piraeus Research Centre (UPRC), Piraeus, GREECE



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INNO3D Project Budget and duration:

Project Duration:

The duration is three years (36 months)

Grant Awarded

€439,560



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Intellectual Outputs in INNO3D

Intellectual Output (IO)	Leader
1. Framework for 3D Printing in each EU Partner institution	Universitat Politecnica de Valencia
2. Situation analysis on 3D Printing education in each EU partner institution and Library	Universidade Nova de Lisboa
3, Blended Curriculum	Limerick Institute of Technology
4. Develop web Portal with Innovative content that will provide up-to-date information on 3D Printing technology as well as an e-learning platform addressed to the project target Group.	MBTHINKTANK SRL, with University of Piraeus Research Center
5. 3D Printing simulation videos	Transilvania University of Brasov
6. Guide for 3D Printing- Best Practice and Policy	University of Crete
7. 3D Printing Trainers Toolkit for theoretical program	Universitatea Politehnica Timisoara
8. Research study on impact of the 3D Printing Training curriculum and teaching materials	Constantine the Philosopher University of Nitra



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Project Progress to Date

Intellectual Outputs in INNO3D

Intellectual Output (IO)	Progress
1. Framework for 3D Printing in each EU Partner institution	****The Framework has been Published on the project website
2. Situation analysis on 3D Printing education in each EU partner institution and Library	****Published on the project website
3, Blended Curriculum	****Published on the project website
4. Develop web Portal with Innovative content that will provide up-to-date information on 3D Printing technology as well as an e-learning platform addressed to the project target Group.	****Web Portal has been created https://www.inno3d.eu/
5. 3D Printing simulation videos	****Published on the project website
6. Guide for 3D Printing- Best Practice and Policy	****Published on the project website
7. 3D Printing Trainers Toolkit for theoretical program	*****Published on the project website
8. Research study on impact of the 3D Printing Training curriculum and teaching materials	***Ongoing Due for delivery in 2022



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BLENDED CURRICULUM (Intellectual Output 03) 8 Modules

Module 1: Introduction to 3D Printing Technologies in Libraries (UPT)

Module 2: Types of Additive Manufacturing Technologies (UTBV)

Module 3: Industrial and Personal 3D Printers (UOC)

Module 4: Design and Materials used for Personal 3D Printers (UNL)

Module 5: 3D Printing Workflow for Trainers (UPV)

Module 6: Basic Maintenance (UKF)

Module 7: Application areas of 3D Printing (UPRC)

Module 8: Relevant Intellectual Property Rights in the Context of 3D Printing (MBTT/TUS)



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	PBL14	PBL15	PBL16	PBL17	PBL18	PBL19	PBL20	PBL21	PBL22	PBL23	PBL24	PBL25	PBL26	PBL27	PBL28	PBL29	PBL30	PBL31	PBL32
skills to be acquired																			
chess_horse		Albert_Einstein_highres	Castle	Base_movil_3.0	fish_fossiliz_fob	Maxillary_Denture_Bas	Micro_Catapult	anatomical_heart	Jewelry_TreeKnot_Vortex2		wind-up+car+gift	dvorak	Adalinda	Mega_Mew_Two_Y	Mega_Mew_Two_Y_sup	Mega_Mew_Two_X	Mega_Mew_Two_X_sup	Traction_Engine	Treasure_Chest_Remix
Skill to recognize mechanical properties like Impact resistance, layer adhesion (isotropy), Heat resistance						X					X							X	
Ability to select Part accuracy				X	X	X					X	X			X		X		
Skill to select Surface finish															X		X		X
Skill to select material post processing				X	X														
Ability to select cold welding procedures				X								X							
About the 3D printing process data																			
Demonstrated ability to recognize STL, AMF, 3MF, PLY, OBJ input files	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ability to recognize technologies estimation built time				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ability to use STL repairing software, Netfabb, Cura, Simplify3D, Slic3r prusa, Pronterface, Repetier Host, Meshmixer, Meshlab, Magics, Deskartes.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Skill to use slicing software Netfabb, Cura, Simplify3D, Slic3r prusa, Pronterface, Repetier Host, Meshmixer, Meshlab, Magics, Deskartes	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Skill to manage Print Quality Troubleshooting Guide	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ability to recognize 3d printing glossary and terminology	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Skill to manage closed surfaces/solids																			
Ability to use platform built simulators																			
Skill to manage booleans operations, symmetry, scaled, duplicated parts with dedicated software	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ability to programming printing parameters (Hotend diameter, slicing layer, skirt, dual printing,	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Competencias



Competencias



Skills about the 3D printing technologies

- Ability to select 3d printing technologies
- Ability to recognize technologies build size
- Skills to recognize dimensional Accuracy on 3D printing technologies
- Capacity to select between conceptual design



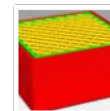
Skills about the 3D printing materials

- Ability to select 3d printing materials
- Skill to recognize mechanical properties
- Ability to select Part accuracy
- Skill to select Surface finish
- Skill to select material post processing
- Ability to select cold welding procedure



Skill about the 3D printing process data

- Demonstrated ability to recognize STL, AMF, 3MF, PLY, OBJ input file
- Ability to recognize technologies estimation built time
- Ability to use STL repairing software,.
- Skill to use slicing software
- Skill to manage Print Quality Troubleshooting Guide
- Ability to recognize 3d printing glossary and terminology



Skills about the 3D printing desktop layout

- Ability to recognize technologies build size
- Ability to recognize dimensional
- Accuracy on 3D printing technologies
- Ability to work with network printers or standalone 3d printer
- Skill to make 3d printer configurations
- Skill to make 3d printer calibration



Skills about the 3D printing post- Processing

- Ability to remove supports on printed parts
- Ability to clean printed parts
- Skill to use electric cutting, cleaning parts
- Skill to use soluble supports filaments (PVA, HIPS)
- Ability to use sanding post Processing
- Ability to use painting technique
- Ability to use welding technique
- Ability to use gluing technique



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Syllabus

1. Information about the **Module 1**

1.1 University	Politehnica University of Timișoara
1.2 Team	UPT_Team
1.3 Trainer_Name	Associate Professor Anca Drăghici Associate Professor Carmen Sticlaru
1.3 Degree level	Postuniversity degree

2. Information about the course

Module title	Introduction to 3D Printing Technologies in Libraries
--------------	--

3. Time budget

3.1 Number of hours	3 h	divided in:	Lecture	100 mins	Laboratory/Project	80 mins
3.2 Time budget distribution (hours) for individual activity:						
(a) Individual study (course, obligatory bibliography, etc.)						1
(b) Additional documentation (recommended bibliography, etc.)						0.5
(c) Preparation for seminary/laboratory/project activities						0.5
(d) Peer learning						0
(e) Exam preparation						0
(f) Other activities						0
3.3 Total individual study (sum (3.7(a)...3.7(f)))				2 h		
3.4 ECTS credits				0.2		

4. Preconditions

4.1 curriculum	Librarian
4.2 competences	Space vision, technical skills, computer using knowledge

En proceso de traducción al castellano



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Module 1: Introduction to 3D Printing Technologies in Libraries

Content

1.1 The role of libraries and 3D Printing	2
1.2 Towards Digital Literacy: 3D Printing and Makerspaces in Libraries	3
1.2.1. Digital Literacy: 3D Printing	3
1.2.2. 3D Printing and Makerspaces in Libraries	3
1.3 Library Policy for 3D Printing	5
1.4. General Description of the Manufacturing Principles.....	6
1.4.1. Classification of manufacturing techniques	6
1.4.2. A short history of 3D printing	9
1.4.3. The need for additive production.....	11
1.5. Advantages of the Additive Manufacturing	14
1.5.1. Low-cost prototyping with very quick turnarounds.....	14
1.5.2. Very low start-up costs.....	14
1.5.3. Large range of (speciality) materials	15
1.5.4. Geometric complexity at no extra cost	15
1.5.5. Limitations of 3D printing.....	15
1.5.6. Lower strength and anisotropic material properties	15
1.5.7. Post-processing and support removal.....	15
1.5.8. Less cost-competitive at higher volumes	16
1.5.9. Less cost-competitive at higher volumes	16
Bibliography.....	16

Module 2: Types of Additive Manufacturing Technologies

Contents

2.1 Material Extrusion.....	2
2.1.1 Fused Deposition Modeling	2
2.2 Material and Binder Jetting	5
2.2.1 Material Jetting	5
2.2.2 Nano-Particle Jetting (NPJ).....	10
2.2.3 Drop a Demand	12
2.2.4 Binder Jetting	15
2.3 VAT Polymerization.....	17
2.3.1 Stereolithography.....	19
2.3.2 Digital Light Projection	26
2.3.3 Continuous Digital Light Processing.....	33
2.4 Powder Bed Fusion.....	34
2.4.1 Selective Laser Sintering.....	36
2.4.2. Direct Metal Laser Sintering.....	40
2.4.3. Selective Laser Melting	42
2.4.4. Electron Beam Melting.....	44
2.4.5. Multi Jet Fusion	48
2.5. Sheet Lamination Process.....	50
2.5.1. Laminated Object Manufacturing	51
2.5.2. Ultrasonic Additive Manufacturing.....	52
2.5.3. Selective Deposition Lamination.....	53
2.6. Direct Energy Deposition	55
2.6.1. Laser engineered net shaping	56
2.6.2. Electron Beam Additive Manufacturing.....	57



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INNO3D Blended Curriculum – Module 3: Industrial and Personal 3D Printers

Contents

3.1 Types of 3D industrial and personal Printers.....6

3.1.1 The use of 3D printing technologies in industry6

3.1.2 Technologies.....8

VAT Photopolymerization.....9

Material Jetting.....9

Binder Jetting10

Material Extrusion.....11

Powder Bed Fusion.....11

Sheet Lamination11

Directed Energy Deposition.....12

Construction 3D Printing (c3Dp).....12

Massivit's proprietary gel dispensing printing technology (GDP)13

3.1.3 Differences between industrial and home desktop 3D printers14

What Makes a Printer Industrial?14

Accuracy.....14

Materials15

Production capabilities and cost16

BeamMaker: an open hardware high-resolution digital fabricator for the masses16

3.2. Commercial 3D industrial Printers18

Big Area Additive Manufacturing (BAAM)18

Electron Beam Additive Manufacturing (EBAM)19

Wire Arc Additive Manufacturing (WAAM).....19

Large-format sand 3D printing.....19

Dreambot3D FDM 3D.....21

Stratasys F series22

Stratasys F90023

Massivit 3D.....24

Essentium HSE 280I HT.....25

CreatBot PEEK-30026

Anisoprint ProM IS 500.....27

3DGence F42028

Roboze Argo29

Delta WASP 4070 Tech.....30

Cincinnati MAAM31

3.3. Commercial 3D personal Printers32

Prusa i3 MK3S+ 3D printer32

Monoprice Voxel33

Formlabs Form 3 – 3L.....34

Original Prusa SL1S SPEED35

Monoprice Delta Mini V236

LulzBot Mini 2.....37

XYZ da Vinci Nano38

Polaroid PlaySmart 3D39

Peopoly Phenom.....40

INNO3D Blended Curriculum – Module 3: Industrial and Personal 3D Printers

3Doodler Create Plus.....41

Toybox 3D Printer.....42

Creativity Ender 3 V2.....43

Elegoo Mars 244

FlashForge Inventor 2S 3D Printer.....45

Glowforge 3D Laser Printer46

3.4. Processing Parameters of the Commercial 3D Printers.....47

3.4.1. Machine parameters48

- Nozzle diameter (defines the Layer thickness limits)48
- Nozzle temperature48
- Bed temperature.....48
- Chamber temperature48
- Build speed.....49
- Build size49
- Layer height49

3.4.2. Working parameters49

- Build orientation49
- Infill density50
- Infill pattern50
- Raster angle and raster width50
- Air gap51
- Contour width and number of contours51
- Layer thickness (depending on the nozzle diameter).....51

Web References52

Bibliography54



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Modulo 4 Design and Materials used for Personal 3D Printers

Contents

Design CAD	
Introduction	
How to design	
Know the User Interface	
2D Sketching	
Create	
Modify	
3D Modeling	
Create	
From 2D	
Basic shapes	
Saving/Exporting	
Materials	
FDM (Filament Deposition Modeling)	
Introduction	
PLA	
ABS	
PET	
Nylon	
TPU	
PC	
SLA (Resin)	
Introduction	
Standard resin	
Clear resin	
Tough resin	
Heat resistant resin	
Rubber-like resin (flexible)	
Ceramic filled resin (Rigid)	
Bibliography	

Modulo 5 - PBL

3	Problem definition_1.pdf. Student Work Sheet logo.stl
3	Problem definition_2.pdf. Student Work Sheet Nefertitti.stl
4	Problem definition_2 - help.pdf
4	Problem definition_3.pdf. Student Work Sheet Vase.stl
4	Problem definition_4.pdf. Student Work Sheet treefog.stl
5	Problem definition_5.pdf. Student Work Sheet Spinner.stl
5	Problem definition_6.pdf. Student Work Sheet buddy.stl
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11	Problem definition_31.pdf. Student Work Traction_Engine.stl
11	Problem definition_32.pdf. Student Work Treasure_Chest_Remix.stl
12	Problem definition_33.pdf. Student Work calibration xyz skills_inno3d



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Modulo 6: Basic Maintenance

- 1.1 Regular maintenance of i3 printers,
Nozzle replacement or replacement, Belt
tension adjustment
- 1.2 Disassembly of hotend & heatbreak
stuck in cooler,
Manual removal of fibre from the extruder,
Checking / aligning the feed wheels
- 1.3 How to shorten a PTFE tube - Original
Prusa printer, Replacement of PEI foil
- 1.4 How to replace a hot end thermistor,
How to replace a heatbreak / heating
block/cooler
- 1.5 Firmware update,
Safety testing,
Printer maintenance tips

Modulo 7: Campos de aplicación

Contents

7.1. Automotive Industry	5
7.1.1. AM in the automotive industry	5
7.1.2. AM requirements	6
7.1.3. 3D Printing advertences	6
7.1.4. Necessary equipment.....	8
7.1.5. Common automotive applications.....	10
7.1.6. Main applications	11
7.1.7. Advantages and Disadvantages of 3D printing	12
7.1.8. Future projects involving 3D Printing technology.....	14
7.1.9. Conclusion.....	15
7.1.10. References.....	16
7.2. Prosthetic Industry.....	17
7.2.1. Other necessary equipment, beyond 3D-printer.....	18
7.2.2. Equipment can be manufactured using 3D printing	18
7.2.3. Disadvantages of 3D printing.	22
7.2.4. Future projects involving 3D printing technology.....	22
7.2.5. References.....	23
7.3. Medical devices Industry	25
7.3.1. Applications of 3D printing in medical devices	26
7.3.2. Conclusion and future work	31
7.3.3. References.....	33
7.4. Aviation Industry	34
7.4.1. Design communication.....	34
7.4.2. Material Jetting (MJ)	35
7.4.3. 3D Printing Benefits.....	36
7.4.4. How 3D printing is influencing the Aerospace Industry	37
7.4.5. 3D Printing Materials for aerospace applications.....	39
7.4.6. The future	40
7.4.7. References.....	41



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**FabLab (Design Factory)
Granja DIMM**



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UPV Farm 3d printer labs DIMM



5 colors 3D printer, FFF and DLP printers

3devo filament extruder





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Dental scanner

UV furnace

RTM vacuum machine for composite materials



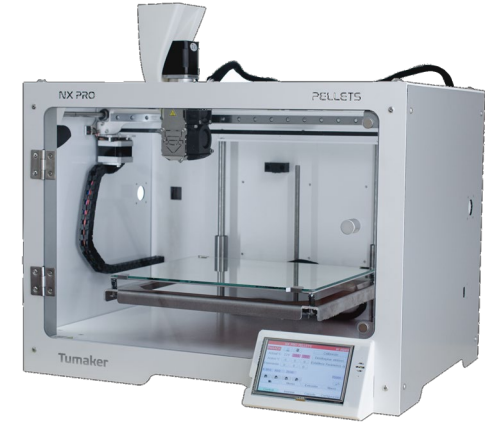
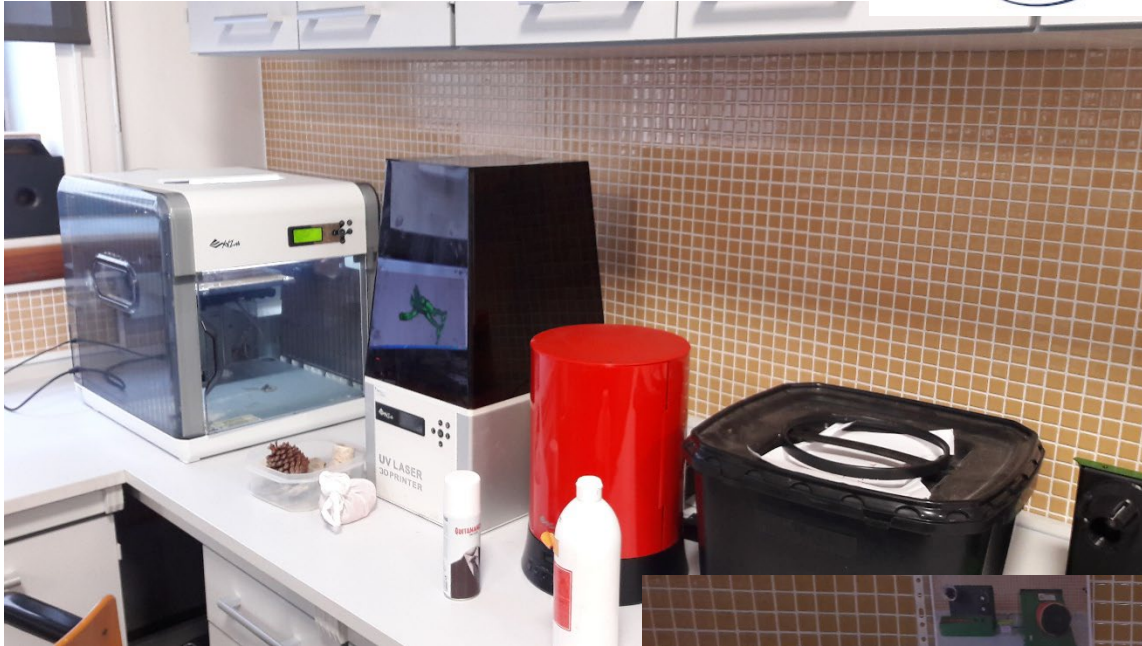
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HP laser scan
Sense scan
Ms Kinect
Revoscan



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Fff printer
SLA printer
Pellet printer tumaker
Filabot filament extruder





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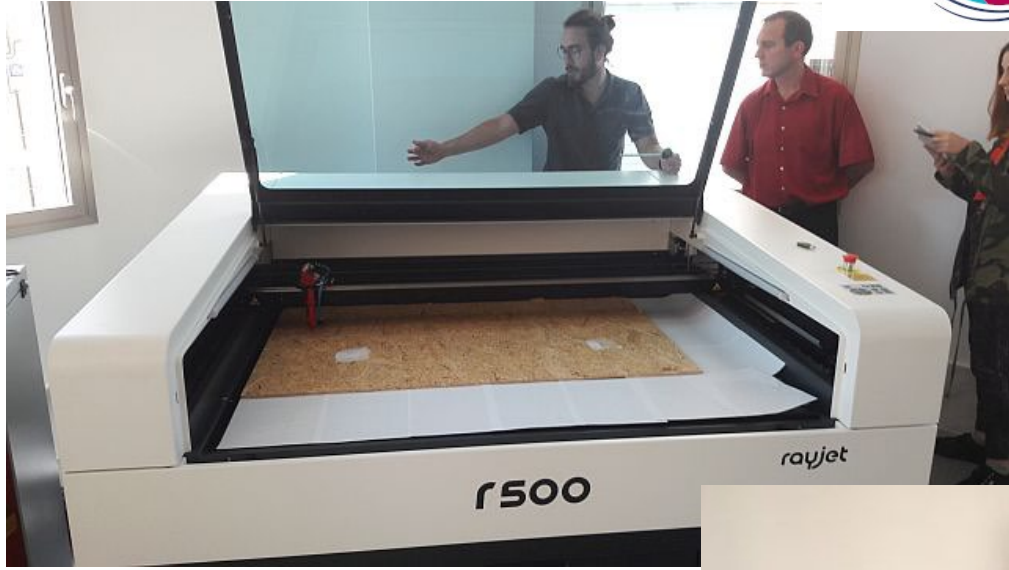
Stratasys™ Dimensión 1200 (ABS&HIPS)
SCA-1200 support removal system
Marketforget GF
BCN Sigma and sigmax

FabLab EPSA





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Laser cutting
CNC cutting
Vinyl cutting

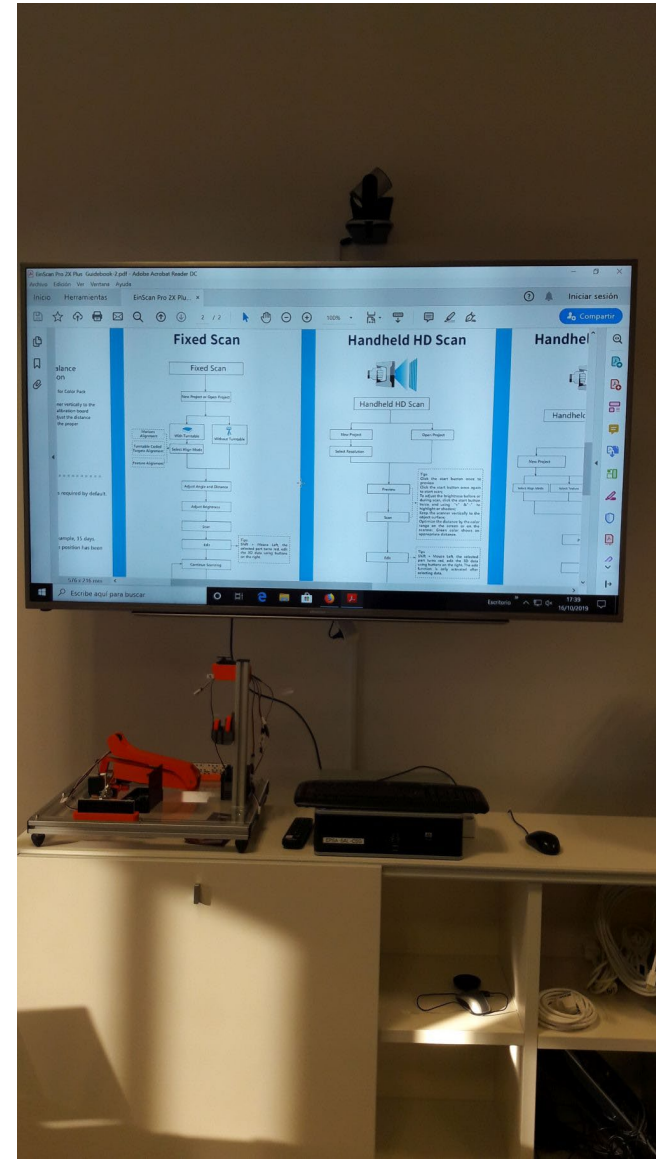




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EinScan Pro 2X

FabLab EPSA





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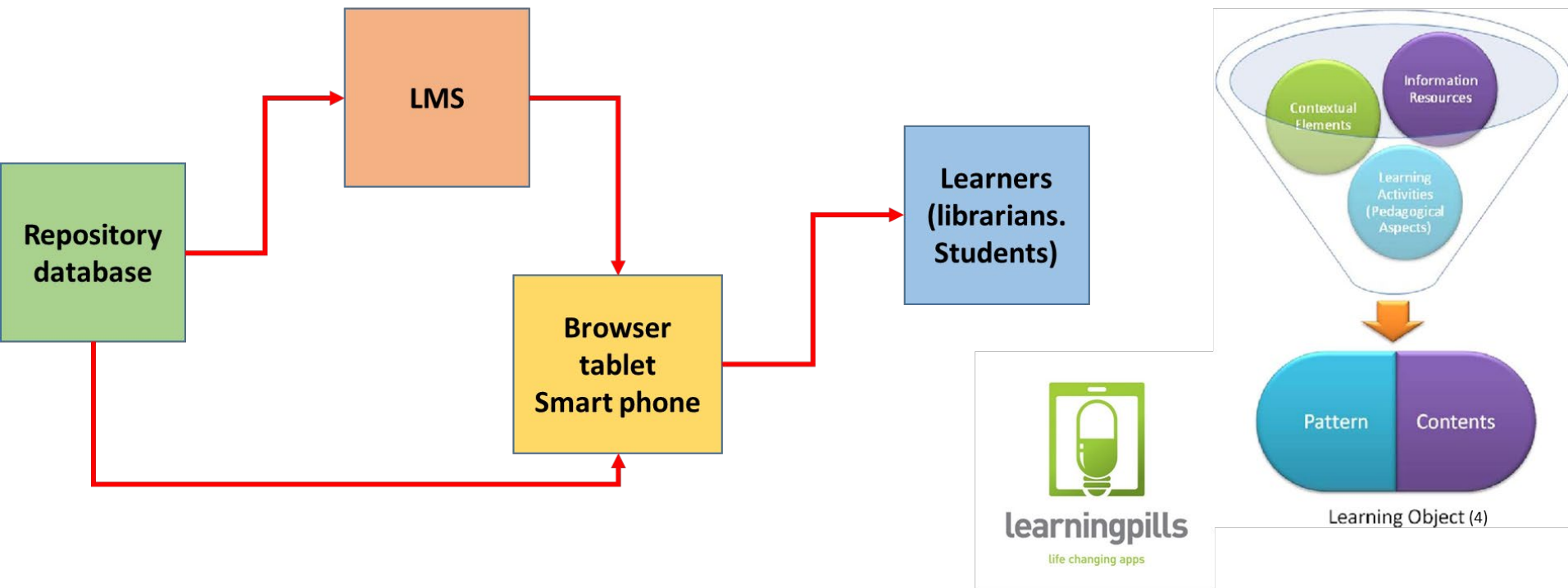
MATERIAL DE FORMACIÓN TRAINING MATERIALS



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WORKFLOW LEARNING PILLS – LEARNING OBJECTS



(3) Learning Object Systems and Strategy: A Description and Discussion. 2010. Interdisciplinary Journal of E-Learning and Learning Objects (IJELLO) 6(1):217-238. License CC BY-NC 4.0. Albert D. Ritzhaupt

(4) Developing Large Scale Learning Objects for Software Engineering Process Model. A. Saavedra, J. M. Arteaga, G. MaríaE.García. Published in ENC 2009. Computer Science, DOI:10.1109/ENC.2009.46Corpus ID: 5523503



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Knowledge Pill is a piece of knowledge packed in multimedia format and made available to everybody that needs it, but some key elements should be respected:

- The use of multimedia format.
- Simplicity, easy to create and to distribute.
- Short, the average Knowledge Pill should not take more **than 3 minutes** to watch.

There are various possible formats for Knowledge Pills:

- Audio.
- Video.
- Multimedia Presentation



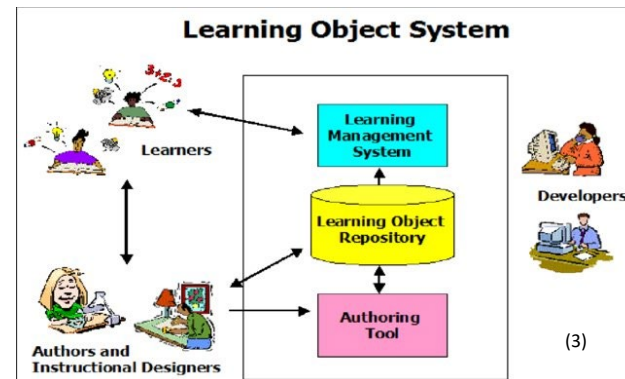


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A **learning object** is "a collection of content items, practice items, and assessment items that are combined based on a single learning objective".[2]

- Learning objects are a new way of thinking about learning content. Traditionally, content comes in a several hour chunk. Learning objects are much smaller units of learning, typically ranging from **2 minutes to 15 minutes**.
- Are self-contained – each learning object can be taken independently
- Are reusable – a single learning object may be used in multiple contexts for multiple purposes
- Can be aggregated – learning objects can be grouped into larger collections of content, including traditional course structures
- Are tagged with metadata – every learning object has descriptive information allowing it to be easily found by a search



(2) Wikipedia.es

(3) Learning Object Systems and Strategy: A Description and Discussion. 2010. Interdisciplinary Journal of E-Learning and Learning Objects (IJELLO) 6(1):217-238. License CC BY-NC 4.0. Albert D. Ritzhaupt



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Training pills 1 Change filament



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Training pills 2 Generate supports



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Training pills 3 Printing multicolor parts



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Training pills – PBL 8 - resolution



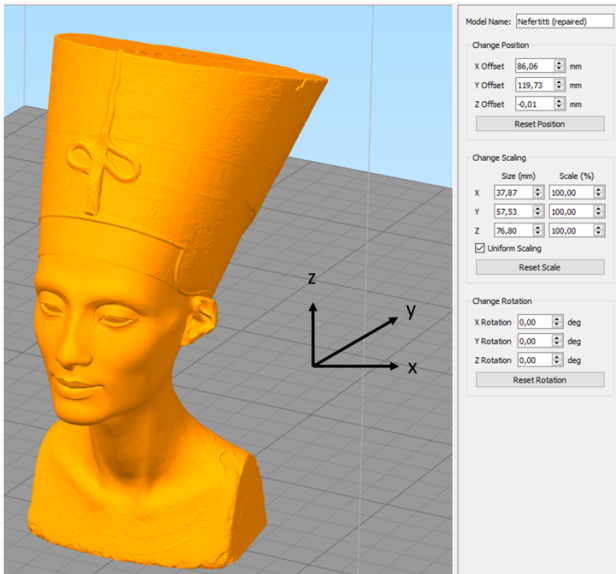
Objectives:

Explain how select 3D printing materials and how orient the part. Explain if necessary to scale the part. Explain how select Part accuracy and how use slicing software (PrusaSlicer) to scale, move the part.

Problem definition:

Some people ask us about the following 3D print part. Material specification will be PLA. In addition, quality request 0.15 mm.

Part dimension



X=37,87 mm; y= 57,53 mm: z = 76,80 mm

Download file at: <http://personales.upv.es/sferrand/Nefertitti.stl>



Questions to be solved:

- 1.- How do you orient the part?
- 2.- It's necessary use supports?. Study different part orientations
- 3.- What is the printing time?
- 4.- How decrease the printing time to 2,5 hours?
- 5.- How do you generate g-code?

References:

https://manual.prusa3d.com/c/English_manuals

<https://www.thingiverse.com/thing:1376105>

https://www.prusaprinters.org/prints/3112#_ga=2.50931626.2065968544.1609843932-42545626.1609843932

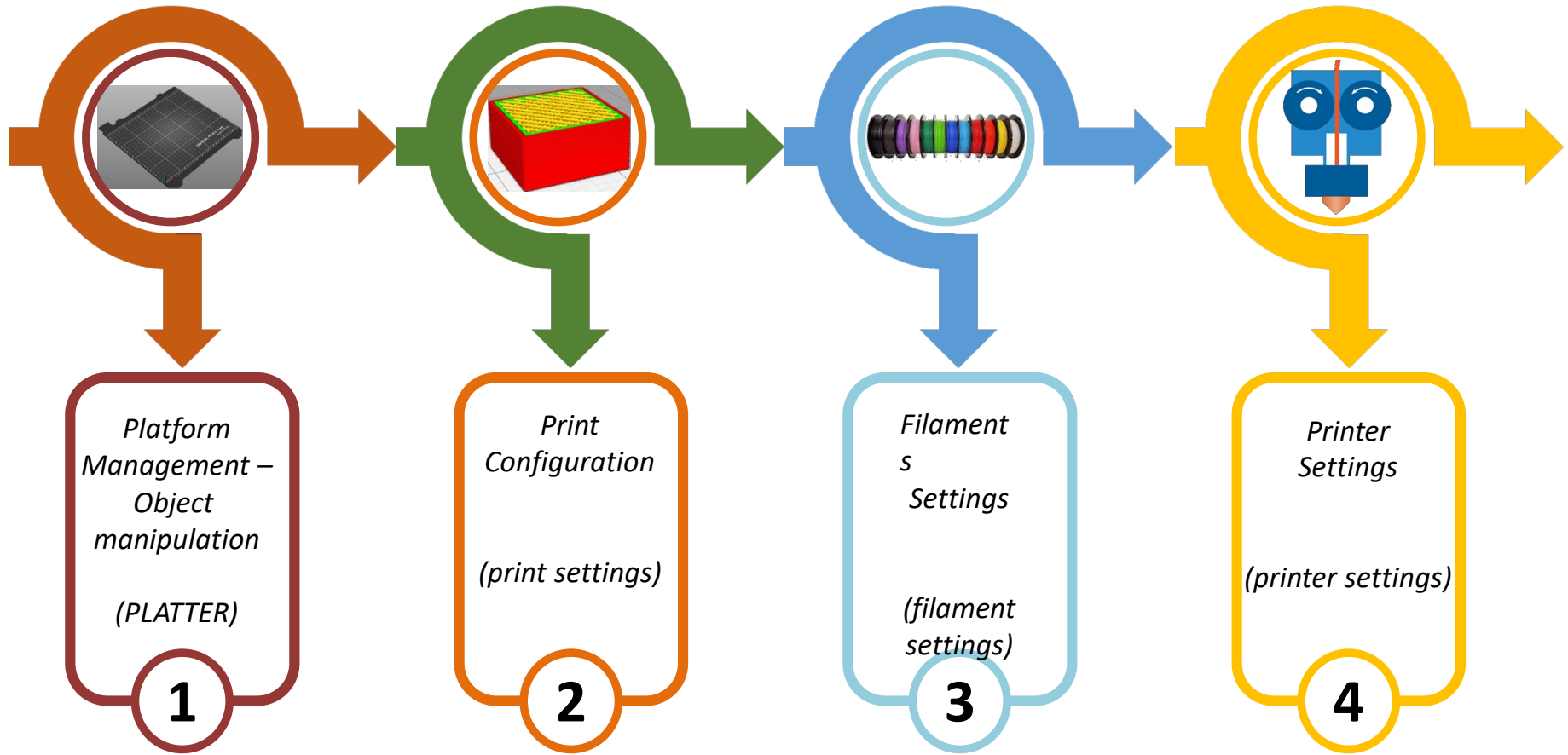




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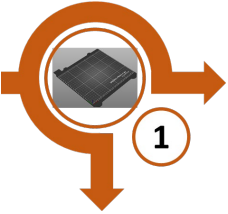


Preparing, optimizing & Slicing 3D Models workflow



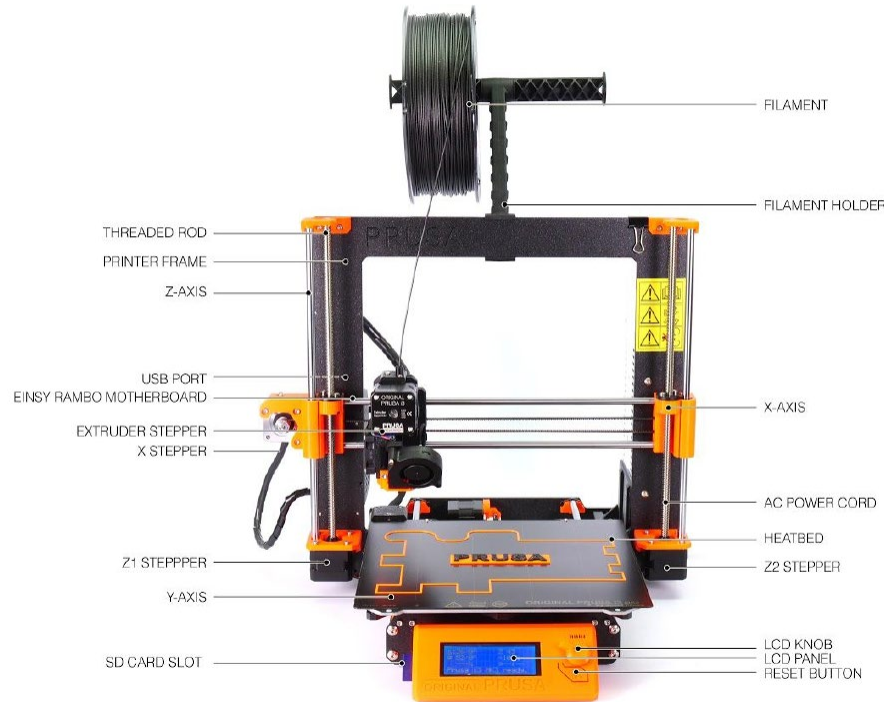


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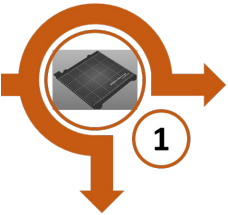


Platform Management

Prusa components

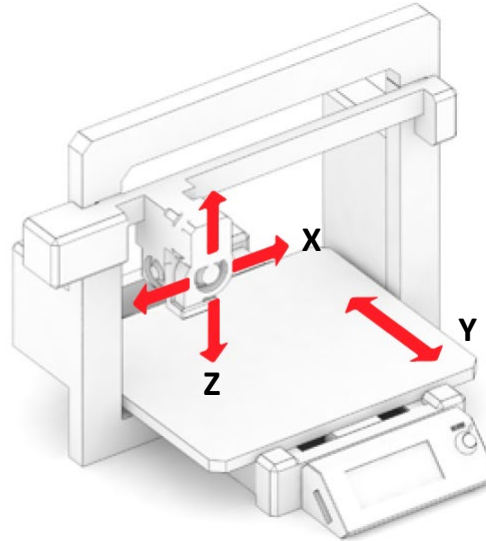


(1) 3D printing handbook. J. Prusa. 2019



Platform Management

Prusa movements



“Cartesian 3D printer is named after the XYZ dimensional coordinate system. The extruder moves in two directions (X and Z), while the print bed moves along the Y-axis. It also means that the print bed is usually square- or rectangle-shaped. Original Prusa i3 MK3S is a cartesian printer.” (1)

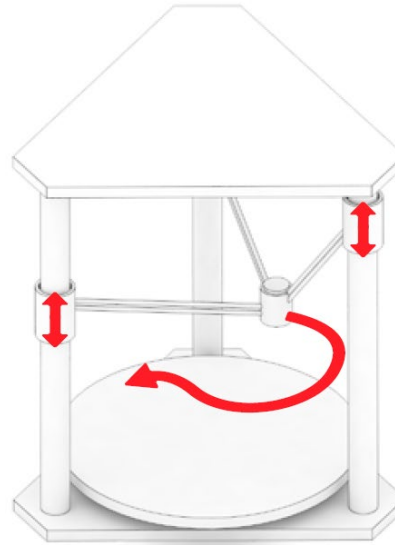
(1) 3D printing handbook. J. Prusa. 2019



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Platform Management



Delta movements

“Delta 3D printers have their extruder movements controlled by three moving arms, which meet in the extruder. Two of the biggest advantages are the speed of printing and large printing volumes. However, the printer requires extremely precise assembly and calibration. The printer’s geometry requires complex calculations for movements of stepper motors in each of the arms”. (1)

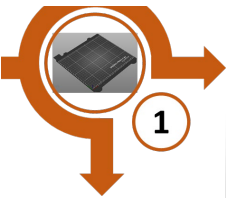
(1) 3D printing handbook. J. Prusa. 2019



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Platform Management – object manipulation



PrusaSlicer-2.0.0+-201905201652 based on Slic3r

Plater | Print Settings | Filament Settings | Printer Settings

Print settings: Simple | Advanced | Expert

Print settings: 0.15mm QUALITY MK3

Filament: Prusament PLA

Printer: Original Prusa i3 MK3

Supports: None

Infill: 15% | Brim:

Object manipulation

Name: Fan-thickness-v3.stl

	X	Y	Z	
Position:	125	105	1.6	mm
Rotate:	0	0	0	°
Scale factors:	100	100	100	%
Size:	39.4	39.4	3.2	mm

Slice now

Loaded

Auto Arrange

Move

Scale

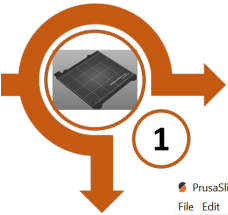
Rotate

Place on face

(1) 3D printing handbook. J. Prusa. 2019



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Platform Management

PrusaSlicer-2.3.3 based on Slic3r

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

Instances

Instance	Visible	Printable
Instance 1	<input type="checkbox"/>	<input type="checkbox"/>
Instance 2	<input type="checkbox"/>	<input type="checkbox"/>
Instance 3	<input type="checkbox"/>	<input type="checkbox"/>
Instance 4	<input type="checkbox"/>	<input type="checkbox"/>
Instance 5	<input type="checkbox"/>	<input type="checkbox"/>

Instance manipulation

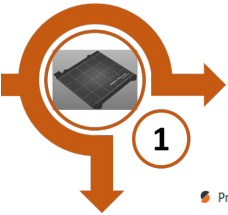
World coordinates	X	Y	Z	
Position:	149.87	91.14	12.5	mm
Rotate:	0	0	0	°
Scale factors:	100	100	100	%
Size:	51.23	45.21	25.01	mm

Inches

Slice now



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Platform Management

PrusaSlicer-2.1.0+win64-201909160915 based on Slic3r

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

Print settings:
 0.20mm QUALITY MK3
 Filament: Generic PLA
 Printer: Original Prusa i3 MK3S
 Supports: None
 Infill: 15% Brim:

Name		Editing
Treefrog.stl	<input type="checkbox"/>	<input type="checkbox"/>
Treefrog.stl	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Instances		
Instance 1	<input type="checkbox"/>	<input type="checkbox"/>
Instance 2	<input type="checkbox"/>	<input type="checkbox"/>
Instance 3	<input type="checkbox"/>	<input type="checkbox"/>
Instance 4	<input type="checkbox"/>	<input type="checkbox"/>
Instance 5	<input type="checkbox"/>	<input type="checkbox"/>

Object manipulation

World coordinates X Y Z

Position: mm

Rotate: °

Scale factors: %

Size: mm

Info

Size: 51.23 x 45.21 x 25.01 Volume: 10459.95
 Facets: 46708 (1 shells) Materials: 1
 Manifold: Yes

Perform cut

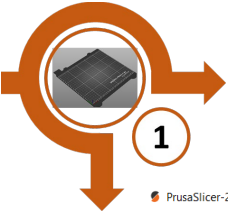
12.50 Z
 Keep upper part
 Keep lower part
 Rotate lower part upwards
 Perform cut

Arranging done.

Slice now



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Platform Management

PrusaSlicer-2.1.0-win64-201909160915 based on Slic3r

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

Print settings: **Simple** **Advanced** **Expert**

Print settings:
0.20mm QUALITY MK3 (modified)
Filament: Generic PLA
Printer: Original Prusa i3 MK3S
Supports: None
Infill: 15% Brim:

Name	Editing
Whistle.stl	<input type="checkbox"/>
Whistle.stl	<input type="checkbox"/>

8.60 (43)

0.20 (1)

ORIGINAL PRUSA i3 MK3
by Josef Prusa

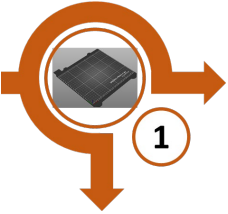
View Feature type Show Feature types Travel Retractions Unretractions Shells Legend

Ready to slice

Slice now



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Platform Management

PrusaSlicer-2.1.0+win64-201909160915 based on Slic3r

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

Feature type

- Perimeter
- External perimeter
- Overhang perimeter
- Internal infill
- Solid infill
- Top solid infill
- Bridge infill
- Gap fill
- Skirt
- Support material
- Support material interface
- Wipe tower
- Custom

ORIGINAL PRUSA i3 MK3 by Josef Prusa

View Feature type Show Feature types Travel Retractions Unretractions Shells Legend

Supports: | None

Infill: 15% Brim:

Name	Editing
Whistle.stl	<input type="checkbox"/> <input type="checkbox"/>
Whistle.stl	<input type="checkbox"/> <input type="checkbox"/>

Object manipulation

World coordinates X Y Z

Position: 126.82 91.81 4.35 mm

Rotate: 0 0 0 °

Scale factors: 100 100 100 %

Size: 35.25 20.75 8.7 mm

Info

Size: 35.25 x 20.75 x 8.70 Volume: 1531.23

Facets: 960 (1 shells) Materials: 1

Manifold: Yes

Sliced Info

Used Filament (m) 1.30

Used Filament (mm³) 3131.15

Used Filament (g) 3.88

Cost 0.10

Estimated printing time :

- normal mode 24m 8s
- stealth mode 24m 15s

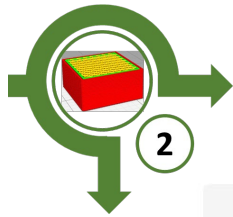
Export G-code

weight, length and cost info

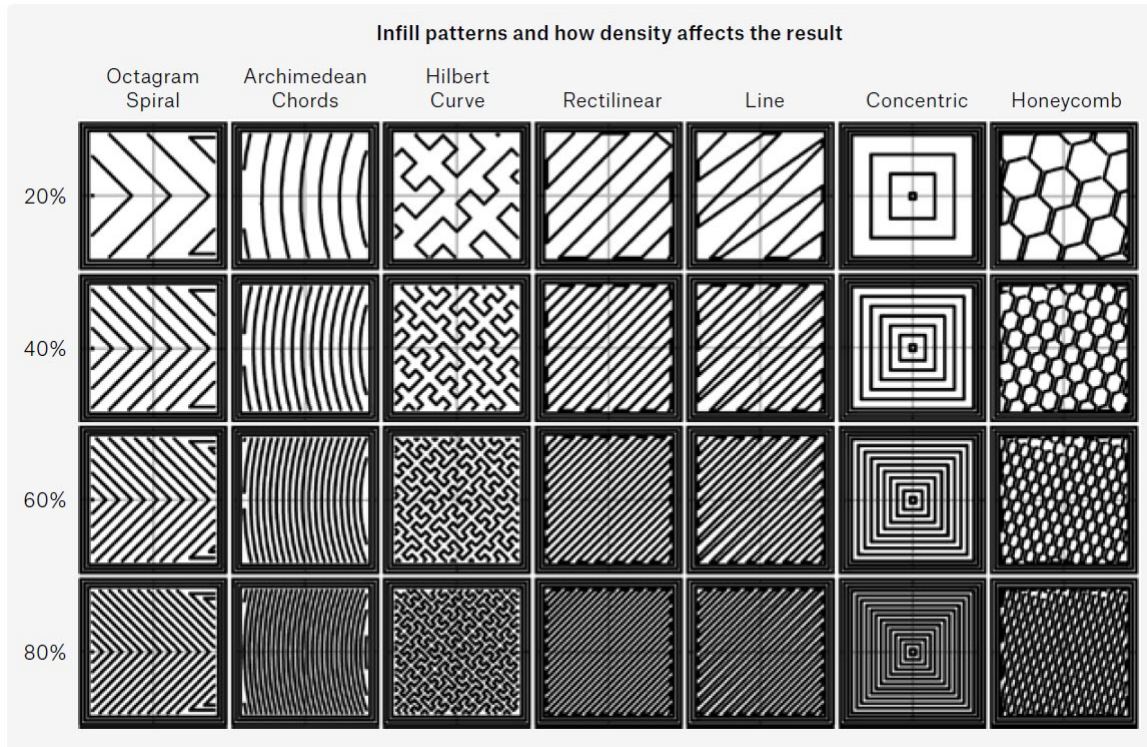
Print Time Info



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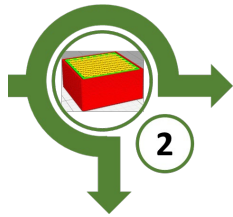
Print configuration



(3) Basis of 3D printing by Josef Průša 2019



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Print configuration

PrusaSlicer-2.1.0+win64-201909160915 based on Slic3r

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

0.20mm QUALITY MK3 (modified)

- Layers and perimeters
 - Infill**
 - Skirt and brim
 - Support material
 - Speed
 - Multiple Extruders
 - Advanced
 - Output options
 - Notes
 - Dependencies

Infill

Fill density:	15%
Fill pattern:	Gyroid
Top fill pattern:	Rectilinear
Bottom fill pattern:	Rectilinear

Reducing printing time

Combine infill every:	1 layers
Only infill where needed:	<input type="checkbox"/>

Advanced

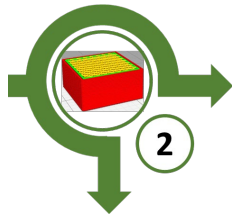
Solid infill every:	0 layers
Fill angle:	45°
Solid infill threshold area:	0 mm ²
Bridging angle:	0°
Only retract when crossing perimeters:	<input type="checkbox"/>
Infill before perimeters:	<input type="checkbox"/>

Fill density selection

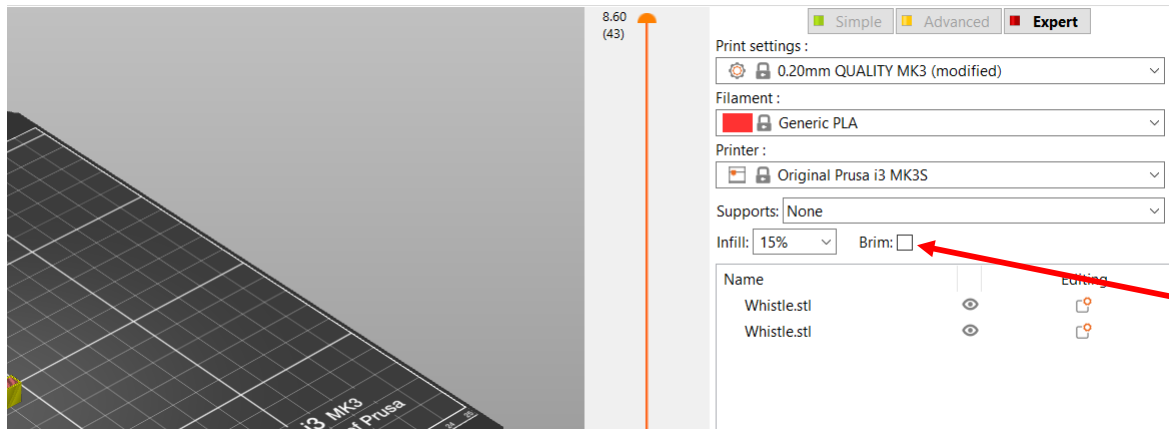
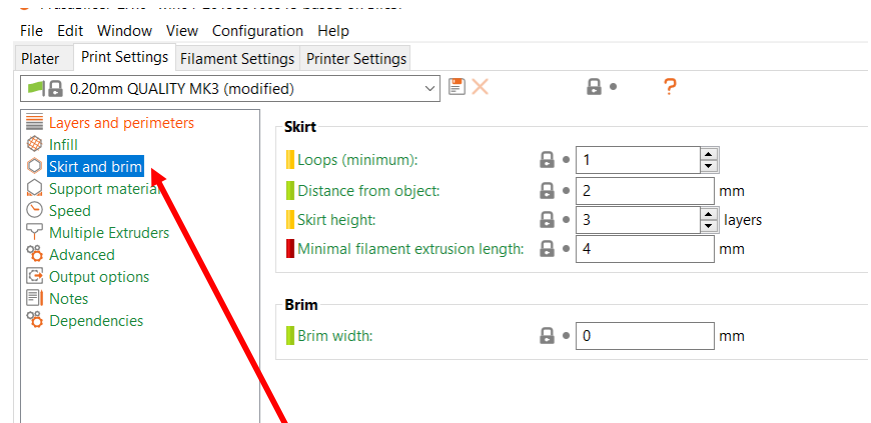
Fill pattern selection



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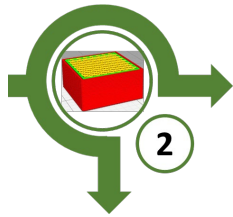
Print configuration



Brim selection

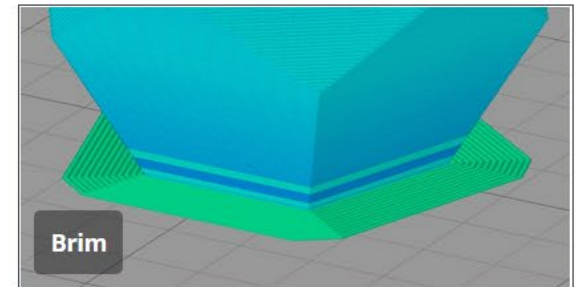
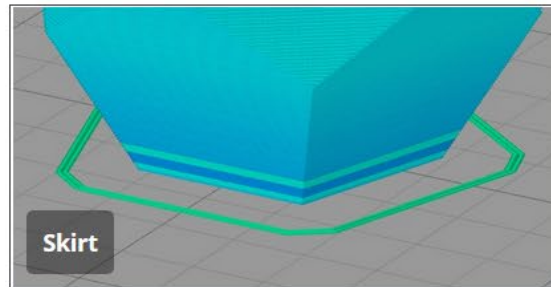
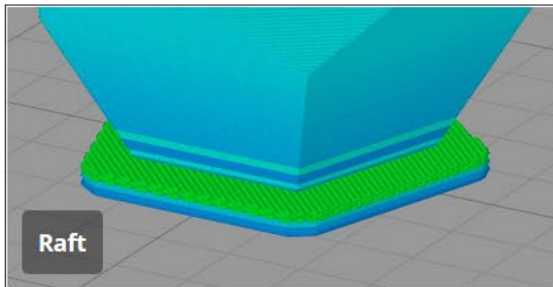


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Print configuration

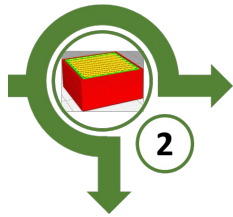
Rafts, Skirts and Brims!



(4) <https://www.simplify3d.com/support/articles/rafts-skirts-and-brims/> , 2019



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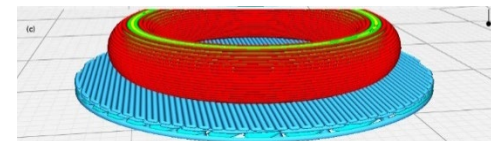
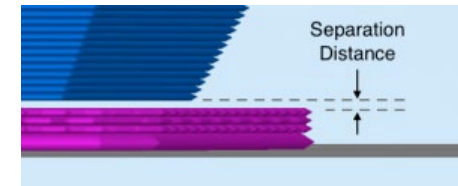


Print configuration

Rafts

A Raft is a horizontal latticework of filament that is located underneath your part. Your 3D printed part will be printed on top of this raft, instead of directly on the build platform surface. **Rafts are primarily used with ABS to help with warping and bed adhesion, but they can also be used to help stabilize models with small footprints, or to create a strong foundation on which to build the upper layers of your part.**

- **Raft Top Layers** – The number of interface layers that are printed at the top of the raft. Your model will be printed on top of these layers, so you usually want at least 2-3 layers to ensure a smooth surface.
- **Raft Base Layers** – The number of extra-thick layers at the very bottom of the raft. These layers are printed slow and thick to ensure a strong bond to the build platform.

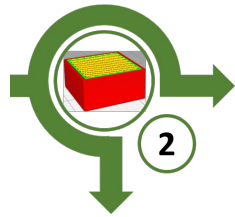


(4) <https://www.simplify3d.com/support/articles/rafts-skirts-and-brims/> , 2019

(5) https://ca.wikipedia.org/wiki/Fitxer:Skirts,_Brims,_Rafts.jpg



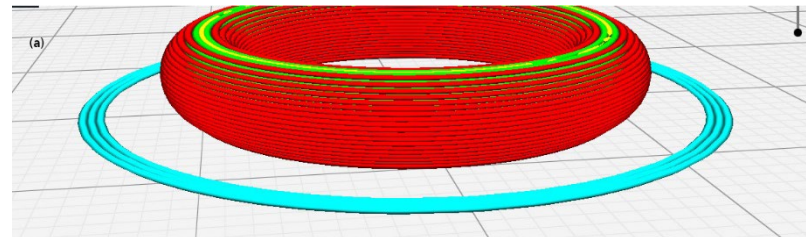
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Print configuration

Skirts

A skirt is an outline that surrounds your part but does not touch the part. The skirt is extruded on the print bed before starting to print your model. **Skirts serve a useful purpose because they help prime your extruder and establish a smooth flow of filament.** Observing the skirt also allows you to detect and adjust any leveling or adhesion issues before the actual model begins printing.

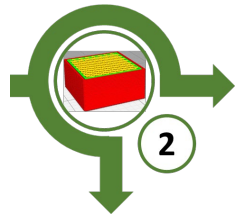


(4) <https://www.simplify3d.com/support/articles/rafts-skirts-and-brims/> , 2019

(5) https://ca.wikipedia.org/wiki/Fitxer:Skirts,_Brims,_Rafts.jpg



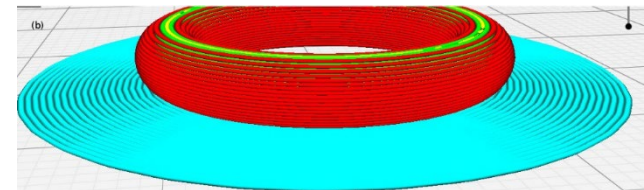
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Print configuration

Brim

A Brim is a special type of skirt that is actually attached to the edges of your model. Typically, the brim is printed with a increased number of outlines to create a large ring around your part, similar to the brim of a hat. Brims are often used to hold down the edges of your part, which can prevent warping and help with bed adhesion. The Brim may be a preferred option to the raft (which also helps with adhesion), as the brim can typically be printed much faster and uses far less filament. Once the print is complete, the thin brim can be separated from the solid model and discarded.

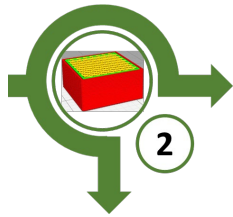


(4) <https://www.simplify3d.com/support/articles/rafts-skirts-and-brims/> , 2019

(5) https://ca.wikipedia.org/wiki/Fitxer:Skirts,_Brim,_Rafts.jpg



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Print configuration

PrusaSlicer-2.1.0+win64-201909160915 based on Slic3r

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

0.20mm QUALITY MK3 (modified)

- Layers and perimeters
 - Infill
 - Skirt and brim
 - Support material**
 - Speed
 - Multiple Extruders
 - Advanced
 - Output options
 - Notes
 - Dependencies

Support material

- Generate support material:
- Auto generated supports:
- Overhang threshold: 55 °
- Enforce support for the first: 0 layers

Raft

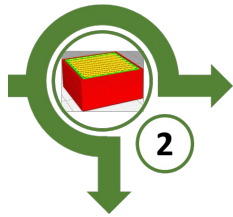
- Raft layers: 0 layers

Options for support material and raft

- Contact Z distance: 0.1 mm
- Pattern: Rectilinear
- With sheath around the support:
- Pattern spacing: 2 mm
- Pattern angle: 0 °
- Interface layers: 2 layers
- Interface pattern spacing: 0.2 mm
- Interface loops:
- Support on build plate only:
- XY separation between an object and its support: 50% mm or %
- Don't support bridges:
- Synchronize with object layers:



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Print configuration

Print settings :

0.20mm QUALITY MK3

Filament :

Generic PLA

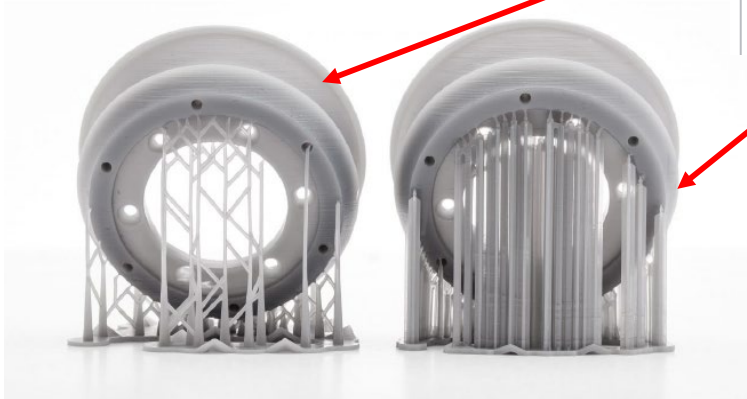
Printer :

Original Prusa i3 MK3S

Supports: None

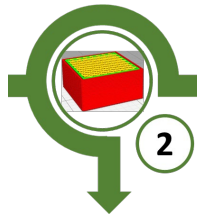
Infill:

- None
- Support on build plate only
- For support enforcers only
- Everywhere





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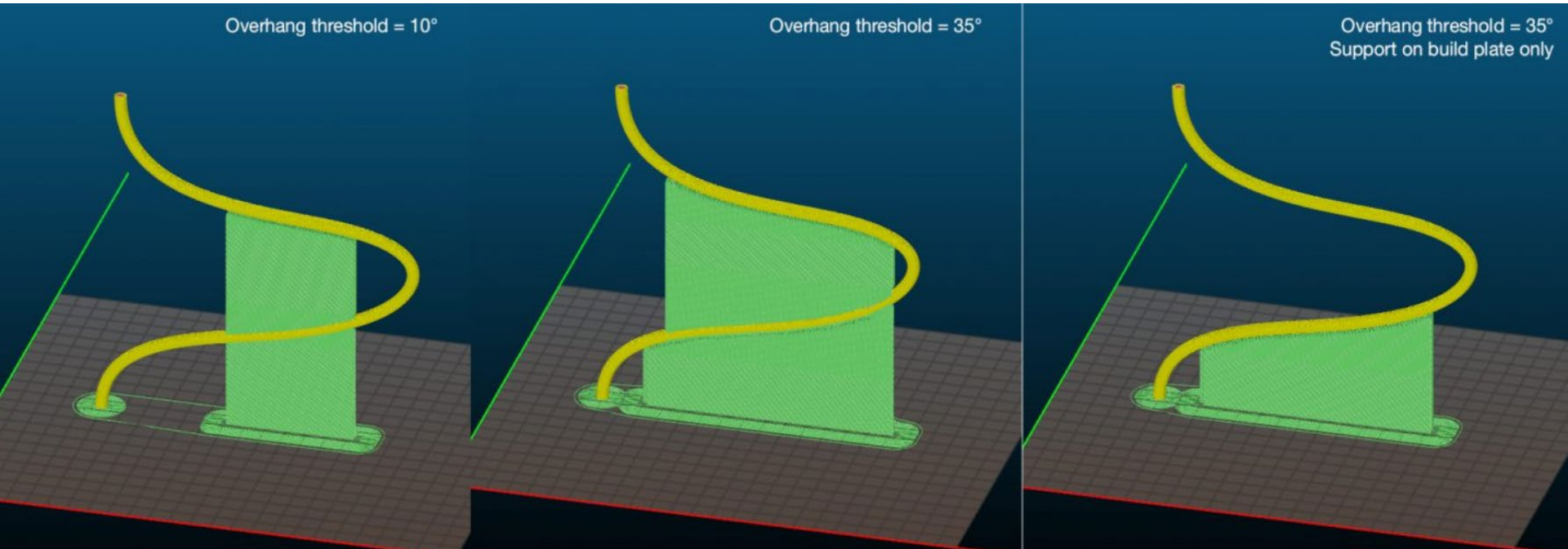


Print configuration

Overhang threshold = 10°

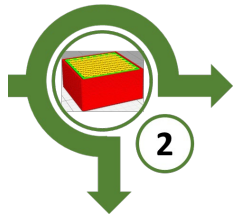
Overhang threshold = 35°

Overhang threshold = 35°
Support on build plate only





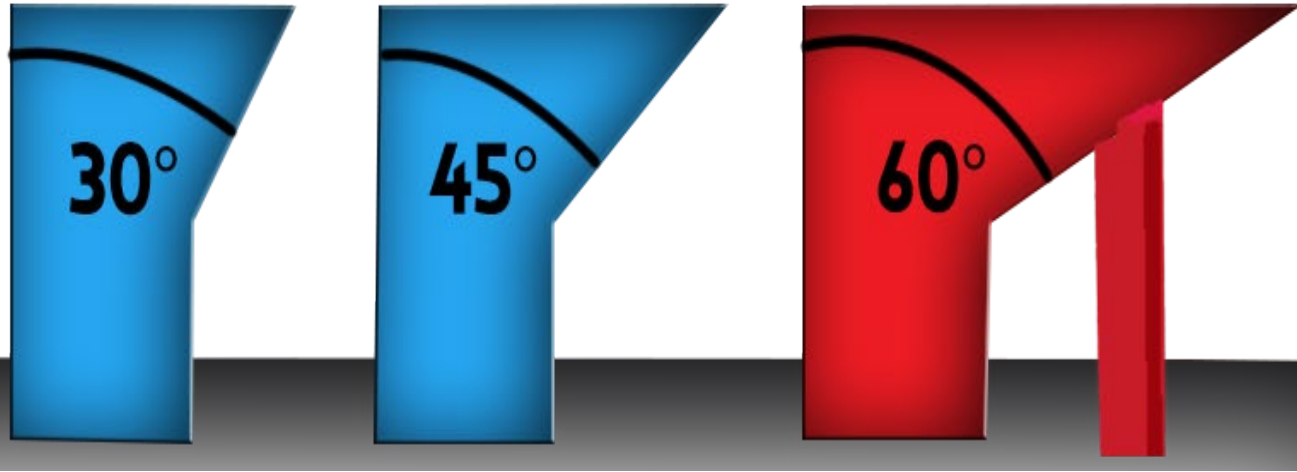
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Print configuration

(1)(2) <https://www.sd3d.com/3d-printing/quality/>

(2)



“Overhang angles are extremely important to take into consideration when designing a part to be 3D printed. Without understanding how support structures work, it is easy to think that any structure can be easily printed with a clean surface quality.

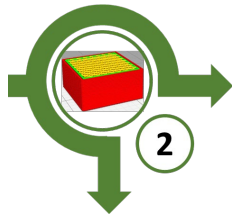
As mentioned above, a fine quality print will not result in any better surface quality over a draft quality print when in reference to the scarring resulting in support for extreme overhangs.

This scarring is just about impossible to get rid of 100%, even on our specialty printer. This scarring is worse on some unique materials, especially on the flexible options. That is why complex flexible models are very difficult to print, and you should be warned of such before moving forward printing with a unique material.

If you have a part with angles roughly 45° or more, then you will require support. This support will leave scarring such as you can see from the image on the right. The more extreme the angle and the closer to the build plate that angle is, the more difficult this support material gets to remove cleanly.” (1)



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Print configuration

Speed selector

PrusaSlicer-2.1.0-win64-201909160915 based on Slic3r

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

0.20mm QUALITY MK3 (modified)

Layers and perimeters

- Infill
- Skirt and brim
- Support material
- Speed**
- Multiple Extruders
- Advanced
- Output options
- Notes
- Dependencies

Speed for print moves

Perimeters:	45	mm/s
Small perimeters:	25	mm/s or %
External perimeters:	25	mm/s or %
Infill:	80	mm/s
Solid infill:	80	mm/s or %
Top solid infill:	40	mm/s or %
Support material:	50	mm/s
Support material interface:	100%	mm/s or %
Bridges:	30	mm/s
Gap fill:	40	mm/s

Speed for non-print moves

Travel:	180	mm/s
---------	-----	------

Modifiers

First layer speed:	20	mm/s or %
--------------------	----	-----------

Acceleration control (advanced)

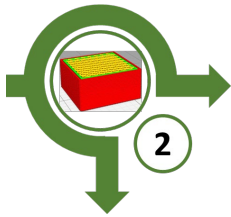
Perimeters:	800	mm/s ²
Infill:	1250	mm/s ²
Bridge:	1000	mm/s ²
First layer:	1000	mm/s ²
Default:	1000	mm/s ²

Autospeed (advanced)

Max print speed:	200	mm/s
Max volumetric speed:	0	mm ³ /s

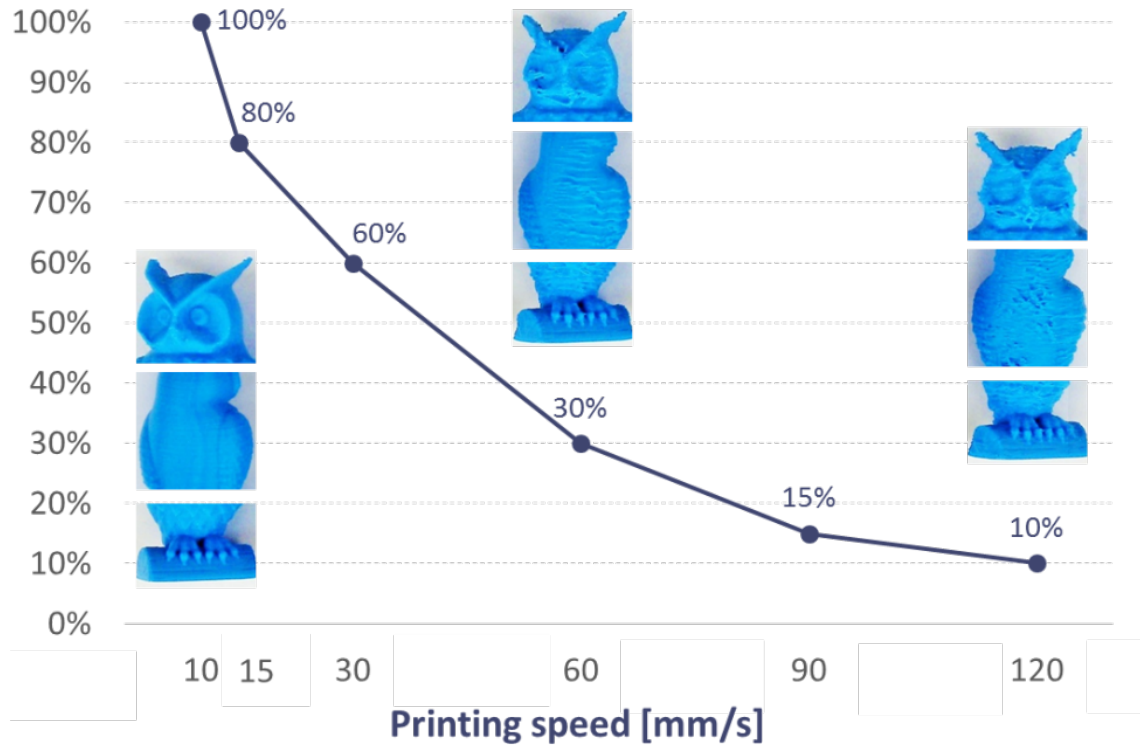


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Print configuration

Quality [as % of top specimen]

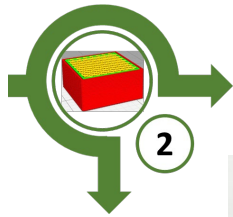


Print speed vs
quality

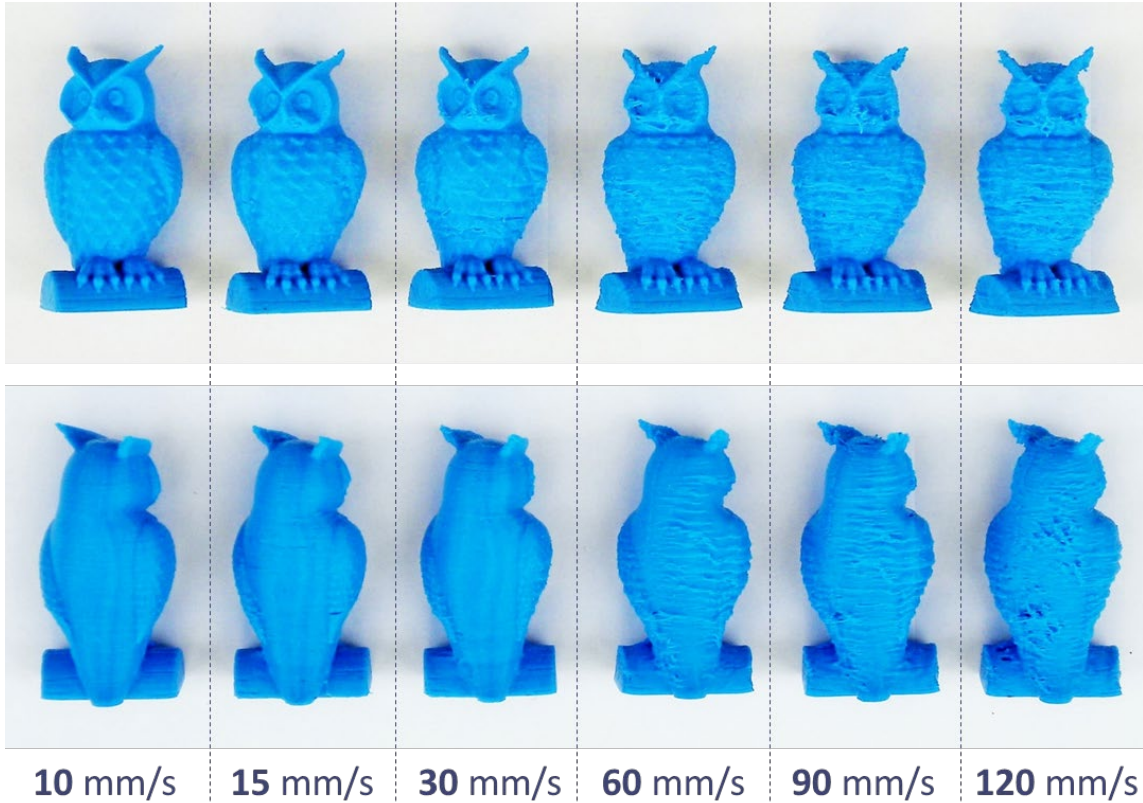
(6) <https://my3dmatter.com/what-is-the-influence-of-color-printing-speed-extrusion-temperature-and-ageing-on-my-3d-prints/>, 2019



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Print configuration

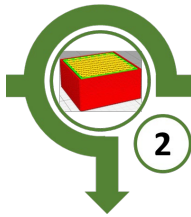


Print speed vs
quality

(6) <https://my3dmatter.com/what-is-the-influence-of-color-printing-speed-extrusion-temperature-and-ageing-on-my-3d-prints/>, 2019



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Print configuration

Layer height selection

The screenshot shows a 3D printing software interface. On the left, a 3D model of a green figure and a red cube is positioned on a black Prusa 13 MK3 print bed. The bed has a grid and is labeled "ORIGINAL PRUSA 13 MK3 by Josef Prusa". On the right, the "Print settings" panel is open, showing a list of layer height presets. A red arrow points to the "0.20mm QUALITY MK3" preset. Below the settings panel, the "Object manipulation" section shows the position, rotation, and scale factors for the object.

Print settings:

- 0.20mm QUALITY MK3
- System presets
 - 0.05mm ULTRADETAIL MK3
 - 0.07mm ULTRADETAIL MK3
 - 0.10mm DETAIL MK3
 - 0.15mm QUALITY MK3
 - 0.15mm SPEED MK3
 - 0.20mm QUALITY MK3
 - 0.20mm SPEED MK3
 - 0.30mm DRAFT MK3
- User presets
 - bcn3d+

Object manipulation

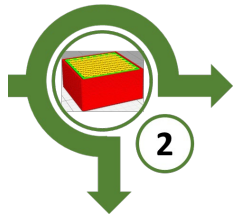
World coordinates	X	Y	Z
Position:	65.6	87.25	51.26 mm
Rotate:	0	0	0 °
Scale factors:	100	100	100 %
Size:	44.32	34.87	102.51 mm

Info

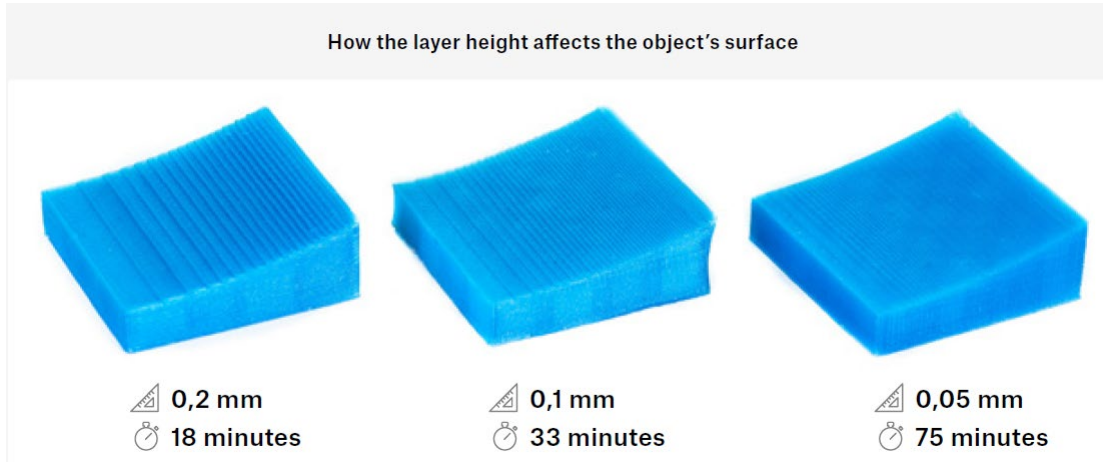
Size: 44.32 x 34.87 x 102.51 Volume: 27542.23



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Print configuration

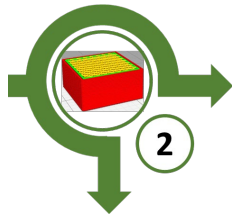


“Layer height – sometimes also called the “Z-axis resolution” has a major impact on both print times and overall surface finish of the printed object. Higher values lead to faster prints and more visible layers on the surface of the object. This effect is especially prominent on surfaces that are nearly parallel to the print bed. Most of the time, layer heights of 0.15mm - 0.20 mm are preferred.”(1)

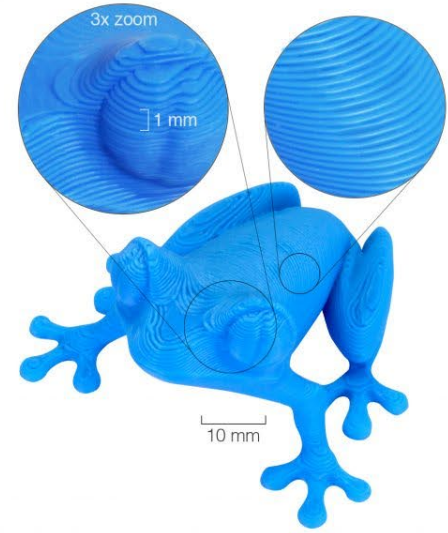
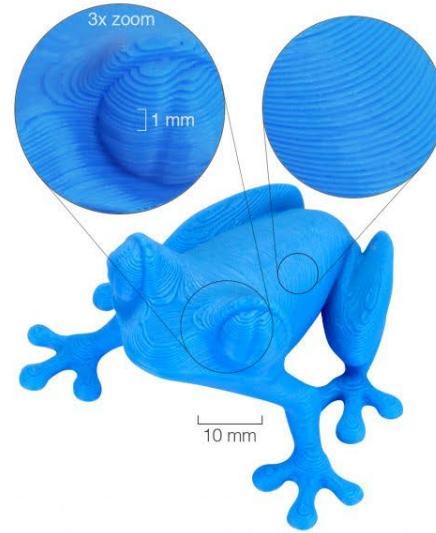
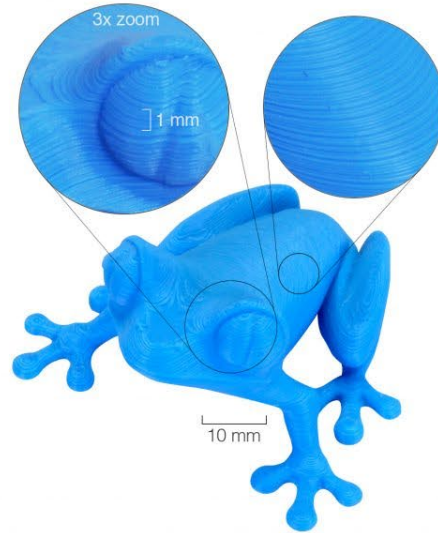
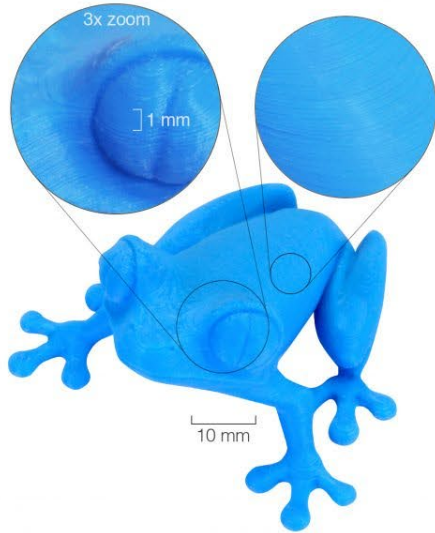
(1) 3D printing handbook. J. Prusa. 2019



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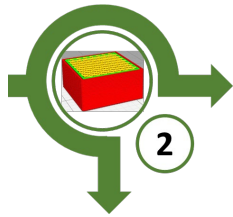


Print configuration



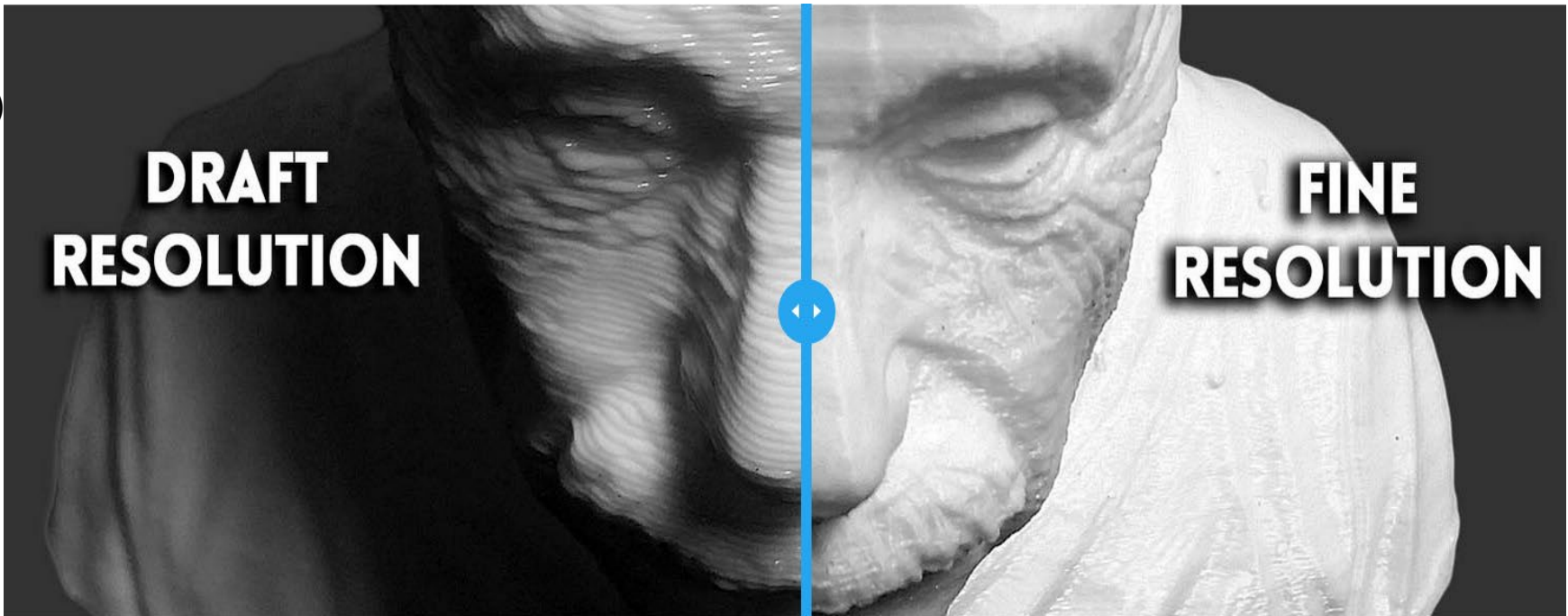


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Print configuration

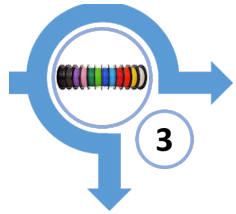
(2)



(2) <https://www.sd3d.com/>



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Filaments Settings

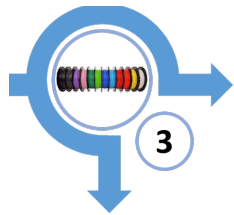
Material selector

Print settings:

- 0.20mm QUALITY MK3
- Filament:
 - Generic PLA
 - ColorFabb nGen
 - ColorFabb nGen flex
 - ColorFabb woodFill
 - E3D Edge
 - E3D PC-ABS
 - Filamentum ABS
 - Filamentum ASA
 - Filamentum CPE
 - Filamentum Timberfill
 - Generic ABS
 - Generic FLEX
 - Generic PET
 - Generic PLA
 - Polymaker PC-Max
 - PrimaSelect PVA+
 - Prusa ABS
 - Prusa HIPS
 - Prusa PET
 - Prusa PLA
 - Prusament ASA
 - Prusament PETG
 - Prusament PETG
 - Prusament PLA
 - SemiFlex or Flexfill 98A
 - Taulman Bridge
 - Taulman T-Glase
 - Verbatim BVOH
 - Verbatim PP
 - User presets
 - PLA_HQ_0314
 - bcn3d+



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Filaments Settings

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

Generic PLA

- Filament
- Cooling
- Advanced
- Filament Overrides
- Custom G-code
- Notes
- Dependencies

Filament

Color:	<input type="text" value="Red"/>
Diameter:	<input type="text" value="1.75"/> mm
Extrusion multiplier:	<input type="text" value="1"/>
Density:	<input type="text" value="1.24"/> g/cm ³
Cost:	<input type="text" value="25.4"/> money/kg

Temperature °C

Extruder:	First layer: <input type="text" value="215"/>	Other layers: <input type="text" value="210"/>
Bed:	First layer: <input type="text" value="60"/>	Other layers: <input type="text" value="60"/>

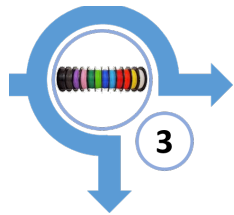
Filament diameter

Material processing temperature

Bed temperature selector



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Filaments Settings

ABOUT PLA

PLA melts at a relatively low temperature of about 175 degrees Celsius. Unlike so-called thermoset materials, PLA can be heated past its melting point multiple times with very little degradation. It's a hard material, but that also means it's somewhat brittle, and once it breaks, it likes to shatter. **Only this material is proven for 50 microns layer height.**

However, PLA is not a perfect material and, just like every other plastic, has some disadvantages. The low melting temperature also means **low-temperature resistance**. Parts start to lose mechanical strength at temperatures **over 60 °C**.

The combination of being both biodegradable and having low-temperature resistance means that it's **not ideal for outdoor use**, not to mention low UV-resistance. Also, PLA is only soluble in chemicals like chloroform or hot benzene. So when connecting multiple pieces, you're better off using just glue.

Even though PLA is biodegradable, and the material on its own is food safe, we do not suggest to repeatedly **drink or eat from your 3D prints**. Because of the small fractures on the print surface, bacteria can build up in there over time. You can prevent this by applying a food-safe coating. When **post-processing PLA**, it's better to use wet sanding. Without water you'll quickly start heating the plastic by friction, it will melt locally and make it hard to keep sanding.

PRINTING SETUP

Nozzle	215 °C	Heatbed	50-60 °C
--------	--------	---------	----------

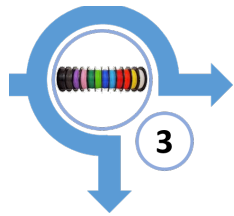
BASIC ATTRIBUTES

+	Easy to print	-	Brittle
+	Can print tiny parts	-	Low temperature resistance
+	Can print huge objects	-	Difficult post-processing
+	Hard and tough		
+	Low warping		














<https://shop.prusa3d.com/en/prusament/715-prusament-pla-lipstick-red-1kg.html>



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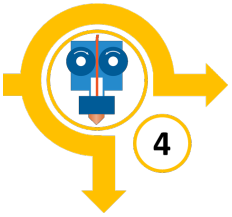


Filaments Settings

	 ABS	 Flexible	 PLA	 HIPS	 PETG	 Nylon	 Carbon Fiber Filled	 ASA	 Polycarbonate	 Polypropylene	 Metal Filled	 Wood Filled	 PVA
	Learn More	Learn More	Learn More	Learn More	Learn More	Learn More	Learn More	Learn More	Learn More	Learn More	Learn More	Learn More	Learn More
Compare Selected	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ultimate Strength	40 MPa	26 - 43 MPa	65 MPa	32 MPa	53 MPa	40 - 85 MPa	45 - 48 MPa	55 MPa	72 MPa	32 MPa	20 - 30 MPa	46 MPa	78 MPa
Stiffness	5 / 10	1 / 10	7.5 / 10	10 / 10	5 / 10	5 / 10	10 / 10	5 / 10	6 / 10	4 / 10	10 / 10	8 / 10	3 / 10
Durability	8 / 10	9 / 10	4 / 10	7 / 10	8 / 10	10 / 10	3 / 10	10 / 10	10 / 10	9 / 10	4 / 10	3 / 10	7 / 10
Maximum Service Temperature	98 °C	60 - 74 °C	52 °C	100 °C	73 °C	80 - 95 °C	52 °C	95 °C	121 °C	100 °C	52 °C	52 °C	75 °C
Coefficient of Thermal Expansion	90 µm/m·°C	157 µm/m·°C	68 µm/m·°C	80 µm/m·°C	60 µm/m·°C	95 µm/m·°C	57.5 µm/m·°C	98 µm/m·°C	69 µm/m·°C	150 µm/m·°C	33.75 µm/m·°C	30.5 µm/m·°C	85 µm/m·°C
Density	1.04 g/cm ³	1.19 - 1.23 g/cm ³	1.24 g/cm ³	1.03 - 1.04 g/cm ³	1.23 g/cm ³	1.06 - 1.14 g/cm ³	1.3 g/cm ³	1.07 g/cm ³	1.2 g/cm ³	0.9 g/cm ³	2 - 4 g/cm ³	1.15 - 1.25 g/cm ³	1.23 g/cm ³
Price (per kg)	\$10 - \$40	\$30 - \$70	\$10 - \$40	\$24 - \$32	\$20 - \$60	\$25 - \$65	\$30 - \$80	\$38 - \$40	\$40 - \$75	\$60 - \$120	\$50 - \$120	\$25 - \$55	\$40 - \$110
Printability	8 / 10	6 / 10	9 / 10	6 / 10	9 / 10	8 / 10	8 / 10	7 / 10	6 / 10	4 / 10	7 / 10	8 / 10	5 / 10
Extruder Temperature	220 - 250 °C	225 - 245 °C	190 - 220 °C	230 - 245 °C	230 - 250 °C	220 - 270 °C	200 - 230 °C	235 - 255 °C	260 - 310 °C	220 - 250 °C	190 - 220 °C	190 - 220 °C	185 - 200 °C
Bed temperature	95 - 110 °C	45 - 60 °C	45 - 60 °C	100 - 115 °C	75 - 90 °C	70 - 90 °C	45 - 60 °C	90 - 110 °C	80 - 120 °C	85 - 100 °C	45 - 60 °C	45 - 60 °C	45 - 60 °C
Heated Bed	Required	Optional	Optional	Required	Required	Required	Optional	Required	Required	Required	Optional	Optional	Required



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Printer Settings

Print bed dimensions

PrusaSlicer-2.1.0+win64-201909160915 based on Slic3r

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

Original Prusa i3 MK3S

General

- Custom G-code
- Machine limits
- Extruder 1
- Notes
- Dependencies

Size and coordinates

Bed shape:

Max print height: mm

Z offset: mm

Capabilities

Extruders:

Single Extruder Multi Material:

Print Host upload

Host Type:

Hostname, IP or URL:

API Key / Password:

HTTPS CA File:
On this system, PrusaSlicer uses HTTPS certificates from the system Certificate Store.
To use a custom CA file, please import your CA file into Certificate Store.

Firmware

G-code flavor:

Bed Shape

Shape

Rectangular

Settings

Size: x: y:

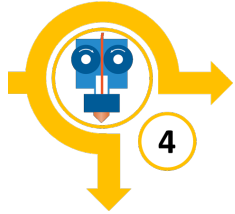
Origin: x: y:

Texture

None

Model

None



Printer Settings

file edit window view Configuration Help

Printer Print Settings Filament Settings Printer Settings

Original Prusa i3 MK3S

- General
- Custom G-code
- Machine limits
- Extruder 1**
- Notes
- Dependencies

Size

Nozzle diameter: mm

Layer height limits

Min: mm
Max: mm

Position (for multi-extruder printers)

Extruder offset: x: y: mm

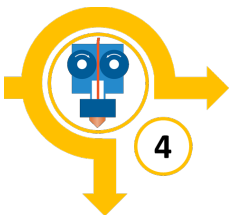
Retraction

Length: mm (zero to disable)
Lift Z: mm
Only lift Z: Above Z: mm Below Z: mm
Retraction Speed: mm/s
Deretraction Speed: mm/s
Extra length on restart: mm
Minimum travel after retraction: mm
Retract on layer change:
Wipe while retracting:
Retract amount before wipe: %

Nozzle diameter



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Printer Settings

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

Original Prusa i3 MK3S

Simple Advanced Exper

General
Custom G-code
Machine limits
Extruder 1
Notes
Dependencies

Start G-code

```
M862.3 P "[printer_model]"; printer model check
M862.1 P [nozzle_diameter]; nozzle diameter check
M115 U3.8.0; tell printer latest fw version
G90 ; use absolute coordinates
M83 ; extruder relative mode
M104 S[first_layer_temperature] ; set extruder temp
M140 S[first_layer_bed_temperature] ; set bed temp
M190 S[first_layer_bed_temperature] ; wait for bed temp
M109 S[first_layer_temperature] ; wait for extruder temp
```

End G-code

```
G4 ; wait
M221 S100
M104 S0 ; turn off temperature
M140 S0 ; turn off heatbed
M107 ; turn off fan
(if layer_z < max_print_height)G1 Z(z_offset+min(layer_z+30, max_print_height))(endif) ; Move print head up
G1 X0 Y200 F3000 ; home X axis
M84 ; disable motors
```

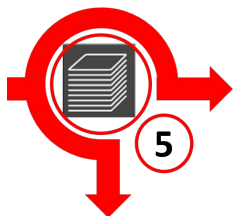
Before layer change G-code

```
:BEFORE_LAYER_CHANGE
G92 E0.0
;[layer_z]
```

After layer change G-code



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Slicing

slicing

PrusaSlicer-2.1.0+win64-201909160915 based on Slic3r

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

Print settings: 0.20mm QUALITY MK3

Filament: Generic PLA

Printer: Original Prusa i3 MK3S

Supports: None

Infill: 15% Brim:

Name: Unification.stl Editing

Object manipulation

World coordinates	X	Y	Z	
Position:	125	105	12.5	mm
Rotate:	0	0	0	°
Scale factors:	100	100	100	%
Size:	104.46	45.21	25.01	mm

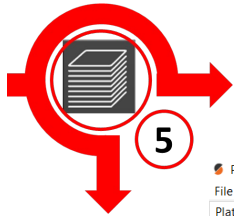
Info

Size: 104.46 x 45.21 x 25.01 Volume: 20902.57

Facets: 92936 (2 shells) Meshlets: 1

Manifold: Yes

Slice now



Slicing

Export g-code

PrusaSlicer-2.1.0+win64-201909160915 based on Slic3r

File Edit Window View Configuration Help

Plater Print Settings Filament Settings Printer Settings

Feature type

- Perimeter
- External perimeter
- Overhang perimeter
- Internal infill
- Solid infill
- Top solid infill
- Bridge infill
- Gap fill
- Skirt
- Support material
- Support material interface
- Wipe tower
- Custom

25.00 (125)

Generic PLA

Printer: Original Prusa i3 MK3S

Supports: None

Infill: 15% Brim:

Name: Unification.stl

Object manipulation

World coordinates X Y Z

Position: mm

Rotate: °

Scale factors: %

Size: mm

Info

Size: 104.46 x 45.21 x 25.01 Volume: 20902.57

Facets: 92936 (2 shells) Materials: 1

Manifold: Yes

Sliced Info

Used Filament (m) 4.08

Used Filament (mm³) 9809.35

Used Filament (g) 12.16

Cost 0.31

Estimated printing time:

- normal mode 1h 38m 17s
- stealth mode 1h 39m 24s

Export G-code

View Feature type Show Feature types Travel Retractions Unretractions Shells Legend

Slicing complete...



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**KEEP
CALM
AND
THANKS
FOR
WATCHING**