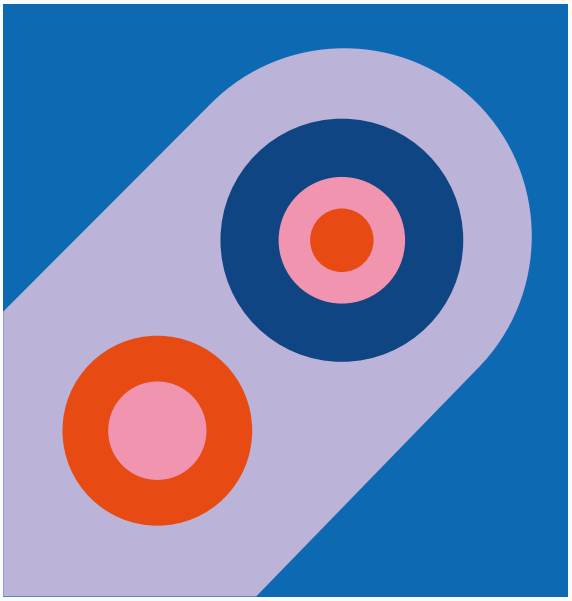
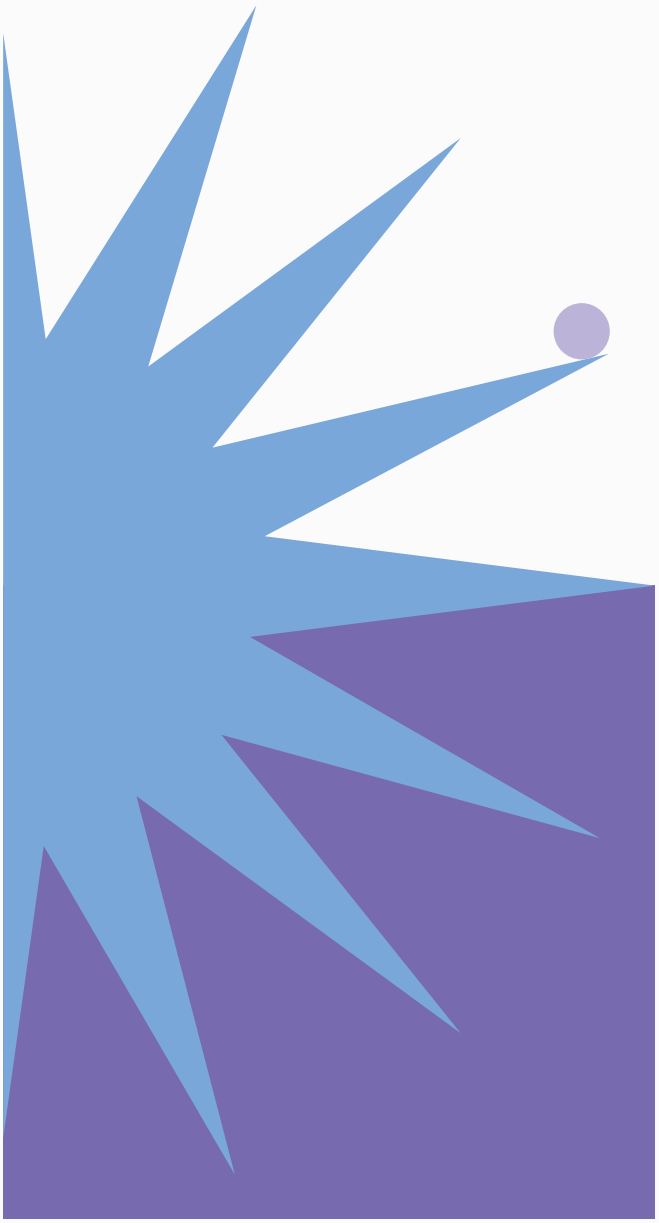
Physical spaces

04





The physical implementation of each OSHub depends on the context and needs of each OSHub location. For example, OSHubs can be based in dedicated permanent physical spaces or they can also occupy temporary spaces at schools or public spaces (e.g., libraries). In addition, as we saw in the previous chapter, OSHubs can serve different roles and functions in their communities.

As such, it is important to create the conditions for OSHubs to be adaptable to different kinds of context, while at the same time to provide the guidelines, recommendations and best practices from existing OSHubs with well-established physical spaces.

This chapter will be divided into two parts: in the first one – 4.1 Open Furniture – we make available the furniture blueprints of what we consider the basic set to furnish an OSHub – stool, table, and bookcase – that anyone can reproduce or adapt; in the second part – 4.2 Guidelines and plans for setting-up a makerspace – , based on the experience of OSHubs Switzerland, France and Greece, and also on their different profiles and action, we provide a set of complementary guidelines and plans on how to establish a makerspace / Fab Lab.

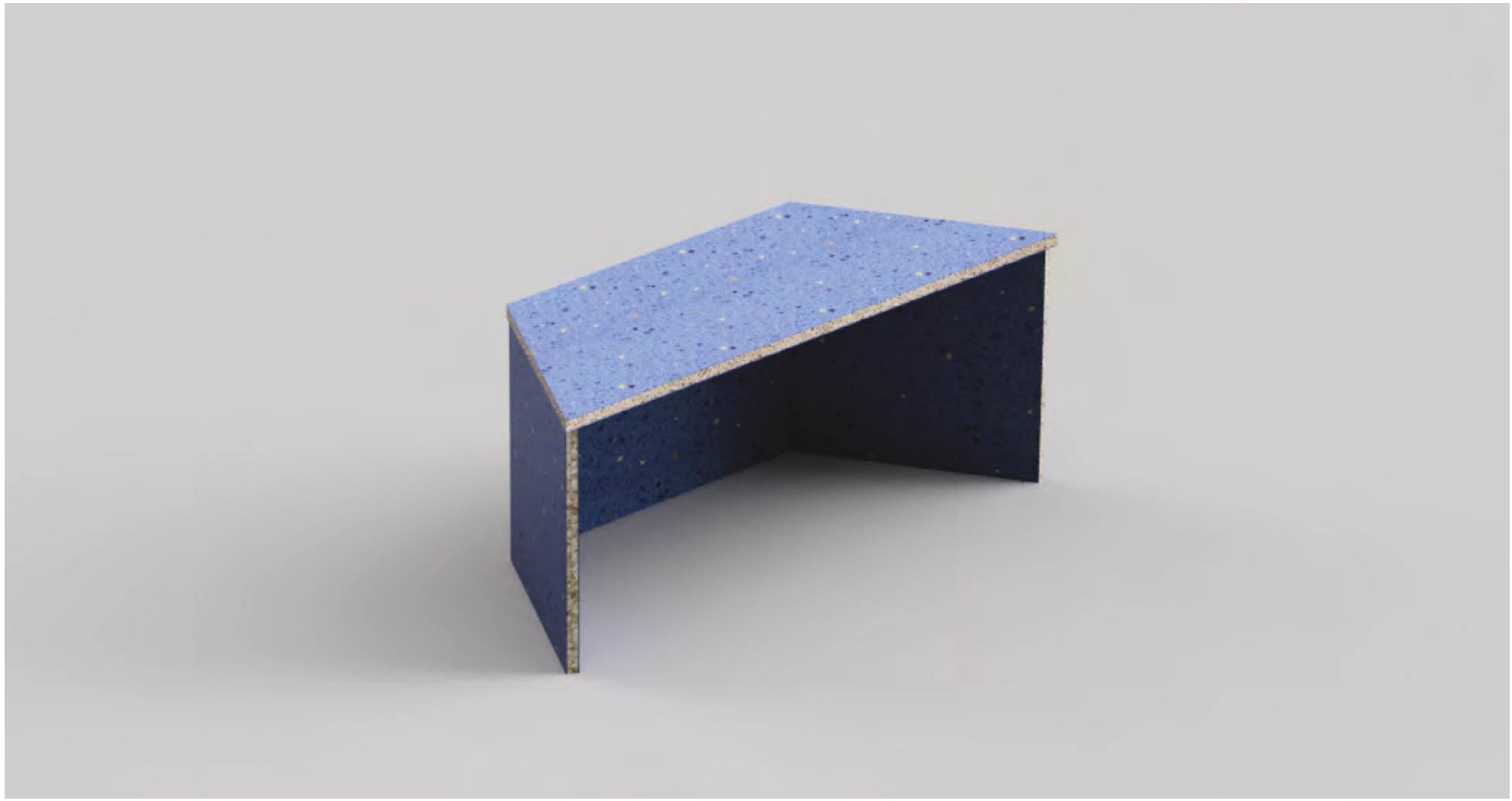
4.1 Open Furniture

In order to support the physical implementation of the OSHubs, we partnered with *NOSIGNER* and Precious Plastic – particularly, *Precious Plastic Portugal* and Precious *Plastic Geneva (Glitter)* – with the objective of creating products that could be made from recycled materials, namely plastic, as well being produced locally.

For that, we designed and prototyped a series of furniture pieces that we consider as the basic set to establish a flexible OSHub space: a stool/bench, a table, and a bookcase.

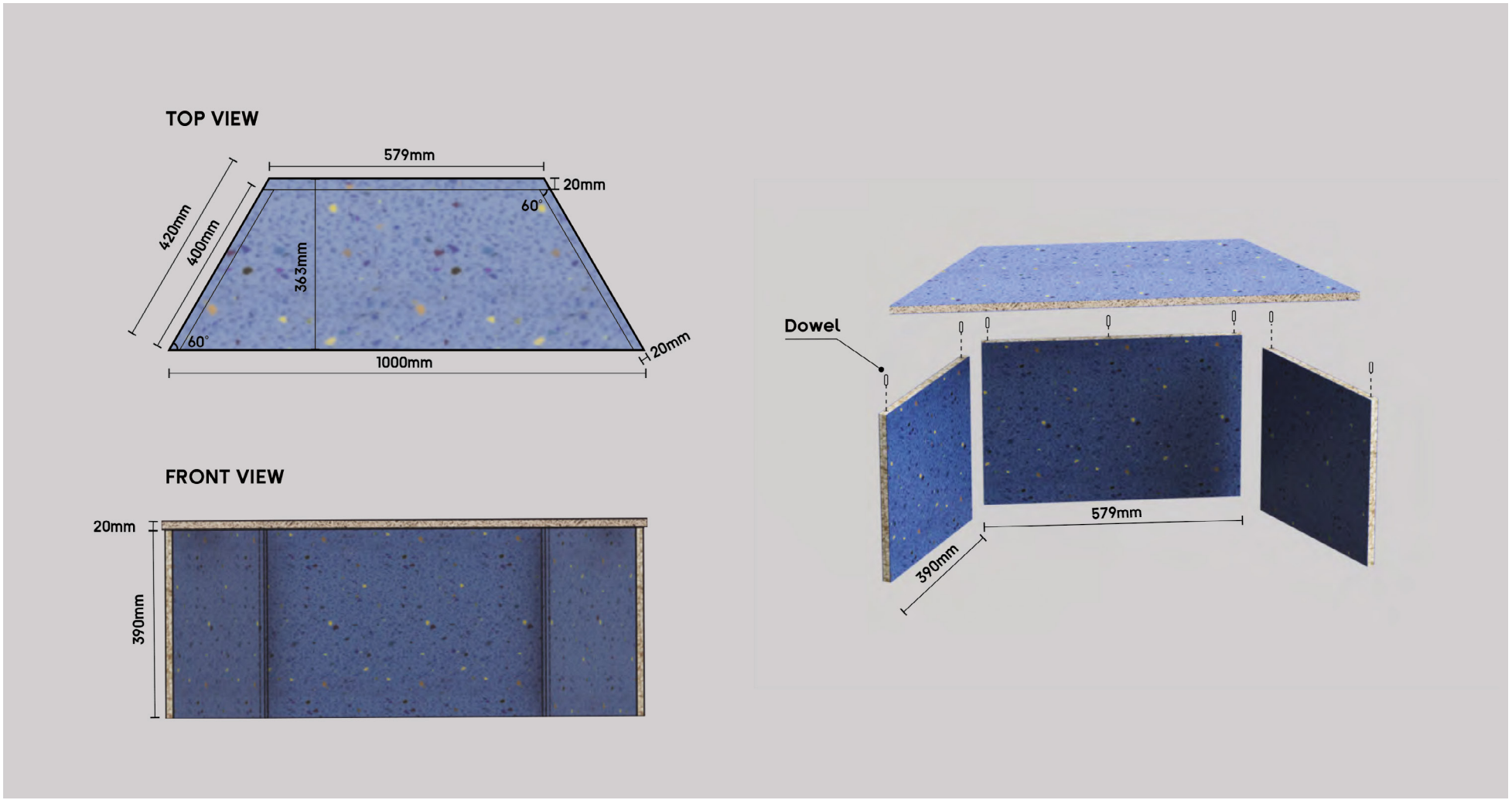
Here we make available the technical drawings and respective steps to produce these objects.

Bench



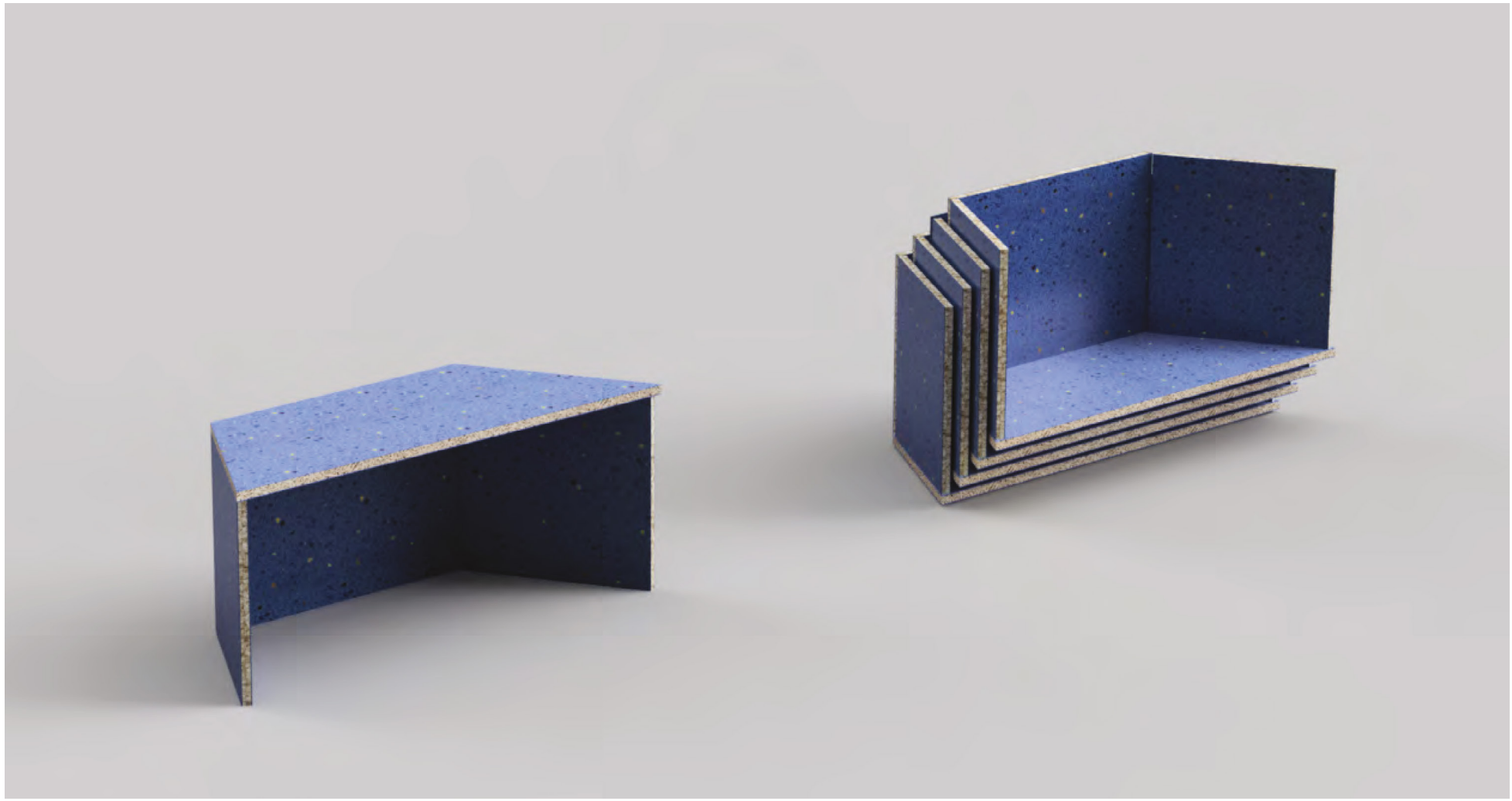
Bench

DIMENSIONS AND ASSEMBLY DRAWING



Bench

STACKING



Bench

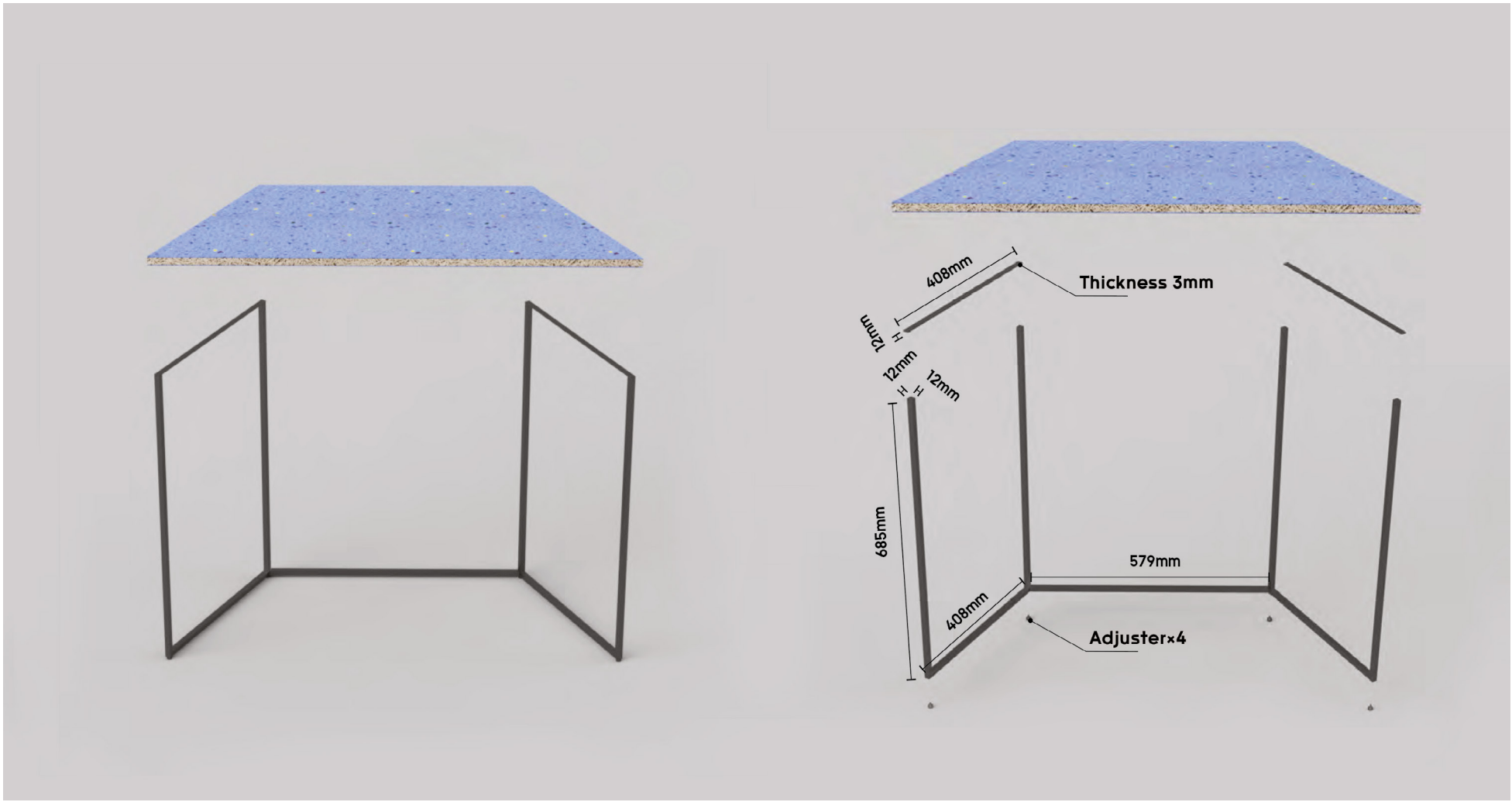
COLOR VARIATION

Table

WITH METAL LEGS

Table

ADJUSTABLE LEGS WITH ADJUSTER



Table

ADJUSTABLE LEGS WITH ADJUSTER

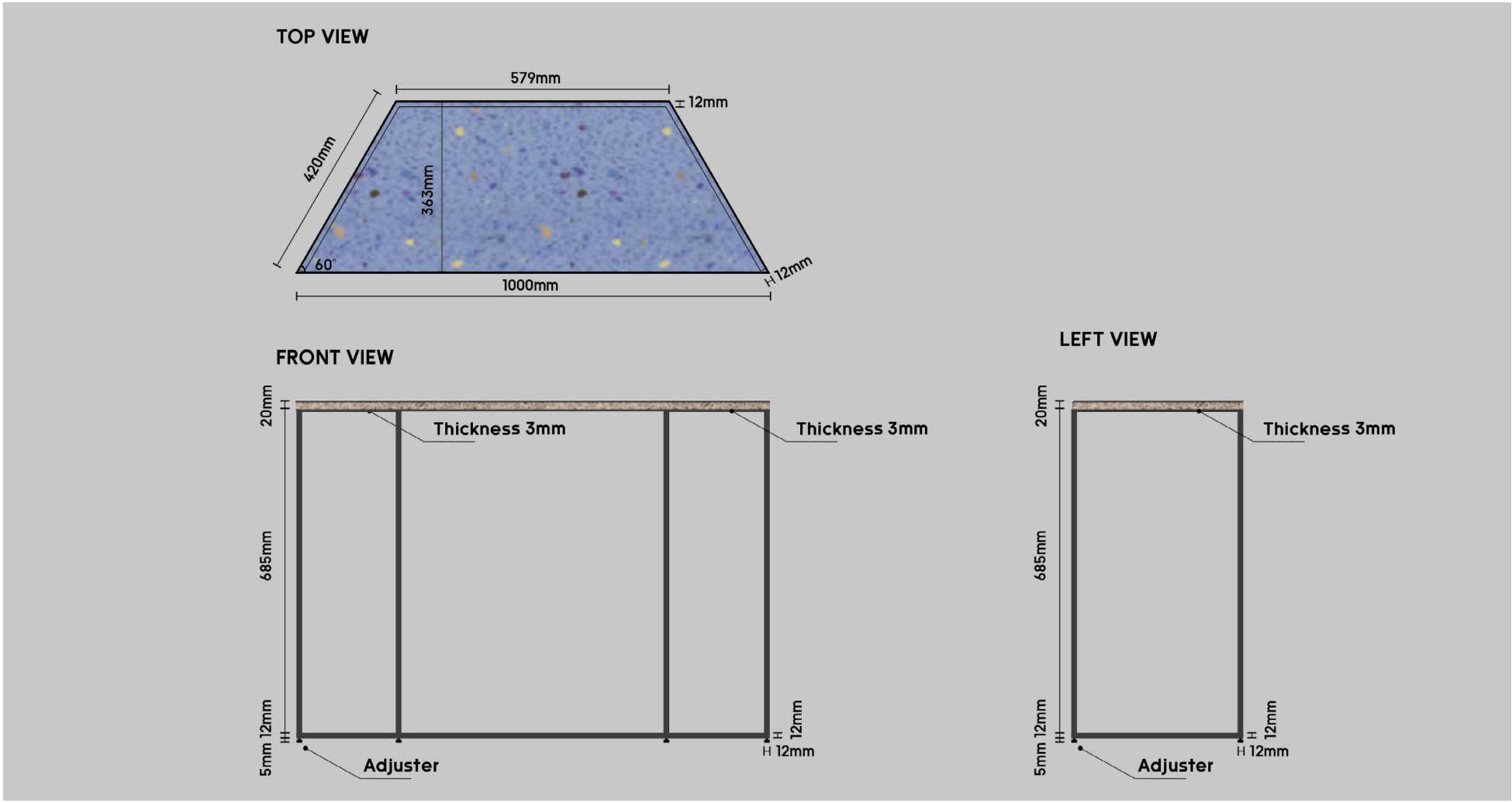


Table with metal legs + Bench

COMBINATION

Table with metal legs

STACKING

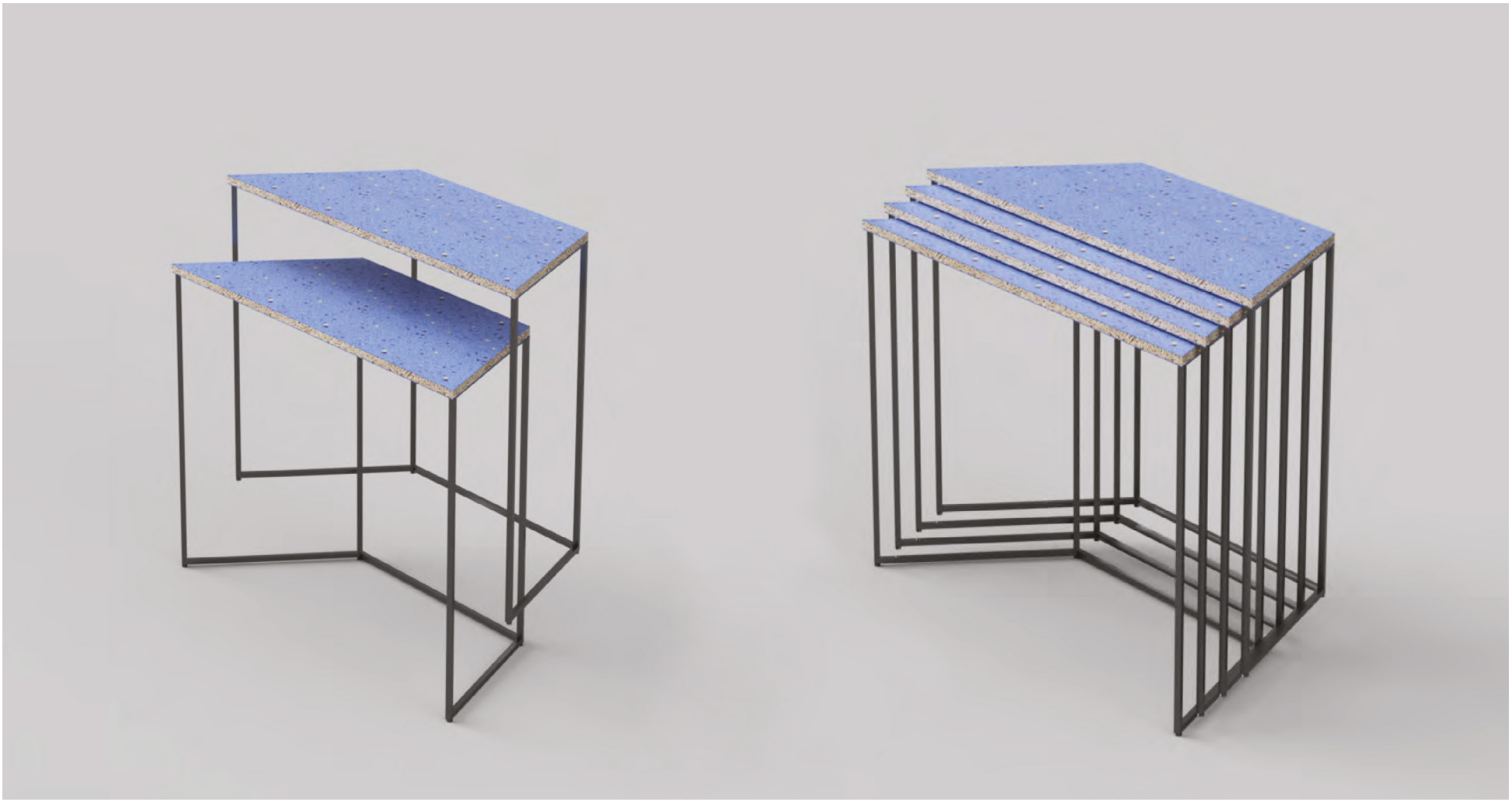
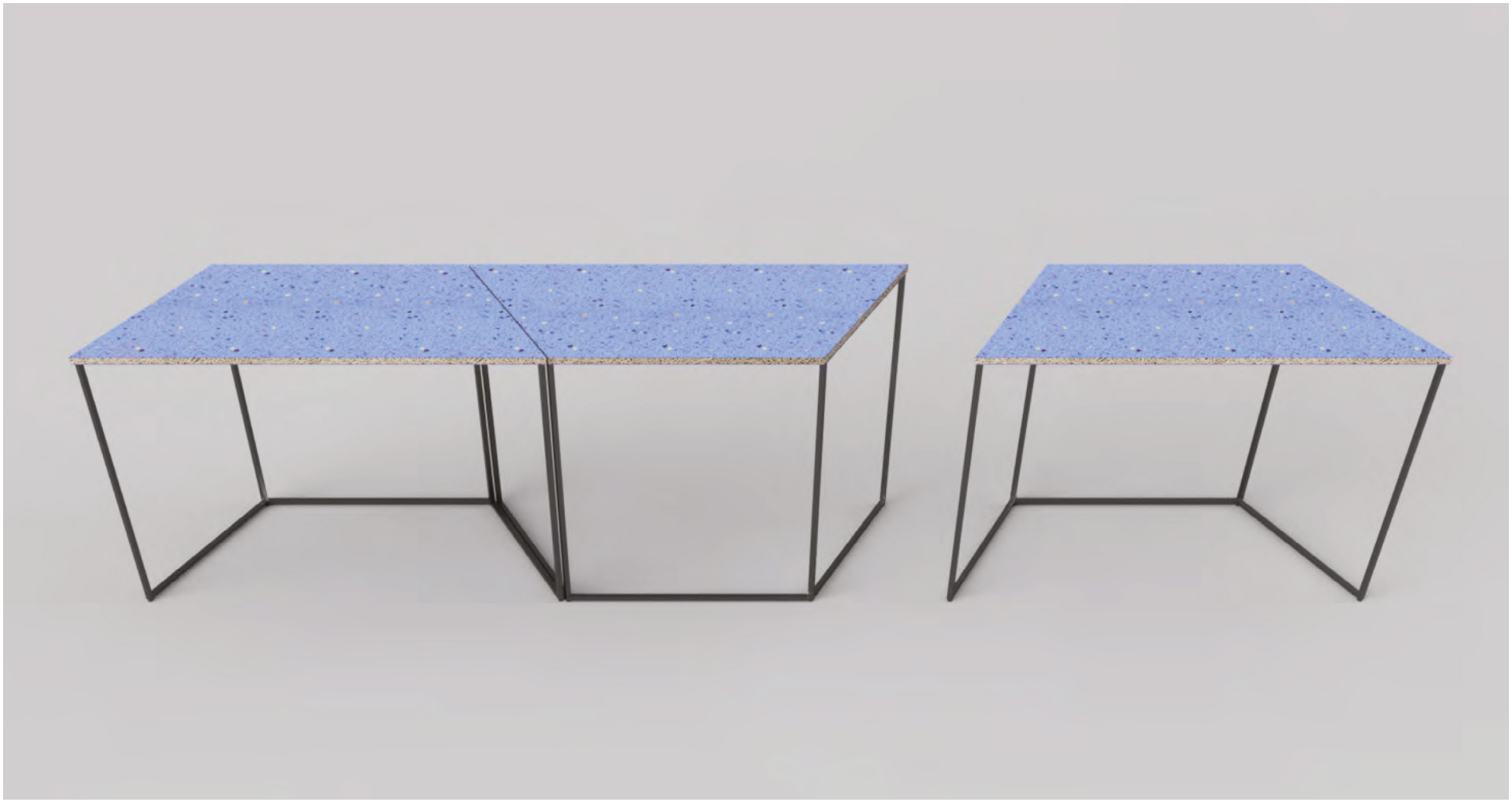


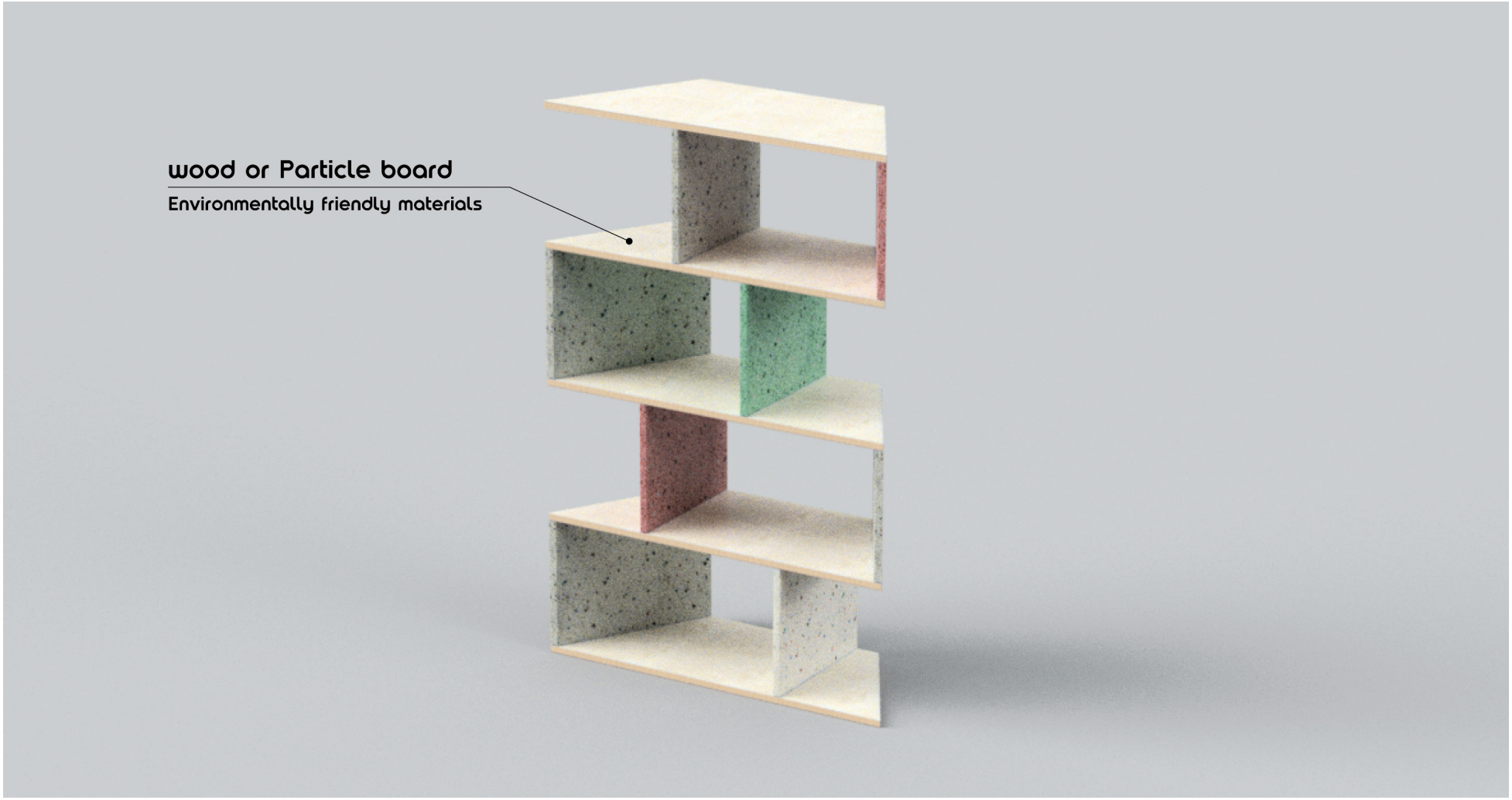
Table with metal legs

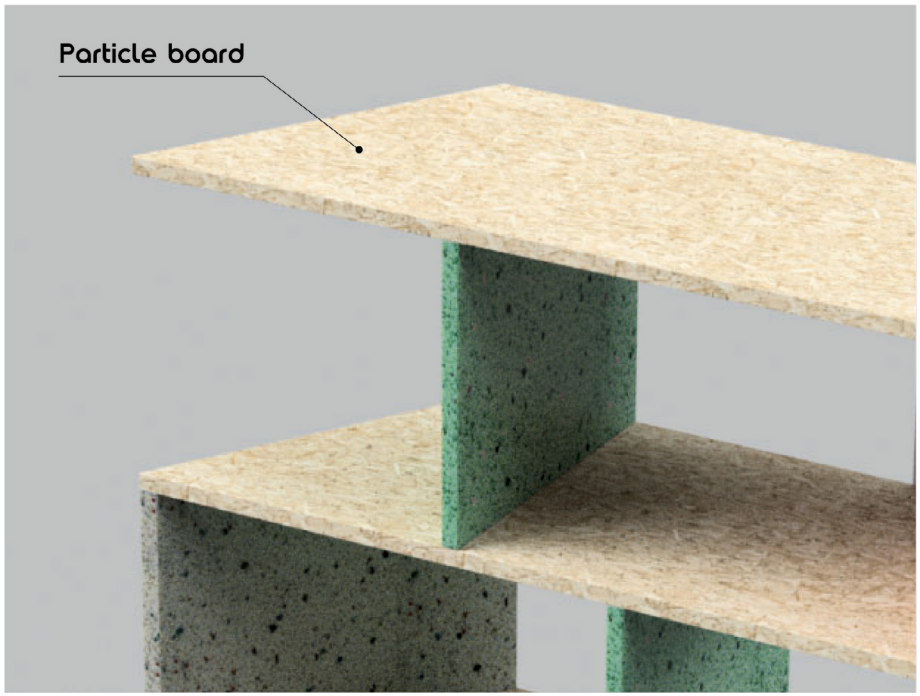
COMBINATION

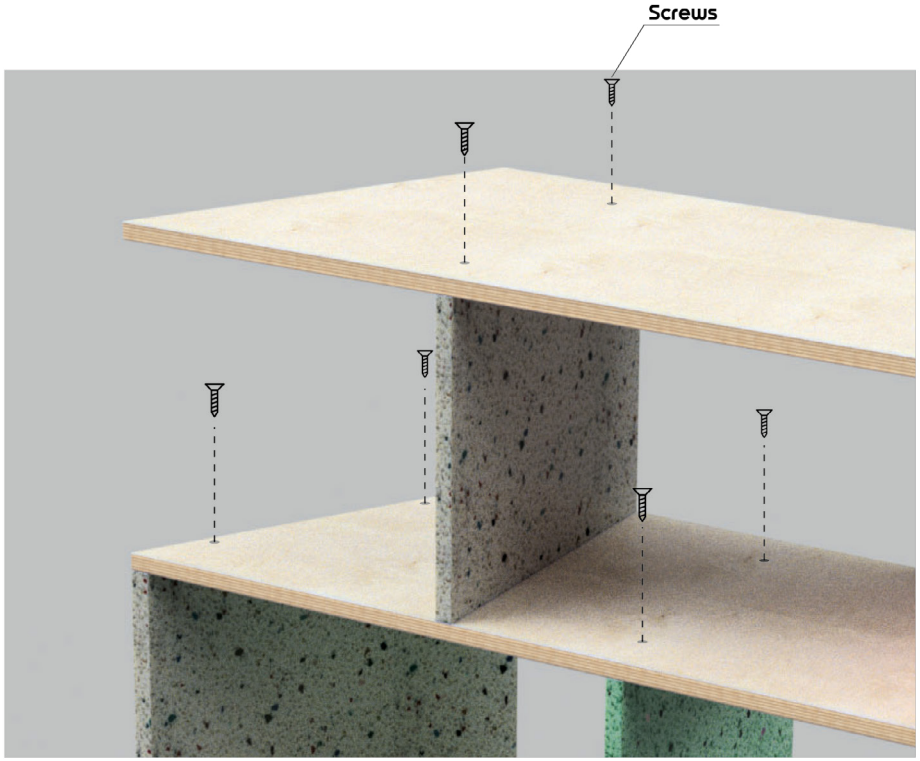


Shelf

COMBINATION

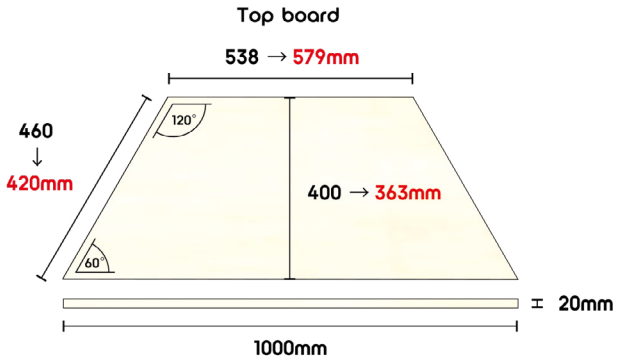


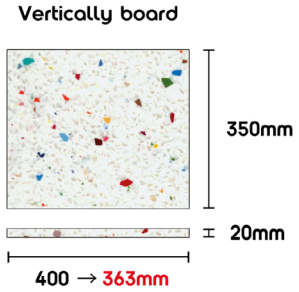


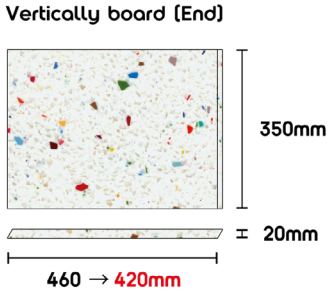


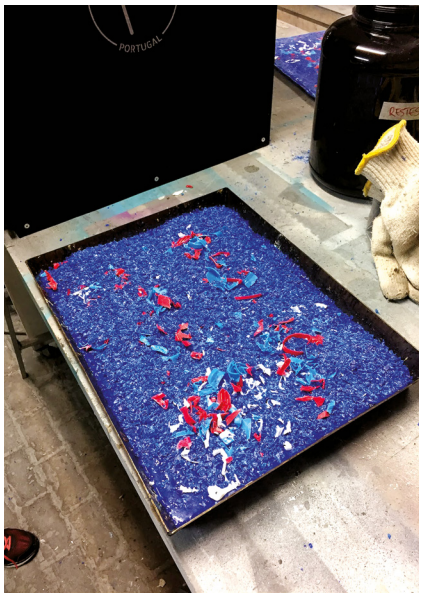
wood or Particle board

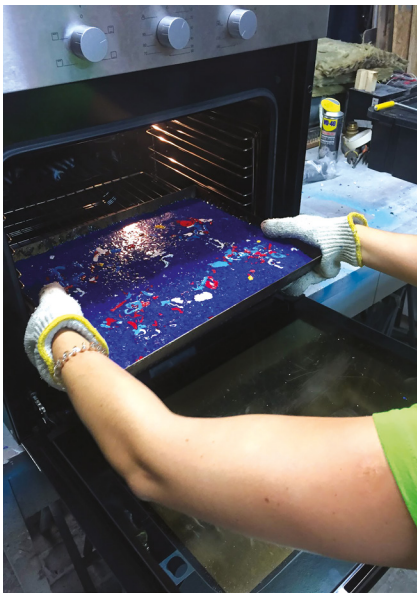
Choose Environmentally friendly materials

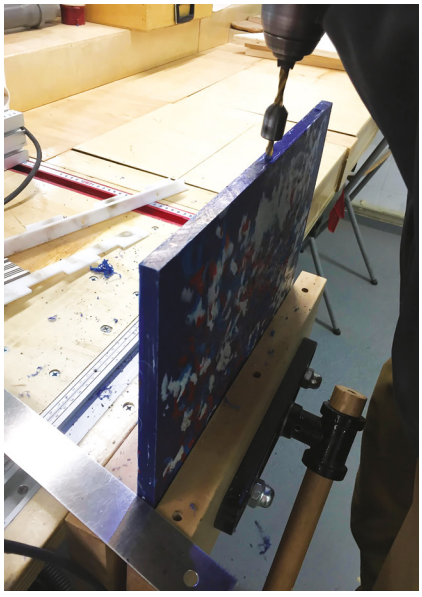




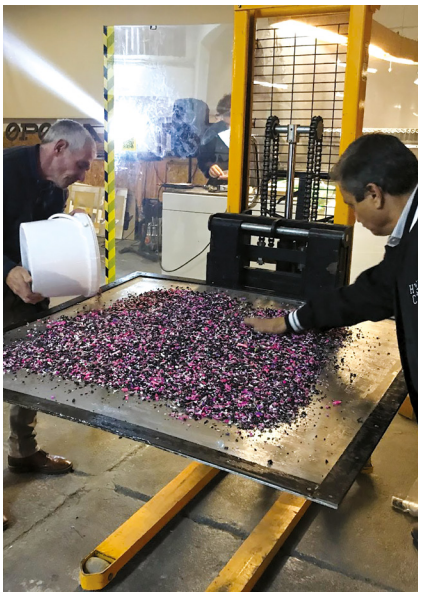
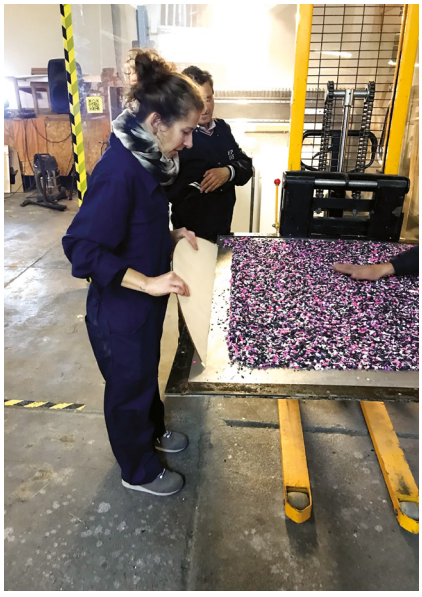



PORTUGAL

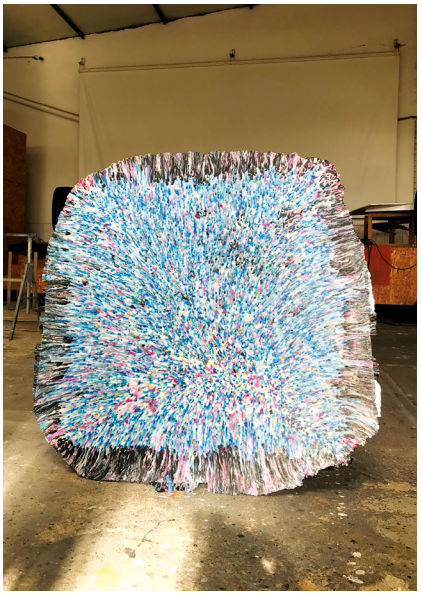






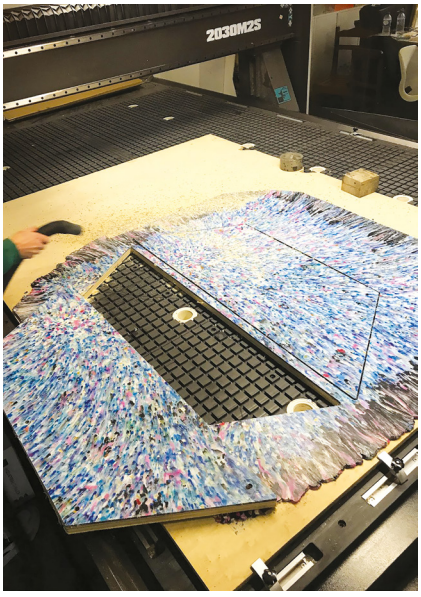









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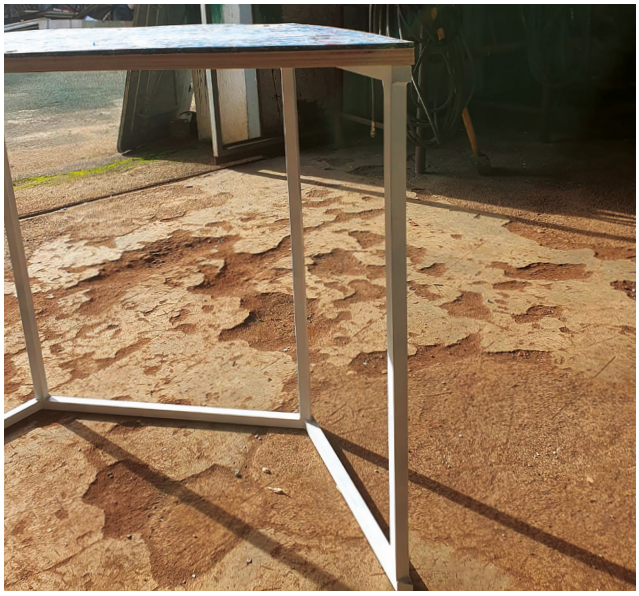
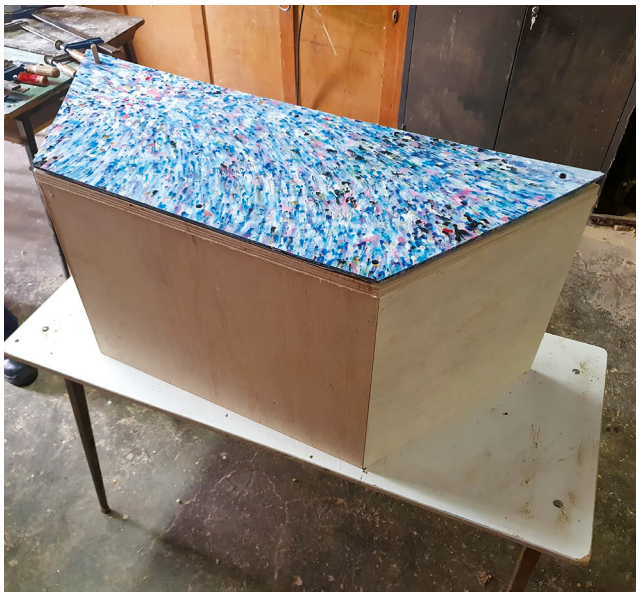


4.2 Guidelines and plans for setting-up a makerspace

Equipment Management Plan and Safety

OPEN SCIENCE HUB
CITÉ DE SCIENCE OUVERTE
SWITZERLAND

1. Workspace[1]

The workspace needs to be organized and spacious enough to provide enough room to move around working makers freely and without danger. We have fire extinguishers, safety paths and signs, adequate lighting, and ventilation. The Fab Lab set up was verified and approved by local authorities for safety at work.

TOOL / EQUIPMENT	QUANTITY
Workbench	6
Worktables	6
Stools	10
Chairs	20
Board	1
Shelves	10

SAFETY EQUIPMENT	QUANTITY
Safety glasses	15
First aid kit	2
Fire extinguisher	2
Work gloves	15
Disposable gloves	100
Disposable respirators	10
Earmuffs	3
Foam ear plugs	10
Portable ventilation	4
Aprons and blouses	10
Safety shoes	5

1. Full list of equipment: https://docs.google.com/spreadsheets/d/1z17m_nNLFLdgokMqLjgo-vQtMEWht4ICGcalyfDD04I/edit?usp=sharing

2. General[1]

All power tools are used after training. Children and beginners can only use them with supervision. Glasses, masks or gloves are worn.

TOOL / EQUIPMENT	QUANTITY
Drill	2
Rotary tool	1
Screwdrivers	10
Wrenches	20
Pliers	20
Knifes	5
Saws	5
Scissors	30
Tape measures	5
Clamps	20
Staple gun	1
Hot glue guns	10
Brushes	30
Heat gun	1

3. Woodworking[1]

All power tools are used after training. Children and beginners are not allowed to use the circular saw. Glasses, masks or gloves are worn.

TOOL / EQUIPMENT	QUANTITY
Circular saw	1
Jig saw	1
Router	1
Sanding machine	1

4. Electronics[1]

The tip of a soldering iron is hot enough to cause burns and should be handled attentively.

Children can use soldering irons under supervision and in small groups. Ventilation is always ensured. Electronics at this level are low-power and safe.

TOOL / EQUIPMENT	QUANTITY
Soldering irons	15
Helping hands	10
Multimeters	3
Oscilloscope	1
Power supply	1
Wire stripper	10
Pliers	5
Solder vacuum	5
Solderless breadboard	15
USB cables	20

5. Textile[1]

Steam irons do get hot enough to cause burns and are used by children with supervision.

TOOL / EQUIPMENT	QUANTITY
Vinyl cutter	1
Sewing machine	1
Digital sewing machine	1
Embroidery scissors	2
Steam iron	1
Knitting machine	1

6. Laser cutting[1]

The primary risk when using a laser cutter is fire within the cutter itself. The laser cutter is never run unattended and the choice of material to cut must be approved by Fab Lab managers. A proper ventilation system is in place.

If the lid of the laser cutter is opened during operation the laser is turned off immediately. Only trained people can use the laser cutter.

TOOL / EQUIPMENT	QUANTITY
Laser cutter	1
Laser cutter for metals	1

7. CNC cutting[1]

Hearing protection and safety glasses must be worn for everyone in the closed area to protect from flying debris. Only trained people can use the CNC.

TOOL / EQUIPMENT	QUANTITY
CNC Shopbot	1
CNC desktop	2

8. BioLab[1]

Disposable gloves and safety glasses must be worn during operations. When dealing with bacteria, waste should be disposed of at a specific collect point. Cleaning hands is mandatory.

TOOL / EQUIPMENT	QUANTITY
Stove	1
Sink	1
Pans	5
Incubator	1
Glasses	50

9. 3D printing[1]

The print extruder does heat to several hundred degrees and should not be touched. PLA is the most used material as it is non toxic. When using the resin 3D printer, goggles, mask and disposable gloves are mandatory to wear.

TOOL / EQUIPMENT	QUANTITY
Filament 3D printers	4
Resin 3D printer	1
UV chamber	1
Food 3D printer	1

10. Computers[1]

TOOL / EQUIPMENT	QUANTITY
Laptops	5
Printer	1
Digital camera	1
Beamer	1

11. Moulding[1]

TOOL / EQUIPMENT	QUANTITY
Vacuum chamber	1
Thermomoulding machine	1

How to engage and support teachers developing pedagogical practices and activities using Fab Lab tools

OSHub-FR is a collaboration between La Casemate – CCSTI Grenoble and the third place *La Machinerie* located at Villeneuve, a low socio-economic background neighbourhood from Grenoble. La Machinerie works as a concierge and meeting place in the heart of the neighbourhood, where it hosts an open space for meeting and learning by doing, promoting the exchange of know-how and local initiatives by residents and actors from the neighbourhood (DIY, repair, homemade, reuse, digital, etc.). In addition, it provides access to several digital fabrication tools, such as 3D printers or laser cutters, allowing to develop and prototype projects and to create all kinds of objects.

As such, the collaboration between La Casemate and La Machinerie works as an effective synergy, where La Machinerie brings the space and mindset for community collaboration, and La Casemate the open science framework, tools and resources, thus creating the conditions to develop projects based on relevant issues together with the local inhabitants (youngsters, families, associations, etc.), by using a multidisciplinary STEAM approach and digital fabrication skills and tools. Furthermore, this participatory space also provides training and resources for educators, and organises workshops, meetings and events, bringing together the different kinds of local actors.

To assist teachers in a Fab Lab project, facilitators can have different strategies, which will highly depend on the presence of a Fab Lab near the school. It is also possible to create a small Fab Lab space in collaboration with a local association or third place or at the school.

This document provides support on how to establish a small Fab Lab / Tinkering Lab, including information about materials, safety and troubleshooting.

1. What is needed to open an educational Fab Lab? Equipment Management Plan and Safety

The tools listed below are safe when used responsibly. All power tools require training and should be used with supervision, and only by students with enough strength to control the tools.

Specific rules and procedures on how to use the tools are explained below, and should be followed every time, even if it is not the first time. If needed, gloves, safety glasses, masks or other specific equipment should be provided.

List of materials

The workspace needs to be organized and spacious enough to provide enough room to move around working makers freely and without danger. We have fire extinguishers, safety paths and signs, adequate lighting, and ventilation. The Fab Lab set up was verified and approved by local authorities for safety at work.

WHAT?	HOW MANY?	WHAT DOES IT LOOK LIKE?	SPECIFICATIONS
Computers	6		Intel Core I5, GeForce GTX, 8GO de RAM, SSD 930 GO
Soldering iron	5		
Tin with lead	1		
Tin without lead	1		
Third hand	5		

Wire stripper	1	
Multimeter	1	
Multimeter measurement kit	1	
Smoke extractor	5	
Heat gun	1	
Glue gun	2	
Glue sticks – coloured and transparent	1 of each	
Scissors	1 of each	
Metal ruler	3 of 50 cm and 1 of 20 cm	

Metal square	2		
Cutter	2		
Glue	4		
Felt pen	1 of each		
Pencils	1 of each		
Erasers	1		
Transparent pockets	1		
Cutting mat	2 of each		
Smartphone	1		IPhone 8+

iPhone-Jack Adapter	1	
Lapel microphone	2	
Tripod	3	
IPhone-tripod clip	1	
Microphone	1	
Light	3	

Safety Rules and Troubleshooting

General instructions for power tools

Power tools need to be turned off whenever they are not being used, and, if possible, should be unplugged to avoid electric injury or voltage problems for the material.

Computers

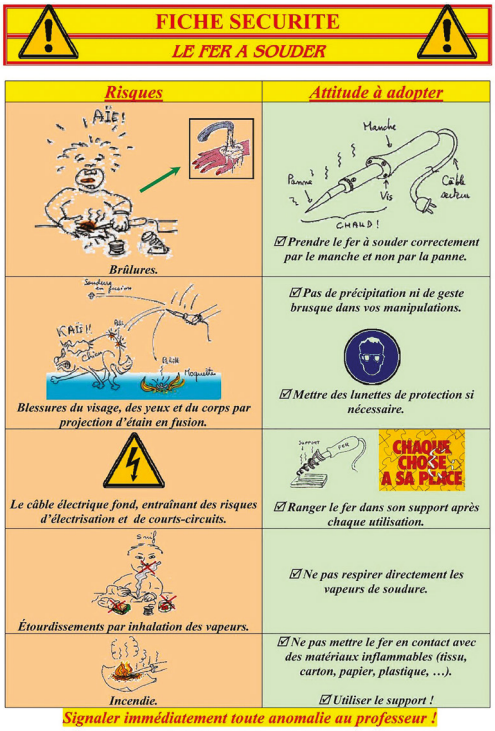
Using ergonomic workstations is important, as well as making sure that students adopt a healthy posture when working on the computers. Before using the Internet, students need to be aware that they should not disclose personal information, such as their city, school, address, phone number, email address or real names.

Soldering iron and smoke extractor

It is fundamental to have a full understanding about the procedures to use a soldering iron[2], with specific attention to the hot parts of the tool. Students should only use a soldering iron under adult supervision.

A smoke extractor must be used every time that the soldering iron is used to avoid inhalation of smoke or tin vapours. It has to be placed behind the working area.

Safety slides should be provided for each soldering station, in order to inform the users, in particular the students, about the risks and safety behaviours.



Heat Gun

Heat guns should only be used by students under adult supervision. Before using it, it is fundamental to explain to the students about all safety considerations, namely the following: heat guns should not be used near combustible or flammable materials/atmospheres; it is important to be aware about the presence and direction of the heat produced; the tool should be switched off before putting it down onto any surface; heat guns should only be stored after cooling down; the hot metal nozzle should never be touched with clothes or skin; air flow should never be directed towards one's body; while the gun is turned on, one should not look into the nozzle; any object should be inserted into the gun nozzle; and the inlet grill should not be blocked or the air obstructed while the tool is being operated.

2. Example of Digital Soldering Station Manufacturer's instructions

Glue Gun

The goal is always to prevent electric shock, skin burns and eye injuries. For that: the hot nozzle and hot glue must not be touched when working with the glue gun; the glue gun should not be pointed towards the direction of another person; the glue gun should be unplugged immediately after the user stops using it; the gun can not be left unattended while it is hot, otherwise it will become a fire hazard and become of danger for other people who may come in contact with the hot appliance; when the gun is not being used, it should to be set down upright on its metal rack and not lying on its side; only glue sticks appropriate for the glue gun should be used; the glue gun needs to be kept away from direct sunlight or moist conditions, in order to reduce any risk of electrical shock or fire.

Scissors, cutters

Safety tips should be explained to the students regarding the use of scissors and cutters, particularly: hands and body should be kept away from the tools and cutting lines; gloves should be used whenever necessary; maximum focus is fundamental while using the tools; the work should be performed on a flat and solid surface; whenever the tool is not being used, the blade should be retracted.

2. Fab Lab machines that can be easily moved and used by students

In addition to the various tools presented above, additional Fab Lab machines are recommended in order to develop a project that will lead to the manufacture of tangible objects with the students, like a 3D printer, vinyl cutter, scroll saw, sewing machine, manual engraving machine and programmable electronic boards. Nowadays, if schools have the possibility of acquiring them, there are already some accessible financial options that will allow developing creativity and technical skills with students.

As an alternative, at La Casemate, CCSTI developed an educational program with a mobile Fab Lab inside a motor vehicle that includes computers, a vinyl cutter, a 3D printer, a laser cutter and an engraving machine. This utility, created in 2018, can go to schools to facilitate the development of projects in areas that don't have access to Fab Labs, like rural areas.

Equipment, Tools, Materials and Safety

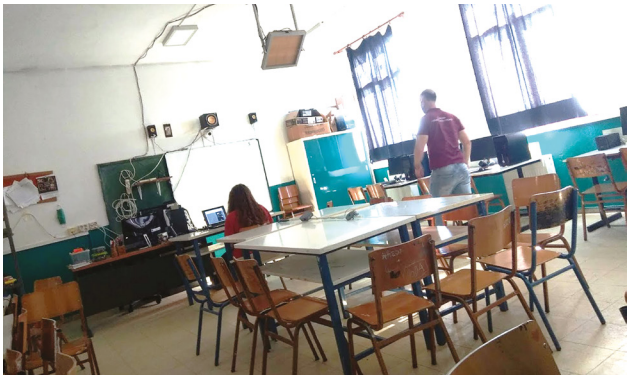
The current document depicts the basic materials, tools and equipment found in the SciCo Maker Labs. The first SciCo Maker Lab was established in the secondary school of Livadochori Limnos and was then reapplied to the Vocational School of Myrina.

The document also states the basic safety points which need to be taken into consideration by all participants and visitors of the Maker Space.

1. Workspace

The SciCo MakerLab was created as part of the European Project Open Science Hub and was first set up in the existing computer lab of the Livadochori High School in Limnos, Greece. It was then reapplied to the Vocational School of Myrina in Limnos.

The goal is to ensure a safe, comfortable and creative maker space for students within and outside school hours, by individuals and teams. Therefore, it has been created in order to have individual work desks, a common workspace in the centre of the room and enough space for people to move around freely, without danger.



2. General Workspace Safety

Initially, users should always ensure that:

- Pathways, exits and safety equipment are kept clear from tools, materials, furniture and equipment.
- The trash and debris should be removed regularly.
- The room should be lighted and ventilated adequately.
- Everyone should know where the first aid kits and fire extinguishers are.
- Safety goggles and gloves are worn when needed.

The remaining general safety procedures (eg, fire escape plan, earthquake "Drop-Cover-Hold" plan, etc) are common to the schools' safety procedures.

3. Inventory

The workspace needs to be organized and spacious enough to provide enough room to move around working makers freely and without danger. We have fire extinguishers, safety paths and signs, adequate lighting, and ventilation. The Fab Lab set up was verified and approved by local authorities for safety at work.

SAFETY TOOLS / EQUIPMENT / MATERIALS PER SPACE	QUANTITY
Fire Extinguisher	1
First Aid kit	1
Safety Goggles	5
Gloves	2
Containers	6
Broom and dust pan	1
Rubbish Bin	1

GENERAL PROJECT TOOLS / EQUIPMENT / MATERIALS PER SPACE	QUANTITY
Scissors	10
Hot Glue Guns	5
Hot Glue sticks	30
Sets of Rulers, Glue, Staplers, etc	5

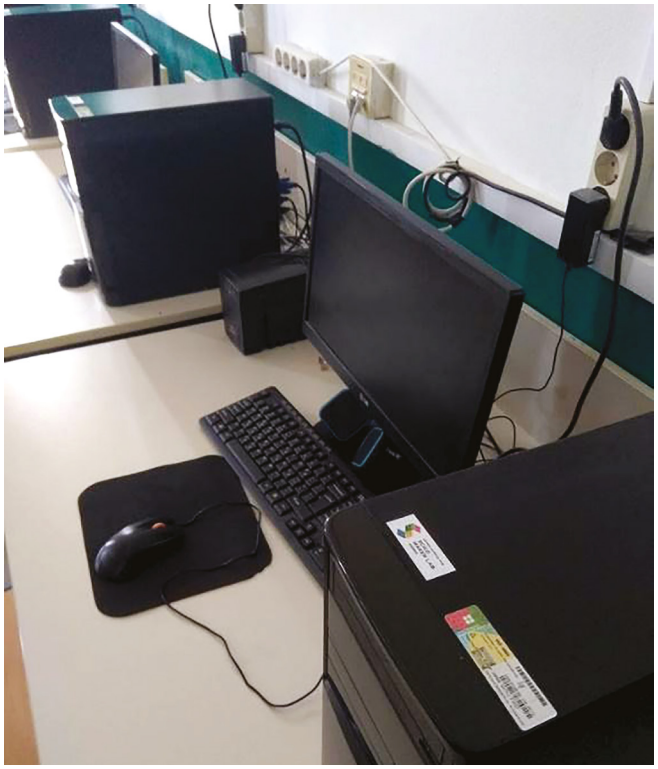
Sets of pens, paper, pencils, crayons, etc	5
Tape (duct tape, masking tape, copper tape, etc)	10
Paintbrushes and Paint	10
Cardboard	50
Popsicle sticks	100
Pipe cleaners	100

4. Computers

Personal computers (pc) are at the core of Scico Maker Lab, as there are used by students to:

- Access information and get inspiration.
- Access digital tools to design, create, and collaborate on projects.
- Programme and write code for their projects.
- Connect to 3D and normal printers to produce patterns, designs, project materials and mock-ups.
- Access tutorials, instructional videos.
- Document projects and learning.
- Connect via online platforms.
- Share projects and communicate work.

All computers run in a Windows or Linux environment and all software used are open accessible educational platforms, such as Tinkercad, Wordpress and App Inventor by MIT.



Computer Safety

Students should be aware of basic ergonomics at their workstations: correct posture and lighting and frequent breaks away from the screen. Additionally, students are trained in order to access age and content appropriate webpages and never disclose personal information (photos, name/surname, phone number, passwords, school, etc).

Inventory

TOOL / EQUIPMENT / MATERIALS	QUANTITY
Desktop computers	10
Printer	1
Laptop	1
Projector	1

5. Electronics

One of the basic tools used during the current academic year are microcontrollers (Arduino) and robotics kits (Lego Education). The former are used in order to introduce students to electricity, electronics, electric circuits, basic programming with ArduBlock and physical computing, whereas the latter include bith Ledo WeDo 2.0 and Lego EV3 kits, in order to introduce students to basic coding, robotics and building.

Microcontrollers & Robotics Microcontrollers allow makers to create advanced electronics and electromechanical systems including robots. This adds the capability to build and experiment with robotics, microcontrollers, and other electromechanical creations.

Apart from the basic Robotic kits and Microcontrollers (Arduino), SciCo MakerLab includes a range of sensors, electric cables, soldering irons, batteries, breadboards, usb cables, LEDs, Bluetooth connectors, copper tape and other materials which are needed to build the projects.

Electronics Safety

All electronic equipment is low-power and safe, however students are introduced to the basics of a short-circuit and safe handling of all tools.

The tip of a soldering iron heats to about 400°F, hot enough to cause burns and should be handled attentively. Under normal soldering conditions, solder containing lead poses no health risk, though makers should be encouraged to wash their hands after a long period of handling leaded solder. Any kind of soldering generates fumes from the flux core of the solder, so the area is ventilated when used. Alternatively, students mostly use solderless breadboards as they can explore circuits in a faster and safer way.

Inventory

TOOL / EQUIPMENT / MATERIALS	QUANTITY
Arduino Microcontrollers	60
Lego Education WeDo 2.0	4
Lego Education EV3	3
Soldering Irons	5
Sensors (temperature, pressure, CO_2, O_3, weight, distance, sound, etc)	100
Breadboards	20
Batteries (AA, 9V)	20
Jumper Cables	200
LEDs	100
Raspberry pi	20
Motors	10
Photoresistors	40
Resistors	100
Buzzers	10
Coin Batteries	10

6. 3D Printer

The SciCo Maker Lab is equipped with a MakerBot Sketch 3D Printer, with which students can print 3D objects from plastic through extrusion. The material used in this printer is PLA (a biodegradable plastic), whereas students create their 3D designs using the Tinkercad or Autodesk platform. They also have the option of searching from ready designs and freely downloading them from sites like Thingiverse.com.

The set up of the printer and basic training was run in collaboration with the provider (Decode Fabrication Lab), who is also responsible for its maintenance.

As an easy and quick activity to introduce students to 3D printing, the Maker Spaces were also equipped with 3D pens. These pens can also be used for mini creations for projects.

The second school already had a 3D printer, which was used in the Maker Lab.

3D Printer Safety

3D printers are generally very safe. The print extruder does heat to several hundred degrees and should not be touched.

Inventory

TOOL / EQUIPMENT / MATERIALS MATERIALS PER SPACE	QUANTITY
3D Printer	1
PLA Spools	6
Build Plates	2
Snip	1
USB for transferring files	1
3D pens	5