



**REGEMAT** 3D

REGEMAT3D Designer  
MANUAL

## Contents

1. Introduction .....	3
2. 3D Objects Viewer .....	4
3. Toolbar .....	6
3.1. Header Configuration .....	6
3.2. Calibrate Header .....	7
4. Objects Configuration.....	9
4.1. Step 1: Scaffold .....	10
4.2. Step 2: Filling .....	12
4.3. Extra Configuration.....	14
4.4. Tool Configuration for each printing .....	15
4.5. Petri bed .....	15
5. Printable code creation .....	17
5.1. Printable Viewer .....	17
6. Printing Process .....	18
6.1. Movements Tab.....	19
7. Advance Tab .....	21
Appendix A: Glossary .....	22
Appendix B: G-code Commands .....	23

## 1. Introduction

REGEMAT3D includes a software to configure the bioprinter and models. It allows to print several 3D objects in a unique process, each one configured independently.

Along this manual, the different possibilities of the software will be explained in detail. The image below displays the main window of REGEMAT3D Designer.

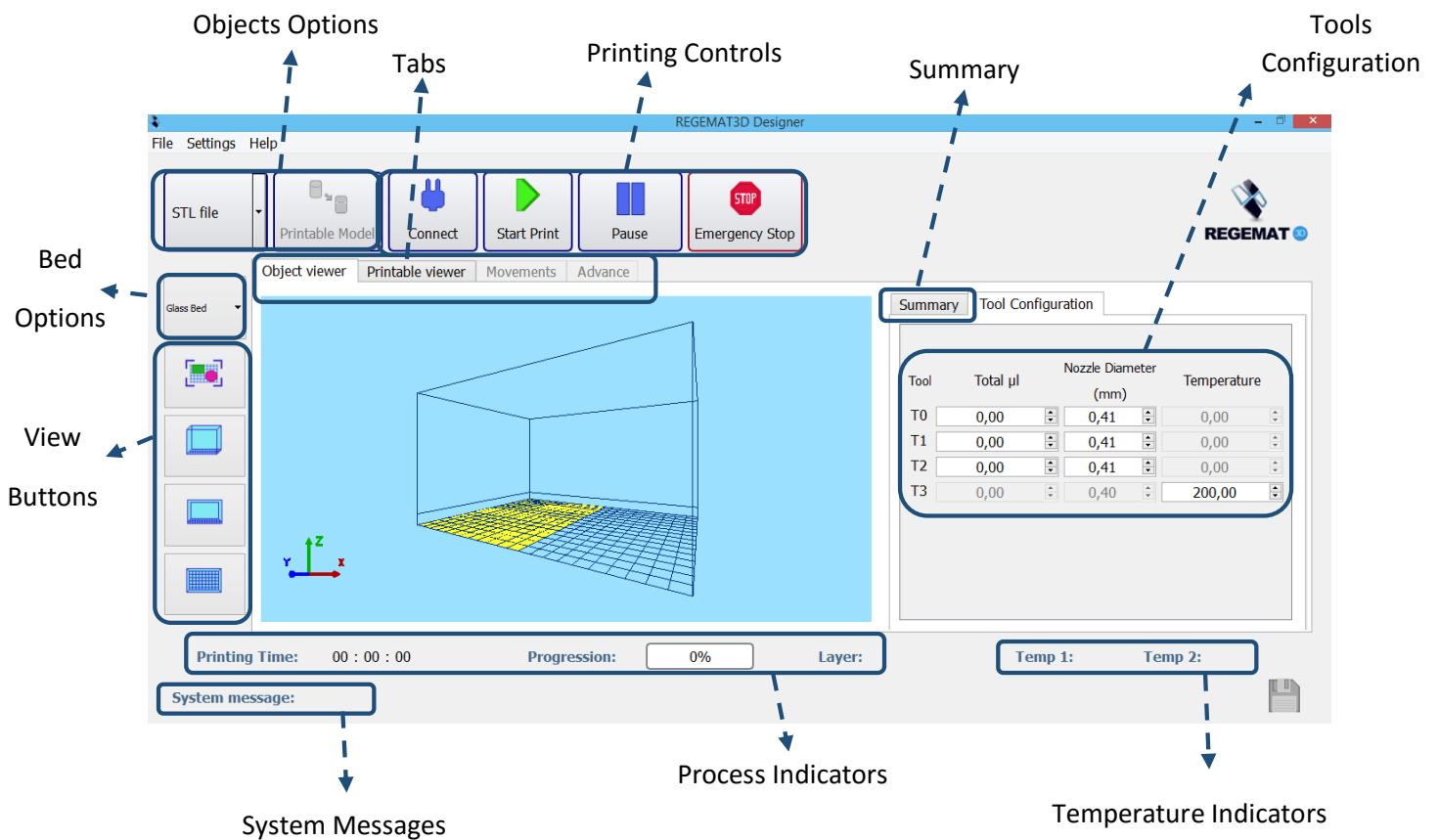


Figure 1: REGEMAT 3D's main window.

## 2. 3D Objects Viewer

In the main window, the first tab is the 3D objects viewer. It shows a gridded representation of the printing bed in which a certain region is colored. This region represents the actual available region in the bed in which, with the current tools used, is possible to print (the size of the header sometimes makes impossible for every tool to access to any place in the bed). So, changes in the configuration of a model will have repercussions on this accessible space.

"Cube" or "Cylinder" options add these simple models automatically. If the chosen option is "Stl file", a window is displayed to choose a .stl file and is added to the viewer.

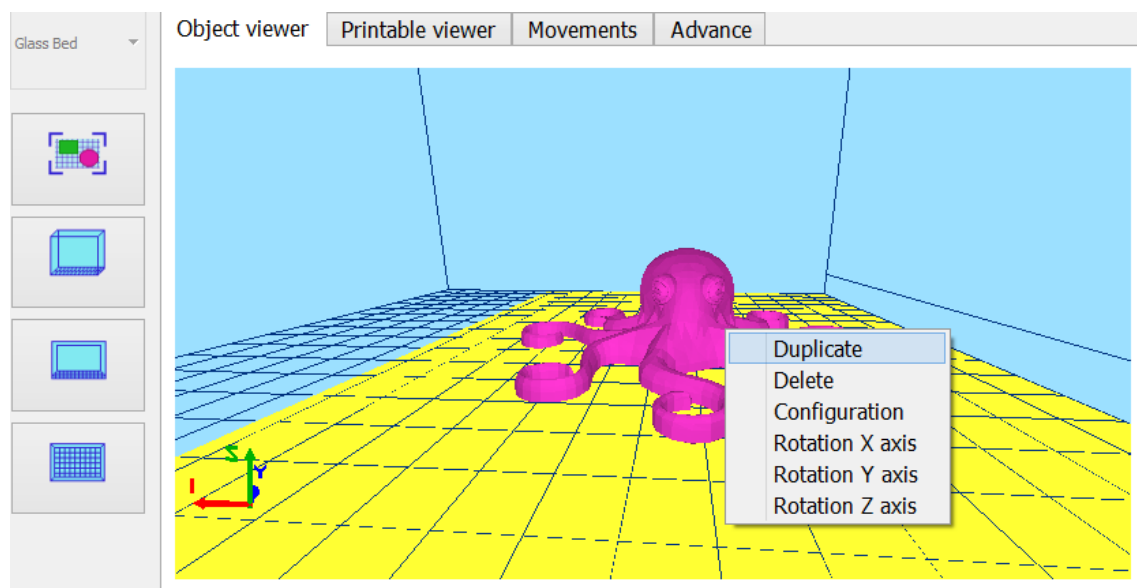
Once a model is added, it can be selected (one click) and moved (left click). Double click on above model to display different actions:

- o **Duplicate:** Click on the model and select "**Duplicate**". This action duplicates the selected model (shape, size and configuration) and adds it to the viewer
- o **Delete:** Click on the model and select "**Delete**".
- o **Configuration:** Click on the model and select "**Configuration**" (detailed in the following section).
- o **Rotation along X axis:** Click on the model and select "**Rotation X axis**". The rotation will be carried out following the projection of the mouse pointer though the X plane while keeping the right button pressed.
- o **Rotation along Y axis:** Click on the model and select "**Rotation Y axis**". The rotation will be carried out following the projection of the mouse pointer though the Y plane while keeping the right button pressed.
- o **Rotation along Z axis:** Click on the model and select "**Rotation Z axis**". The rotation will be carried out following the projection of the mouse pointer though the Z plane while keeping the right button pressed.

Concerning the visualization, it is possible to zoom in and out (mouse wheel), rotate the camera (keeping the left mouse button pressed over "free space") and translate the camera (by keeping the mid button pressed as displace the mouse).

On the right side of the viewer there are some buttons related to several standard visualization modes:

- o **Focused View:** This option is disabled in 3D Model Viewer. It focus the models in the viewer window, while keeps the camera orientation (available in "**Printable Viewer**").
- o **Isometric View:** It sets the camera on an isometric perspective.
- o **Front View:** It sets the camera on a frontal perspective.
- o **Top View:** It sets the camera on a superior perspective.



*Figure 2: 3D Objects Viewer and options*

### 3. Toolbar

REGEMAT3D Designer has a toolbar with the following structure:

- 1) File
  - a. **Save Printable object** for a future process.
  - b. **Load Printable file** load a Printable Object.
  - c. **New printing...**: Clear the Object Viewer, Printable Viewer, configurations...
- 2) Settings
  - a. **Extra Configuration** to set speeds, skirt...
  - b. **Header Configuration** (detailed in section *4.1.Header Configuration*).
  - c. **Target Configuration**: to set x, y positions of the target with T0.
  - d. **Edit Colors** for customizing the interface.
  - e. **Expert** to activate or deactivate advance tab
- 3) Help
  - a. **Technical Support**.
  - b. **Graphics Information**.
  - c. **User Manual**.
  - d. **About REGEMAT3D...**
  - e. **Version**

#### 3.1. Header Configuration

Due to the modular design of REGEMAT3D Bioprinter, it is possible to change the header. Furthermore, sometimes it is necessary adjust some parameters.

“**Header Configuration**” is situated in the toolbar “**Settings > Header Configuration**”.

The window display a table, each row refers to a tool and each column to a specific parameter.

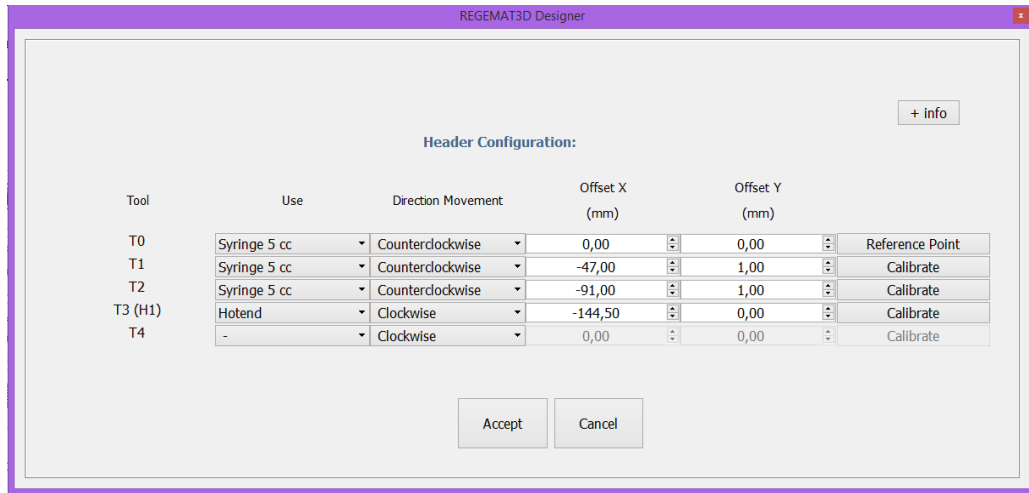


Figure 3: "Header Configuration" window.

REGEMAT3D bioprinter allows until 5 tools as the same header.

"Use" field indicates the kind of tool:

- ➔ Syringe 3 cc
- ➔ Syringe 5 cc
- ➔ Syringe 10 cc
- ➔ Hotend
- ➔ Heated Syringe
- ➔ Pellets
- ➔ Null (-)

Next parameter is **Direction Movement** is used for change the extrusion direction of a tool.

The following two parameters are relative to internal configurations, when some of these parameters change, it is necessary connect the Bioprinter in order to modify them. It is necessary adjust these offsets, this process is detailed in the following section

- **Offset X (mm):** X distance between current tool and T0.
- **Offset Y (mm):** Y distance between current tool and T0.

### 3.2. Calibrate Header

To carry out the offsets (X,Y) for each tool , proceed as follows:

- 1) Connect the Bioprinter (USB cord, power supply, green button and software connect button).
- 2) Go to "**Calibrate Header**" window and click on "**Reference Point**", T0 is located over the center of the target.
- 3) Click on "**Calibrate**" button of a specific tool and press "**Move**".



- 4) Check the position of the current tool, the selected tool must be located in the center. Otherwise, set value X and Y and press "**Move**" until the tool is in the correct position. After the adjustment press "**Accept**".

If some offsets have changed, accept the new header configuration and follow the instructions.



## 4. Objects Configuration

Before starting any printing, it is necessary to configure the parameters for each model loaded in the viewer. The configuration of a model is divided into two steps, enumerated in the configuration window: “**1. Scaffold**” and “**2. Filling**”.

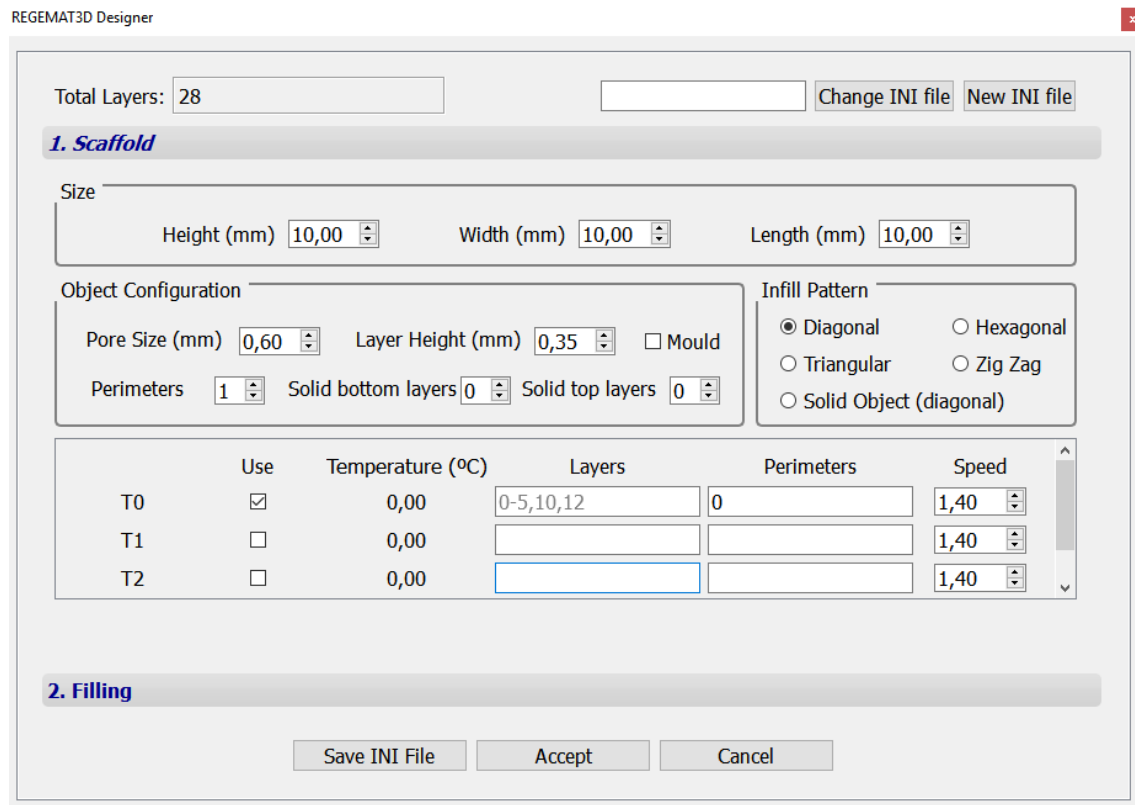


Figure 4: Configuration screen.

At the top of the configuration window there is a total layer display. It is automatically modified when the values of “**Height (mm)**” or “**Layer Height (mm)**” are changed and represents the layers to print for that model.

In the upper right corner there are two buttons to load and save a configuration file (.INI). This files contain the main features of the printing configuration of a model (number of layers, infill algorithm, layers and kind of filling...). When an INI file is loaded, the properties will be loaded to the current object. Since, as mentioned above, the layers and kind of filling will be as well loaded, in some cases it will be necessary to fit the current model to the size saved in the INI file.

The button “**Change INI file**” loads a saved configuration, while the button “**New INI file**” saves a new configuration archive. After setting the configuration, to save the changes it is mandatory

to press **"Save INI File"** button, to introduce the changes in the INI file selected, created or to create a new one.

#### 4.1. Step 1: Scaffold

In the first step of the configuration the **"Scaffold"** is set. It constitutes the main structure of the printed model.

The fields named as **"Size"** allow to modify the dimensions of the 3D model. If the model configured is a **"Cube"**, it is possible to set height, length and width. For **"Cylinders"** we can set height and diameter. In the case of **"STL file"** there is a single option to resize the model, **"percentage"**, and corresponds to a percentage resize.

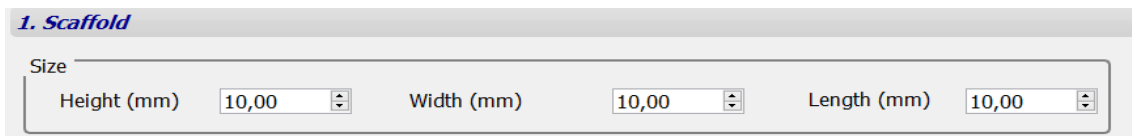


Figure 5: Set "Cube" dimensions.

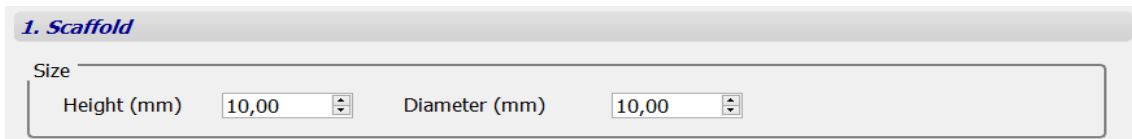


Figure 6: Set "Cylinder" dimensions.

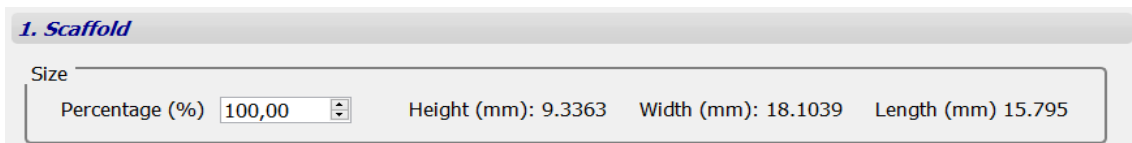


Figure 7: Set percentage resize for "STL File".

In **"Object Configuration"** section it is possible to set the values:

- **Pore Size (mm).**
- **Number of Perimeters (Perimeters)** with which the model will be printed. This value can be set to zero (no perimeters).
- **Solid bottom layers:** This option allows to set a number of solid layers in the object's base.
- **Solid top layers:** Like the above mentioned case, but top layers.
- **Mould.** Enables the mould mode. The model will be hollow except for the solid layers customized. With this mode on, filling will only be configurable concerning field's tool and amount of material per layer. The filling porosity will be zero.
- **Layer Height (mm).**

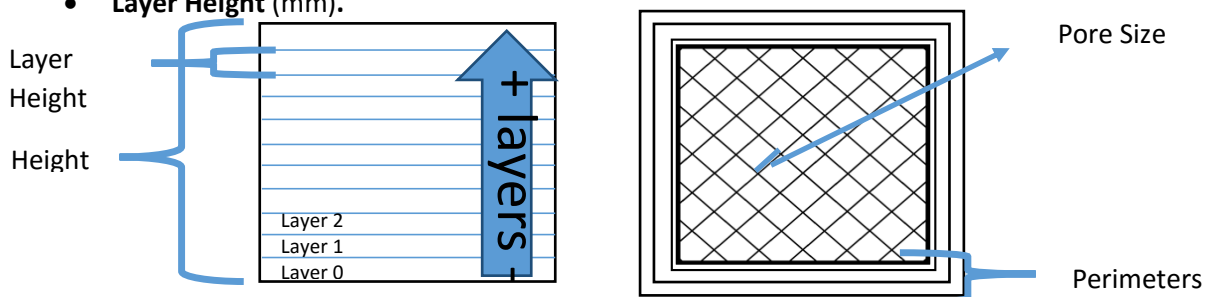
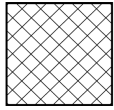
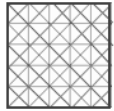


Figure 8: Top view and side view of an object.

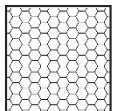
In "Infill Pattern" section, infill pattern of the Scaffold can be set. The geometries available are:



**Diagonal:** Two directions are alternated in every layer. The final pattern can be seen on the image at the side.



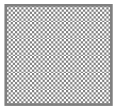
**Triangular:** In every layer the infill direction is changed in 45°.



**Hexagonal:** Honeycomb pattern.



**ZigZag:** It is formed a Zigzag pattern which alternates its direction every layer. If the filling is configured, the alternation and space between parallel lines of the infill changes in order to fit the filling volume required and the filling tools diameter.



**Solid Object (diagonal):** The model will be filled in every layer with the same tool as the Scaffold had been configured, with no porosity. This pattern uses diagonal infill.

At the end of this section, the user can set the relation between layers/tools or perimeters/ tools for the scaffold, each layer can be built with a different tool, but all the selected tools must have the same nozzle diameter for the infill (relations between layers and tools).

If only one tool is required it is necessary to toggle the corresponding "Use" box, leaving the field layers empty. If several tools are needed, the corresponding "Use" boxes must be toggled.

	Use	Temperature (°C)	Layers	Perimeters	Speed
T0	<input checked="" type="checkbox"/>	0,00	-	0	1,40
T1	<input checked="" type="checkbox"/>	0,00		2	1,40
T2	<input checked="" type="checkbox"/>	0,00	4-8,12,15	1,3	1,40

Figure 9: Mixed Scaffold Configuration.

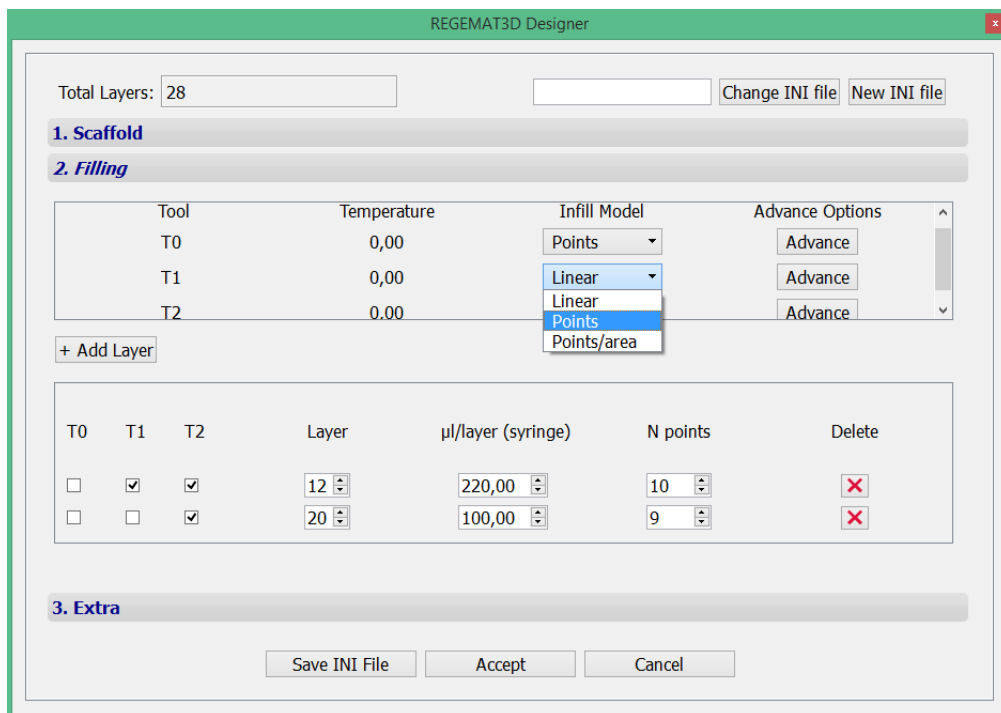
To specify the layers for each tool (in a mixed scaffold), the notation required is: commas to separate individual layers or blocks of layers, and hyphens to indicate ranges. It is mandatory leave one of tool's "Layers" box empty, this tool will be used by default. In the example (see the above figure) tool 2 builds layers from 4 to 8 (both included) and 12 and 15, tool 1 builds the rest of the layers (tool 0 is not used for this scaffold: "-").

In order to set the perimeters, the notation is similar to the layer's case, the main difference is that it is mandatory set all the perimeters. In the example, four perimeters are chosen,

perimeters 0 (most external) and 2 are built with tool 0, perimeter 1 with tool 1 and perimeter 3 with T2. The last column shows the flow material speed.

#### 4.2. Step 2: Filling

In this step, filling is configured. It contains two sections, the first of them corresponding to the configuration of the tools to fill with, and the last conceived for the specification of the layers to fill, amount of material and parameters for the infill model.



REGEMAT3D Designer

Total Layers: 28 Change INI file New INI file

**1. Scaffold**

**2. Filling**

Tool	Temperature	Infill Model	Advance Options
T0	0,00	Points	<span>Advance</span>
T1	0,00	Linear	<span>Advance</span>
T2	0,00	Points	<span>Advance</span>

+ Add Layer

T0	T1	T2	Layer	ul/layer (syringe)	N points	Delete
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	12	220,00	10	<span>✖</span>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	20	100,00	9	<span>✖</span>

**3. Extra**

Save INI File Accept Cancel

Figure 10: Step 2: "Filling" configuration.

The first section is dedicated to the settings of the available tools for filling (syringes and heated syringes). Tools are displayed into rows, and for each one it is presented the recommended temperature, the **"Infill model"** and the advance options.

The column **"Infill Model"** refers to the filling algorithm. Three possibilities are available:

5. **Linear:** The material is deposited in straight lines, following the internal scaffold structure.
6. **Points:** The material is deposited in the center of every pore of the infill pattern.
7. **Points/area:** The material will be deposited in **"N points"** distributed all over the layer.

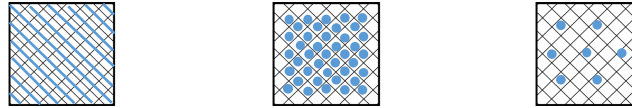


Figure 11: Differences between: "Linear", "Points" and "Points/area".

In the last field there is an **"Advance"** button for each **"T"** in order to adjust some extra parameters (see figure 11).

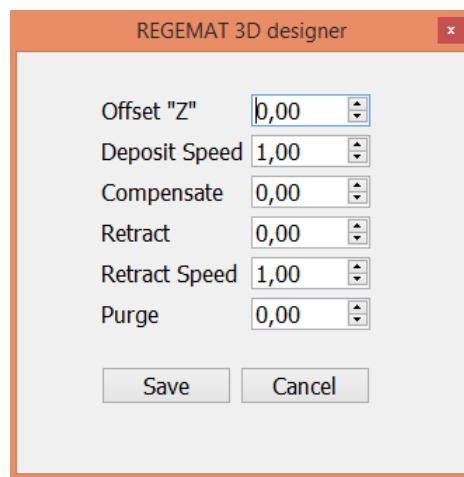


Figure 12: "Advance Options".

The available parameters in **"Advance Options"** are:

- **Offset "Z"**: The difference in level between tool 0 and the current tool.
- **Deposit Speed**.
- **Compensate**: To specify the amount of material for compensate before each printing process.
- **Retract**: To specify the amount of material for retract after each printing process.
- **Retract Speed**: Speed for compensate and retract actions.
- **Purge**: To specify the amount of material for extrude before each complete process.

After tools configuration, the second table is used to select layers in which a chosen tool will deposit material.

The first field indicates the selected tools, the second one specifies the layer. The following two indicate the amount of material required in each layer for each tool:

- **" $\mu$ l/layer (syringe)"**: Volume of material for each layer and tool.
- **"N points"**: used with **"points/area"** infill model. Number of points that a tool will deposit in this layer.

The last column is used to delete all the information for a selected layer.

### 4.3. Extra Configuration

Extra Configuration is used for some extra parameters common to all objects (**Settings > Extra Configuration**) .

“Retract /Compensate” options in relation to scaffold are:

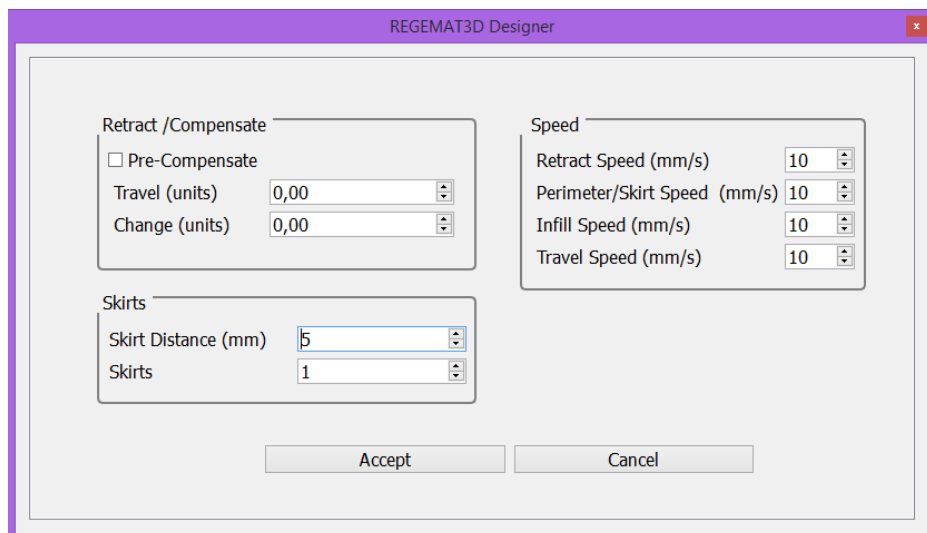
- **Pre-compensate:** this option allows syringes deposit some materials before printing process.
- **Travel (units):** amount of material to retract each travel.
- **Change (units):** amount of material to retract each layer change.

“Speed” parameters are:

- **Retract Speed (mm/s)**
- **Perimeter/Skirt Speed (mm/s)**
- **Infill Speed (mm/s)**
- **Travel Speed (mm/s)**

In the last box, there are two options:

- **“Skirts”:** Number of squares around the objects in order to clean tools before a printing.
- **“Skirts Distance (mm)”:** Distance between the objects and the Skirts.



Retract /Compensate		Speed	
<input type="checkbox"/> Pre-Compensate		Retract Speed (mm/s)	10
Travel (units)	0,00	Perimeter/Skirt Speed (mm/s)	10
Change (units)	0,00	Infill Speed (mm/s)	10
		Travel Speed (mm/s)	10

Skirts	
Skirt Distance (mm)	5
Skirts	1

Figure 13: Step 3: "Extra".

#### 4.4. Tool Configuration for each printing

There are some parameters which are necessary set up for each printing process. There is a specific tab for these actions in the home screen.

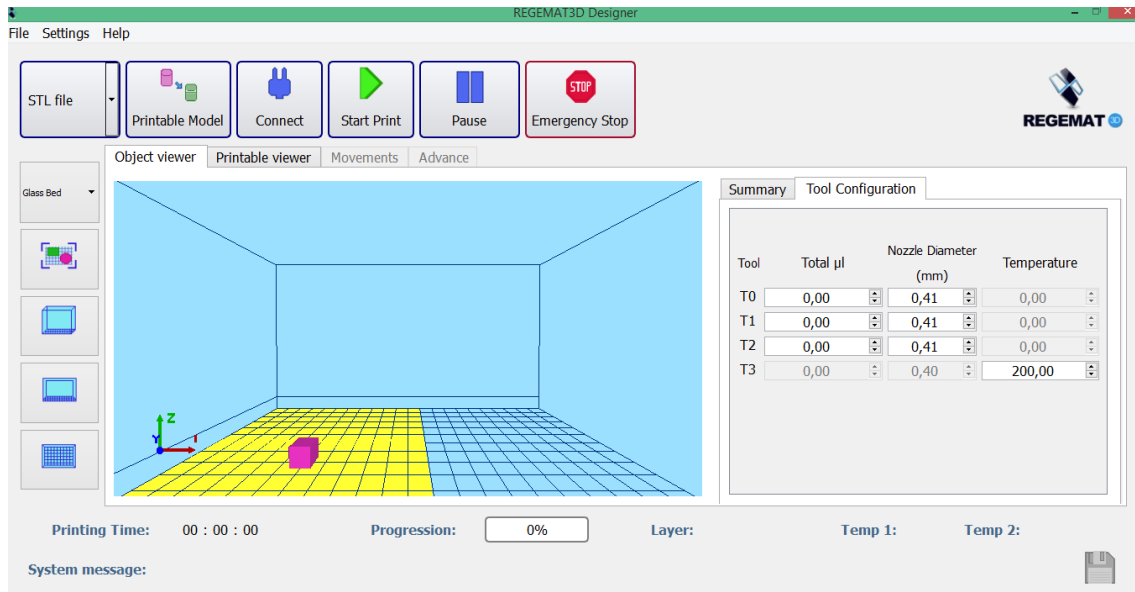


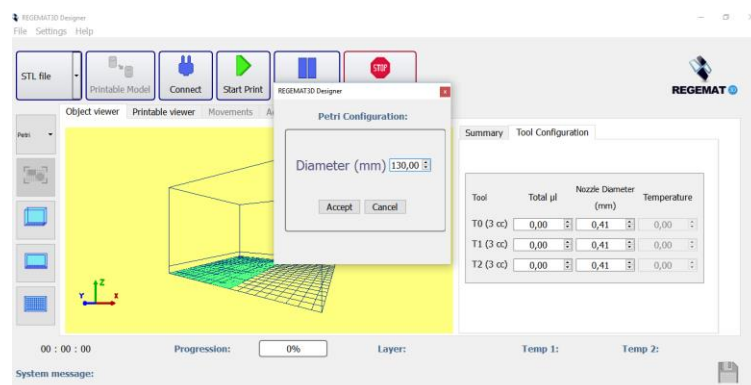
Figure 14: Tool Configuration tab.

For each syringe used is mandatory set **"Total  $\mu$ l"**, amount of material refilled in a syringe. The **"Nozzle Diameter (mm)"** specifies the diameter of the needle. **"Temperature"** for a hotend or syringe heated. It indicates the target temperature for the process. This value must be lower than the **"Max. Temp."** in **"Header Configuration"**.

#### 4.5. Petri bed

REGEMAT 3D allows print in a petri dish with T0. The steps to be followed before the process are:

1. Exchange the glass bed for the petri bed.
2. Choose **"Petri bed"** option and set the inner diameter.



3. Go to “Header Configuration” and unset T3.

REGEMAT3D Designer

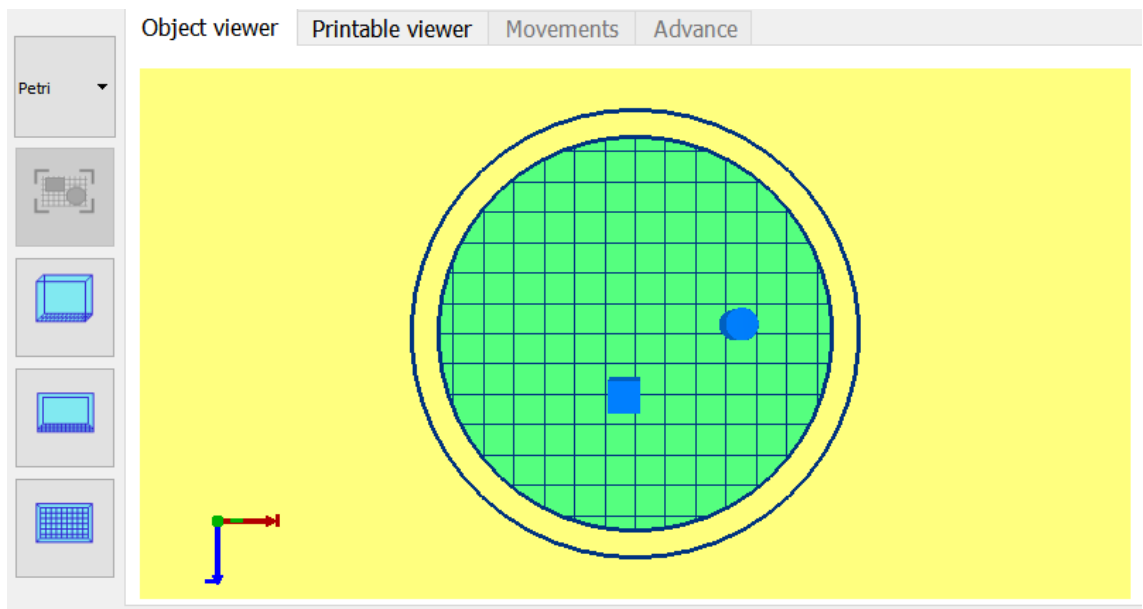
+ info

**Header Configuration:**

Tool	Use	Direction Movement	Offset X (mm)	Offset Y (mm)	
T0	Syringe 3 cc	Counterclockwise	0,00	0,00	Reference Point
T1	Syringe 3 cc	Counterclockwise	-43,00	0,00	Calibrate
T2	Syringe 3 cc	Counterclockwise	-86,00	0,00	Calibrate
T3	-	Clockwise	0,00	0,00	Calibrate
T4	-	Clockwise	0,00	0,00	Calibrate

Accept Cancel

4. Remove physically the extruder (T3) from the header and T1 and T2 syringes.
5. It is possible to start the configuration process.





## 5. Printable code creation

Before a printing, it is necessary export the configuration to printable code (press “**Printable Model**”). “**Printable Viewer**” display the generated models and advance tab contains the code. In the main screen, there is a summary tab for the main characteristics (infill pattern, syringes and tools, amount of material, volumes) of the configured objects.

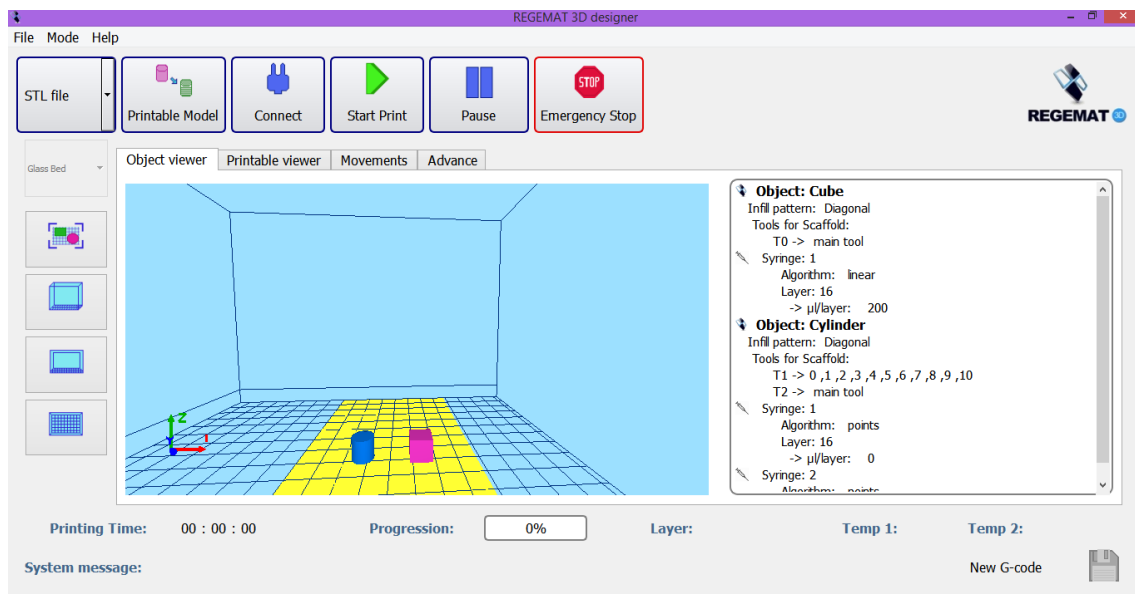


Figura 14: Visor 3D y resumen de configuración.

### 5.1. Printable Viewer

User can check the created code through the “**Printable Viewer**”, it shows extrusions and deposits, each tool is represented in a different color.

At the right size, there are some different options for the visualization:

- “**Show All**” represents all the code completely. If this option is unchecked “**Layer**” field is activated and it is possible choose a specific layer to display.
- “**Color Legend**” shows the correspondence between tools and colors in the “**Printable Viewer**” (these colors can be changed in “**Mode > Edit Colors**”).

The same movements described for the “**Object Viewer**” can be used in this viewer, except objects options and rotations (the generated code is static). In addition, the four perspective buttons are available for this viewer.

## 6. Printing Process

Once the printable code (G-Code) is generated the printing process can be started. To start a printing press **“Start Print”** button. Remember before pressing this button that the printer must be connected (pressing **“Connect”** button) as well as the USB cord from the printer to an USB port in your computer.

During printing it is possible to pause the process to resume later by pressing **“Pause”** button or to kill the entire process with **“Emergency Stop”** button, action also performed with the physical **“Emergency Stop”** button included.

While printing the fields at the bottom of the main window allow to know some real time parameters of the current printing. **“Printing Time”** field shows how much time the printer has been working, **“Progression”** field indicates the approximate percentage of printing done, **“Layer”** field shows the current layer that is being printed in front of the total to print, and **“Temperature”** field displays the temperatures of extruder and heated syringes in front of the configured temperature.

**“System message”** field provides information concerning the state of the printer during printing. The states are:

- **Homing:** All Three axes in the printer are moving towards the origin of coordinates.
- **Heating:** The tools configured to reach a temperature different from ambient are in heating process. The printer will remain stopped until the temperatures are the configured
- **Cooling:** A fan is above the objects cooling it
- **EMERGENCY STATE:** The printer is in Emergency State.
- **M113?:** The printer was turned off during an Emergency Stop and after turning it on, the emergency state will continue and no printing will begin. To solve this the emergency state must be finished by deactivating the emergency stop button (mechanically or in the program depending on the way the emergency state was called). It is also possible to finish the program emergency state by the command M113 (see Appendix B).
- **Printing...:** Any of the states not mentioned above (movements, printing...).

**NOTE:** The mechanical Emergency Stop state will only be finished by pulling up the button. While it is pressed no command or instruction given through the program will finish this state.

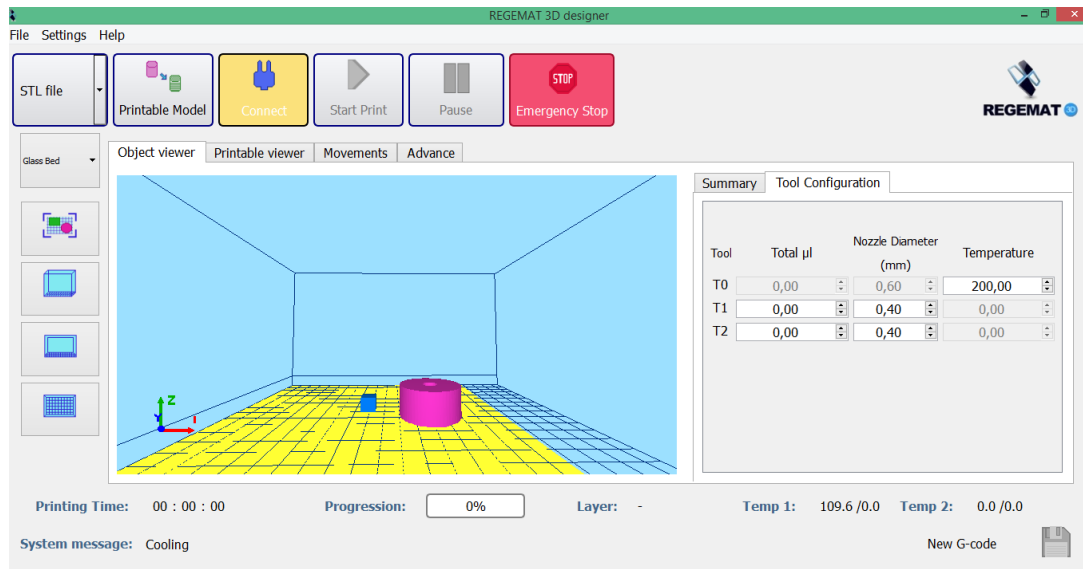


Figure 15: Emergency State.

## 6.1. Movements Tab

"**Movements**" tab is available when the printer is connected ("**Connect**" button). It allows to move the header (X and Y axes) and bed (Z axis) as well as heat the tools (extruder and heated syringes) and extrude and retract material.

To move the header we must select the tool we want to displace, and fill in the fields "X", "Y", "Z" and "Speed," and press "Move" button. To move the header in a direction it is mandatory to press "Homing" in that direction so the movement is well referenced.

"**Homing**" buttons move the heather to the origin of coordinates which is labeled.

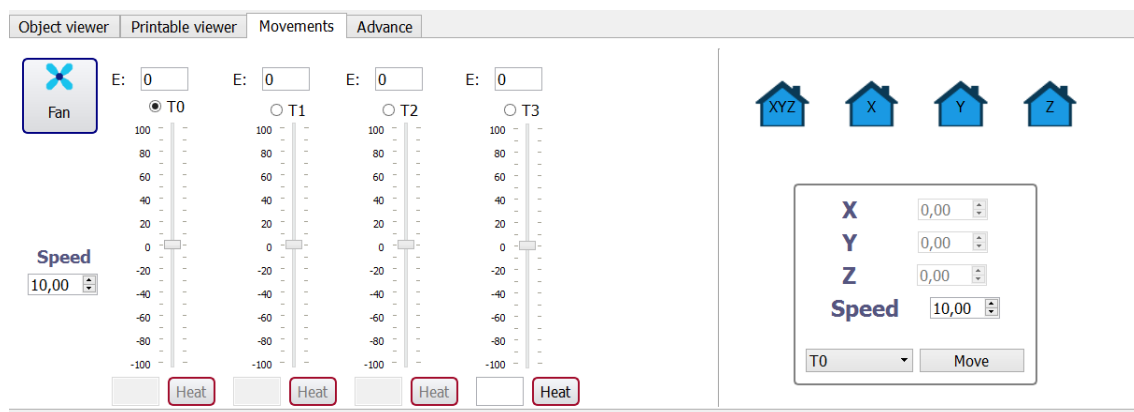


Figure 16: "Movements" tab.

On the left side of this tab it is possible to extrude and retract material as well as heat the extruder or heated syringes. This option is fundamental when changing the plastic coils or to



prepare the substances in the syringes (take the material to the end of a syringe) to get a high quality printing.

By displacing the bars in each tool, the selected quantity of material will be deployed. If the tool selected is an extruder or a heated syringe, this option will be disabled until the configured temperature was reached. To heat a tool is necessary to fill the field temperature (degrees Celsius or centigrade) and press "**Heat**" button.

## 7. Advance Tab

This tab consists in two sections. In the right side the printable code (generated or loaded) is shown. In the left side it is shown the communication between electronic board and printer. In the upper part of this section it is possible to directly communicate to the printer. This is a main issue to processes guided by REGEMAT3D Technical Support in case any problem occurs.

To daily tasks this tab can be deactivated in “**Mode > Expert**”.

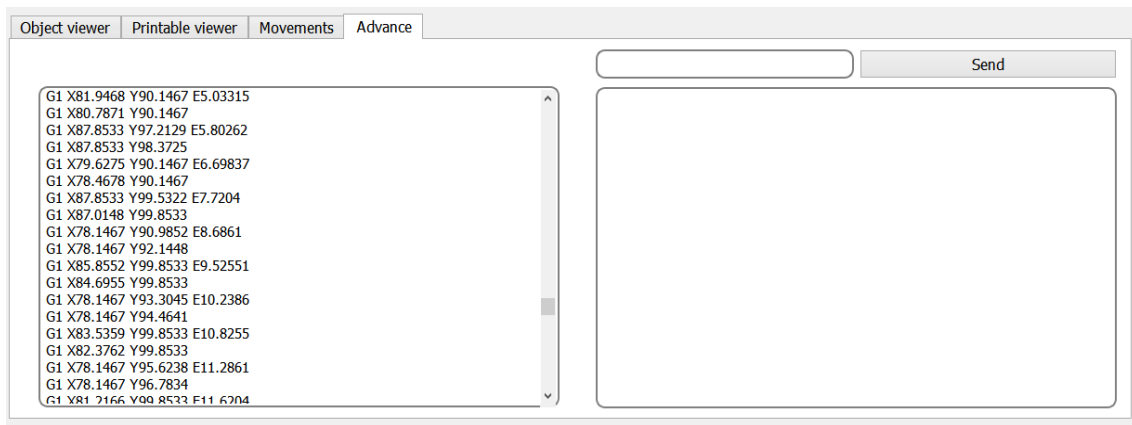


Figure 18: "Advance" tab.

## Appendix A: Glossary

- **Printing Header:** Printer unit capable of moving along the three axes, formed by different tools (extruders, syringes and heated syringes).
- **Compensate:** Extrusion of a certain quantity of material.
- **Printable Code (G-code):** Code that contains all the information of the desired printing and controls the communication between board and printer.
- **Filament:** 3D printable material in the coil which is printed through the hotend.
- **Hotend:** It is the final section in the extruder, responsible to melt the plastic filament:



- **Heated Syringe:** It is a syringe surrounded by resistances so the material inside can be heated before being printed.
- **Retract:** It is the opposite action to compensation, collecting material.
- **Scaffold:** Main structure in a model.
- **Skirt:** Movements carried out at the beginning of printing that surrounds the models responsible for cleaning the tools to be used (optional).
- **STL:** File format native to the stereolithography CAD software created.
- **Tool:** Every device capable of extrusion in the header.

## Appendix B: G-code Commands

It is possible to directly communicate with the printer in "**Advance**" tab, by writing a command and pressing "**Send**". Now some of the most important commands are described:

**M104 Sx Hy:** Selects the temperature x desired for tool y (extruder or heated syringe). This command allows to execute other orders.

**M106:** Starts fan.

**M107:** Stops fan.

**M109 Sx Hy:** Selects the temperature x desired for tool y (extruder or heated syringe) and waits until it is reached.

**M112:** Emergency stop.

**M113:** Finish emergency state.

**G1 Xx Yy Zz Ff Ee:** Controlled movement. This command moves **the active tool** to the position given by "x, y, z", extruding during the movement a quantity of material "e" at a velocity "f". Every single part of this command is optional except from **G1** (communication of movement). if **Ff** is avoided the velocity will be the current and if **Ee** is avoided the movement will take place without extrusion.

**G28:** Moves the three axis to the origin of coordinates.

**G28 X:** Moves x axis to its origin of coordinates.

**G28 Y:** Moves y axis to its origin of coordinates.

**G28 Z:** Moves z axis to its origin of coordinates.

**G92:** Resets the current position (x,y,z) to (0,0,0).

**G92 E0:** Resets the current tool extrusion to zero.

**Tt:** Changes to tool "**t**".