

# Primi passi con la Stampa 3D

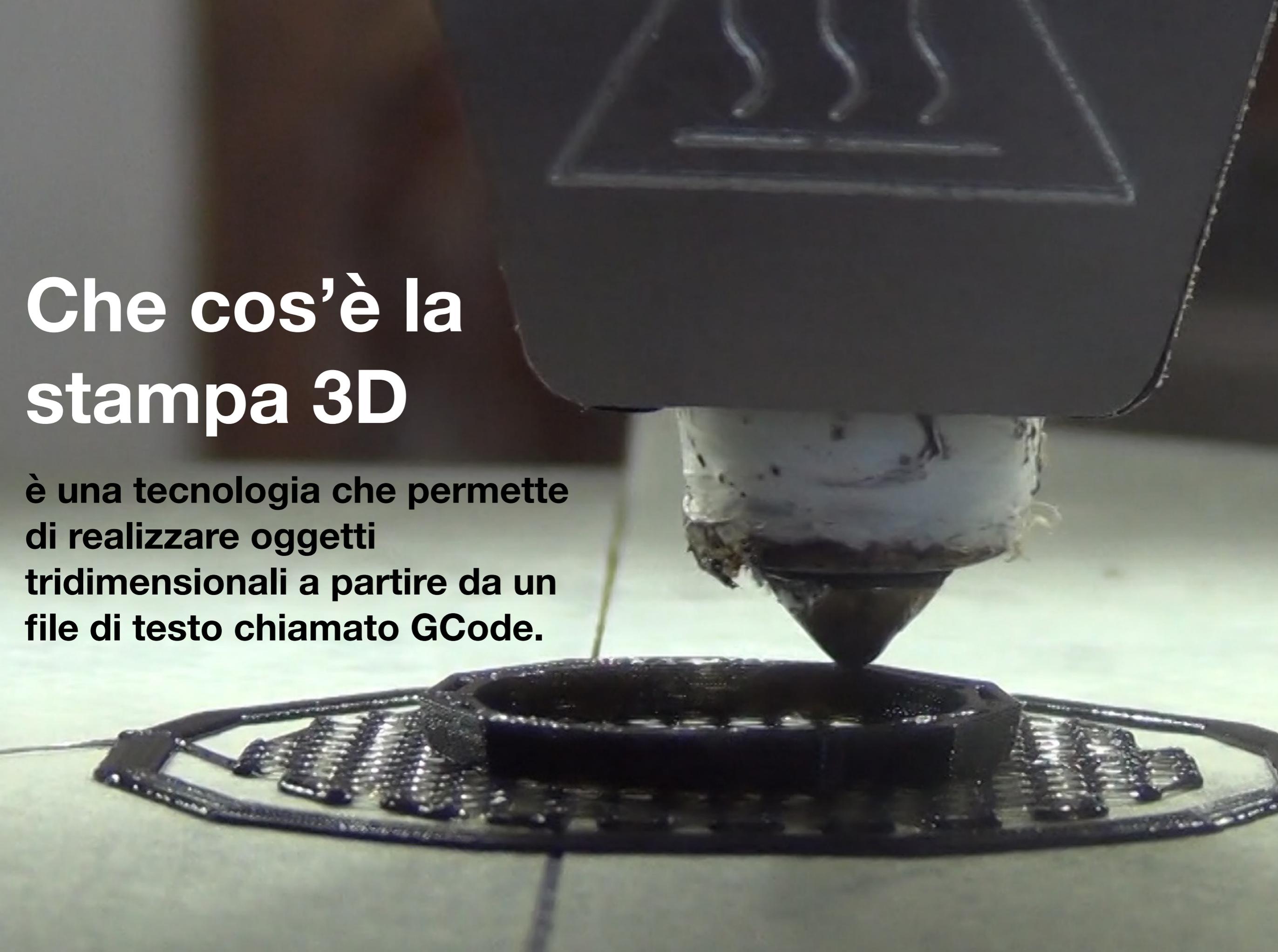
Dall'idea  
all'oggetto



MAKERS LAB

# **Che cos'è la stampa 3D**

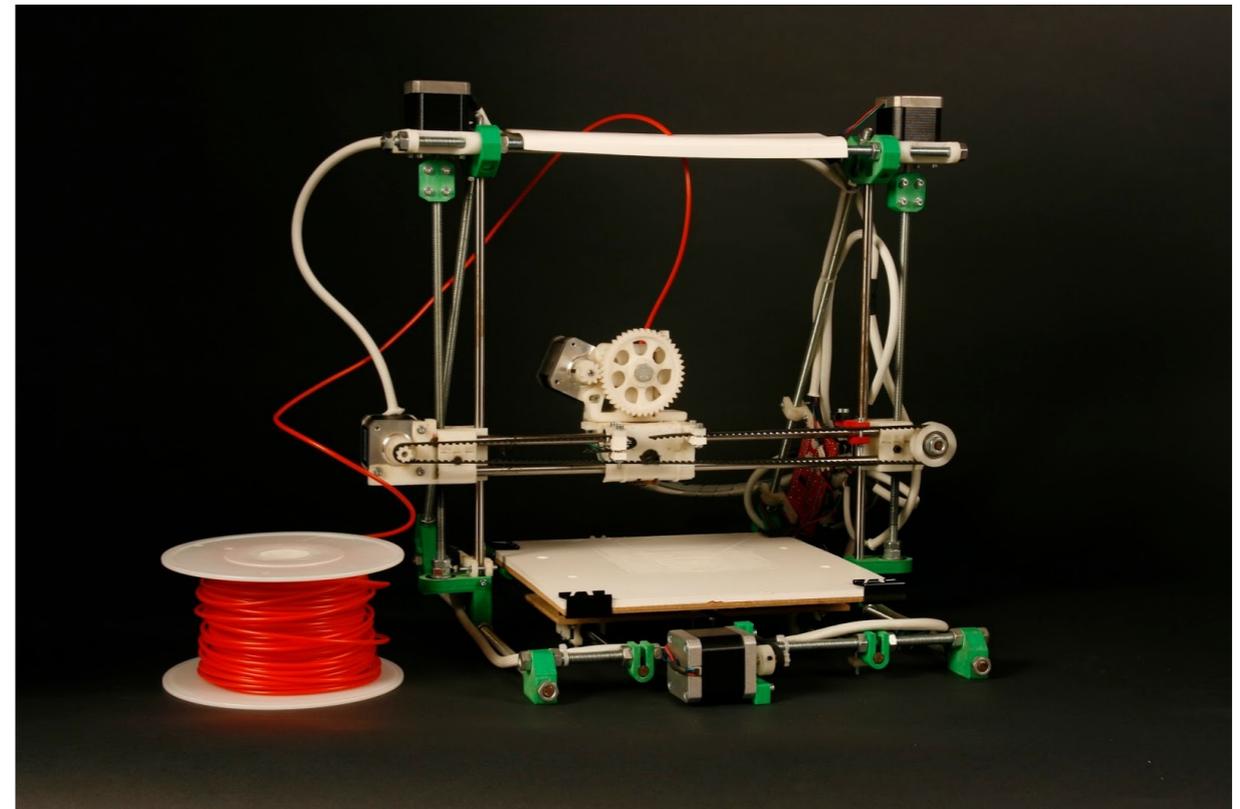
**è una tecnologia che permette  
di realizzare oggetti  
tridimensionali a partire da un  
file di testo chiamato GCode.**



# Tecnologie di stampa

Tanti modi per ottenere oggetti 3D, stesso concetto, diversa tecnologia, diversi risultati.

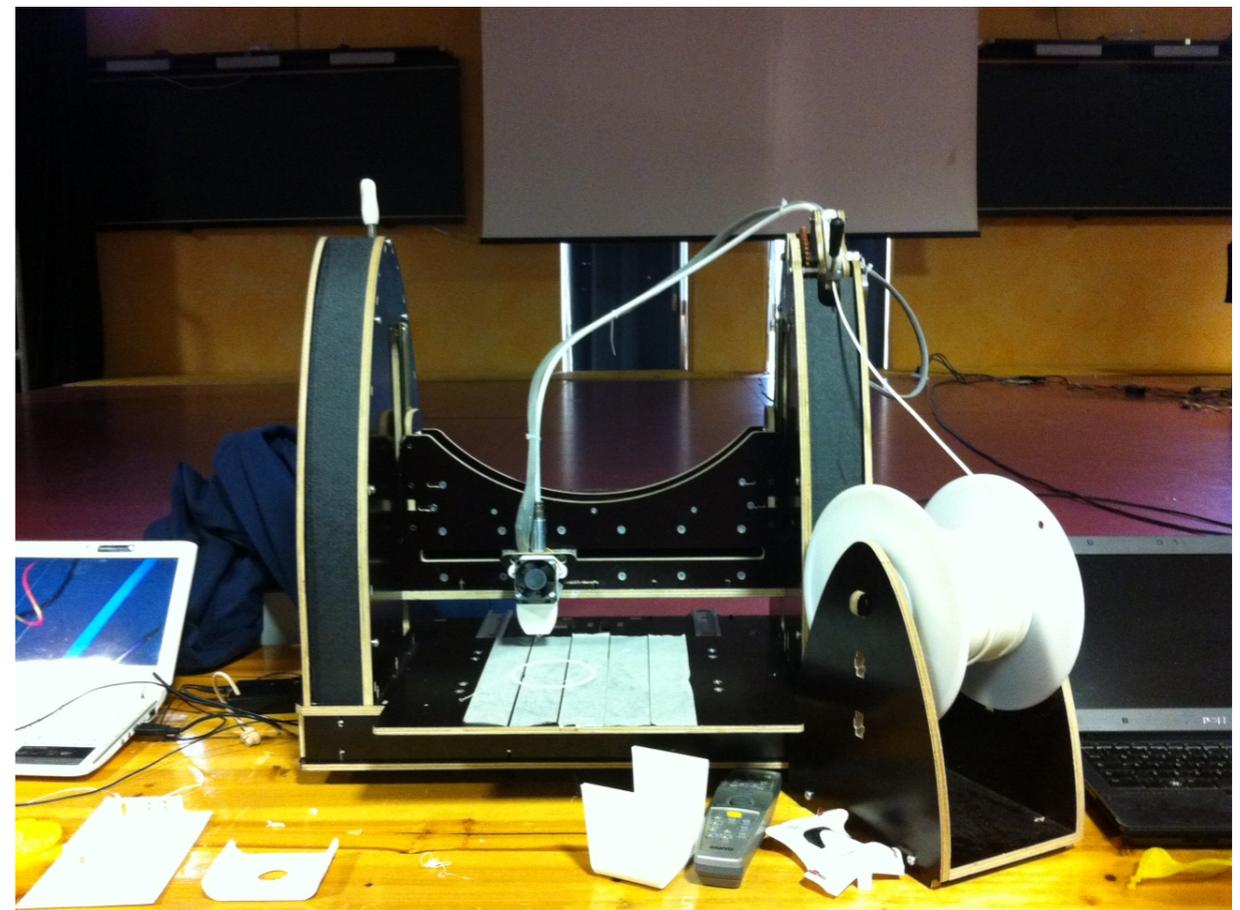
- Estrusione (FDM)
- Granulare (MLS, EBM, SLM, SLS)
- Polveri e inchiostro (PP)
- Polimerizzazione attraverso la luce (DLP)



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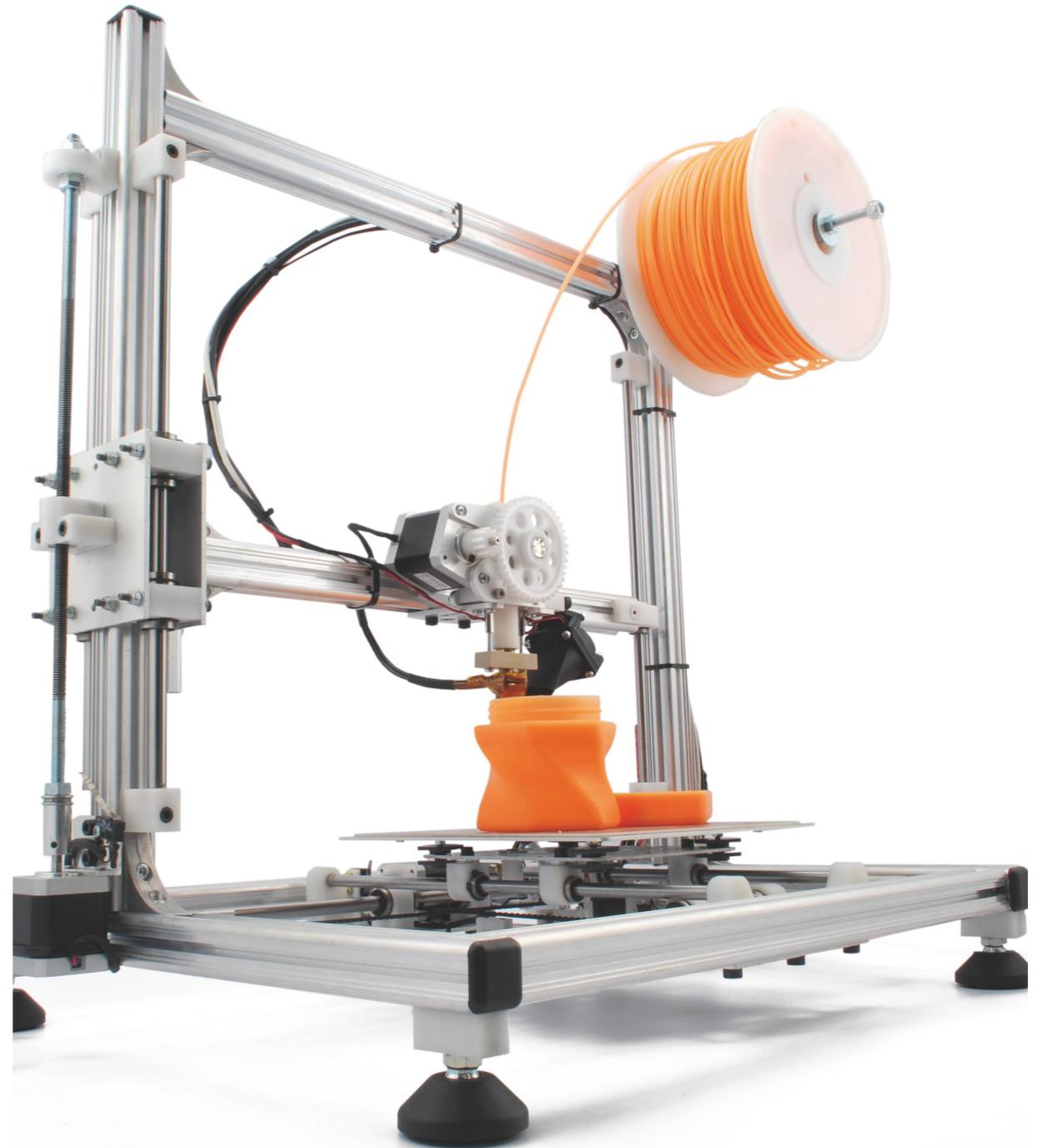
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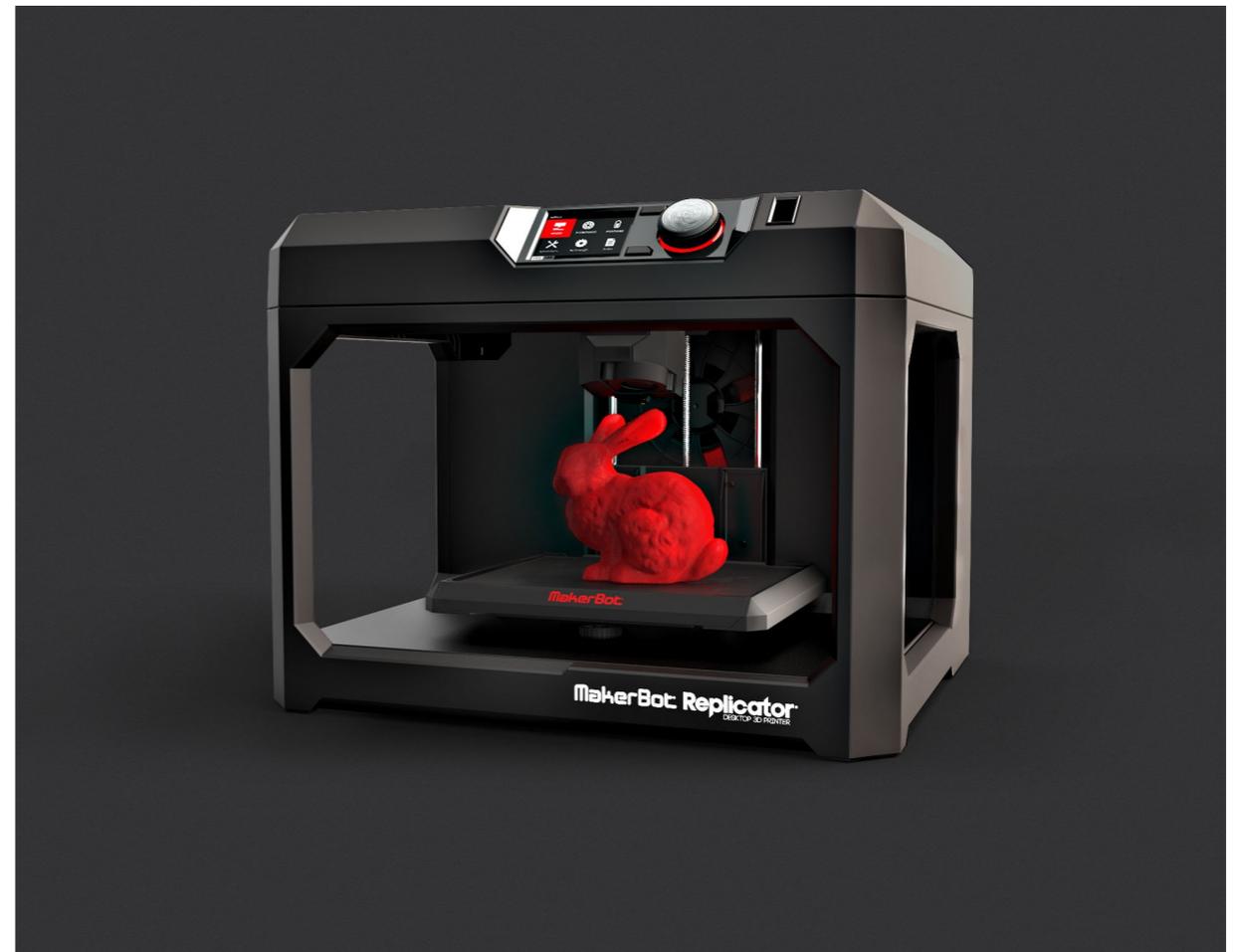
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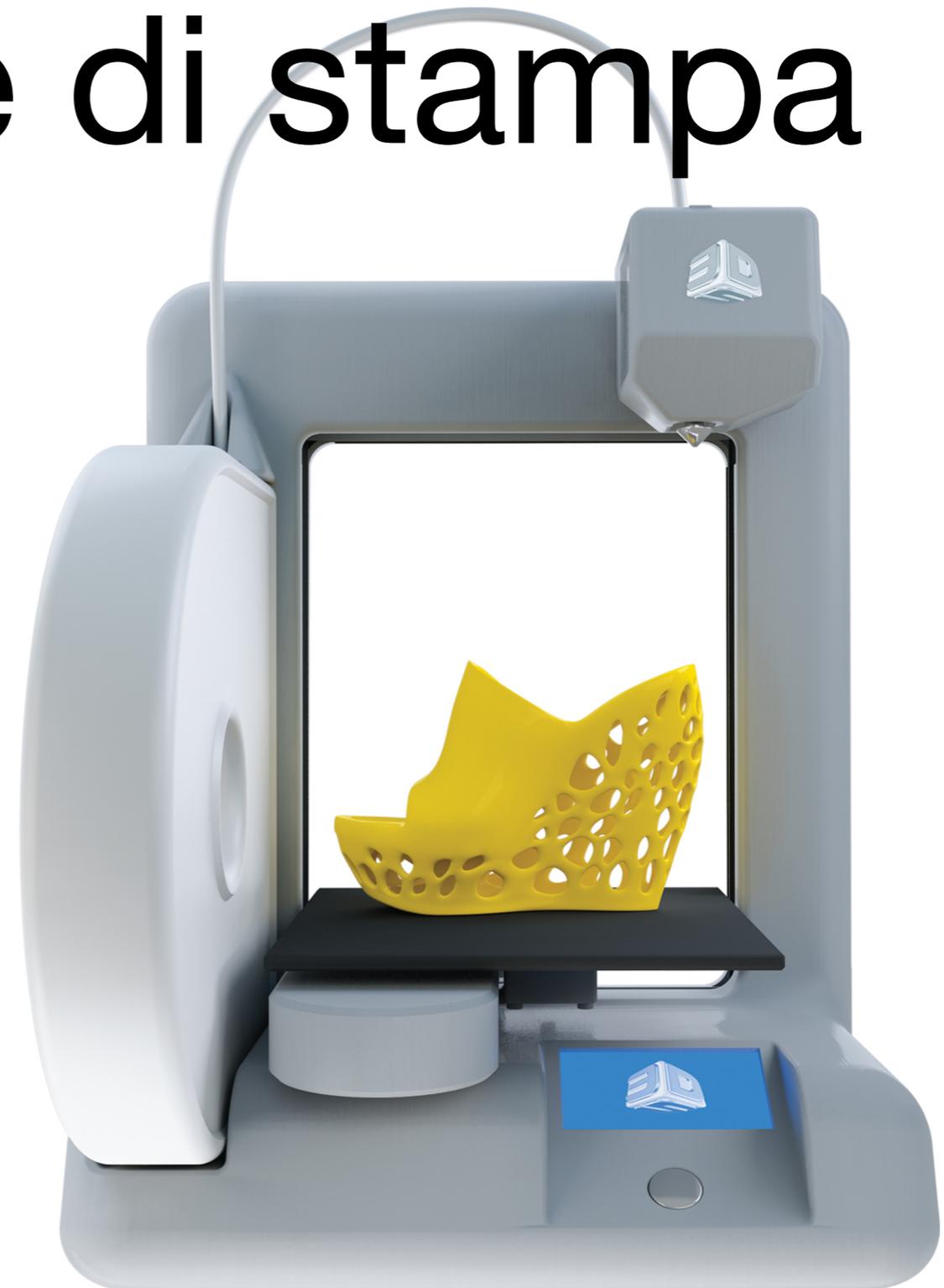
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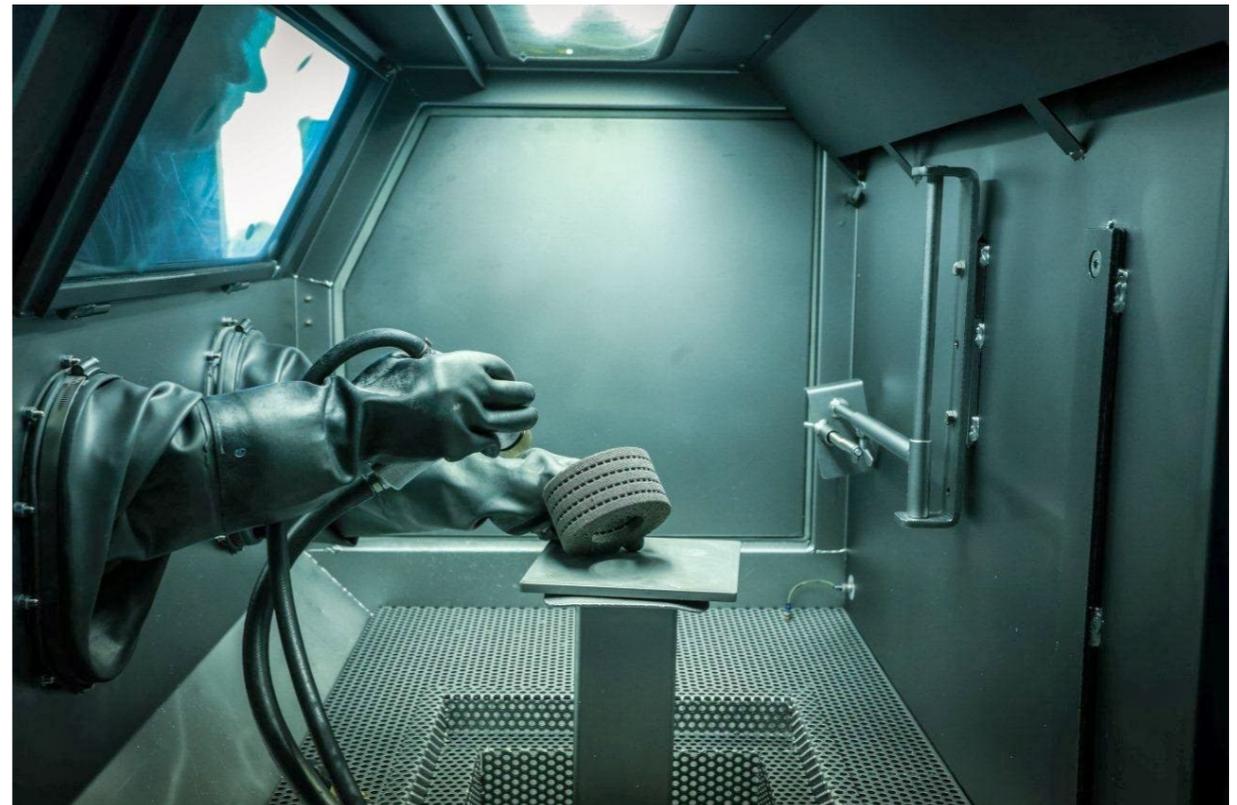
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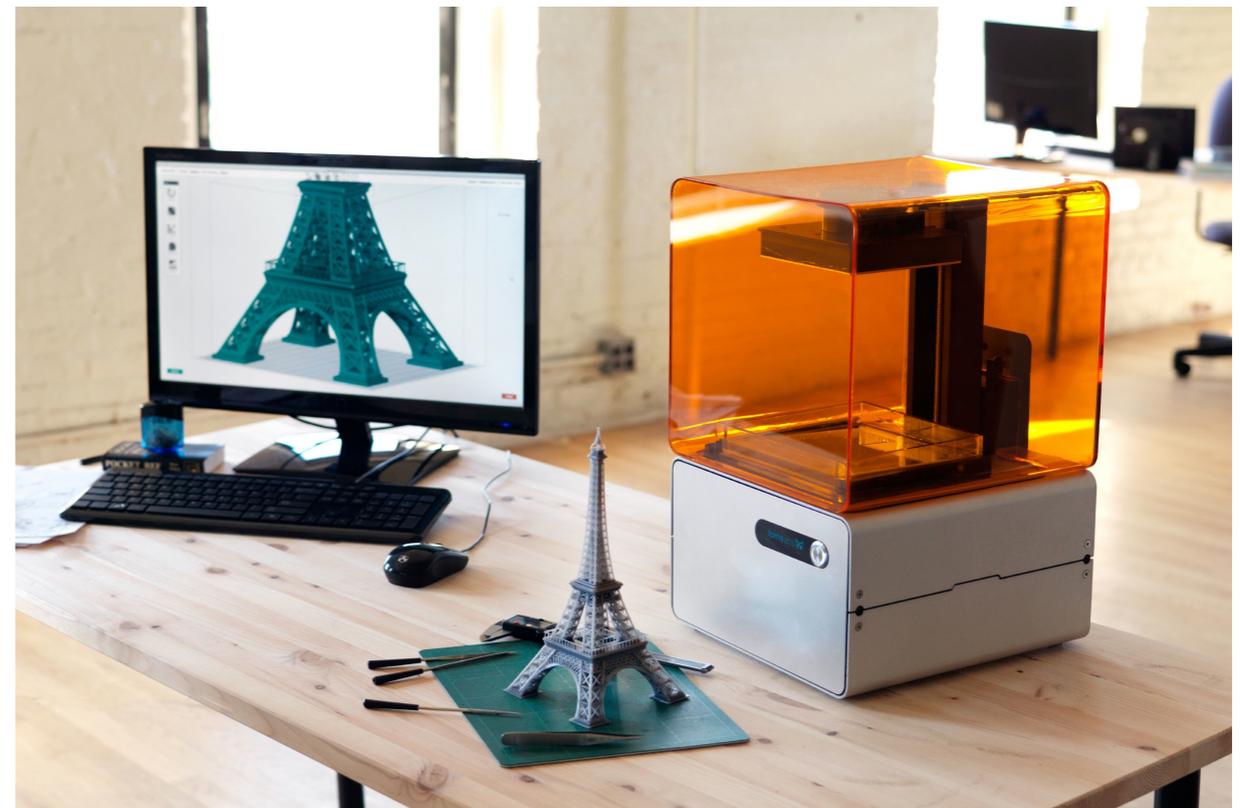
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# Stampiamo

- ▶ MODELLO VIRTUALE 3D 
- ▶ SLICING 
- ▶ STAMPA 

# Stampiamo

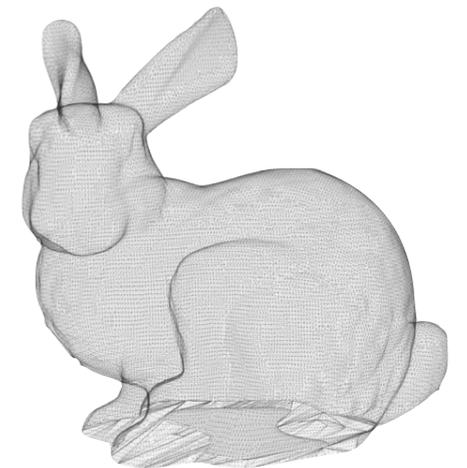
▸ MODELLO VIRTUALE 3D



▸ SLICING



▸ STAMPA



# Stampiamo

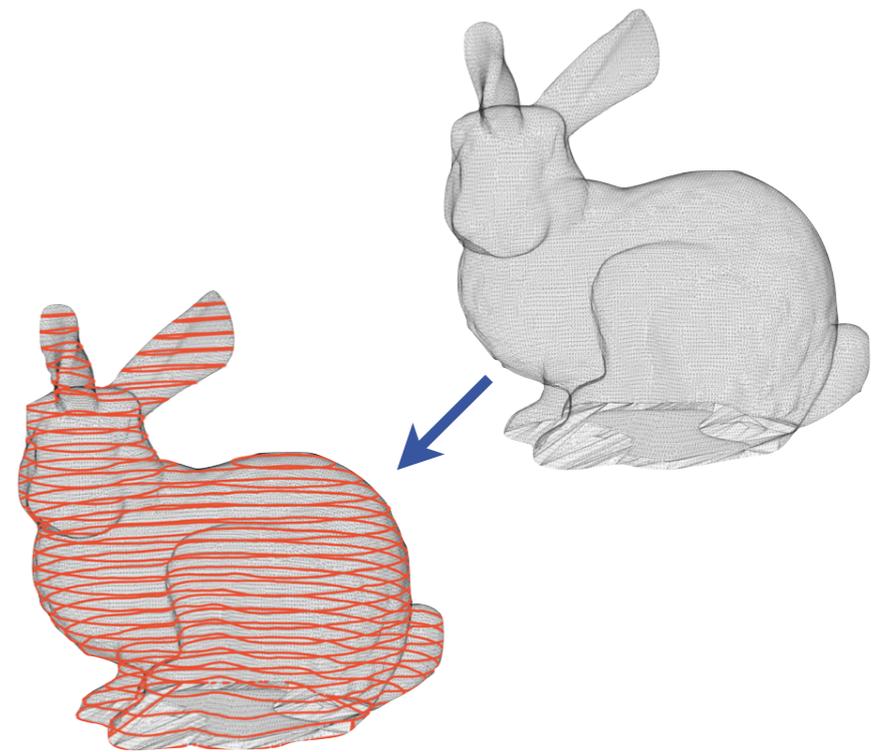
▸ MODELLO VIRTUALE 3D



▸ SLICING



▸ STAMPA



# Stampiamo

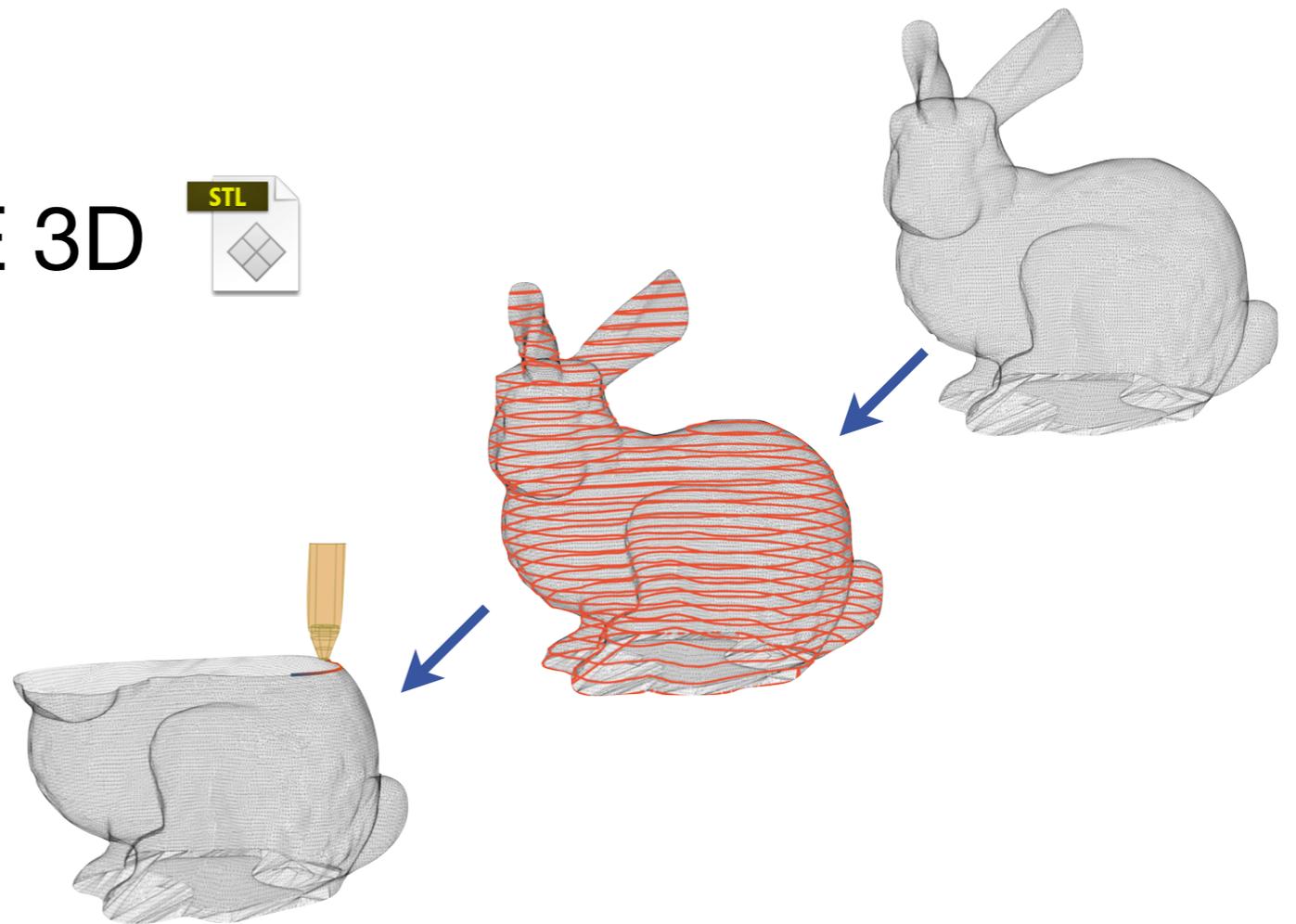
▶ MODELLO VIRTUALE 3D



▶ SLICING



▶ STAMPA



# Slicing

Affettiamo l'oggetto!





# Cura

Cura - 14.09

Basic | Advanced | Plugins | Start/End-GCode

**Quality**

Layer height (mm)

Shell thickness (mm)

Enable retraction

**Fill**

Bottom/Top thickness (mm)

Fill Density (%)

**Speed and Temperature**

Print speed (mm/s)

Printing temperature (C)

**Support**

Support type

Platform adhesion type

**Filament**

Diameter (mm)

Flow (%)

1 hour 47 minutes  
1.92 meter 15 gram  
2.92





# Layer height

The screenshot shows the Cura software interface. On the left is a settings panel with tabs for 'Basic', 'Advanced', 'Plugins', and 'Start/End-GCode'. The 'Basic' tab is active, showing the following settings:

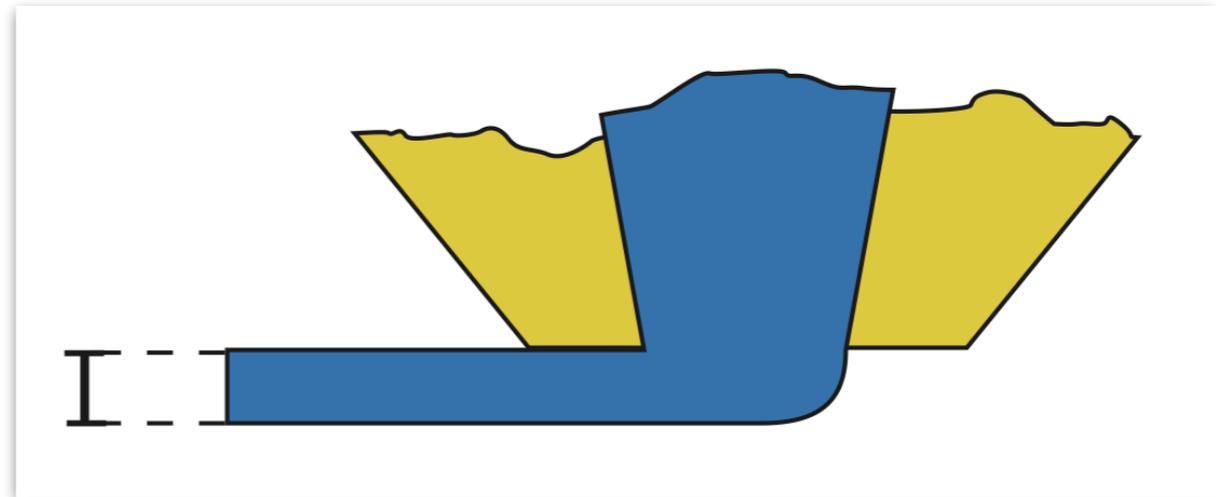
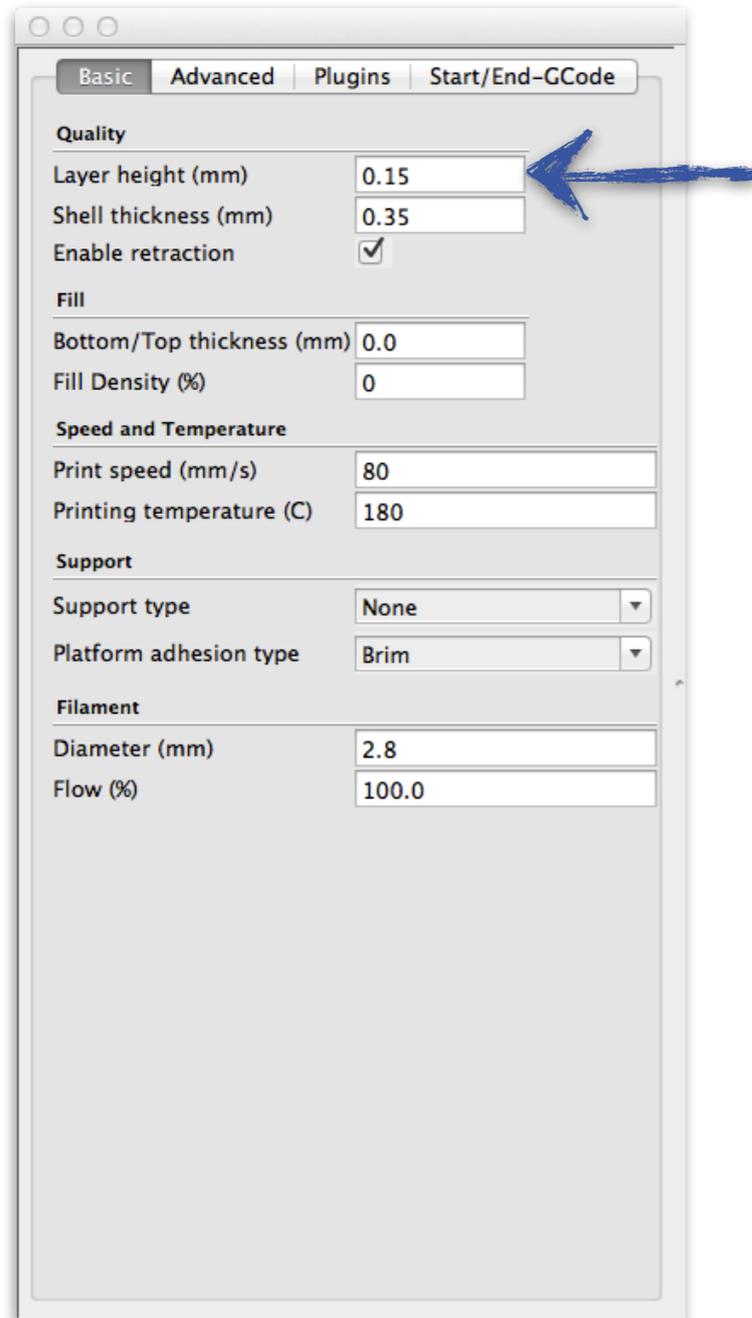
- Quality**
  - Layer height (mm): 0.15
  - Shell thickness (mm): 0.35
  - Enable retraction:
- Fill**
  - Bottom/Top thickness (mm): 0.0
  - Fill Density (%): 0
- Speed and Temperature**
  - Print speed (mm/s): 80
  - Printing temperature (C): 180
- Support**
  - Support type: None
  - Platform adhesion type: Brim
- Filament**
  - Diameter (mm): 2.8
  - Flow (%): 100.0

On the right, a 3D model of a red bowl is shown on a blue checkered floor. A vertical scale bar on the right side of the model indicates a height of 234 mm, with a white marker at 139 mm. Above the model, a blue arrow points to the 'Layer height (mm)' input field in the settings panel. In the top right corner of the 3D view, there are icons for a printer, a save icon, and a 'YM' icon. Below these icons, the following statistics are displayed:

- 24 minutes
- 0.24 meter 2 gram
- 0.37



# Layer height



L'altezza del layer è un parametro molto importante, influisce sulla qualità della stampa e sul tempo di stampa.

Valore consigliato:  
circa 1/4 del diametro dell'ugello



# Shell Thickness

The screenshot shows the Cura software interface with the following settings and information:

- Quality:**
  - Layer height (mm): 0.15
  - Shell thickness (mm): 0.35
  - Enable retraction:
- Fill:**
  - Bottom/Top thickness (mm): 0.0
  - Fill Density (%): 0
- Speed and Temperature:**
  - Print speed (mm/s): 80
  - Printing temperature (C): 180
- Support:**
  - Support type: None
  - Platform adhesion type: Brim
- Filament:**
  - Diameter (mm): 2.8
  - Flow (%): 100.0

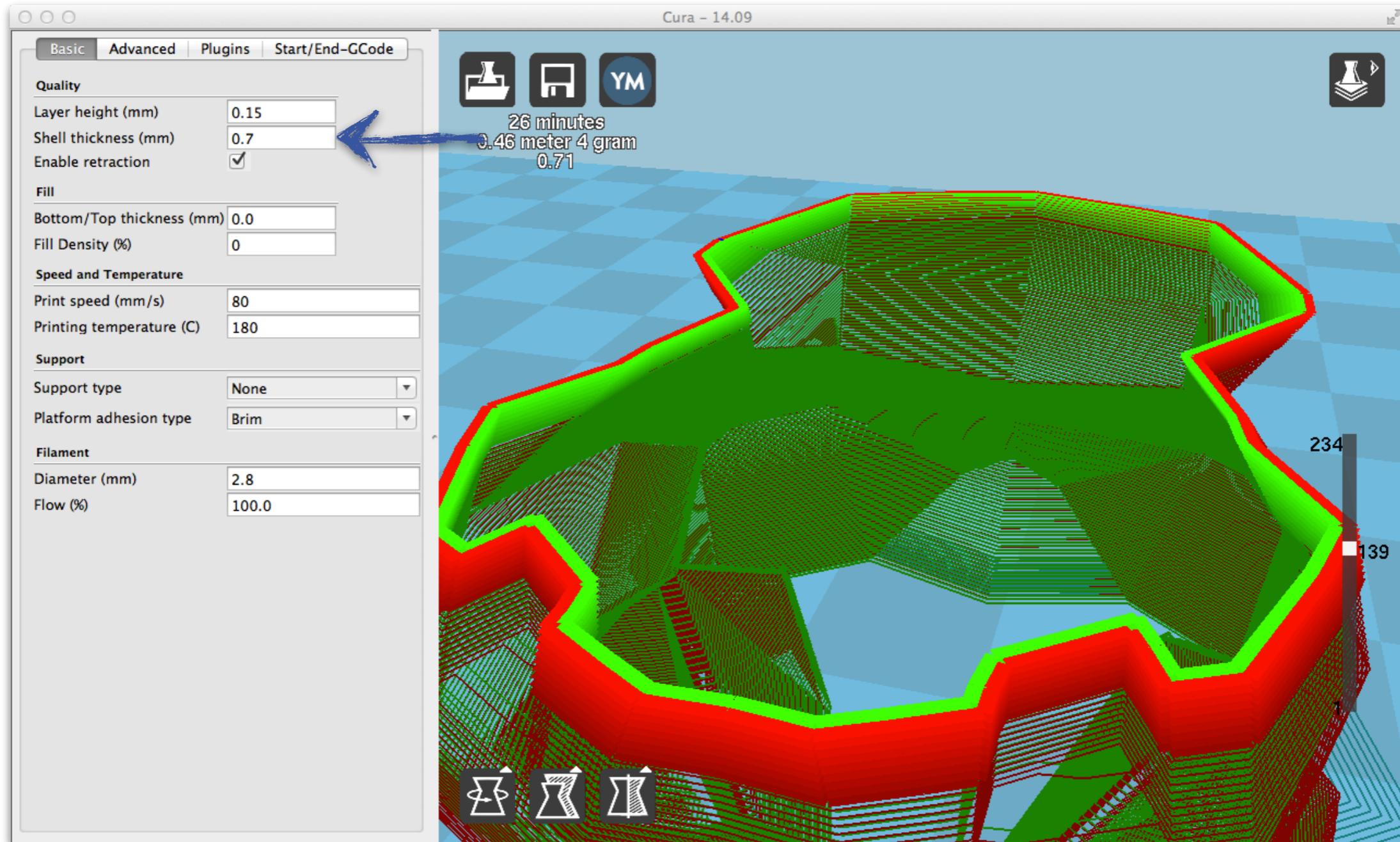
Additional information displayed in the interface:

- Estimated print time: 24 minutes
- Estimated volume: 0.24 meter 2 gram
- Estimated weight: 0.37

The 3D model shows a red shell with a thickness of 0.35 mm. The shell is composed of multiple layers, and the thickness of each layer is 0.15 mm. The shell is shown in a perspective view, highlighting its complex geometry.



# Shell Thickness





# Shell Thickness

The screenshot shows the Cura software interface with the following settings and visual elements:

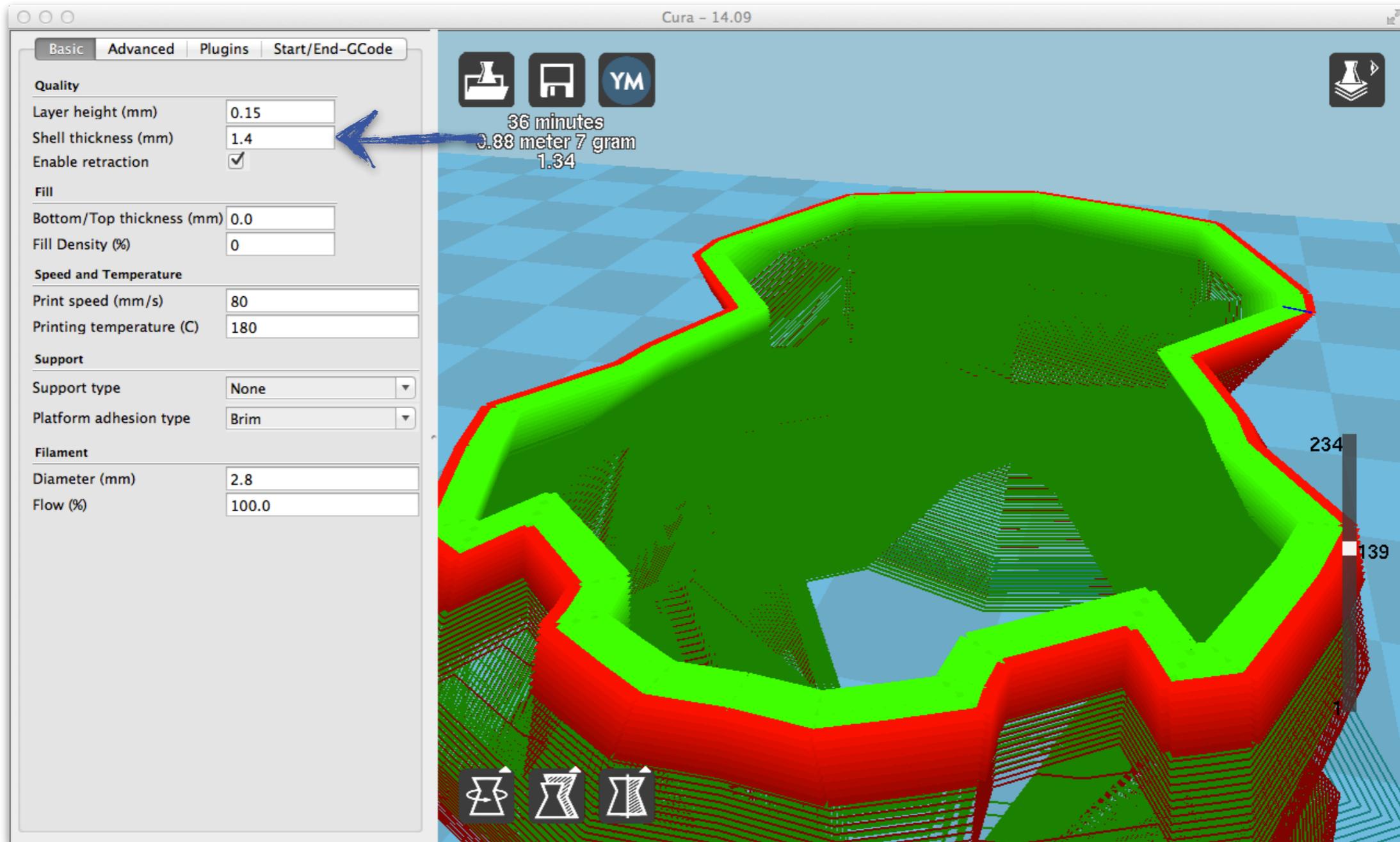
- Quality:**
  - Layer height (mm): 0.15
  - Shell thickness (mm): 1.05 (highlighted with a blue arrow)
  - Enable retraction:
- Fill:**
  - Bottom/Top thickness (mm): 0.0
  - Fill Density (%): 0
- Speed and Temperature:**
  - Print speed (mm/s): 80
  - Printing temperature (C): 180
- Support:**
  - Support type: None
  - Platform adhesion type: Brim
- Filament:**
  - Diameter (mm): 2.8
  - Flow (%): 100.0

3D Model and Metrics:

- 3D model of a multi-layered shell structure, colored red and green.
- Print time: 30 minutes
- Volume: 0.67 meter 5 gram
- Weight: 1.03
- Height scale: 234 and 139

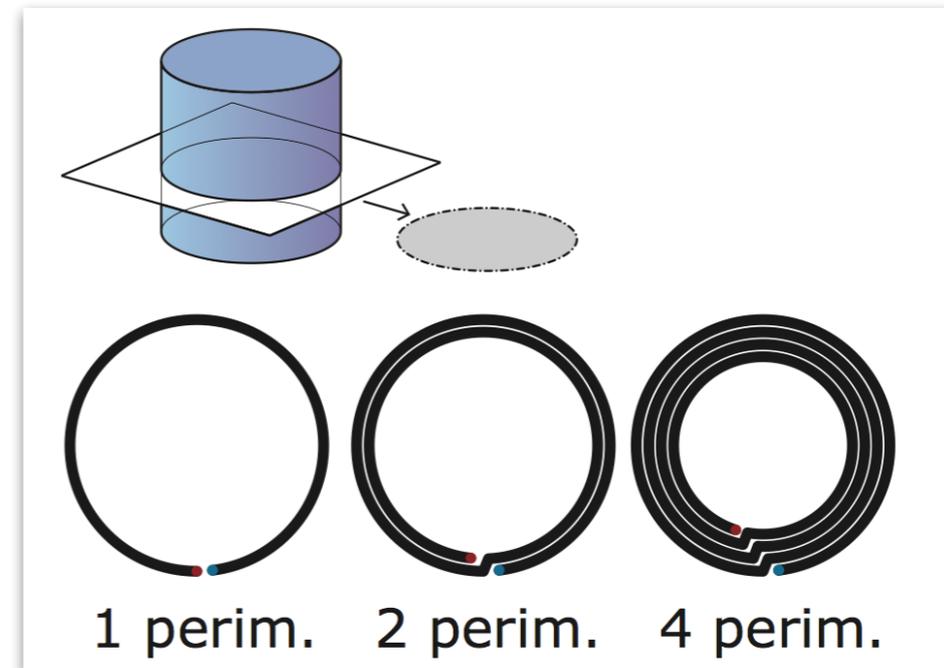
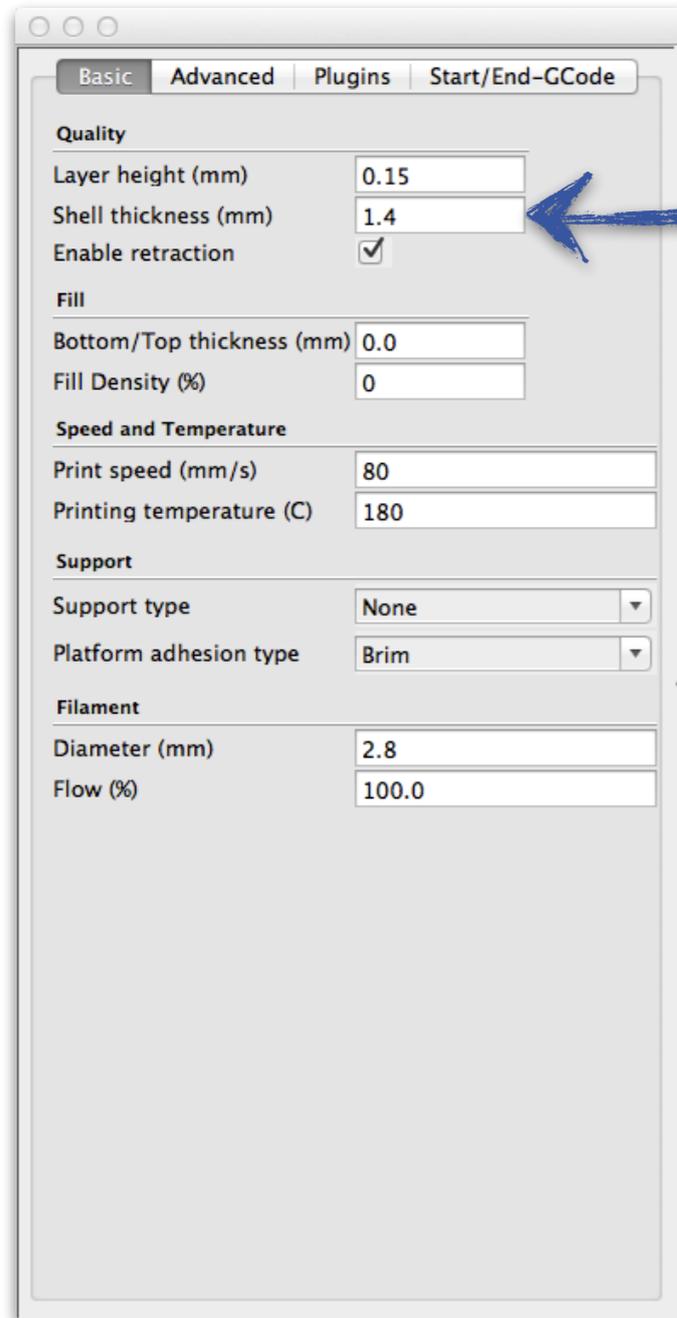


# Shell Thickness





# Shell Thickness



Valore consigliato:  
multiplo da 1 a 5 del  
diametro dell'ugello



# Bottom/Top thickness

The screenshot shows the Cura software interface with the following settings and 3D model details:

Category	Setting	Value
Quality	Layer height (mm)	0.15
	Shell thickness (mm)	0.7
	Enable retraction	<input checked="" type="checkbox"/>
Fill	Bottom/Top thickness (mm)	0.45
	Fill Density (%)	0
Speed and Temperature	Print speed (mm/s)	80
	Printing temperature (C)	180
Support	Support type	None
	Platform adhesion type	Brim
Filament	Diameter (mm)	2.8
	Flow (%)	100.0

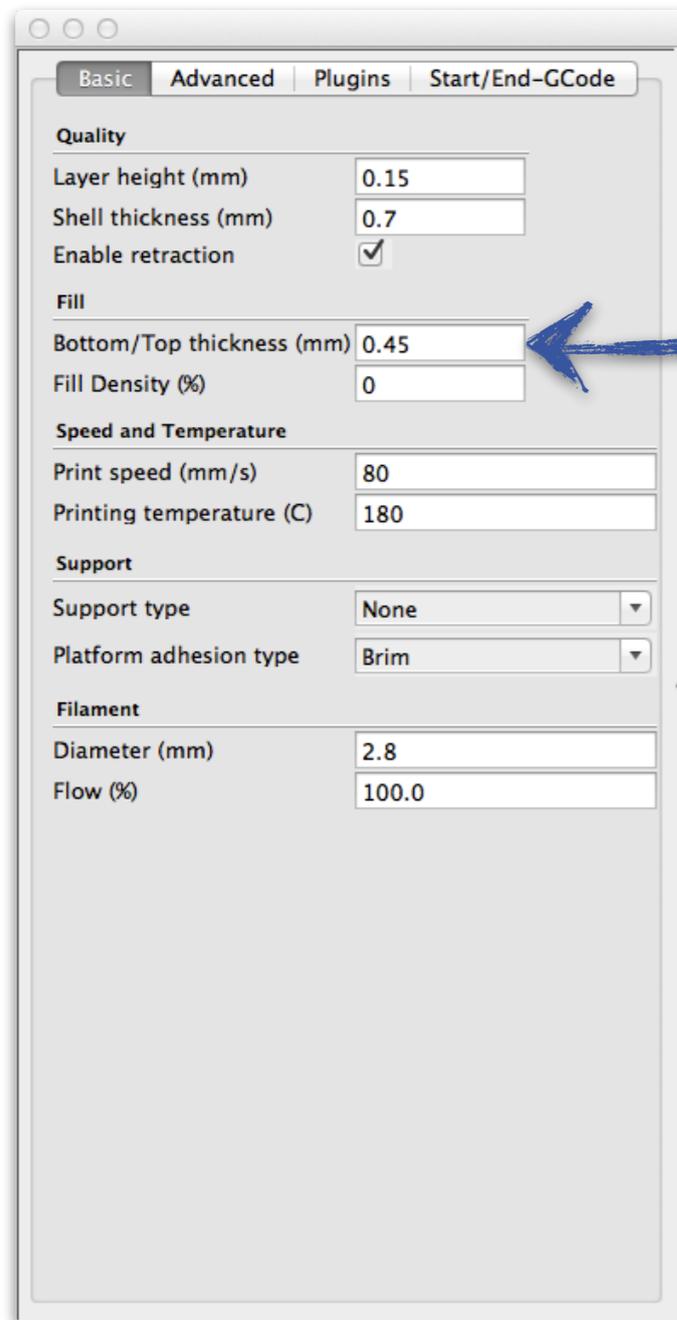
3D Model Information:

- Print time: 54 minutes
- Volume: 0.66 meter 5 gram
- Scale: 1.00
- Dimensions: 234 (width) x 112 (height)

The 3D model shows a complex, multi-layered part with a red outer shell and a yellow/green inner fill. A blue arrow points to the 'Bottom/Top thickness (mm)' setting in the left panel, which is currently set to 0.45.



# Bottom/Top thickness



Negli expert setting si può impostare di stampare solo una tra le due pareti top/bottom

Valore consigliato:  
multiplo dello spessore del Layer



# Fill density

The screenshot shows the Cura software interface. On the left is a settings panel with the following options:

- Quality**
  - Layer height (mm): 0.15
  - Shell thickness (mm): 0.7
  - Enable retraction:
- Fill**
  - Bottom/Top thickness (mm): 0.45
  - Fill Density (%): 10
- Speed and Temperature**
  - Print speed (mm/s): 80
  - Printing temperature (C): 180
- Support**
  - Support type: None
  - Platform adhesion type: Brim
- Filament**
  - Diameter (mm): 2.8
  - Flow (%): 100.0

The main 3D view shows a red and green part with a yellow grid fill. A blue arrow points from the 'Fill Density (%)' input field to the grid. In the top right of the 3D view, there are icons for a printer, a file, and 'YM', along with the following statistics:

- 1 hour 14 minutes
- 0.98 meter 7 gram
- 1.49

On the right side of the 3D view, there is a vertical scale bar with values 1, 139, and 234.



# Fill density

The screenshot shows the Cura software interface. On the left is a settings panel with the following options:

- Quality**
  - Layer height (mm): 0.15
  - Shell thickness (mm): 0.7
  - Enable retraction:
- Fill**
  - Bottom/Top thickness (mm): 0.45
  - Fill Density (%): 20
- Speed and Temperature**
  - Print speed (mm/s): 80
  - Printing temperature (C): 180
- Support**
  - Support type: None
  - Platform adhesion type: Brim
- Filament**
  - Diameter (mm): 2.8
  - Flow (%): 100.0

The main 3D view shows a yellow grid structure with a red shell. A blue arrow points from the 'Fill Density (%)' field to the grid. In the top right of the 3D view, there are icons for a printer, a save icon, and a 'YM' icon, with the following statistics: 1 hour 28 minutes, 1.28 meter, 10 gram, and 1.96. On the right side of the 3D view, there is a vertical scale bar with markings at 1, 139, and 234.



# Fill density

The screenshot shows the Cura 14.09 software interface. On the left is the 'Basic' settings panel, and on the right is a 3D view of a yellow and red object on a blue checkered floor. A blue arrow points from the 'Fill Density (%)' field in the settings to the object's interior.

**Settings Panel (Basic Tab):**

- Quality
  - Layer height (mm): 0.15
  - Shell thickness (mm): 0.7
  - Enable retraction:
- Fill
  - Bottom/Top thickness (mm): 0.45
  - Fill Density (%): 100
- Speed and Temperature
  - Print speed (mm/s): 80
  - Printing temperature (C): 180
- Support
  - Support type: None
  - Platform adhesion type: Brim
- Filament
  - Diameter (mm): 2.8
  - Flow (%): 100.0

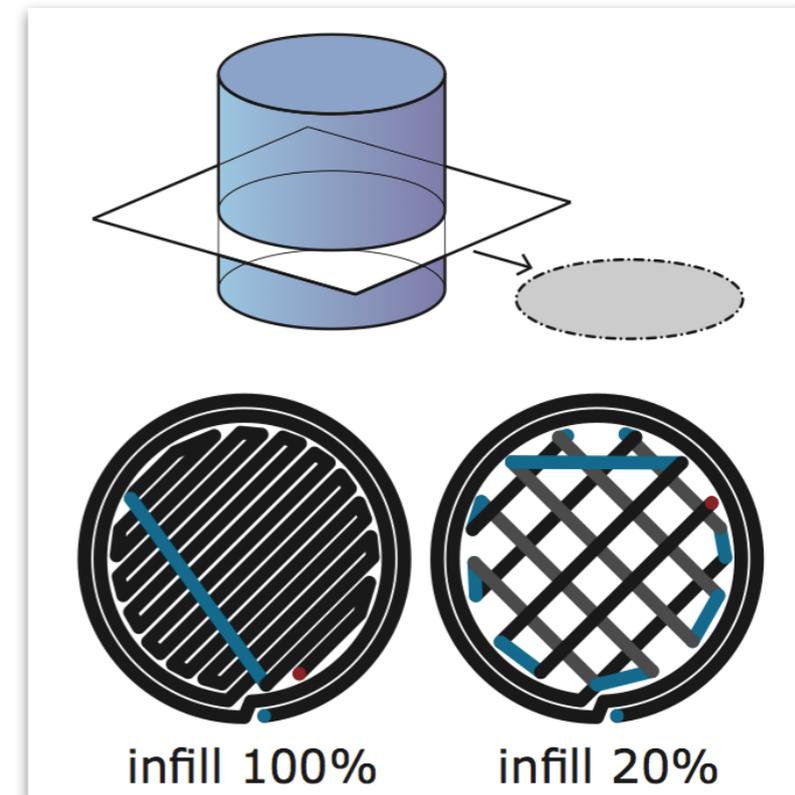
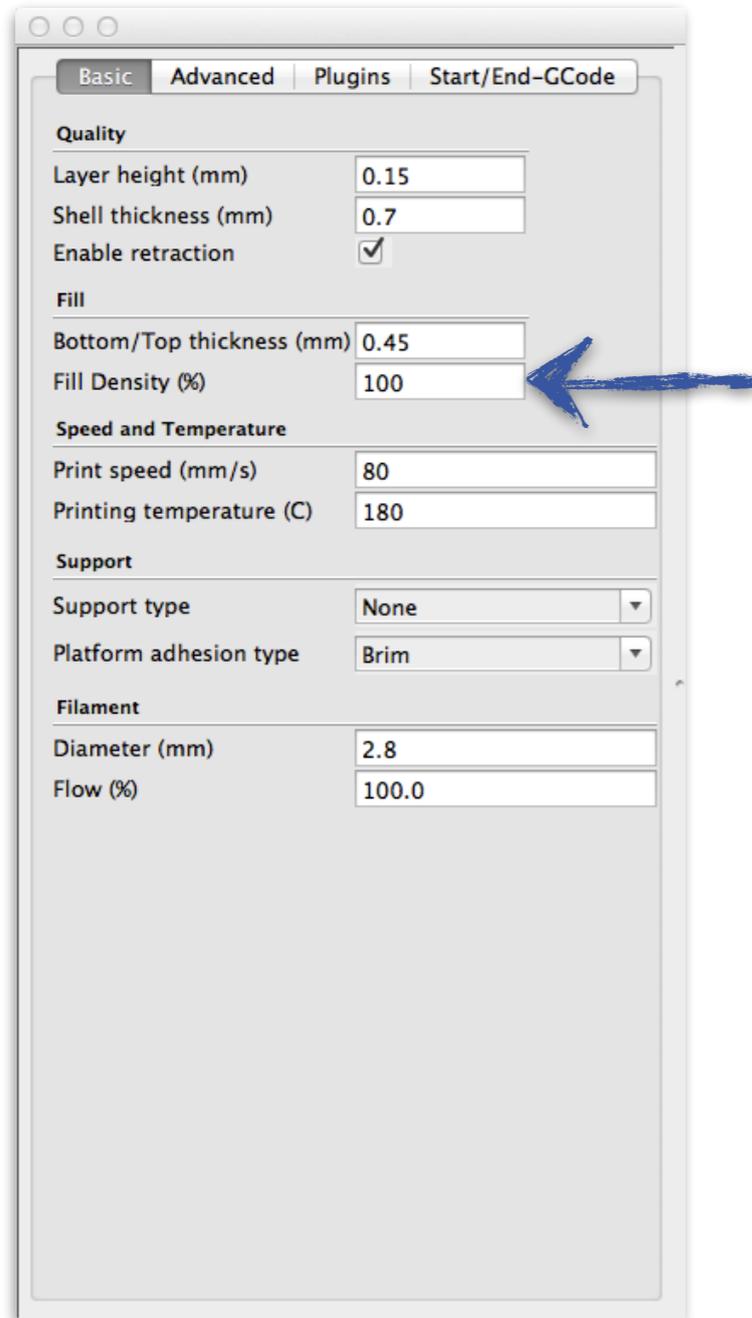
**3D View Information:**

- 2 hours 3 minutes
- 3.67 meter 28 gram
- 5.61

**Vertical Scale:** 234, 139, 1



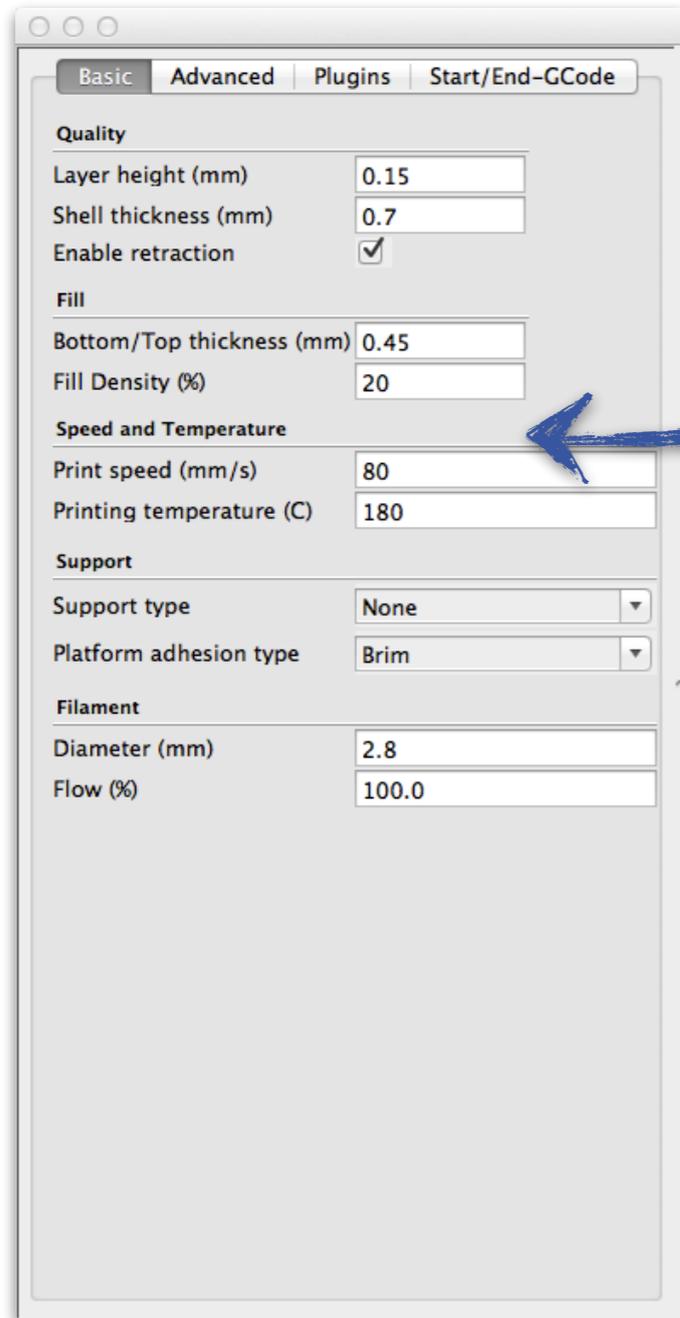
# Fill density



Se impostata troppo alta il pezzo tenderà a ritirare, se troppo bassa sarà difficile chiudere le superfici superiori orizzontali.



# Speed & temperature



Ad alte velocità si ottengono delle stampa qualitativamente basse ma in tempi rapidi.

Il range di valori tipico va dai 30 ai 120 mm/s

Se la temperatura impostata è troppo bassa il materiale non riesce a fluire bene all'interno dell'ugello, se troppo alta il materiale non è in grado di raffreddare adeguatamente tra uno strato e l'altro.

tendenzialmente il PLA si stampa tra 175 e 210°C, l'ABS tra 210 e 230°C, il Nylon tra 230 e 245°C e il TPU tra 220 e 245°C



# Supports

The screenshot displays the Cura software interface. On the left is the settings panel, and on the right is the 3D model view.

**Settings Panel (Left):**

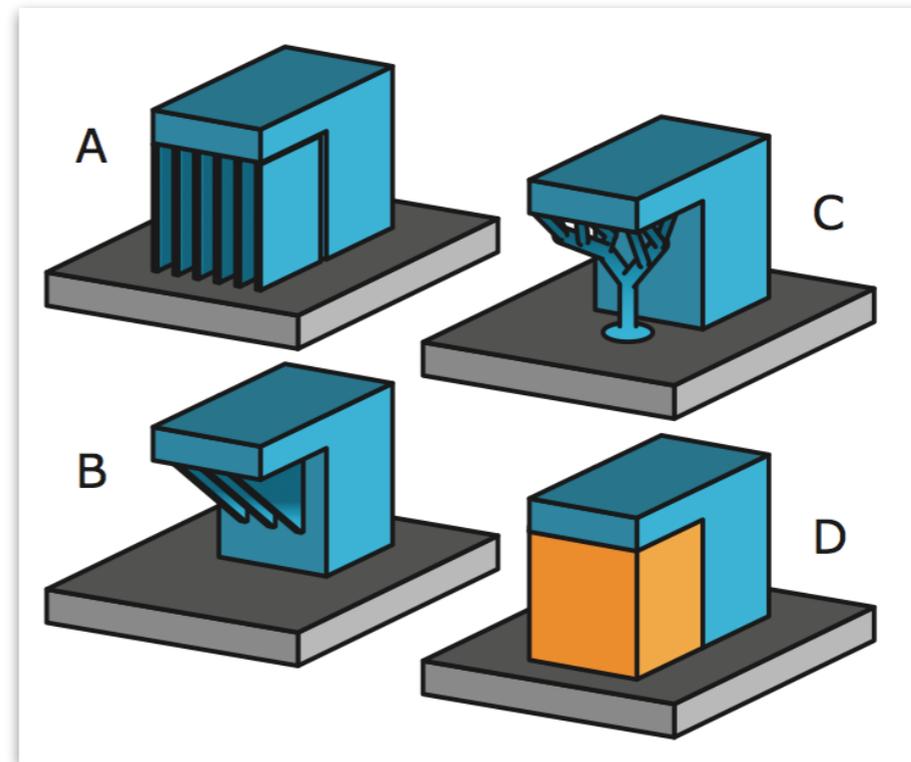
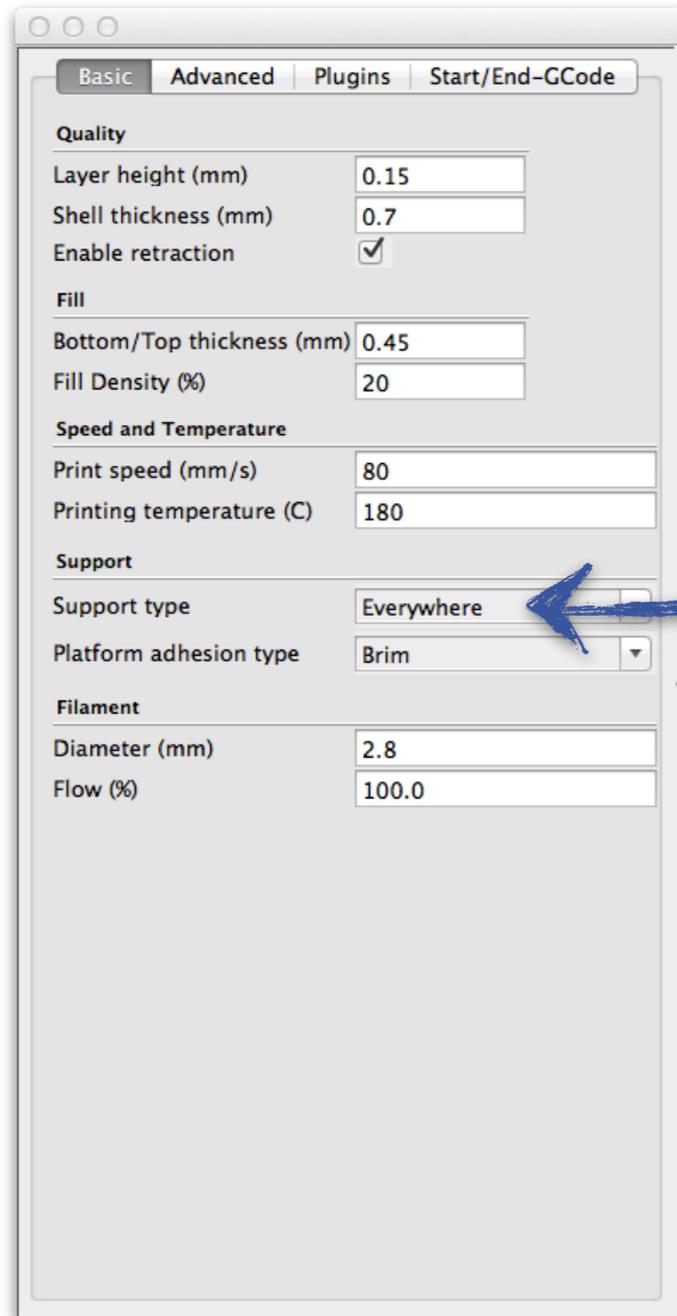
- Quality
  - Layer height (mm): 0.15
  - Shell thickness (mm): 0.7
  - Enable retraction:
- Fill
  - Bottom/Top thickness (mm): 0.45
  - Fill Density (%): 20
- Speed and Temperature
  - Print speed (mm/s): 80
  - Printing temperature (C): 180
- Support
  - Support type: Everywhere (indicated by a blue arrow)
  - Platform adhesion type: Brim
- Filament
  - Diameter (mm): 2.8
  - Flow (%): 100.0

**3D Model View (Right):**

- Print time: 1 hour 55 minutes
- Print length: 1.61 meter
- Print weight: 12 gram
- Print volume: 2.46
- The model shows a yellow grid-like structure (support) on a red base (platform).
- A vertical scale bar on the right indicates a height of 234 and 46.



# Supports



i supporti possono essere generati in realtà in molte maniere:

- in automatico dal programma di slicing (A)
- tramite modellazione personale da parte dell'utente (B)
- con un programma di generazione supporti tipo Meshmixer (C)
- depositandoli con un doppio estrusore in un altro materiale potenzialmente solubile in acqua (D)



# Platform Adhesion

Cura - 14.09

1 hour 28 minutes  
1.28 meter 10 gram  
1.96

Quality

Layer height (mm)	0.15
Shell thickness (mm)	0.7
Enable retraction	<input checked="" type="checkbox"/>

Fill

Bottom/Top thickness (mm)	0.45
Fill Density (%)	20

Speed and Temperature

Print speed (mm/s)	80
Printing temperature (C)	180

Support

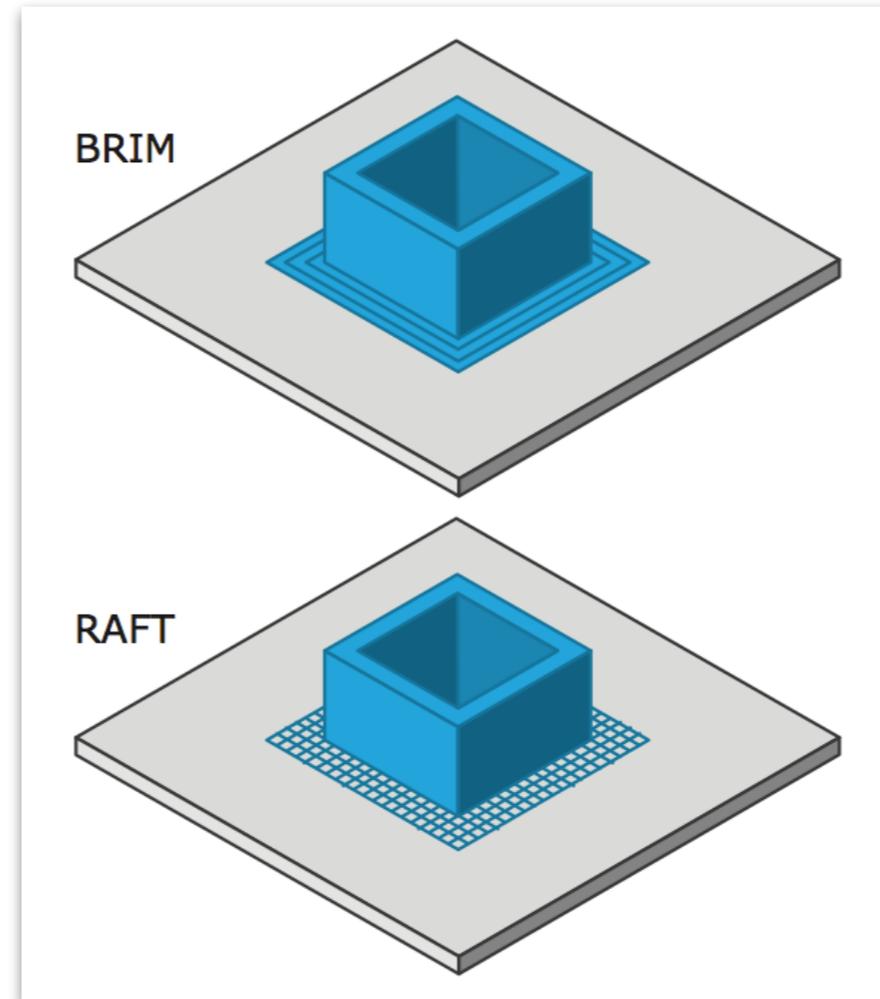
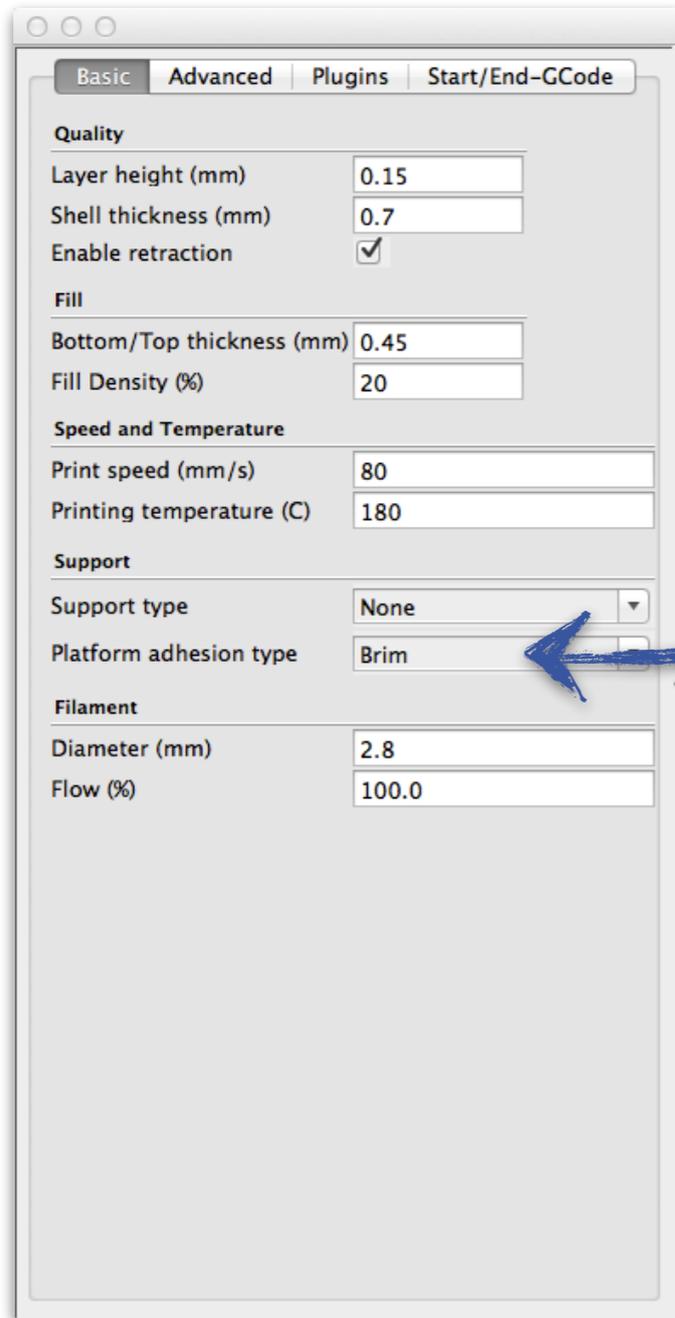
Support type	None
Platform adhesion type	Brim

Filament

Diameter (mm)	2.8
Flow (%)	100.0

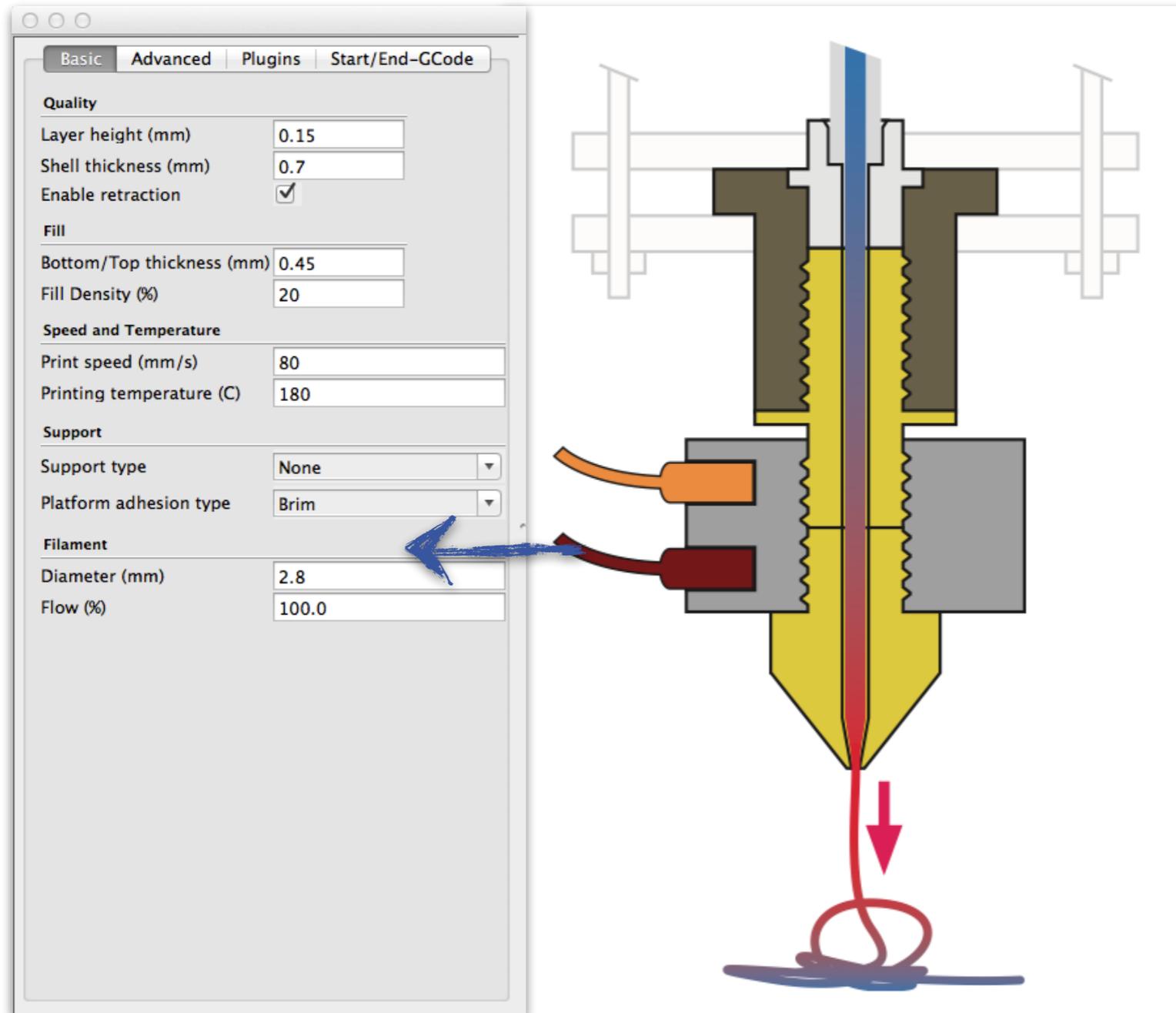


# Platform Adhesion





# Filament

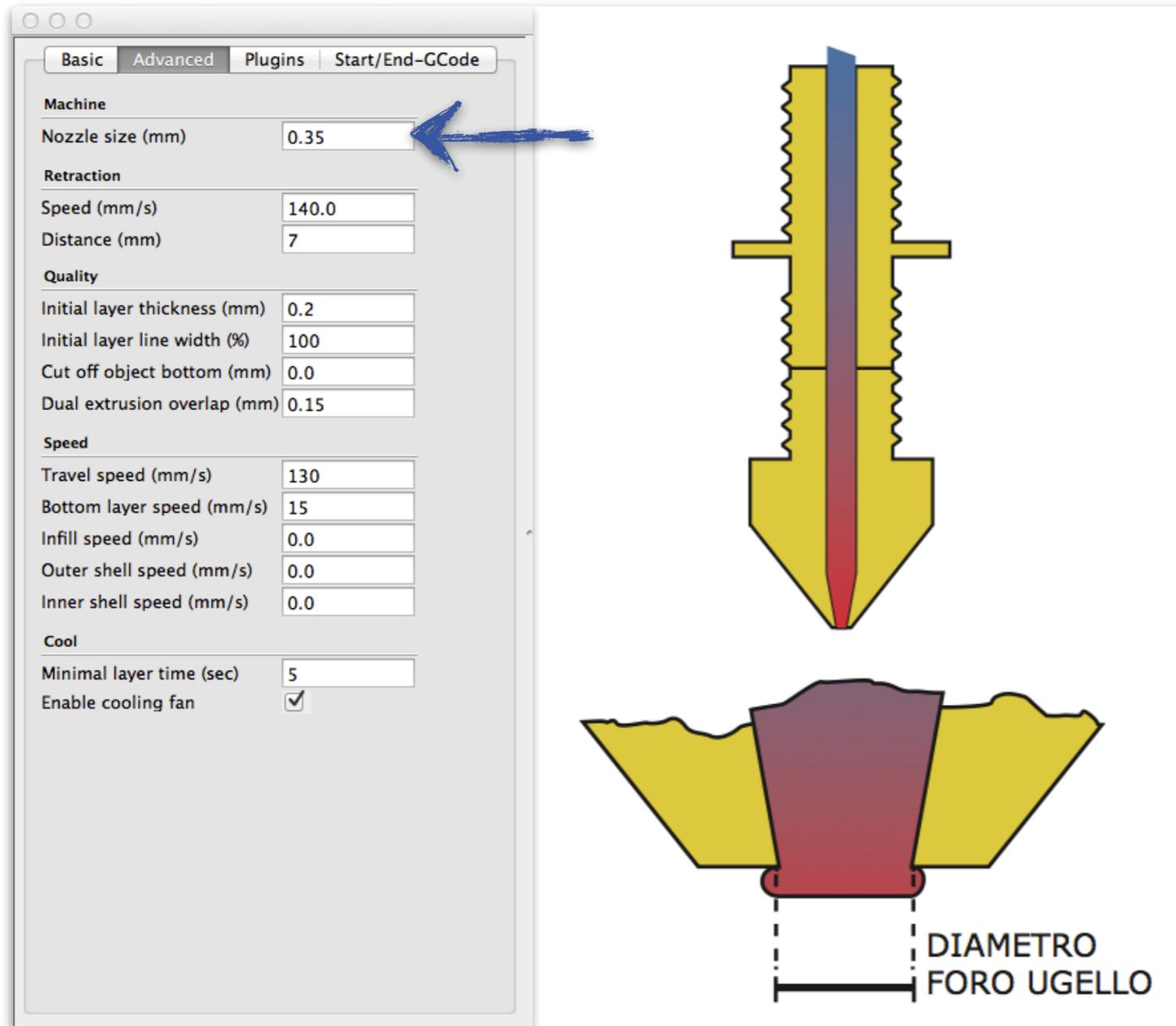


Flow rappresenta il flusso di materiale che viene estruso dall'ugello ed è determinato da quanto il motore dell'estrusore spinge il filo all'interno dell'hot end.

Il flow si misura in Estep/mm, cioè n° di giri compiuti dal motore per estrudere 1mm di filamento.



# Nozzle size

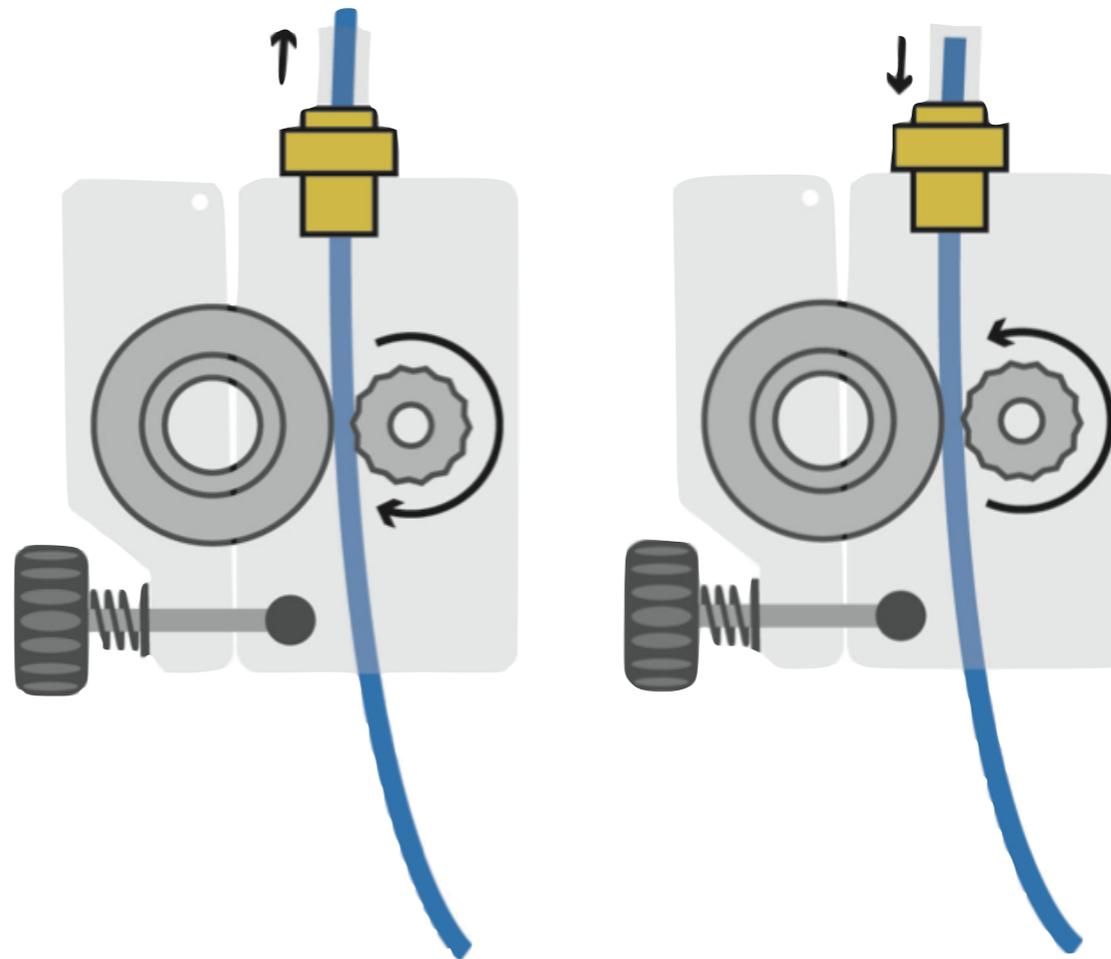
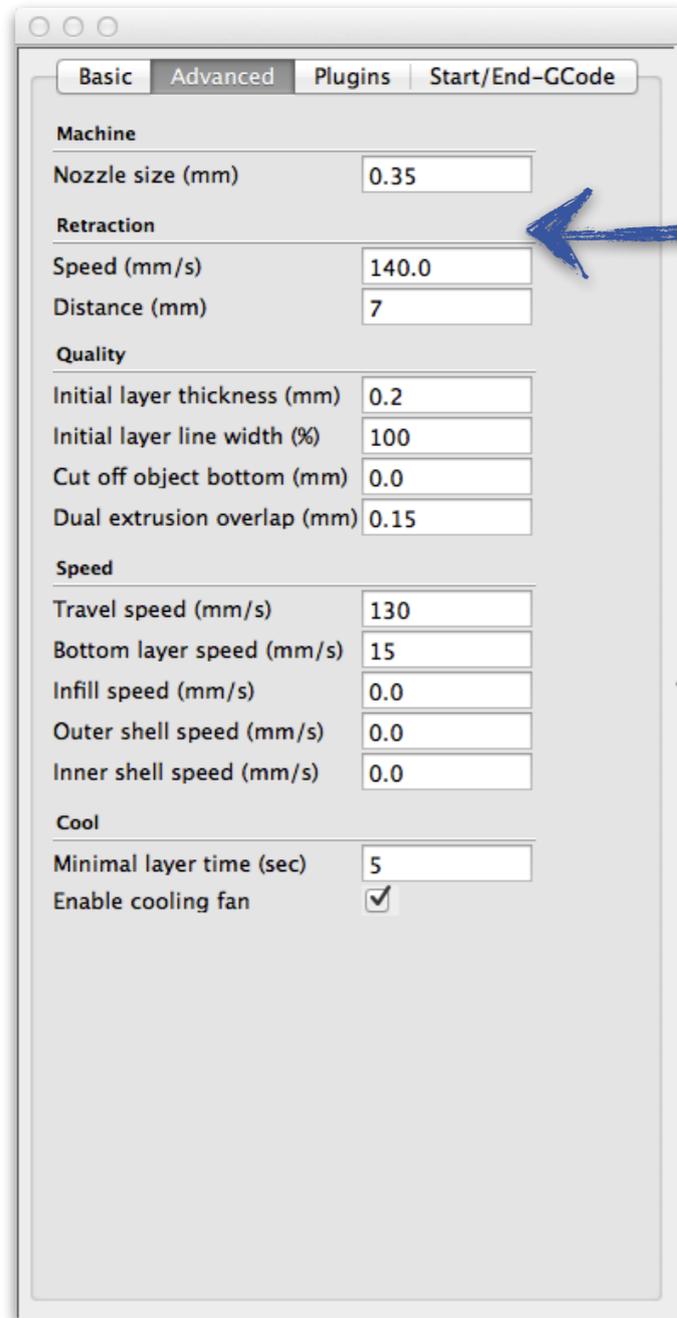


Il diametro del foro dell'ugello determina lo spessore di parete (in figura a lato 2 perimetri da  $0.35\text{mm} = 0,7\text{mm}$ ) e il riempimento interno. Nella figura sotto è possibile vedere una sezione dell'hot end e il dettaglio dell'ugello in fase di estrusione.

Le dimensioni tipiche del foro dell'ugello sono  $0,35\text{mm}$ ;  $0,4\text{mm}$ ;  $0,5\text{mm}$ ;  $0,7\text{mm}$ ;  $0,8\text{mm}$



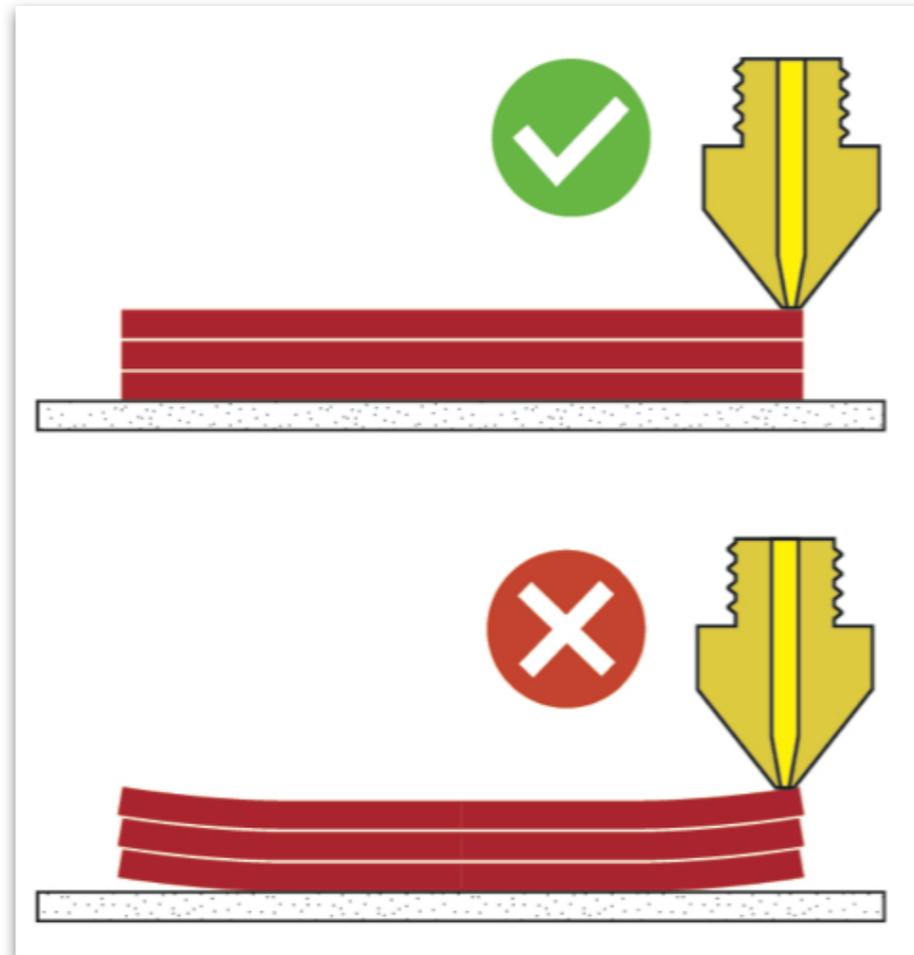
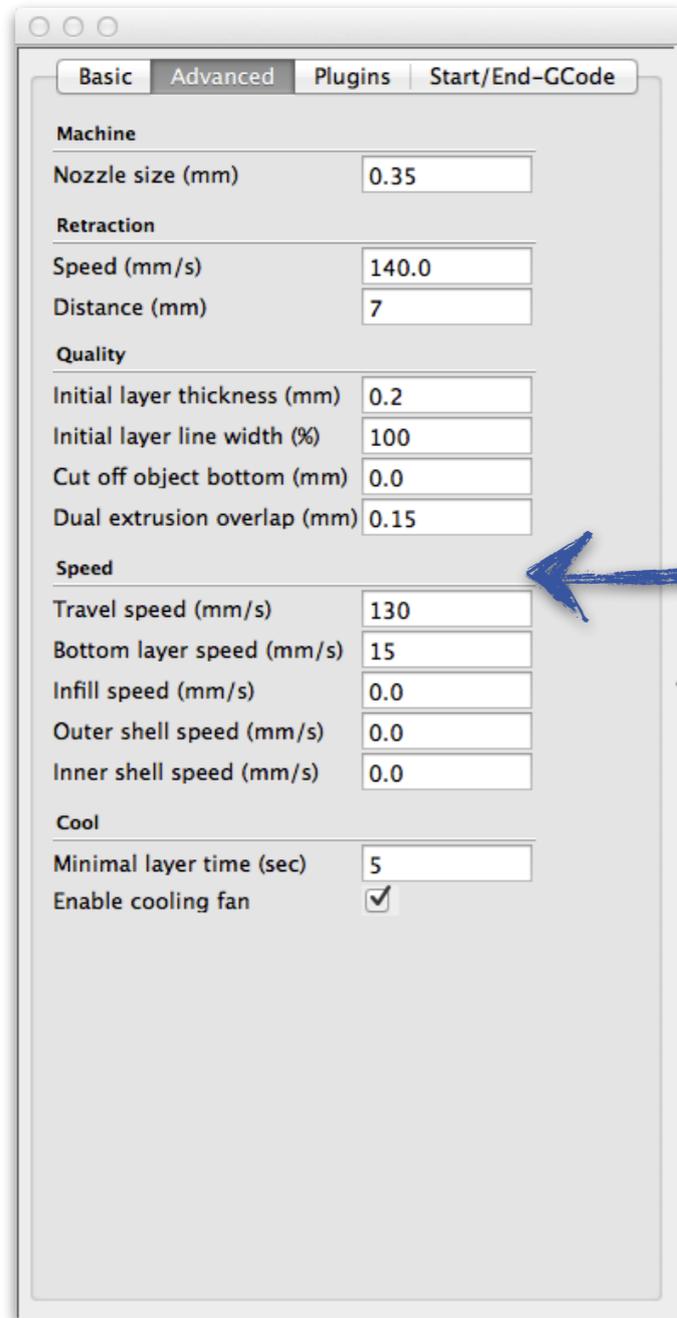
# Retraction



Velocità in un range di valori tra 110 e 150mm/s e distanza in range di valori tra 4,5 e 8mm di solito danno buoni risultati.



# Speed

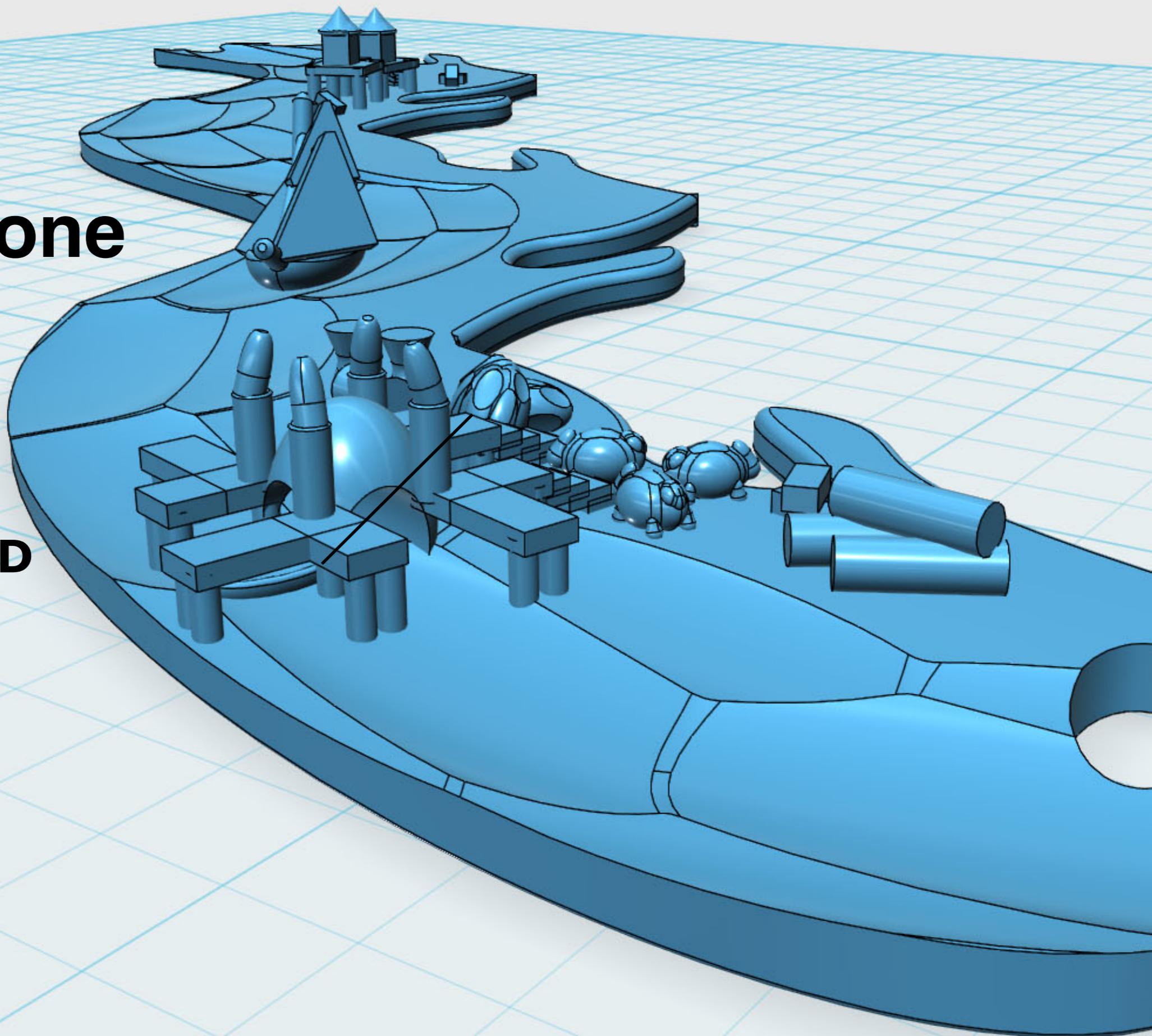


Depositare correttamente a basse velocità il primo strato di materiale garantisce in molti casi la buona riuscita della stampa



# Modellazione 3D

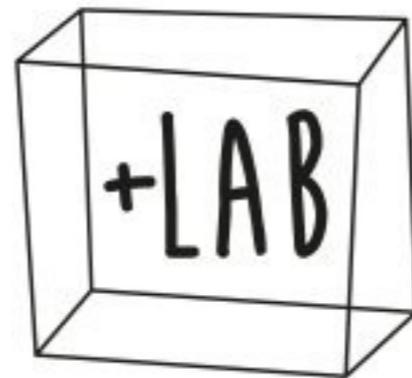
**Impariamo  
le basi del  
disegno 3D**



# Siti e Link utili



MakerBot Thingiverse



# Primi passi con la Stampa 3D

Relatore: Andrea Mantelli



## MAKERS LAB

Le informazioni contenute in queste diapositive sono state prese da “LINEE GUIDA WORKSHOP MY FIRST 3D PRINT” una guida realizzata dal +Lab del Politecnico di Milano.

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