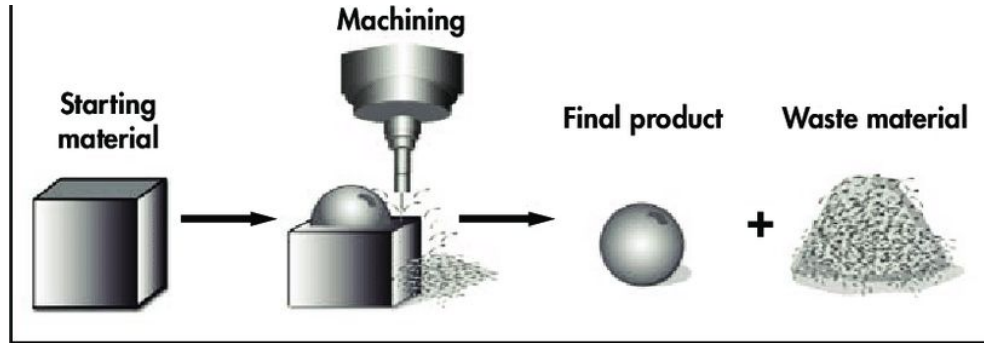
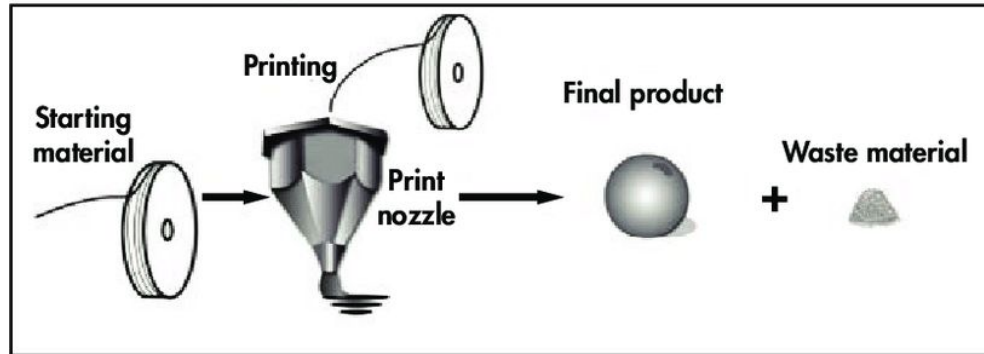


3D Printing GEARS 2023



Additive manufacturing



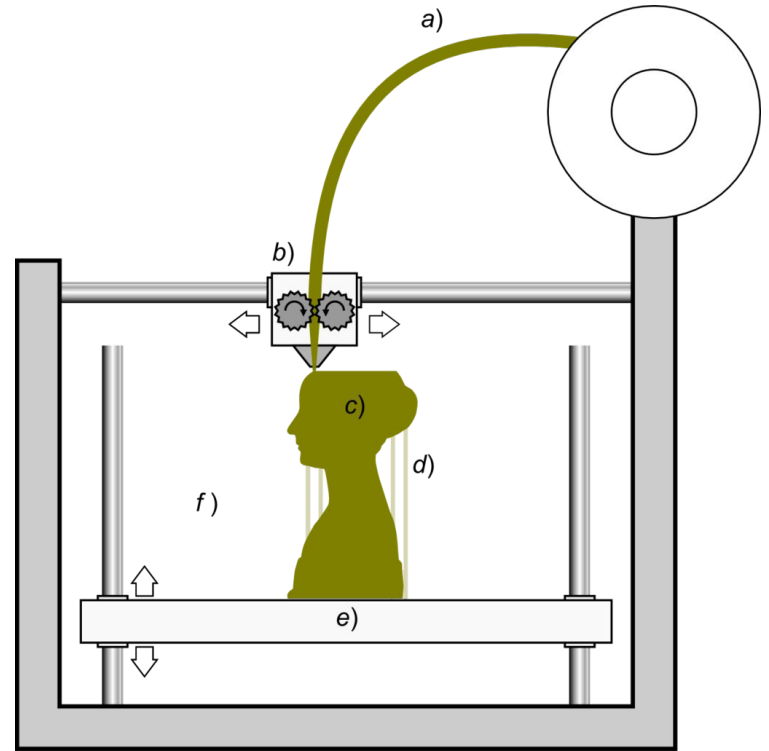
SOURCE: U.S. Government Accountability Office, 2015.

Applications

- Rapid Prototyping
 - Often cheaper and less labor intensive than other manufacturing methods
- Producing odd shaped components or components with complex internal features
- Low cost manufacturing
- Less waste than subtractive manufacturing.

3D Printing Methods

- FDM (Fused Deposition Modeling)
 - Most common and cheap. Filament extruded in layers.



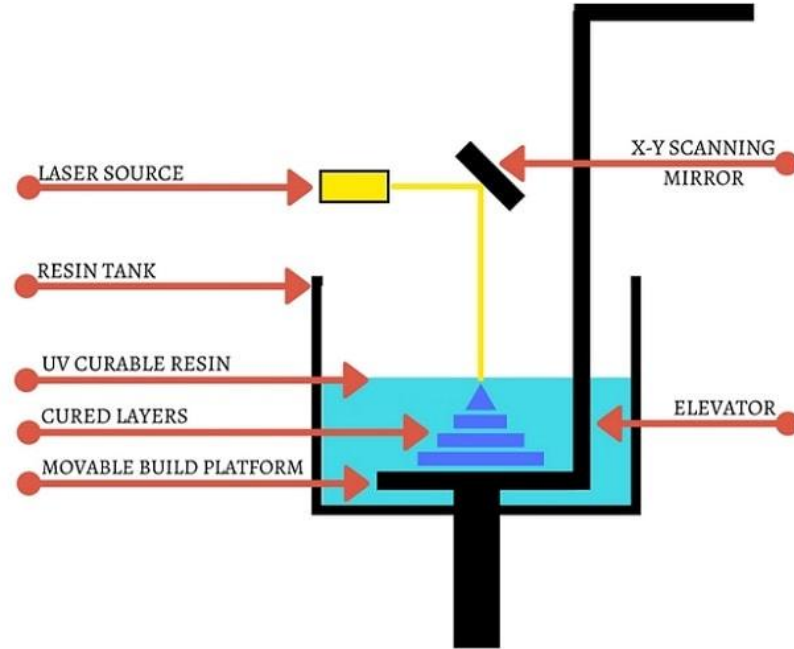
By Paolo Cignoni - Own work, CC BY-SA 4.0

Close-up!



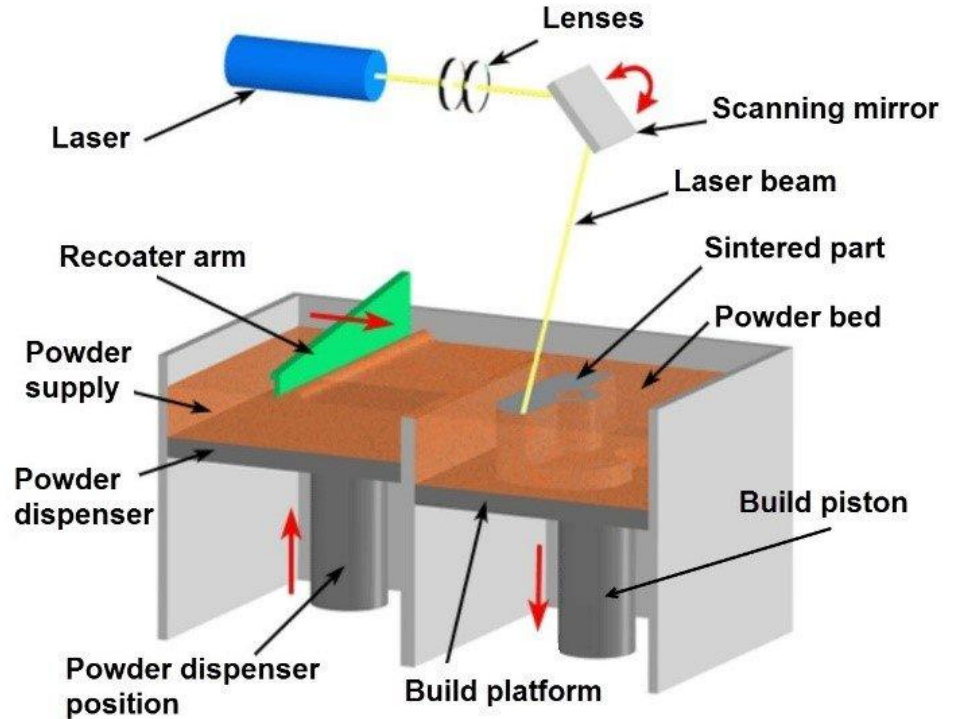
3D Printing Methods

- SLA (Stereolithography)

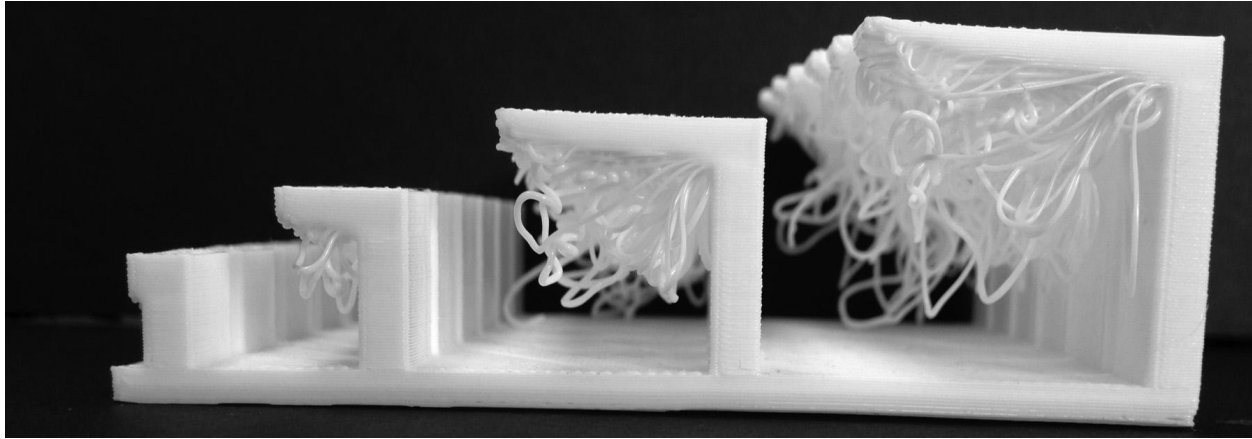


3D Printing Methods

- Selective Laser Sintering (SLS)
 - Used for one type of metal, or metals with the same melting point.
- Direct Metal Laser Sintering (DMLS)
 - Similar process to SLS, can be used with alloys, or metals with different melting points.

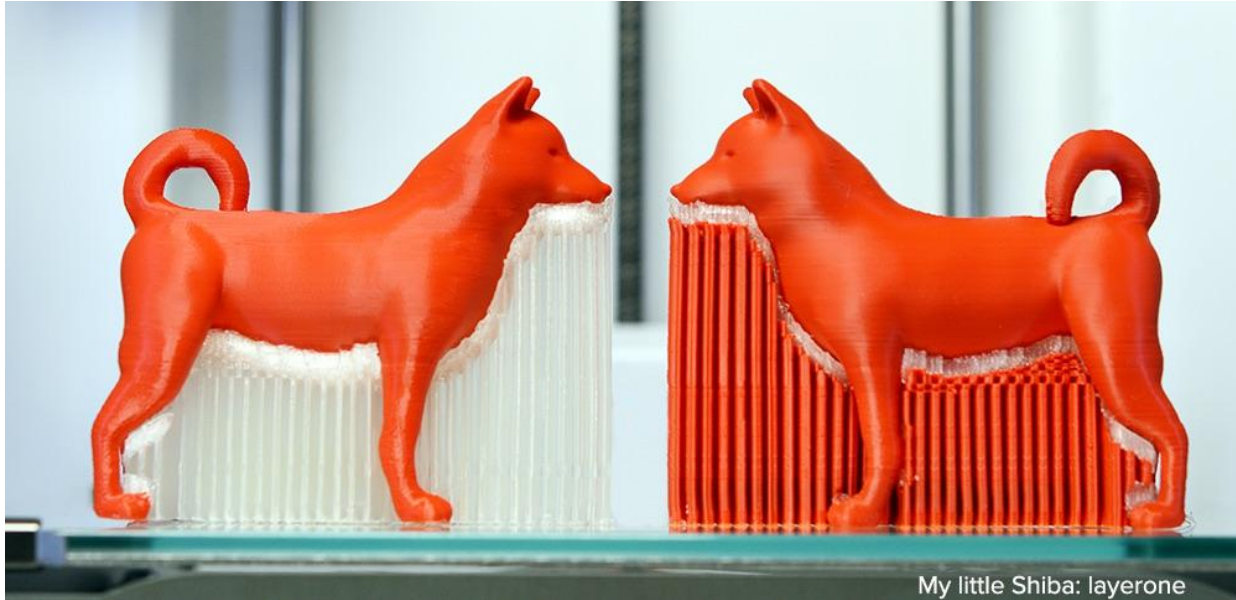


Design Considerations



- Avoid large overhangs and unsupported features.

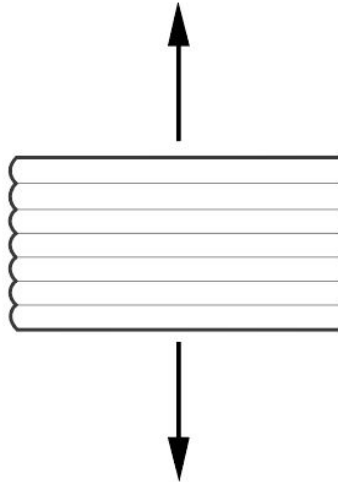
Design Considerations



Design Considerations

Print orientation affects strength

Tension load
normal to layers
Part is weak



Tension load
parallel to layers
Part is strong



Hubs.com

Design Considerations

Different material choices change the characteristics of the print:

- PLA
 - Most common, cheap, easy to print. Not very strong
- ABS
 - Stronger than PLA, still easy to print and higher melting point
- Resin
 - Higher Detail
- Metals, carbon fiber, kevlar
 - High strength and lightweight parts, but the machines are expensive and specialized.

3D printers can be cheap!

- Basic FDM printers can be less than \$200

