3D printing — Additive Manufacturing

Machining — Subtractive Manufacturing

CAD → Processing → 3D printer

Slow

FDM — Fused Deposition Modelling

Plastic

MultiJet Printing

UV curable resin

SLA — Stereolithiography

SLS — Selective laser sintering

SLS

Plastic Laser

Aluminum Laser

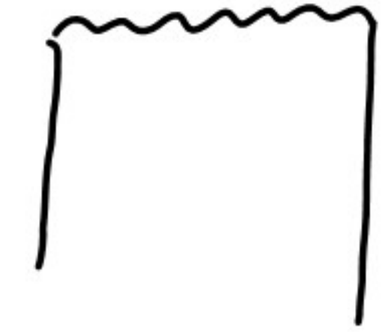
Titanium Electron Beam

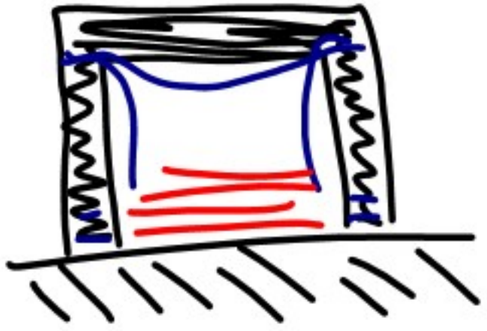
Binder Jetting

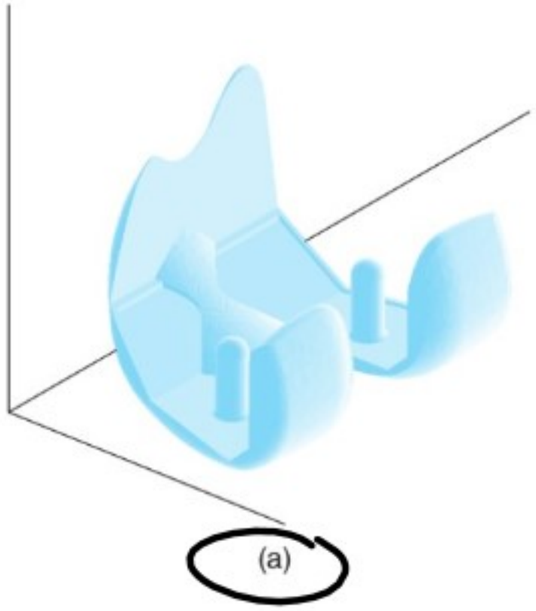
Ceramics

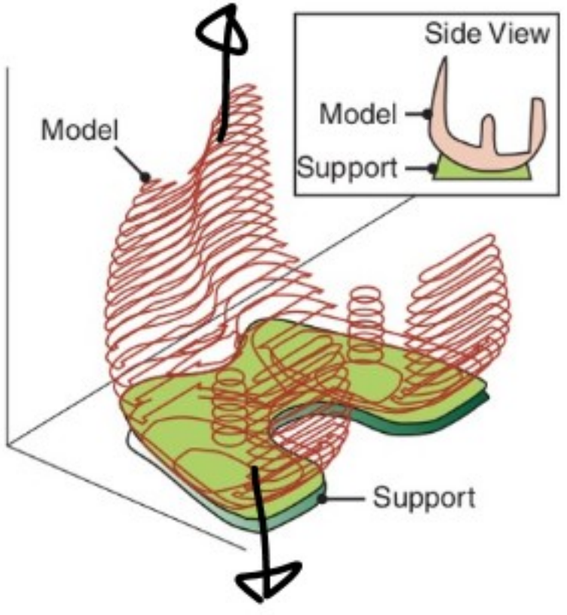
Process	Supply phase	Layer creation technique	Type of phase change	Materials
Stereolithography	Liquid	Liquid layer curing	Photopolymerization	Photopolymers (acrylates, epoxies, colorable resins, and filled resins)
CLIP	Liquid	Liquid layer curing	Photopolymerization	Similar to stereolithography
Multijet/PolyJet	Liquid	Liquid layer curing	Photopolymerization	similar to stereolithography
Material jetting	Liquid	Droplet deposition	Solidification	Polymers and wax
Fused-deposition modeling	Solid	Extrusion of melted polymer	Solidification	Thermoplastics such as ABS, polycarbonate, and polysulfone
Binder jetting	Powder	Binder-droplet deposition onto powder layer	No phase change	Ceramic, polymer, or metal powder; sand
Selective laser sintering	Powder	Layer of powder	Sintering	Polymer powder such as nylon
Selective Laser melting	Powder	Layer of powder	Solidification	Metal powders such as stainless steel, titanium, copper, and aluminum
Electron-beam melting	Powder	Layer of powder	Solidification	Titanium and titanium alloys, cobalt chrome
Laminated-object manufacturing	Solid	Deposition of sheet material	No phase change	Paper and polymers
Laser-engineered net shaping	Powder	Injection of powder stream	Solidification	Titanium, stainless steel, aluminum

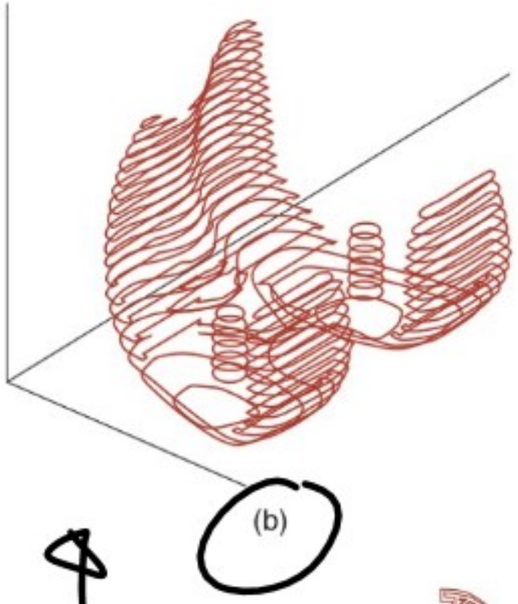
FDM



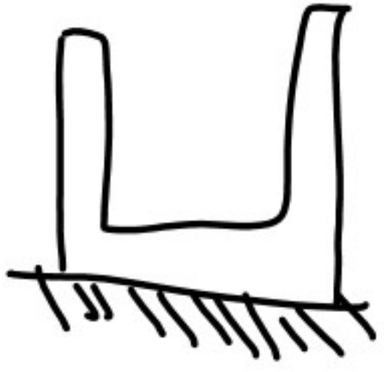






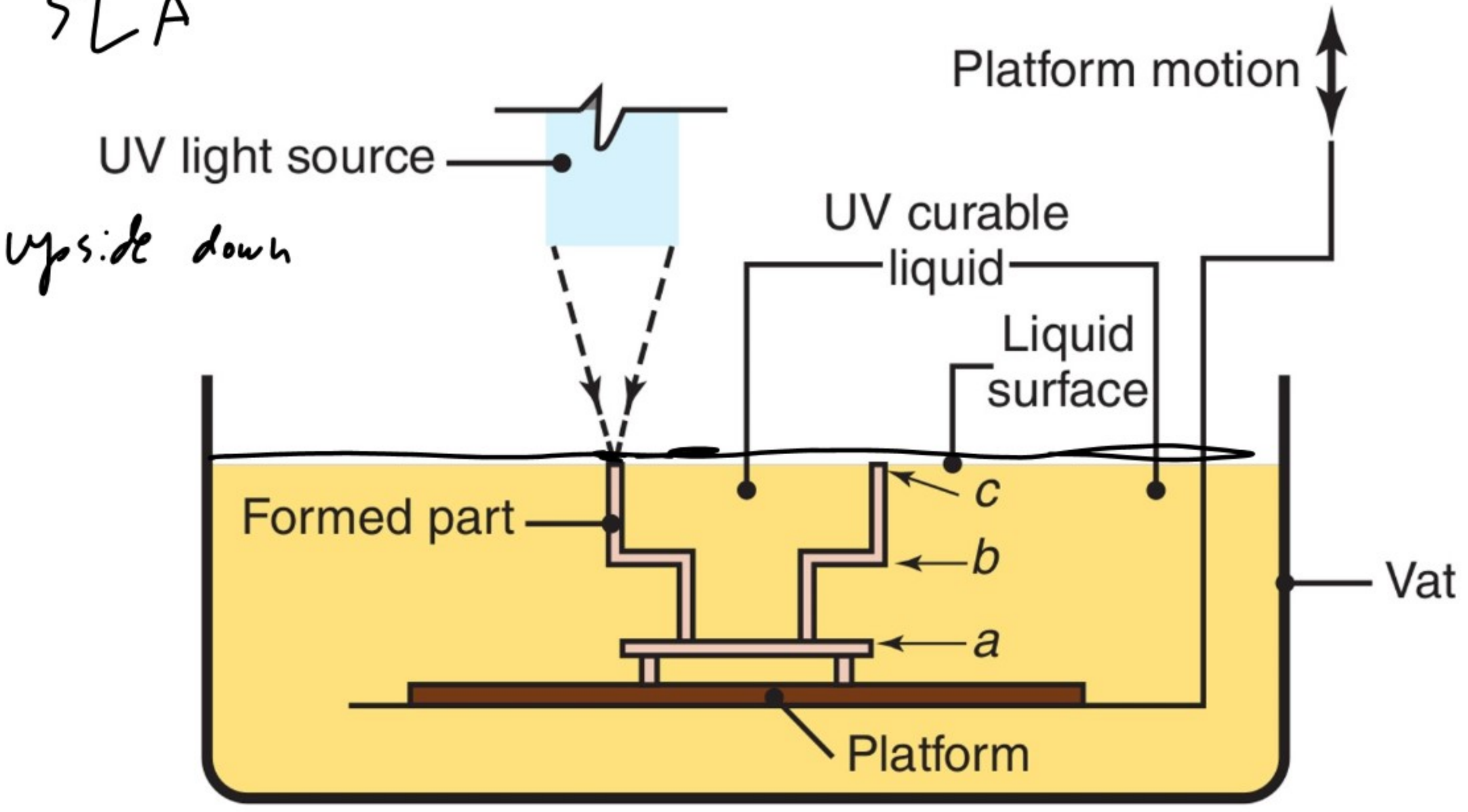


layer thickness
0.01"

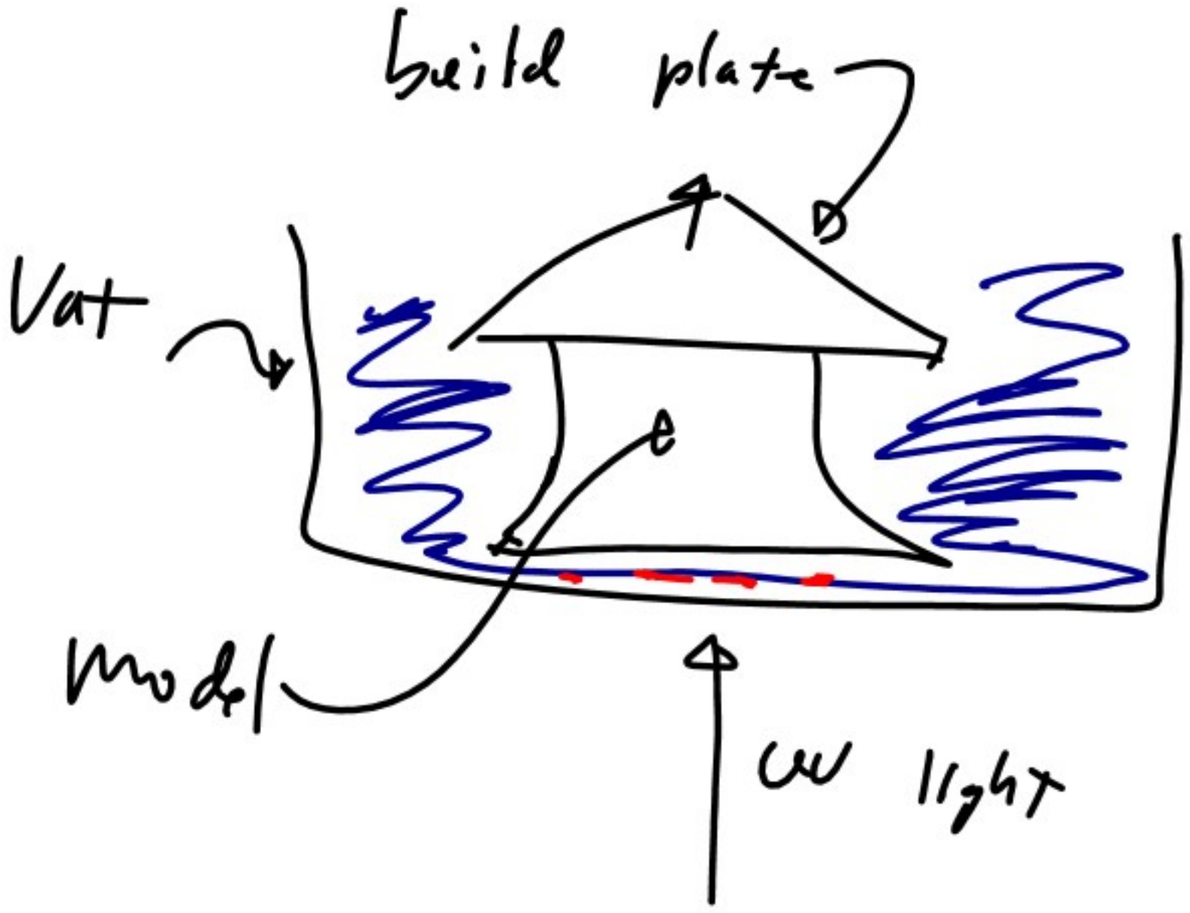


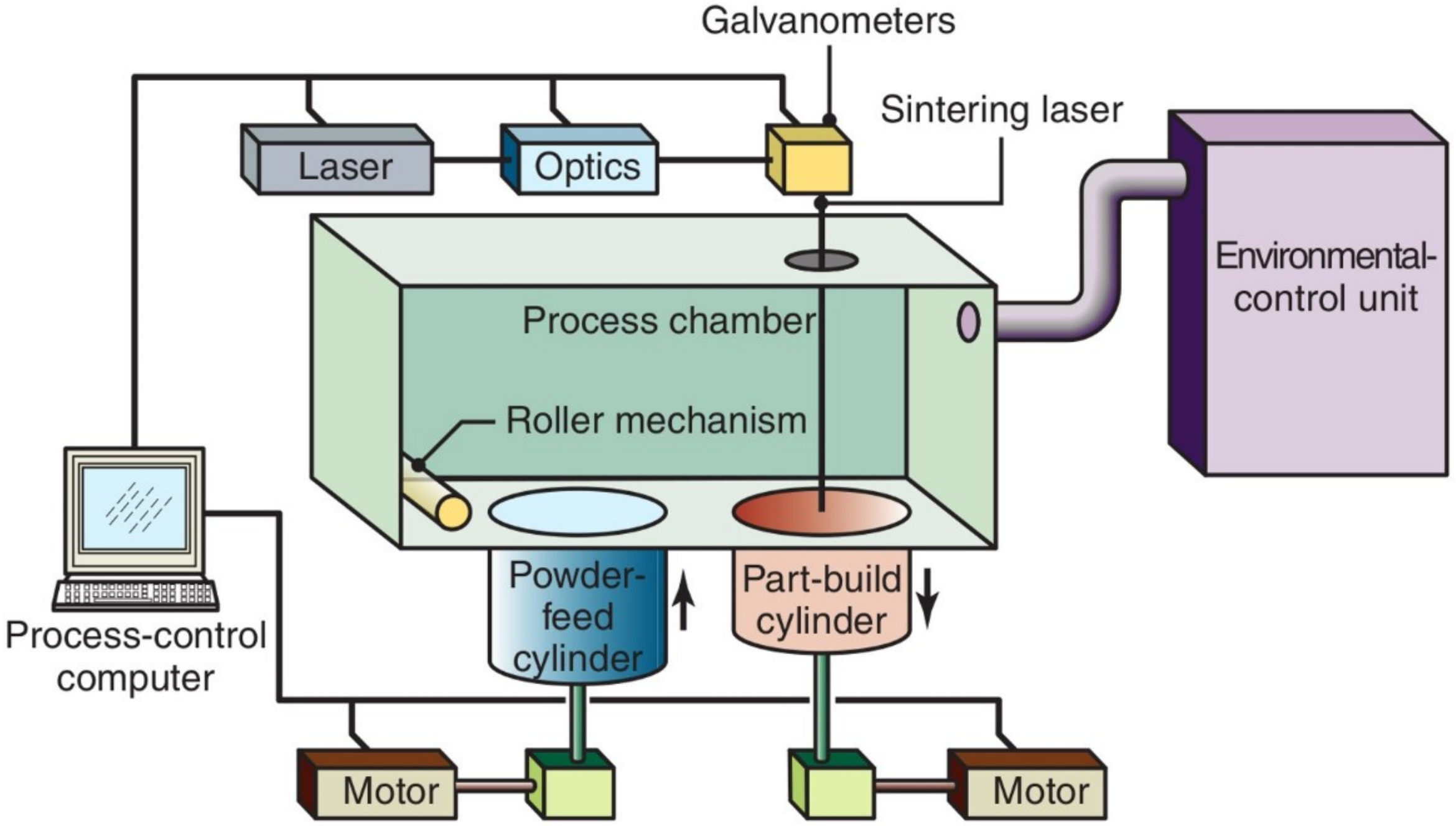
SLA

upside down

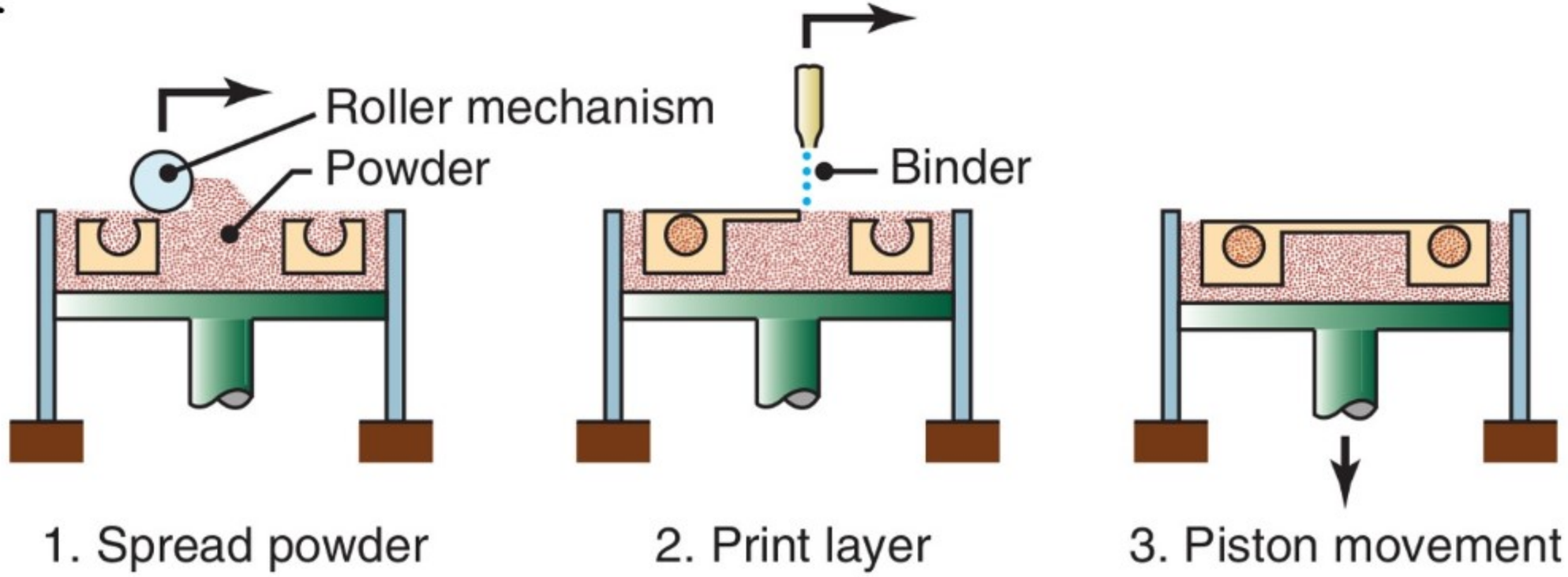


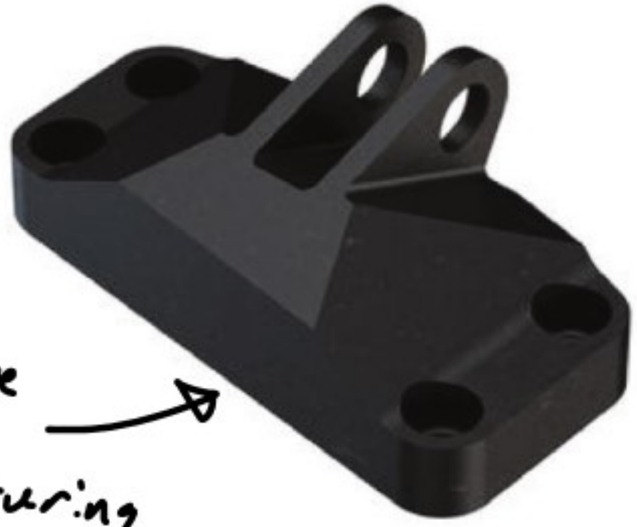
SLA




Galvanometers
Sintering laser
Laser
Optics
Environmental-control unit
Process chamber
Roller mechanism
Process-control computer
Powder-feed cylinder
Part-build cylinder
Motor
Motor

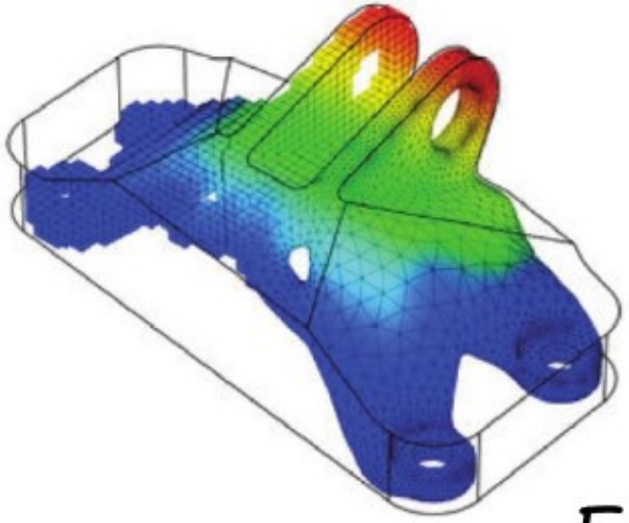
SLS


Roller mechanism
Powder
Binder
1. Spread powder
2. Print layer
3. Piston movement
4. Intermediate stage
5. Last layer printed
6. Finished part



Subtractive Manufacturing

(a)



(b)

FEA

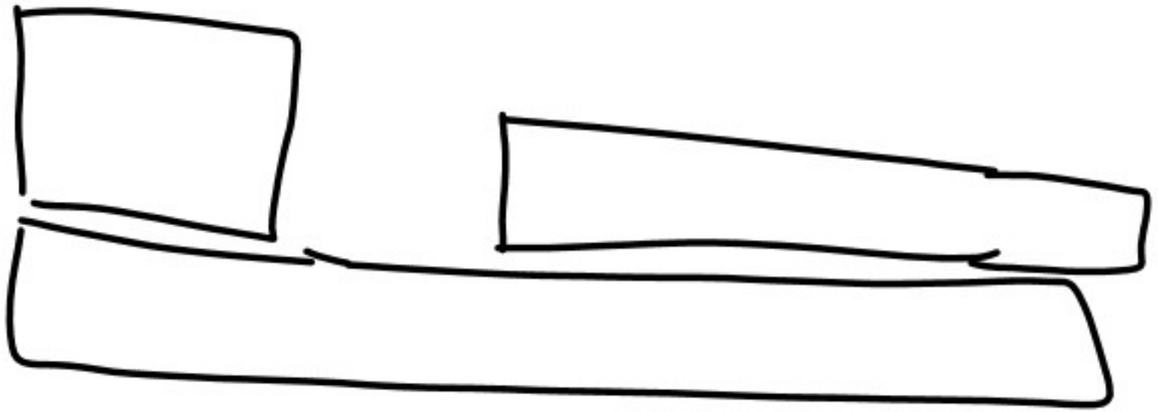
Finite element analysis

Topology Optimization

Additive Manufacturing

(c)

Aerospace

- FDM (https://youtu.be/AW-8EVRI5H8)
- FDM Close Up (https://youtu.be/uwpmOKgtZEQ)
- SLA (https://youtu.be/n_muoXfXlEg)
- SLS (https://youtu.be/9l354lmxazs)
- Material Jetting (https://youtu.be/oi0JEhGqTuU)
- Electron Beam Melting (https://youtu.be/jqjD-FWMexo)
- Topology Optimization (https://hackaday.com/2019/08/02/computer-optimized-3d-printed-bookshelves/)
- Concrete 3D Printing (https://www.tiktok.com/@ericmartinmoney/video/7056279651836022062)
- Press Brake (https://www.tiktok.com/@kukamachina/video/7152516763983416619)
- Centrifugal Casting (https://www.tiktok.com/@lukas.thasme/video/7154585293696290053)
- Something Scarry (https://www.tiktok.com/@wdrcnctools/video/7154741091177123114)

Gap bed Lathe