

UNIT-2

* Liquid Based Rapid prototyping System :

Most liquid based rapid prototyping system build parts in a vat of photo curable liquid resin, an organic resin that cures or solidifies under the effect of exposure to light, usually in the UV range. The light cures the resin near the surface, forming a thin hardened layer.

* Stereo lithography apparatus :

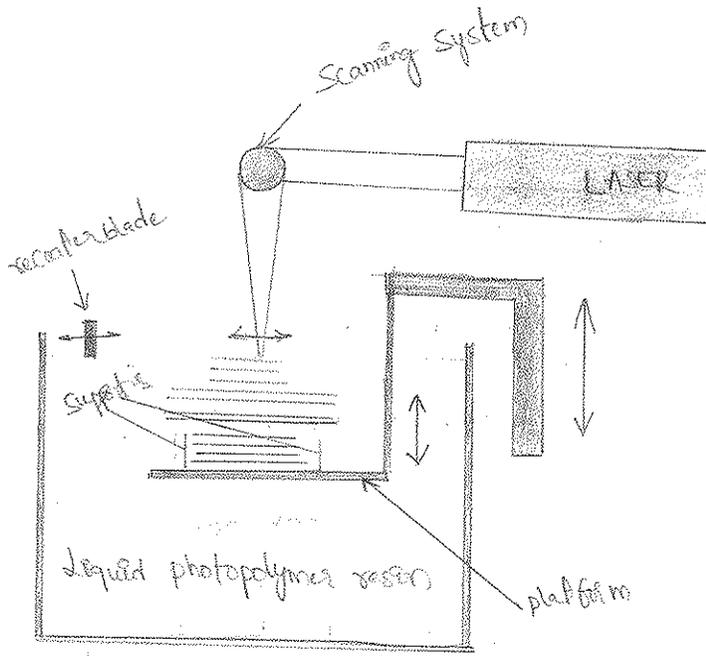
Stereo lithography apparatus (optical fabrication, photo-solidification (or) resin printing) is a form of 3D printing technology used for creating models, prototypes, patterns, and production parts in a layer by layer fashion using photochemical processes by which light causes chemical monomers and oligomers to cross-link together to form polymers. These polymers then make up the body of 3D-solid. Stereolithography can be used to create prototype for products in development, medical models, and computer hardware, as well as in many other applications. While stereolithography is fast and can produce almost any design, it can be expensive.

Stereolithography models have been used in medicine since the 1990s, for creating accurate 3D models of various anatomical regions of a patient, based on data from computer scans.

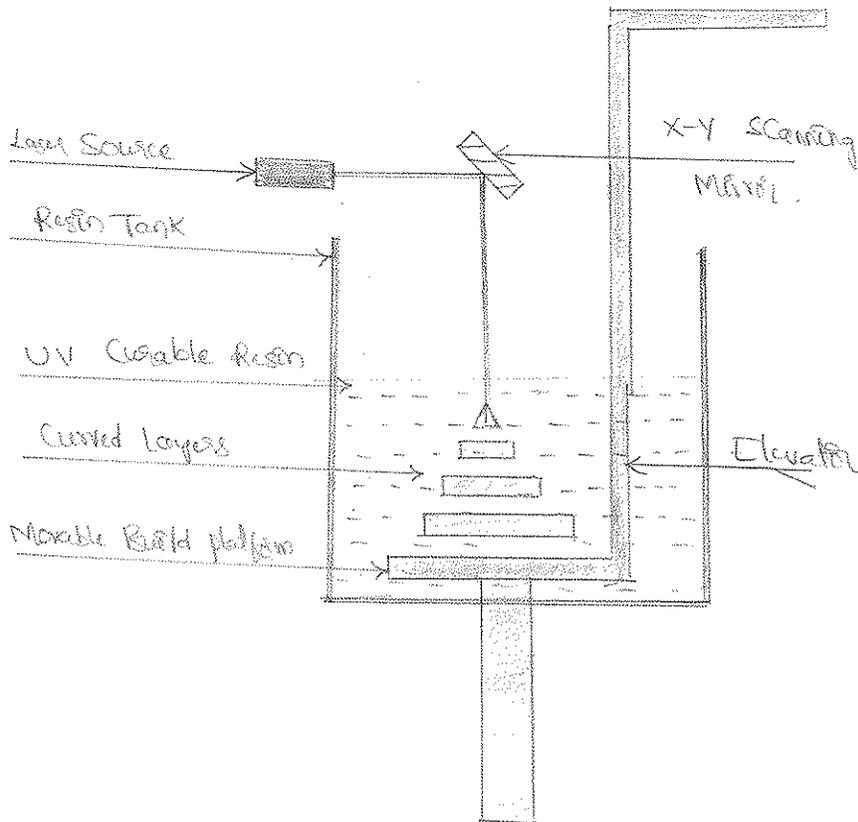
* Working principle :

The layer draws a pattern on that layer curing only the shape desired in the first of the model. The basic principle of stereolithography is the selective curing of photopolymer (a resin) using a UV laser. A thin layer of liquid resin (generally 50-100 microns deep) is prepared in the machine's building.

* Stereolithography (SLA)



* Working principle:



Advantages of SLA :

- It's quick. A major advantage of SLA is that the part that the can be built in a relatively short period of time since curing is fast.
- It's cheap.
- It aids prototyping.
- It's a multi-material process.
- It creates tools, quickly.
- High quality parts.
- Snap-together assemblies
- Scaling is easy.

Limitations of SLA :

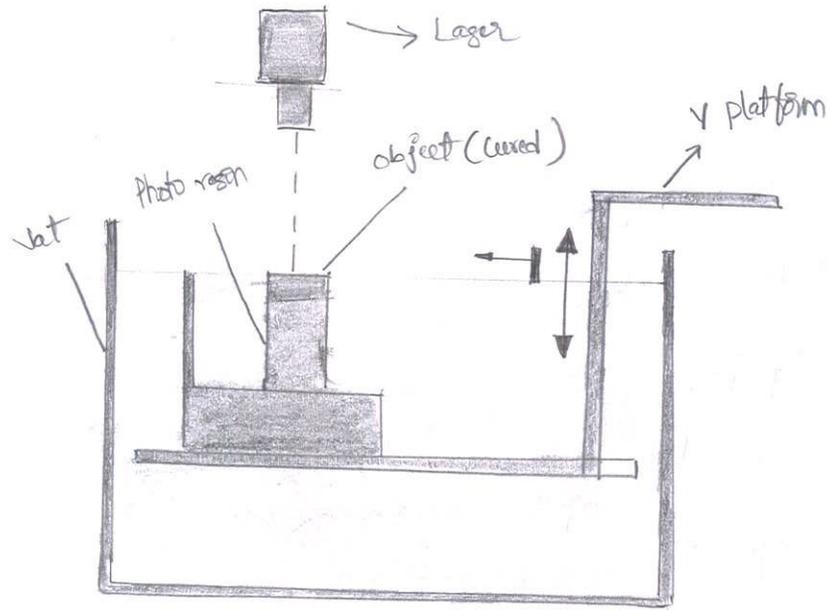
- Fragility : Stereo lithography uses equivalent materials which were resins.
- Expensive machines : If we had predicted the boom in 3D printing in the past few years experts have neglected the cost of the machines and the difficulty of their operation.

* Photo Polymerisation :

photo polymerization, that is, light induced polymerization, is a form of 3D printing where materials (photopolymers, radiation-curable resins, and liquid) collected in a vat are successively cured into layers one layer at a time by irradiating with a light source thereby providing a 2D patterned layer.

polymerization, in polymer chemistry, is the process of reacting monomer molecules together in a chemical reaction to form three-dimensional networks or polymer chains. There are many forms of polymerisation and different systems exist to categorize them.

* Photo polymerisation :



Advantages :-

Photo polymerization is a special form of free-radical polymerisation where light is used to initiate polymerization. This method has many advantages over conventional polymerization in terms of less energy consumption, reduced waste, higher productivity (fast cure) and lower reaction temperature.

Advantages and disadvantages of photopolymer 3D printing :-

- Small printing speed, especially when working with SLA printers ;
- Small assortment of materials ;
- Some materials are toxic ;
- Support structures for overhangs are required.

* Layering Technology :-

Application layering (app layering) is a technology for delivering virtual applications that run in layers separate from a virtual desktop, but interact with the operating system and other apps as if they were installed natively on the base image.

Layer Technology to advance Supply Chain :-

- plan
- Digitize
- Synchronize
- Extend And Visualize
- Leverage Digitization to Innovate.

→ Software engineering is a fully layered technology. To develop a software, we need to go from one layer to another. All these layers are related to each other and each layer demands the fulfillment of the previous layer.

* Laser and Laser Scanning:

Laser Scanning is a popular land surveying method that can accurately measure and collect data from objects, surfaces, buildings, and land scapes. Laser scanners collect information in the form of point cloud data, which consists of millions of 3D coordinates (XYZ coordinates).

Specially, laser scanning, also known as high-definition surveying (HDS) or reality capture, is a means of using a laser to map an area with high accuracy. On a construction site, laser scanning is used to capture detailed data, providing accurate information for every nook and cranny on a site.

* 3D Laser Scanning is used in numerous applications: Industrial, architectural, civil surveying, urban topography, mining, reverse engineering, quality, archaeology, dentistry, reverse engineering, and mechanical dimensional inspection are just a few of the versatile applications.

* Case Study:

A case study involves a up-close, in-depth, and detailed examination of a particular case or cases, within a real-world context. For example, case studies in medicine may focus on an individual patient or ailment; case studies in business might cover a particular firm's strategy or a broader market; similarly, case studies in politics can range from a narrow happening over time to an enormous undertaking.

Generally, a case study can highlight nearly any individual, group, organization, event, belief system, or action. A case study does not necessarily have to be one observation (n=1), but may include many observations.

Case study research has been extensively practiced in both the social and natural sciences.

Advantages and Disadvantages of Case Studies:

- Case studies allow a lot of detail to be collected that would not normally be easily obtained by other research designs.
- Case studies tend to be conducted on rare cases where large samples of similar participants were not available.
- Within the case study, scientific experiments can be conducted.

Case Studies & Application Examples:

- Automated marble refining.
- Improving the quality of pharmaceutical packing components.
- Fully automated surface quality check of bearing balls.
- Machine vision opens up new markets.
- Machine vision for the big drill - machine vision for tunnels.
- Raman Spectroscopy measures Corona infected cells.

* Solid Ground Curing :-

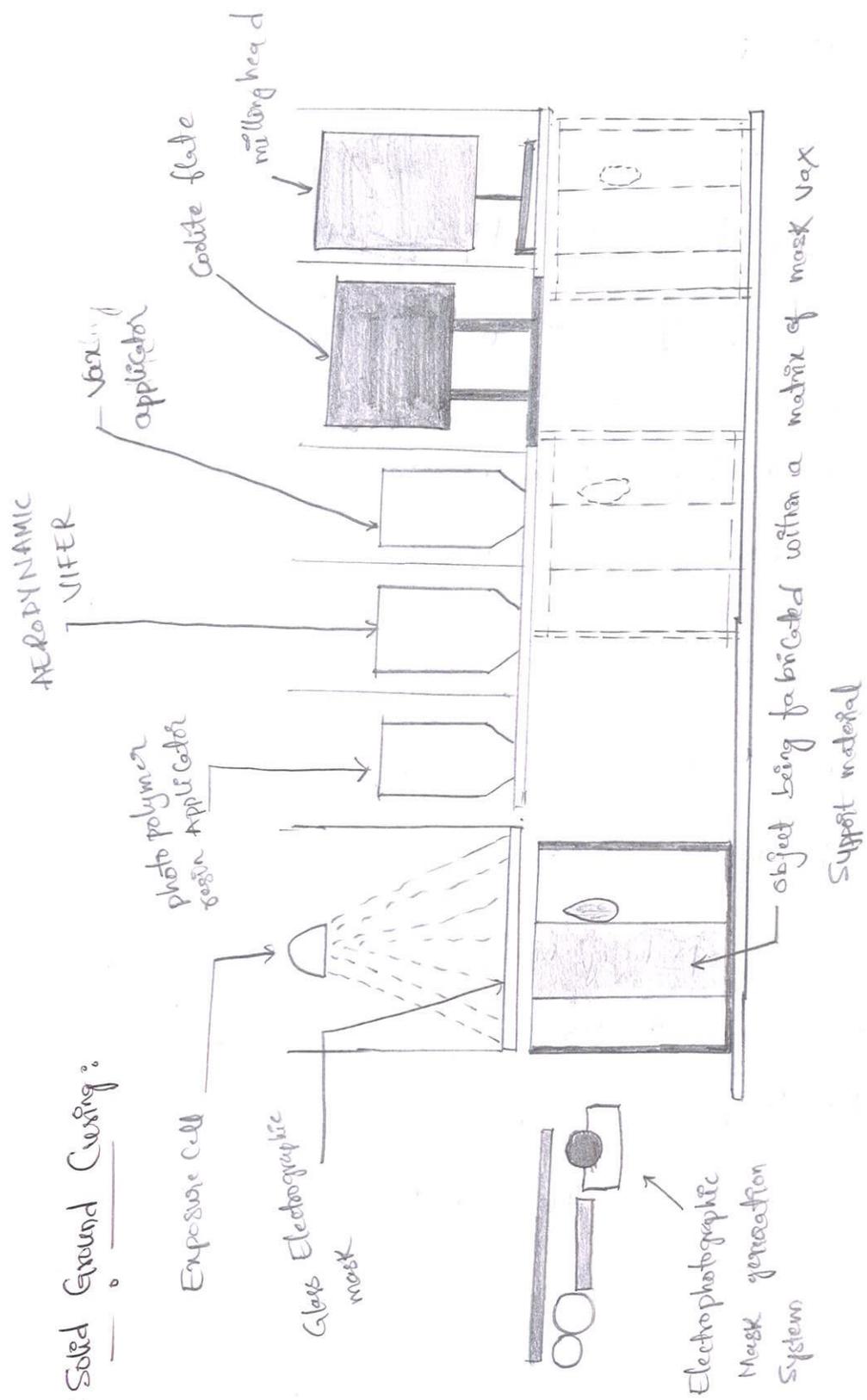
Solid ground curing (SGC) is a photo-polymer-based additive manufacturing (or 3D printing).

Technology used for producing models, prototypes, patterns (and production parts, in which the production of the layer geometry is carried out by means of a high-powered UV lamp through a mask; As the basis of solid ground curing is the exposure of each layer of the model by means of a lamp through a mask, the processing time for the generation of a layer is independent of the complexity of the layer.

→ SGC was developed and commercialized by Cubital Ltd. of Israel in 1988.

~~##~~ In the alternative name Solid System, while the method offered good accuracy and a very high fabrication rate, it suffered from high acquisition and operating costs due to system complexity.

* Solid Ground Curing:



Specification	Details
Accuracy	0.1% upto 0.020" max.
Flatness	typical 0.006"
Resolution	x-y 0.004", z- 0.004" - 0.006"
Smallest feature	x-y 0.024", z- 0.006"

Solid ground Curing utilizes the general process of hardening of photopolymer by a complete lighting and backing of the entire surface, usually specially prepared masks. In SAC process, each layer of the prototype is cured by exposing to an ultra violet (UV) lamp instead of by laser scanning.

The primary advantage of the Solid ground Curing system is that it does not require a support structure since wax is used to fill the voids, highly accurate products can be obtained.

* Disadvantages:

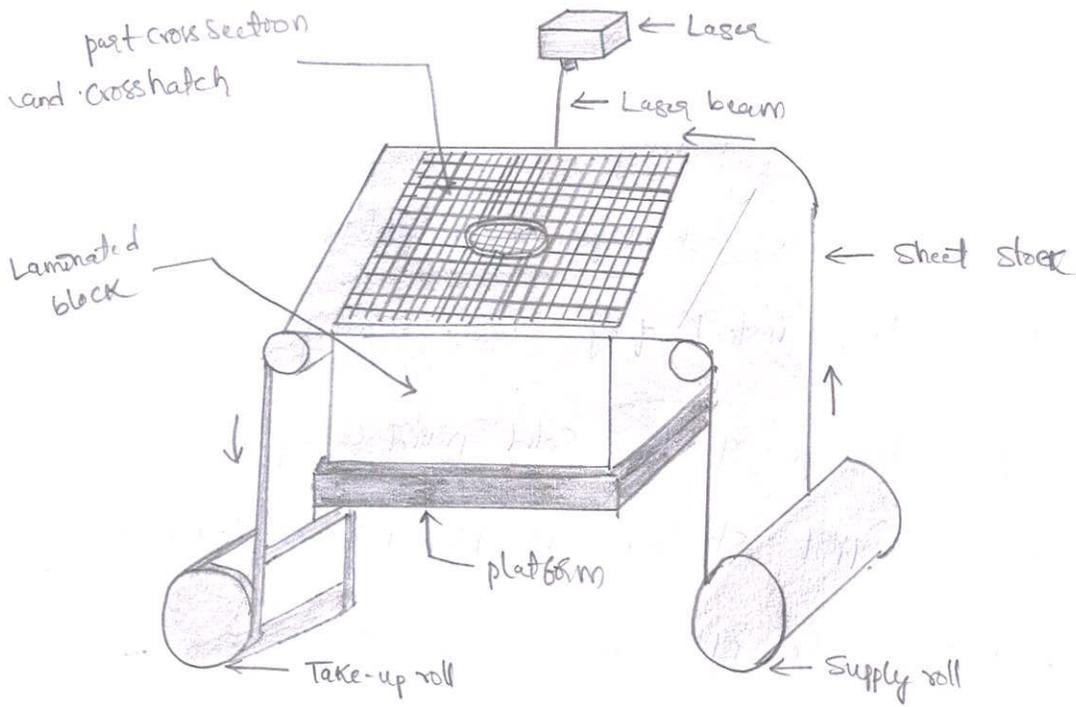
Although it offers good accuracy coupled with high throughput, it produces too much waste and its operating costs are comparatively high due to system complexity.

* Laminated Object Manufacturing (LOM) :-

Laminated object manufacturing is a 3D printing method, developed by Helix Inc (now Cubic Technologies). In the LOM technology, the layered material is rolled on the building platform. Usually, the material is coated with an adhesive layer and the feeding roller heats in order to melt the adhesive.

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* Laminated Object Manufacturing :-



The process is performed as follows,

1. Sheet is adhered to a substrate with a heated roller.
2. Laser traces desired dimensions of prototype.
3. Laser Cuts hatches non-part areas to facilitate waste removal.
4. Platform with Completed layer moves down out of the way.
5. Fresh Sheet of material is rolled into position.
6. Platform moves into new position to receive next layer.
7. The process is repeated until full model or prototype prepared.

* Working principle :-

It was developed by the California-based Heliosys Inc. (now Cubic Technologies). During the LOM process, layers of plastic or paper are fused or laminated - together using heat and pressure, and then cut into the desired shape with a Computer-Controlled laser or blade.

* Advantages:

- Ability to produce larger-scaled models.
- Uses very inexpensive paper.
- Fast and accurate
- Good handling strength
- Environmentally friendly
- Not health threatening.

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* Disadvantages:

- Need for decubing, which requires a lot of labor.
- Can be a fire hazard.
- Finish, accuracy and stability of paper objects not as good as materials used with other RP methods.

* Applications:

LOM machines are mainly used for rapid prototyping plastic parts. Its low price and fastness make it convenient to make prototypes, even though the produced objects are far from end-use parts.

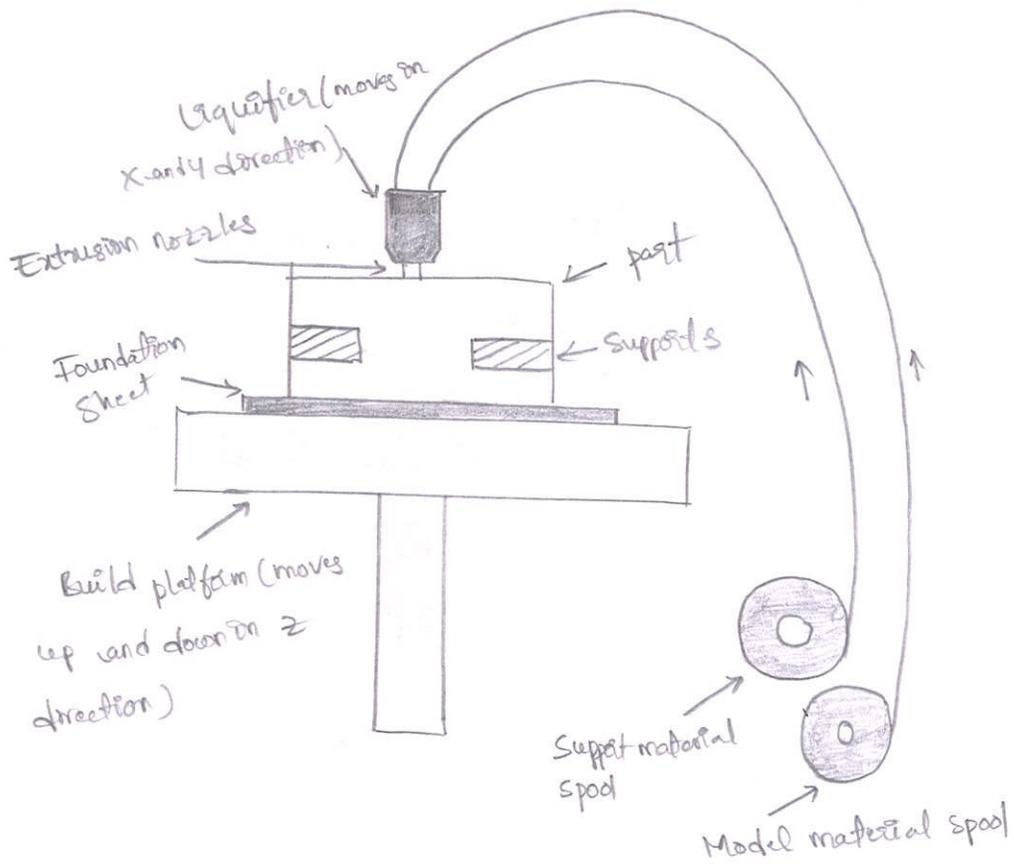
* Fused Deposition modeling:

Fused deposition modeling (FDM) is a technology where the melt extrusion method is used to deposit filaments of thermal plastics according to a specific pattern. Similar to SDP, the layout for FDM consists of a print head able to move along X and Y directions above a build platform.

Fused deposition modeling (FDM), also known as fused filament fabrication (FFF), is the most widely used type of 3D printing at the consumer level.

FDM works on an "additive" principle by laying down material in layers. A plastic filament or metal wire is unwound from a coil and supplies material to an extrusion nozzle which can turn the flow on and off. Stepper motors (servo motor) are typically employed to move the extrusion head.

* Fused Deposition Modelling:



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* Applications:

FDM printed parts are used for a massive amount of applications across industries, from prototypes to final parts, Companies in the automotive, aerospace, medical, maritime and railway have already adopted FDM as a manufacturing process.

* Advantages:

- Speed, Parts produced with FDM can be ready in a few minutes or couples of hours, making it one of the fastest choices in 3D printing.
- Accuracy.
- Affordability.
- Ease of Use.
- Scaling.

* FDM Disadvantages / Limitations:

- The print quality of FDM / FFF 3D prints are not as good as those by SLA or SLS.
- 3D printing with fused deposition modeling is slow.
- The layer-by-layer printing in FDM can sometimes lead to problems with warping and model shrinking.