3D LEARNING CONTENT GLOSSARY

3D Printing Terms Glossary

The list of terms and abbreviations in this glossary are commonly used in industry to refer to 3D printing or additive manufacturing forms or functions. There are many others, more rarely used or specific to niche industry applications, that are not included here.

This glossary is a living document; open to additions and changes. If you have a suggestion or comment, please contact us at research@stratasys.com.

How to use the glossary:

- The glossary is organized in alphabetical order. If you already know the term you can scroll directly to it.
- To search for a term or abbreviation within the PDF – Press Ctrl +F on your keyboard and type the term in the pop-up search box.

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3D Printer (Also Modeler):	An additive fabrication machine that is designed to join materials to make objects from 3D model data through depositing of material usually layer upon layer also known as 3D printing.
3D Printing:	A process of fabricating objects from 3D model data through depositing of material usually layer upon layer.
3D CAD:	Three dimensional computer aided design.
3D CAD Model:	Three dimensional computer aided design model.
4D Printing:	4D printing refers to “time” as the fourth dimension. (Newtonian definition of time: Time, as perceived by Sir Isaac Newton, is part of the fundamental structure of the universe—a dimension in which events occur in sequence. Without time, there is no motion and no transformation. Our universe would stay frozen.) 4D printing is the printing of combined materials that are programed to transform and self-assemble through time. 3D Printed models that contain the potential for change over time. When exposed to the correct stimulus they rearrange their shape according to pre-programmed patterns.

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A	**Additive Fabrication**	(Synonyms: 3D Printing, Rapid Manufacturing, Additive Manufacturing, Layer Manufacturing)—An automated method to build models, prototypes, tools and manufactured parts directly from CAD data, that constructs these parts by depositing and bonding materials on a layer-by-layer basis.
	Air Gap	The distance between roads (rasters or contours).
	Anisotropy	The property of being directionally dependent, which implies different properties in different directions, as opposed to isotropy, which describes uniformity in all directions.
	Anisotropic Digital Material	Digital materials that have an anisotropic 3D phase structure design, with corresponding anisotropic properties along different axes within a single object.
B	**Base Layer**	(Synonyms: Pedestal, Brim, Raft, Skirt)—Sacrificial initial layers used to stabilize the part on the build tray to create a strong foundation and ensure a level build plane.
	BASS	Break-Away Support Structure.
	Bead	(Synonyms: Road, Path)—The data used to describe extruder tip position and extrusion properties when building a part on an FDM™ printer. It also describes the thin strip of extruded thermoplastic deposited by the 3D printer.
	Binder Jetting (BJ)	A binder jetting machine will distribute a layer of powder onto a build platform. A liquid bonding agent is applied through inkjet print heads bonding the particles together. The build platform will be lowered and the next layer of powder will be laid out on top. By repeating the process of laying out powder and bonding, the parts are built up in the powder bed. Binder jetting does not require any support structures. The built parts lie in the bed of unbonded powder. The entire build volume can therefore be filled with several parts, including stacking and pyramiding of parts. These are then all produced together. Binder Jetting works with almost any material that is available in powder form. *Source: https://www.additively.com/en/learn-about/binder-jetting#read-more*
	Boundary Curves	A closed curve used to define a region in the XY plane. Two different types of boundary curves are present in the system: part boundary curves (as a result of slicing) and support boundary curves (as a result of support generation).
	Bounding Box	A particular area of the build tray that encompasses all of the designs to be printed.
	Build Plate	(Synonyms: Tray, Platen, Bed, Build Sheet, Substrate and Foundation)—See Platen.

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	Build Sheet	(Synonyms: Tray, Platen, Build Plate, Bed, Substrate and Foundation)—See Platen.
	Build Time	Print time.
C	**CAD**	Computer Aided Design.
	CAGD	Computer Aided Geometric Design.
	CAM	Computer Aided Manufacturing.
	CMB	Chromeleon Backup Archive. File format supported by Stratasys FDM printers.
	Concept Model	The parts that are used early in the design process when alternatives are being conceived. The primary use is for product visualization and design communication.
	Contour	Toolpaths that follow the outline of a region. Regions are defined by contours and then filled with rasters.
	Curl	A distortion of horizontal walls that involve two or more layers in which shrinkage of a newly-formed layer, while adhering to the previous layer, causes those layers to curl.
	Curve	A generic term used to describe any of the planar paths (contained in x-y plane) that are present in the software at every z-layer. Curves are the result of slicing, support generation and toolpath generation.
D	**DDM**	Direct Digital Manufacturing.
	Direct Digital Manufacturing (DDM)	The process of going directly from a digital representation of a part to the final product (finished goods) via additive fabrication technologies.
	Digital Material	Engineered materials manufactured from two or more different constituent materials, according to a digitally encoded three dimensional phase structure design (the DM code), and produced by an additive manufacturing process.

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	Drill Guide	Device that aligns a boring tool and controls the depth of penetration.
E	**Envelope**	The modeling envelope is the space where the part is built. The part must be small enough to fit inside the modeling envelope. The left side of the modeling envelope corresponds to the plane defined by X = 0. The front of the modeling envelope corresponds to the plane defined by Y = 0. The bottom of the modeling envelope corresponds to the plane defined by Z = 0.
	EUP	End-Use Parts.
	End-Use Parts (EUP)	(Synonyms: Production Parts)—The components, sub-assemblies or products that are sold to a customer or put into service.
	Extruder	The extruder draws the filament from the spool, melts it, and pushes it through a nozzle onto the build plate.
F	**Facet**	A triangular element of an STL file that has an outward-facing surface normal.
	FDM	Fused Deposition Modeling. The Stratasys-patented additive manufacturing process that extrudes a filament of semi-molten thermoplastic to build parts.
	Fill	Density of the material inside the 3D printed model. Fill influences the model's weight and strength.
	Fill Style	The pattern of roads used to create the interior of a part. FDM fill styles are Solid-Normal, Sparse, Sparse–Double Dense, Sparse–High Density and Sparse–Low Density.
	Filament	The thermoplastic filament material (both model and support material) that is used to build parts in FDM technology. The filament comes on a spool and is loaded into the 3D printer.
	Finished Goods	Manufactured items that are ready for shipment and sale to the customer. These items may be the final product or a sub-assembly, component or raw material in a receiving plant, or post-processed (such as sanded, painted, and polished).
	Fixture	A device that locates and holds work pieces in manufacturing operations.

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	Foundation	(Synonyms: Tray, Platen, Build Plate, Bed, Build Sheet and Substrate)
	Functional Prototyping	The process of making physical models or parts for design verification and performance testing.
	Fused Deposition Modeling (FDM)	A modeler with a temperature-controlled head that extrudes thermoplastic material layer by layer. A fused deposition modeling machine melts a plastic filament and extrudes it through a nozzle. The melted material is laid down on the build platform, where it cools and solidifies. By laying down layer on layer, the part is built. Fused deposition modeling requires support structures which anchors the parts on the build platform and supports overhanging structures. Through the use of a second nozzle, the support structure can be built in a different material. Several parts can be produced at the same time as long as they are all anchored on the platform. *Source: https://www.additively.com/en/learn-about/fused-deposition-modeling#read-more*
G	**Gantry**	The apparatus that allows the extruder assembly to move around.
	Gauge	Any device for measuring or checking the dimensions of an object.
H	**Head**	Liquefies the thermoplastic modeling material and extrudes it into precise layers that fuse to form the complete model.
	Home	A head and platen position for the FDM hardware. It is the mechanical X = 0, Y = 0, Z = 0 position. (The head is positioned in the left corner of the modeling envelope and the platen is at the top position.)
	Homing	Moves the modeling material head and the platen to the home position. Homing readies 3D Printers and production system for model building, which includes initializing the head and platen locations, XYZ starting coordinates, and purging of material from the tip. This is done automatically when a file is sent to the 3D printer or production system and before the model is built.
	Hygroscopic	A tendency to absorb moisture.

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I	**Insight**	Software used by Fortus® 3D Printers to prepare STL files for 3D print production. This is a powerful software tool that gives users the ability to maximize efficiency of the building process by changing default settings for each layer and creating custom part characteristics (e.g., manipulating the infill, toolpath generation). Once the toolpaths are generated and optimized for the model, the file is exported in the .cmb format (See CMB definition), which will be read by the 3D printer to print the model.
J	**Jig**	A device that locates and holds work pieces in manufacturing operations while guiding or locating tools.
K		
L	**Layer**	A 2D, horizontal cross-section used to additively construct a part. The thickness of each layer is equal to the slice height.
	Layer Thickness	The height of the slices used to manufacture an FDM part. Thicknesses can be 0.005 in. (0.127 mm), 0.007 in. (0.178 mm), 0.010 in. (0.254 mm) and 0.013 in. (0.33 mm). Shorthand for these thicknesses are 5 slice, 7 slice, 10 slice and 13 slice, respectively.
M	**Manufacturing Center**	The designation applied to Fortus 3D Production Systems (e.g., Fortus 400mc™).
	Manufacturing Tools	Any item that plays a role in the production of finished goods. Examples include hand tools, molds and gauges. These are categorized in four areas: patterns; molds and dies; shop tools (jigs); and work holders (fixtures) and gauges.
	Material Jetting	Material jetting machines utilize inkjet print heads to jet melted materials, which then cool and solidify. By adding layer on layer, the part is built. Wax materials are used with this technology. Material jetting requires support structures for overhangs, which are usually built in a different material. *Source: https://www.additively.com/en/learn-about/material-jetting#read-more*
	Material	The substance used by the modeler to build or support the part. This is generally a type of polymer plastic.
	Mesh	Collection of stitched surface patches to represent 3D data model. A way to represent solid objects through polygon division.

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	Modeler	(Synonym: 3D Printer) An additive fabrication machine that manufactures parts. The process forms three-dimensional objects from 3D model data (CAD-generated solid, surface models or Voxel-based models). The designed object emerges as a solid three-dimensional part through the deposition of material, layer-by-layer, also known as 3D printing.
	Modeling Envelope	The space within the modeler where the part is built. The part must fit inside the modeling envelope.
	Mold	A tool with a pocket or cavity for giving a particular shape to something in a molten or plastic state.
N	**Nesting**	Positioning of parts on the tray for optimal build efficiency. Orientation, printing time and material use are common parameters to consider.
O	**Open Curve**	A gap between part boundary contours on a particular layer of a sliced STL file.
P	**Part Boundary Curves**	The outline of the surface of a part at a horizontal cross-section. The part boundary contours are the end result of the slice operation.
	Path	(Synonyms: Road, Bead)—The data used to describe extruder tip position and extrusion properties when building a part on an FDM printer.
	Pattern	Physical representation of a design that is used to produce molds, dies or tools.
	Pedestal	(Synonyms: Base Layer, Brim, Raft and Skirt)
	Perimeter Curve	The outline of a slice.
	Platen	(Synonyms: Tray, Build Plate, Bed, Build Sheet, Substrate and Foundation)—The Z-stage table on which the modeler builds parts. The table moves down in the Z direction so that the extrusion head can build successive Z layers.
	Polygon	A figure with three or more sides. When a polygon has more than three sides, they must all lie on the same surface. *http://docs.mcneel.com/rhino/5/help/en-us/index.htm#popup_moreinformation/polysurface.htm*

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	Photopolymer Jetting (PolyJet)	Photopolymer jetting machines utilize inkjet print heads to jet a liquid photopolymer which is immediately cured by a UV lamp. By adding layer on layer, the part is built. Several materials can be jetted at the same time. Photopolymer jetting requires support structures for overhangs, which is usually built in a different material. The support material is generally a UV curable gel-like material which enables easy removal and leaves a well-defined and smooth object surface. *Source: https://www.additively.com/en/learn-about/photopolymer-jetting#read-more*
	PolyJet Printing	PolyJet 3D printers jet layers of curable liquid photopolymer onto a build tray and instantly UV-cures the tiny droplets of liquid photopolymer. Models are precisely printed in layers as fine as 14 microns (on the Stratasys J750 in High Quality mode) for smooth surfaces and complex geometries. Material properties range from rubber to rigid, transparent to opaque, neutral to vibrantly colored and standard to biocompatible.
	Print Time	(Synonym: Build time)—How long it will take to 3D print a part.
	Purge	The process to clear the extruder head. A purge part may be added to the build tray to provide a path for the extruder head to clear itself while printing the designated CAD design part.
Q		
R	**Raft**	(Synonyms: Base Layer, Brim, Pedestal and Skirt)—See Base Layer.
	Raster	A zig-zag pattern of material extruded from a die, usually used to fill in the area within a contour. This pattern can be adjusted so that there is negative air gap or positive air gap between each toolpath section to create different desired densities for a part.
	Road	(Synonyms: Bead, Path, Toolpath)—The data used to describe extruder tip position and extrusion properties when building a part on a 3D printer.
S	**Self-Supporting Angle**	(Synonym: Supporting Angle)—The minimum slope (measured from horizontal) that allows an overhanging feature to be built without a base structure below it. The recommended default value is generally around 45 degrees but depends upon material, slice modeler and build mode.
	Skirt	(Synonyms: Base Layer, Brim, Raft and Pedestal)—See Base Layer.

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Slice	(Synonym: Layer)—A horizontal cross-section of user-defined thickness that describes the geometry of an additive fabrication part.
Slice Curve	The horizontal outline of a part to be produced. Slice curves will be stacked vertically at intervals consistent with the layer thickness.
Slice Height	See Layer Thickness.
Slice Thickness	See Layer Thickness.
Slicing	The process of taking a 3D data model and dividing it into horizontal 2D thin slices so tool paths can be generated, allowing the printer to print the slices layer upon layer.
Solid Freeform Fabrication (SFF)	Another term used to describe 3D printing and additive manufacturing. More specifically, it typically refers to complex freeform solid objects or models that are made with an additive fabrication process.
Sparse	A fill pattern that produces a semi-solid part constructed of interwoven roads that are separated by a user-defined air gap. Variations include “low-density” and “high-density” where the air gap between rasters is varied larger or smaller.
Stair Stepping	See Stepping.
Stepping	Small, abrupt transitions in the horizontal build plane that are evident on all surfaces not parallel to the X, Y or Z planes. Stepping results from the layer-based procedures of additive fabrication.
Stereolithography Apparatus (SLA™)	Stereolithography machines build parts out of liquid photopolymer through polymerization activated by a UV laser. Parts are built on a build platform inside a vat filled with the liquid photopolymer. The laser scans the surface of the vat to solidify the material. The build platform is lowered into the vat and the part is built layer by layer. Stereolithography requires support structures for overhangs, which are built in the same material. *Source: https://www.additively.com/en/learn-about/stereolithography #read-more*
STL	**ST**ereo**L**ithography file format. See .STL File

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	.STL File	A file format commonly used as input for additive fabrication systems. This file describes only the surface geometry of a three dimensional object without any representation of color, texture or other common CAD model attributes. The file describes a raw, unstructured, triangulated surface by the unit normal and vertices of the triangles using a three-dimensional Cartesian coordinate system.
	STL Model	A Mesh format that represents the surfaces of 3D model data as a mosaic of small triangles. In many ways, an STL model is similar to a simple finite element mesh that uses only triangular elements.
	Substrate	(Synonyms: Tray, Platen, Build Plate, Bed, Build Sheet and Foundation)—See Platen.
	Supports	Scaffold of sacrificial material upon which overhanging geometry is built. Also used to rigidly attach the part to the build platform.
	Support Style	A user-definable build option that describes the pattern and spacing of the base structure that upholds the part.
	Surface Finish	A measure of the texture or roughness of a surface. It is quantified by the vertical deviations of a real surface from its ideal form. If these deviations are large, the surface is rough; if they are small, the surface is smooth.
T	**Tip**	The nozzle through which the extrusion head extrudes the semi-liquid material for building the part. Tip size determines the layer thickness and road width for an FDM part.
	Toolpath	See Road.
	Toolpath Width	Horizontal measure of a road. Toolpath widths are determined by the tip size.
	Tray	(Synonyms: Platen, Build Plate, Bed, Build Sheet, Substrate and Foundation)—See Platen.
U		
V	**Volumetric Pixel or Voxel**	Volume element representing a value on a regular grid in 3D space.

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W	**Warp**	Deformation of vertical walls (generally from too much heat).
	Watertight	(Also Water Tight)—A watertight mesh is one with no holes, cracks or missing features.
	WaterWorks™	A soluble support removal system used for FDM parts.
	Work Holder	Any device that restricts the motion of and positions a part during a manufacturing operation. Examples include vises, clamps, jigs and fixtures.
X		
Y		
Z		

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Our Mission

Stratasys Education is committed to promoting 3D printing in education and bridging the gap between academia and industry. In collaboration with educators and students, we're providing learning tools and resources for universities, vocational schools, high schools and elementary schools, as well as for research and informal study.

Reshaping What's Next

3D printing technologies were developed in the 1980s, but only recently have they become more popular and available to professionals and students. The Industrial Revolution and the Information Age have unlocked the potential to create, innovate and fabricate concepts and ideas with the help of computer aided design and additive manufacturing.

3D printing is advancing rapidly, making its way to consumers and reshaping manufacturing in the 21st century. The way we know manufacturing today might completely change tomorrow. 3D printing opens up inspiring possibilities and opportunities, such as the ability to produce a fully functional "machine" in one print. It is the only manufacturing process that can interlock parts within parts to produce functioning closed systems that require no assembly.

Furthermore, because 3D printers produce objects directly from computer models, users can immediately hold, evaluate, test and use their ideas – and share them digitally with the world. The Internet revolutionized the creation, modification and dissemination of digital media. Now, 3D printing makes that possible for physical objects.

Recognizing education as the foundation for career readiness, and to support its means to drive future innovation, we're providing this glossary. We hope it will aid the communication between students, professors and industry professionals, or between any 3D printer users.

This glossary is a living document; open to additions and changes. If you have a suggestion or comment, please contact us at research@stratasys.com.

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