SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF AEROSPACE ENGINEERING

19ASZ401 – 3D PRINTING FOR SPACE COMPONENTS
IV YEAR VII SEM
UNIT-II DESIGN FOR ADDITIVE MANUFACTURING
TOPIC: DESIGN FOR AM

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Topics Covered

- How FDM Works
- Support Material
- Think Outside the Box
- Layer Resolution and Part Height
- Radius Corners
- Remove Excess Material
- Avoid Unnecessary Supports
- Bridges
- Z Axis Holes and Perimeters
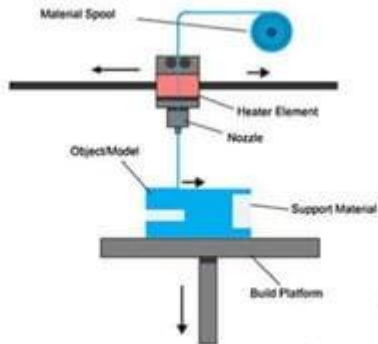- Part Strength and Layer Direction
- When in Doubt Consult the Manual

How FDM Works

▶ FDM printers extrude a thermoplastic from a nozzle onto a build platform

▶ Builds part layer by layer
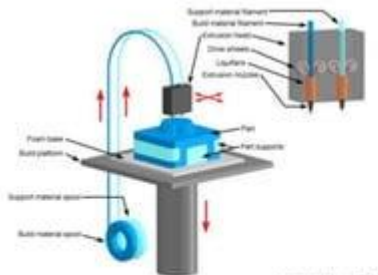
Support Material

Dissolvable

- 2 Types
  - Dissolvable
    - More freedom of design
    - Better surface finish on underside of part
    - Ability to easily clear supports from internal passages
  - Same as part material
    - Rough finish on supported areas of part
   - Removed by mechanical methods

Same as material

Think Outside The Box and The Complexity Paradox

▶ AM offers a wider range of design possibilities

▶ Use generative design and topology optimization when possible/practical

▶ Large degree of design freedom eliminates the need for sub assemblies in some cases

▶ Lattices and organic structures

Original Part (Design Space)

Multi-Load Case TopOpt

Faceted Model Result
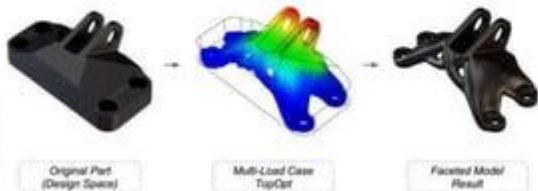
Layer Resolution VS. Part Height

► When possible part height should be divisible by layer resolution (layer thickness) to ensure accurate part height.

► Printer can only print multiples of the layer height in the z direction so if the part is not divisible by the layer height the part my end up shorter that designed.

► Example1: Part is 16mm tall and layer height is .1mm than the part is sliced into 160 layers

► Example 2: Part is 56.58mm tall and layer height is .1mm than part would be sliced into 565.8 layers. Not possible.

Radius Corners/Add Fillets

- Radius corners to speed up print times and reduce bulging in corners
- Add fillets to intersections of thin features to add additional strength

Remove Excess Material

► Remove unnecessary material from designs to reduce part cost
► AM is opposite of CNC where you may leave material to reduce machining costs

Avoid Unnecessary Supports

▶ Use self sustaining angles when possible
  ▶ A self sustaining angle is 45 degrees or more

Avoid Unnecessary Supports

▶ Use self sustaining part geometry for the entire part not just potential overhangs
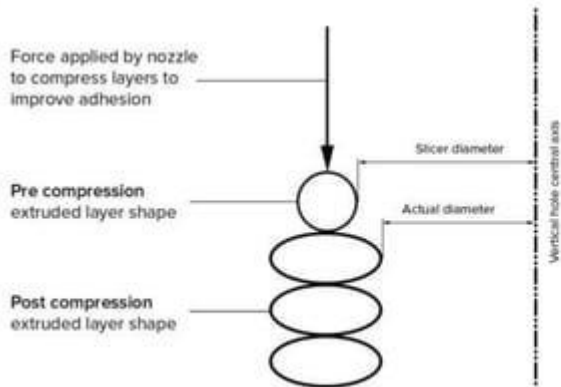
Bridges

- Bridges span the cap between two features.
- Keep bridges short and avoid when possible
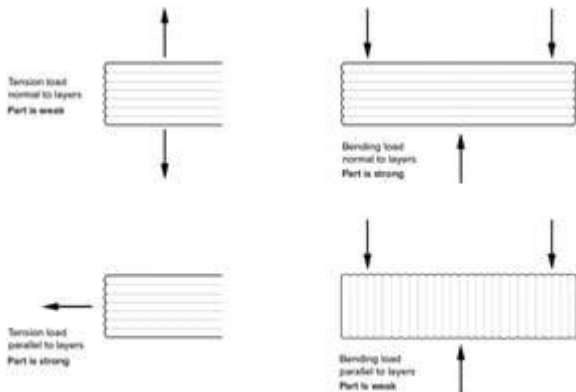- Longer bridges will sag

Z Axis Holes and Perimeters

▶ Expect holes in some cases to be smaller than nominal diameter
▶ Expect parts overall to be larger than nominal dimensions

Force applied by nozzle to compress layers to improve adhesion

Slicer diameter

Actual diameter

Vertical hole central axis

Pre compression extruded layer shape

Post compression extruded layer shape

Part Strength and Layer Direction

► Part strength is significantly impacted by the layer orientation
► Orient part correctly on the build platform to provide strength in key directions

Tension load normal to layers
Part is weak

Bending load normal to layers
Part is strong

Tension load parallel to layers
Part is strong

Bending load parallel to layers
Part is weak

When in Doubt Consult the Manual

► Each printer is different so it is best to consult the manufacturer's design guides for best results

THANK YOU