AUTODESK UNIVERSITY

Using Part Consolidation to Optimize Parts for Additive Manufacturing

Alexander Jones
Engineer, 3D Printing

Luke Ice
Staff Engineer, 3D Printing

Course Agenda

- **Introduction to Additive Manufacturing**
  - What is Additive Manufacturing
  - Unique design capabilities with 3D Printing
- **Understanding of Part Consolidation**
  - The Benefits of Part Consolidation
  - Motivations of using Part Consolidation
- **Example of Part Consolidation**

Introduction to Additive Manufacturing

What is Additive Manufacturing?

Image Source:
3D Hubs

- Additive Manufacturing (AM) is the process of additively building up a part one layer at a time
- 3D Printing (3DP) and AM are often used interchangeably
  - 3DP is the technology
  - AM is when it is used to manufacture something
- There are several different types of 3DP ranging from extrusion technologies to laser-based technologies
- Many materials can be 3D printed including metals, polymers, ceramics, and even biologics

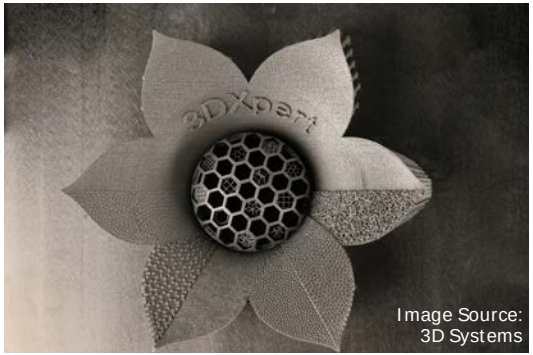
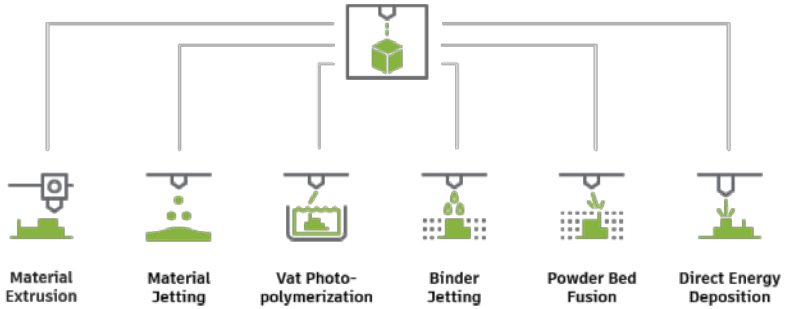


Image Source:
3D Systems



Unique Design Capabilities with 3D Printing

Design Advantages help Enhance Part Functionality!

As-Printed Assemblies

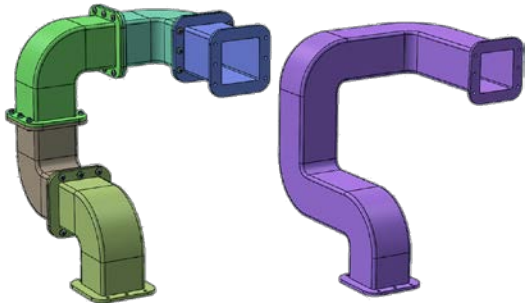
Assemblies can be 3D printed in the assembled form to remove any assembly steps and prevent disassembly

Image Source: Materialise

Light-Weighting

Lattice and Generative Design methods can be utilized to reduce the weight of the part

Image Source: Diegel O., Nordin A., Motte D. (2019) Guidelines for Part Consolidation.



Part Consolidation

Multi-piece designs can be combined into a single part for lower costs and improved functionality

Understanding Part Consolidation

The Benefits of Part Consolidation

- Consolidated assemblies removes the need for parts to be assembled with welding, pinning, bolts, or other methods
- Removes the assembly step, reducing manufacturing time and costs
- Reduces the number of parts reduces potential for tolerance stack and alignment issues
- Creates easier change over processes

- Part count reduction 20:1
- Production time reduced by 75%
- A better, lighter part
- Assembly errors eradicated

Image Source: 3D Systems

Motivations to Use Part Consolidation

Ensure there are benefits from using part consolidation methods

Image Source: APS Fulfillment

Reduce the Number of SKUs

Image Source: The Architect's Newspaper

Maximize Structural Integrity

Image Source: Tulsa Welding School

Reduce Assembly Processes

Example of Applying Part Consolidation

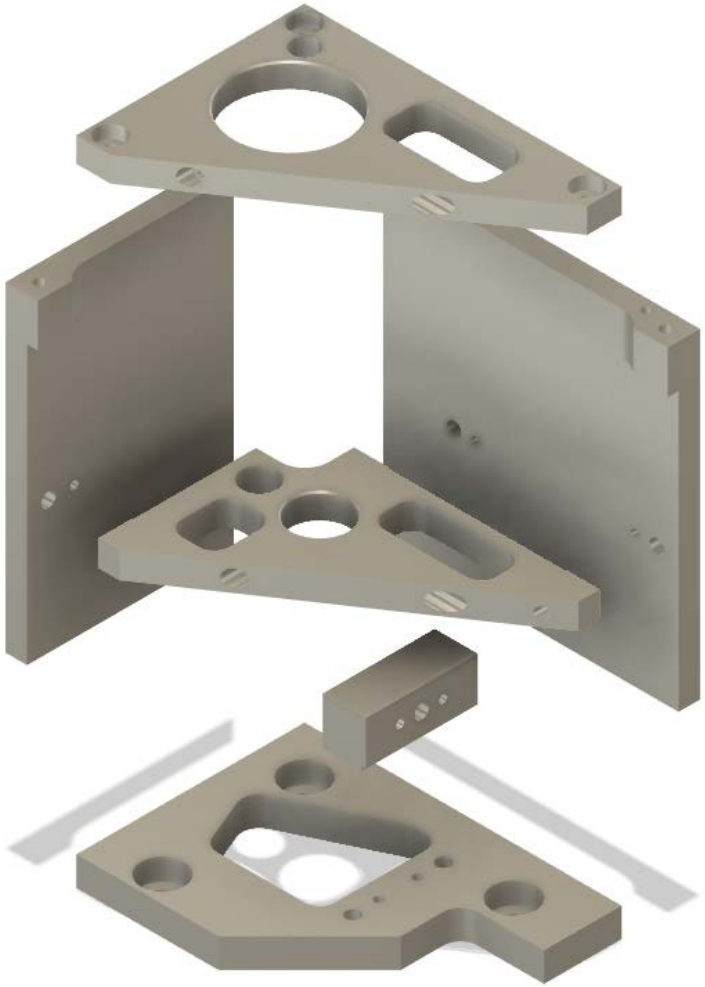
Part Consolidation

Original Part

Total of 6 parts

The original assembly of parts is a bunch of machined plates that are then welded or fastened together.

This current method is not ideal for this application due to the precision required to align the parts and potentials for tolerance stack-up issues



Part Consolidation

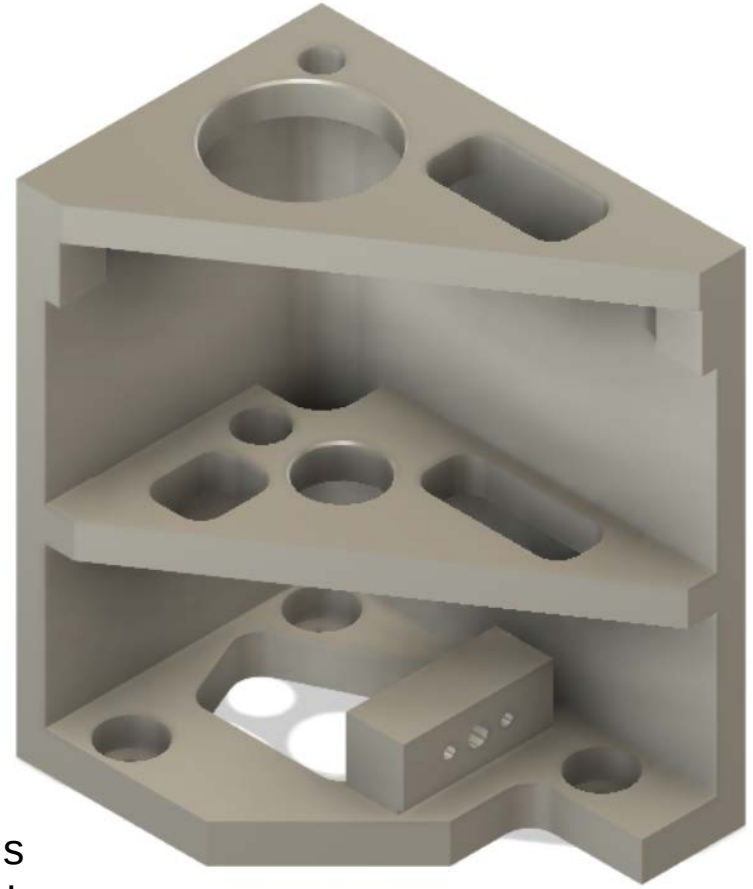
Merging all the elements into 1

Total of 1 Part | Volume = 77,640.4 mm^3

Using a 3D CAD software (e.g. Fusion360) the parts can simply be merged into one single body.

Fillets and other small modifications are often added to ensure printability

This single-bodied part can then be exported and sent to the 3D Printer



Note: It is key to keep in mind the design considerations for 3D printing. Often modifications to the consolidated design are done for successful printing

Part Consolidation

Using Generative Design to Further Optimize

Total of 1 Part | Volume = 9,014.8 mm^3

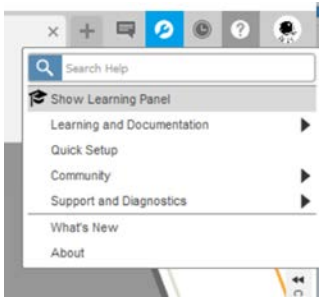
The part can be further improved by removing all excess material

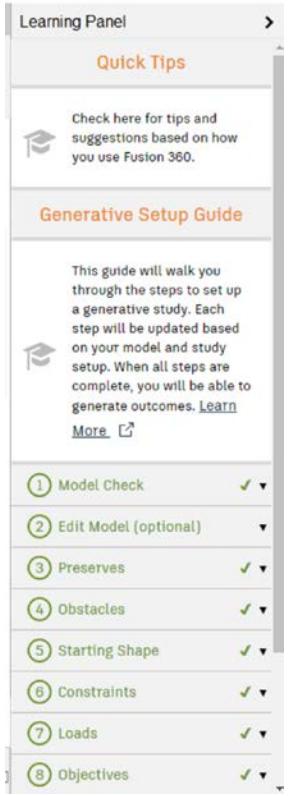
Generative Design software uses the stresses seen by the part to calculate where the material is required and removes all excess material

Note: Not all Generative Design outputs are 3D printable. Need to specify the desired manufacturing method.

Fusion 360 Learning Resources

- Learning Panel
  - Be sure to turn on the Learning Panel inside the Fusion 360 software. It provides details about how to use most workspace tabs and tools
- Autodesk Design Academy
  - https://academy.autodesk.com/course/129267/introduction-cad-learn-fusion-360-90-minutes
- Autodesk Learn & Support
  - https://www.autodesk.com/products/fusion-360/learn-support





AUTODESK UNIVERSITY