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Leveraging Generative Design Technology to Enhance Product Design for Manufacturing

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Learning Objectives

- Outline Generative Design best practices for products intended to be mass manufactured by casting or injection molding
- Understand how Generative Design Technology can leverage current product design workflows
- Learn Fusion 360 best practices after achieving a Generatively Designed part
- Outline how Generative Design Technology best practices can enhance plastic product design in the future

Description

Generative design is a hot topic, but existing manufacturing methods like casting and injection molding seem to be hiding behind the curtains. This presentation will focus less so on additive manufacturing and more so on mass manufacturing methods currently being used industry wide. By leveraging existing generative design technology with casting and injection molding best practices, we can re-shape how current product design for manufacturing workflows can be achieved. By demonstrating the capabilities of new generative design technology, this talk will expose the new feature enhancements showcasing a realistic approach to the manufacturing and product design world which can be implemented into product design and manufacturing workflows today.
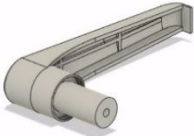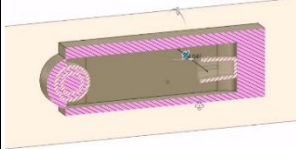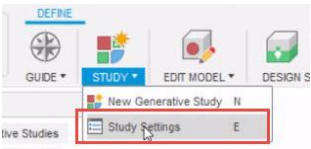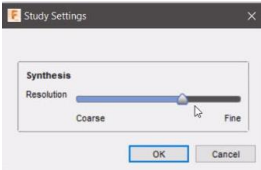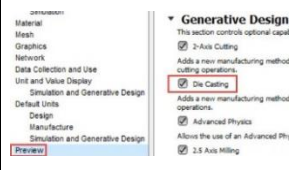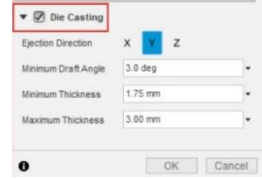
Speakers
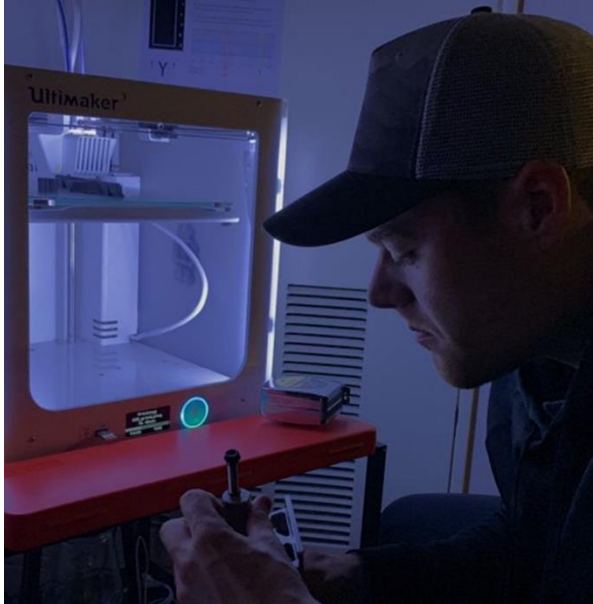
Adam studied Plastics and Composites Engineering at Western Washington University and has gained exposure to a variety of Autodesk products including Moldflow, Fusion 360, and Netfabb. His experience revolves around product design for mass manufacturing, additive manufacturing, and injection molding simulation/analysis. Adam currently specializes in Moldflow at Autodesk and has been doing so for over one year now.

Mason is a degreed plastics engineer from Penn State and started using Autodesk Moldflow in 2003. He has experience with both thermoplastic and thermoset materials, part/mold design, and processing. Mason currently helps Autodesk customers implement and adopt Moldflow simulation tools.

Generative Design Best Practices

Product development workflows continue to change as the technology with which we use day to day evolves. Generative Design presents a new tool to the product development cycle which can accelerate design time, reduce material waste, and connect the product designers with manufacturers. To maximize the potential of this technology, there are some best practices which should be considered first. Generative Design requires knowledge of certain boundary conditions, loading conditions, and constraints to achieve a presentable and usable model design which satisfies all criteria for the ultimate finished product design for mass manufacturing.

Die Casting with Generative Design

1: Original CAD	2: Geometry Removal	3: Obstacle Geometry	4: Study Settings
5: Increase Synthesis Resolution	6: Apply Loading/Constraints	7: Enable Die Casting	8: Assign Ejection Direction, Draft Angle, and Wall Thickness

Exploring Generative Design Outcomes

The outcomes from a setup demonstrated by the best practices above result in multiple different satisfactory designs created by the loading conditions and pre-defined geometry. This leads the product development cycle into secondary operations using Fusion 360 to analyze the model and perform additional geometrical touch where needed.
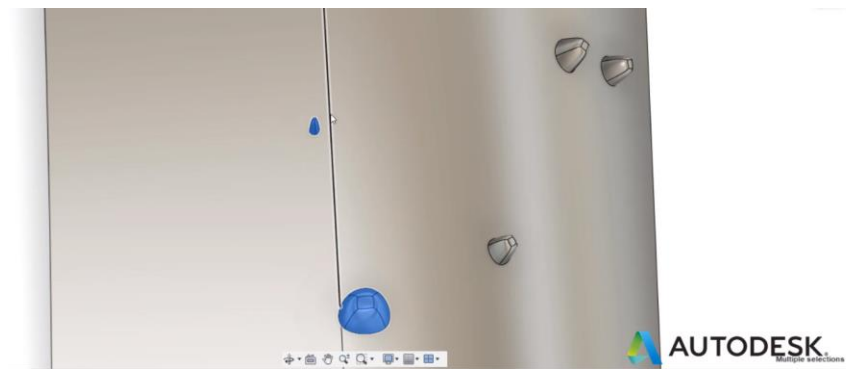

GENERATIVE DESIGN OUTCOMES
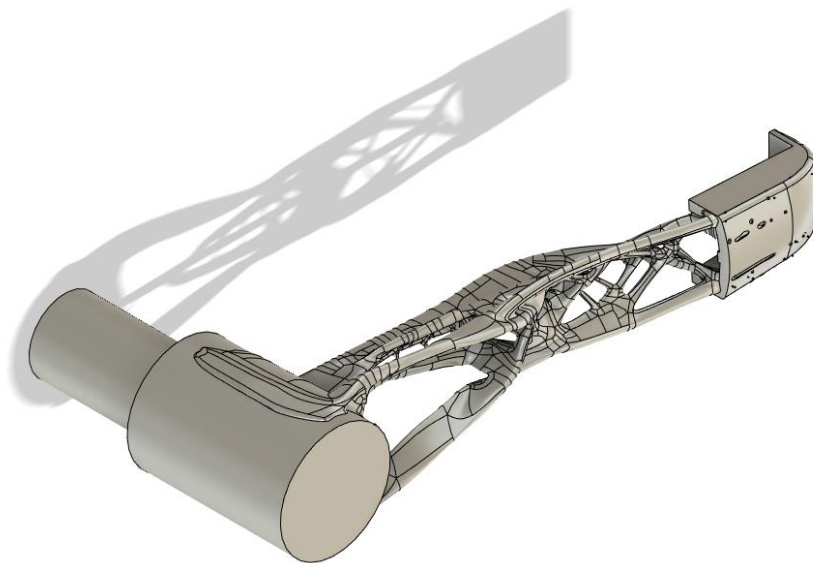
ORIGINAL GENERATIVELY DESIGNED DOOR HANDLE

# Learn Fusion 360 Best Practices after Achieving a Generative Design Part

Once the ideal generatively designed part has been chosen from the various outcomes, additional clean up might be required before simulation, 3D printing or other secondary workflows. Fusion 360 customers can work with either solid CAD geometry or mesh bodies depending on user preference. CAD validation tools, T-Spline technology and traditional CAD modification tools allow part designers to further optimize their designs within Fusion 360.

CAD Modifications

Within the Fusion 360 Design space, designers can select various surfaces and features and simply delete them from the generative design outcome. The use of push-pull technology and historical extrude-cut features can also be used to modify the final part design. Fusion 360 also contains a Validate command that will attempt to repair small gaps, edge inconsistencies and poor surfaces.
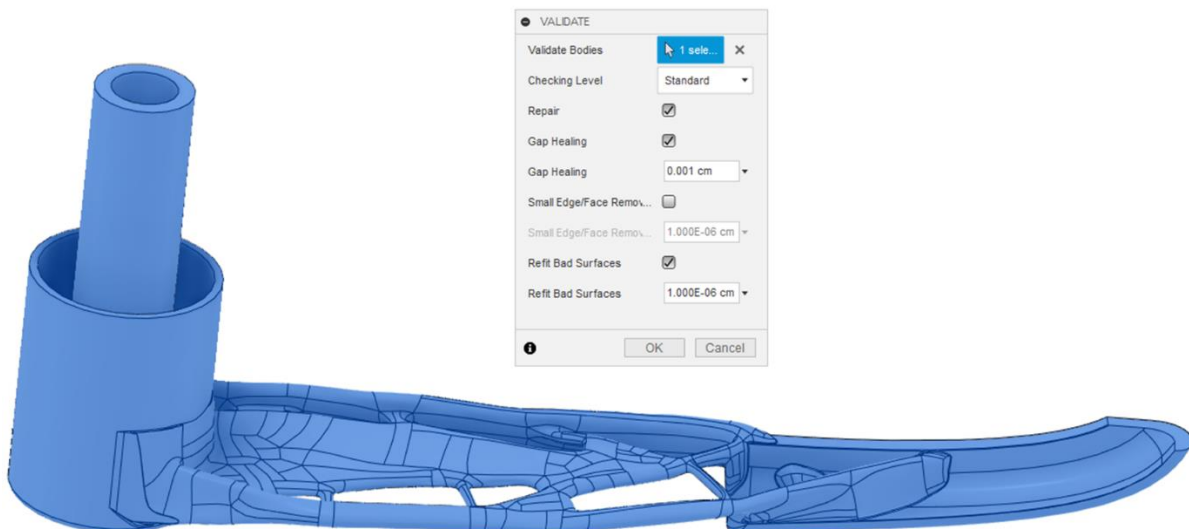

HIGHLIGHT/DELETE FEATURE USED TO CLEAN GENERATIVE DESIGN OUTCOME
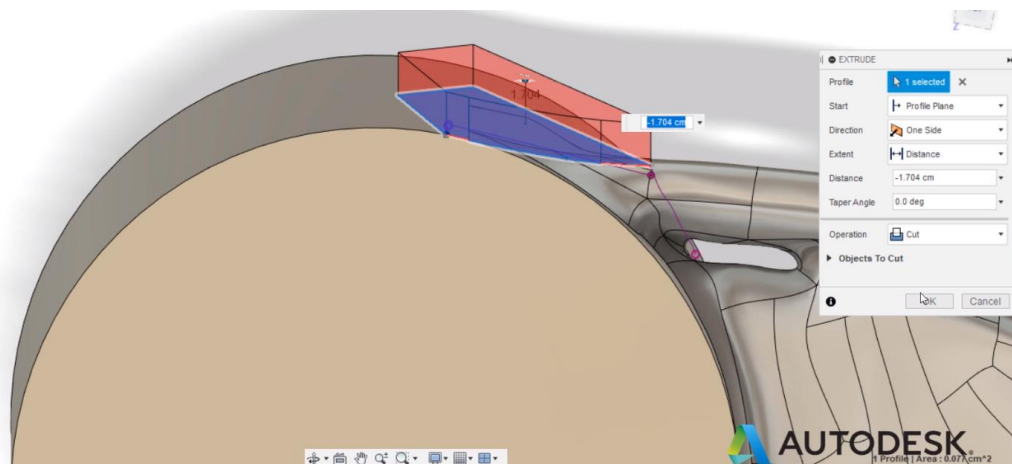
EXTRUDE/CUT FEATURE USED TO CREATE TANGENT EDGE SURFACE
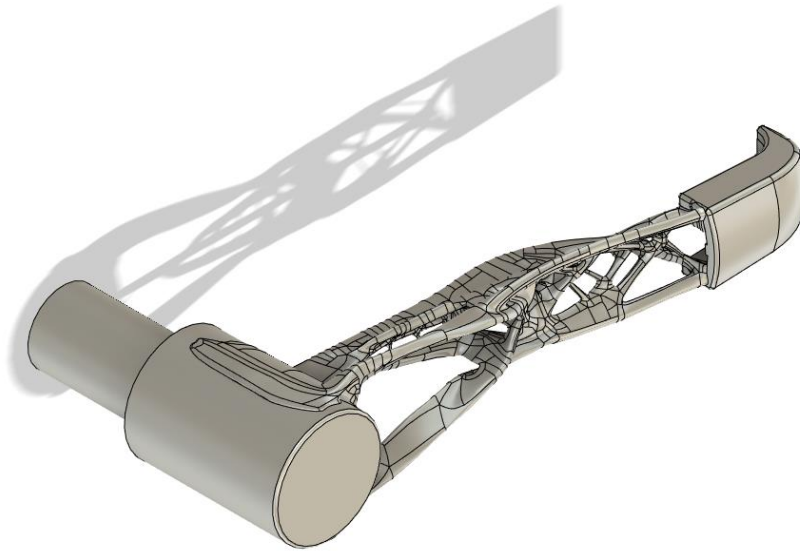
*MODIFIED GENERATIVELY DESIGNED DOOR HANDLE*

VALIDATE COMMAND WITHIN FUSION 360

## Plastic Part Design Solutions with Generative Design

Additional simulation tools can be utilized to ensure that the generatively designed part meets all design criteria and manufacturing methods. Some of these simulation tools can be found with the Fusion platform and others would require the use of other Autodesk products. Generatively designed parts that have been generated using the casting tool can be simulated through Autodesk Moldflow simulation tools.

Interoperability between Fusion and Moldflow

Once generative design outcomes have been validated, Fusion 360 allows designers to send solid models directly to various simulation tools such as Moldflow and CFD. Moldflow users that wish to send solid models back to Fusion for additional modification can also use the Autodesk Fusion 360 Modify tool within Moldflow Insight.
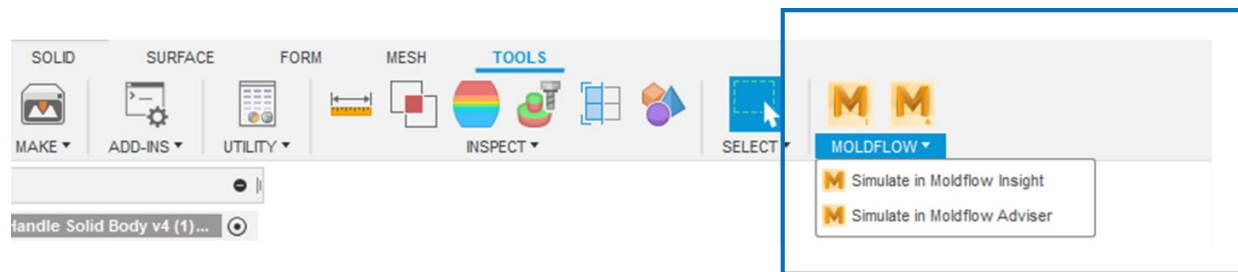

DIRECT IMPORT OPTION FROM FUSION 360 TO MOLDFLOW INSIGHT OR ADVISER
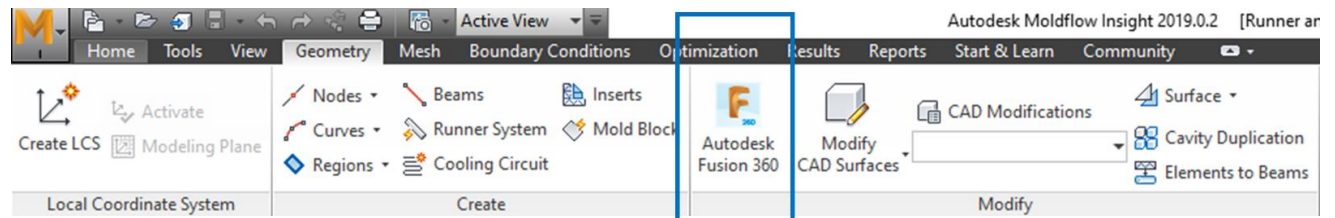
AUTODESK FUSION 360 MODIFY TOOL WITHIN MOLDFLOW INSIGHT

Moldflow Adviser for Thermoplastic Injection Molding Simulations

Moldflow Adviser is a user-friendly thermoplastic injection molding simulation tool that allows plastic part designers to verify their CAD designs earlier within the design cycle. Moldflow Adviser has simple tools such as part only design verification features to evaluate nominal wall thickness, draft angle, and undercuts. Adviser users can also determine optimal gate locations, processing conditions and material selection on various plastic part designs.
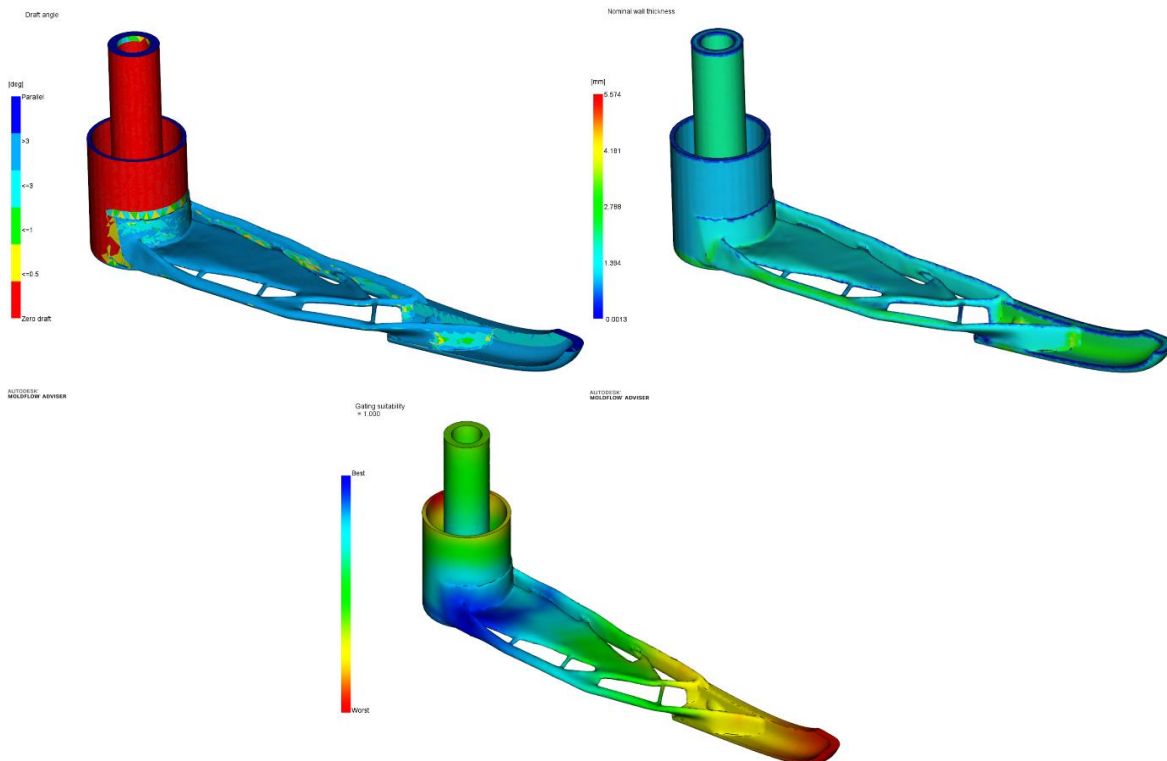

MOLDFLOW ADVISER PLOTS SHOWING DRAFT ANGLE, WALL THICKNESS AND GATING LOCATIONS

## Moldflow Insight for Additional Molding Simulations

Moldflow Insight can also be used to validate generatively designed solutions from Fusion 360. While Moldflow Adviser is ideal for part designers using thermoplastic injection molding, Moldflow Insight has additional capabilities such as thermosetting materials, powdered metal injection molding, and compression molding. Moldflow Insight allows analysts to determine deflection values and reduce these values using Design of Experiment analyses. Process specific results such as powder concentration and shear stress can also be evaluated when looking a metal injection molding.

Powder volume concentration
Time = 30.60[s]

[%]
61.00

59.73

58.46

57.18

55.91
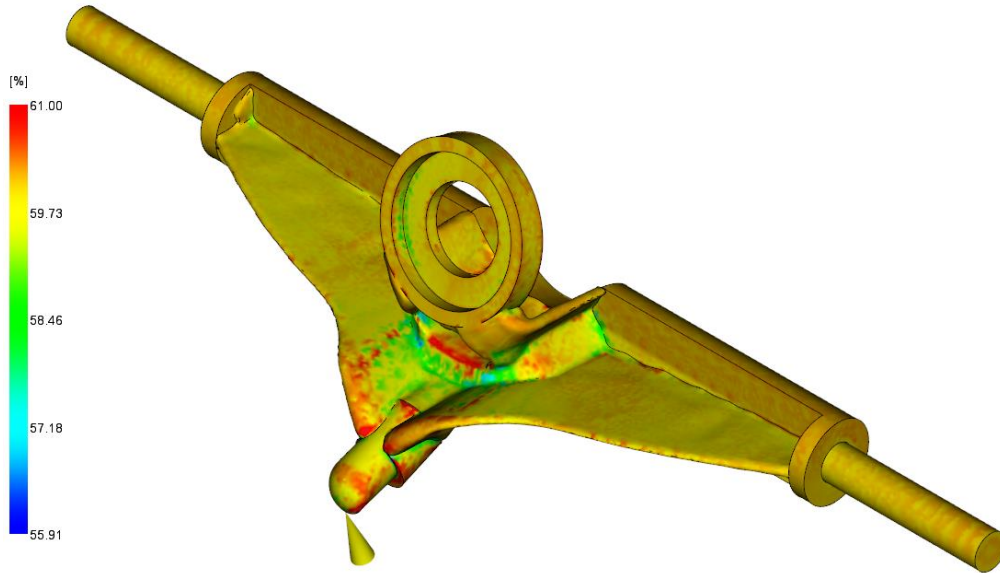
MOLDFLOW INSIGHT PLOT USING METAL INJECTION MOLDING SHOWING POWDER CONCENTRATION

Shear stress at wall
Time = 0.6061[s]

[psi]
49.73

37.30

24.86

12.43

0.0000
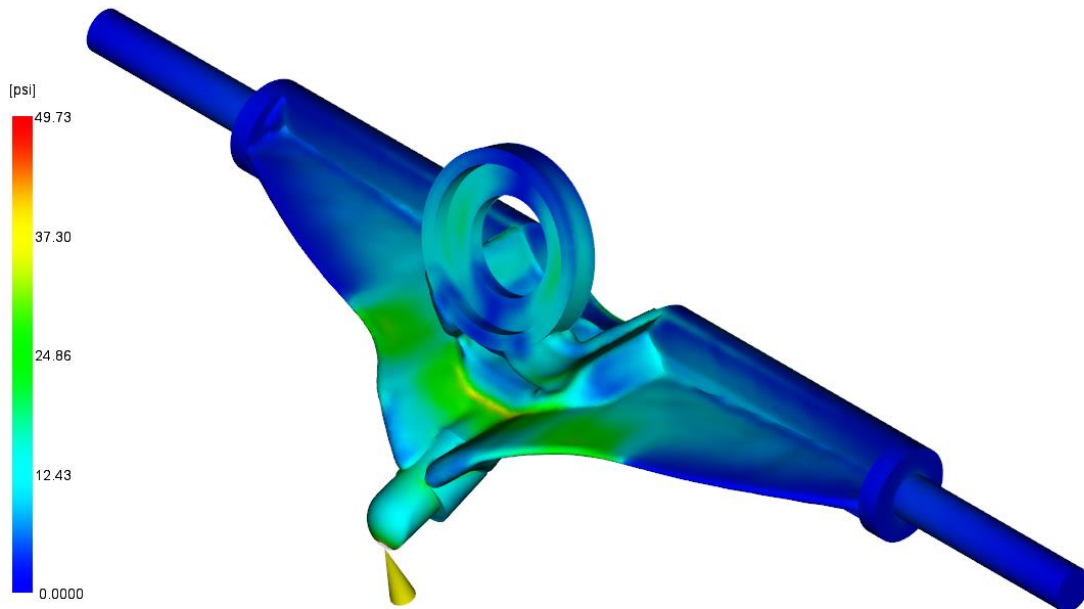
MOLDFLOW INSIGHT PLOT USING METAL INJECTION MOLDING SHOWING SHEAR STRESS