CP9884 - From Art to Part: Plastic Part Design with Product Design Suite

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Class summary

- Do you need to take a concept and make it a reality?
- Does that reality include injection-molded parts?
- Do you need to get your design reviewed and approved quickly?

In this class we will look at answers to these questions, and at an even more important question:

- How can we make changes on an overall assembly's shape while still developing individual piece details?

To do this we will explore workflows within Product Design Suite software and add a dash of Moldflow Design for good measure.

Key learning objectives

At the end of this class, you will be able to:

- Discover how to use multibody tools and derived parts in Inventor
- Learn how to set up Moldflow Design to monitor plastic part design
- Discover how to use Showcase to present designs and alternatives to decision makers
- Learn how to use Inventor software's new 3D print environment to set up part creation

About me

- Applications Consultant with Synergis Technologies
- Previously:
  - Design Engineer
    - Plastic part design and testing
    - Tooling approval
    - Co-developed in-house course on injection molded part design

Last words before we start…

- This is a basic level class.
  - Some Inventor experience is assumed, but not expert level.
  - No plastics design knowledge is assumed.
- Further information is available in:
  - Other AU classes –
    - CP11294 Inventor Flexible Modeling
    - CP9911 Get Your Inventor D(e)river License
    - CP11801 3D Printing With Inventor
    - CP10387 Combining Inventor and 3D Printing in Early Prototype Development
  - Help
  - Resin manufacturer’s design guides
  - Wikipedia, YouTube, etc.

Agenda

- Plastic Part Design Challenges
- Inventor’s Derived Part Workflow
- Inventor’s Multibody Part Workflow
- Inventor’s Plastic Part Features
- Moldflow Design Use
- Showcase Use
- 3D Print Environment Use
- If I’d Had This Back Then – My Workflow

Injection Molded Plastic Part Challenges

Injection Molded Plastic Part Design Challenges

- Functions are combined within parts
- Wide range of geometry possible
- Part Performance
  - Aesthetics
  - Net Shape
  - Strength
- **<u>Designs change frequently</u>**

Injection Molded Plastic Part Manufacturing Challenges

- Expensive tooling
  - – both design and fabrication
- **Minimize Production Costs**
  - **Easy to fill**
  - **Easy to cool**
  - **Forgiving geometry**
- Machine setup – Getting good parts in production

  https://en.wikipedia.org/wiki/Injection_moulding

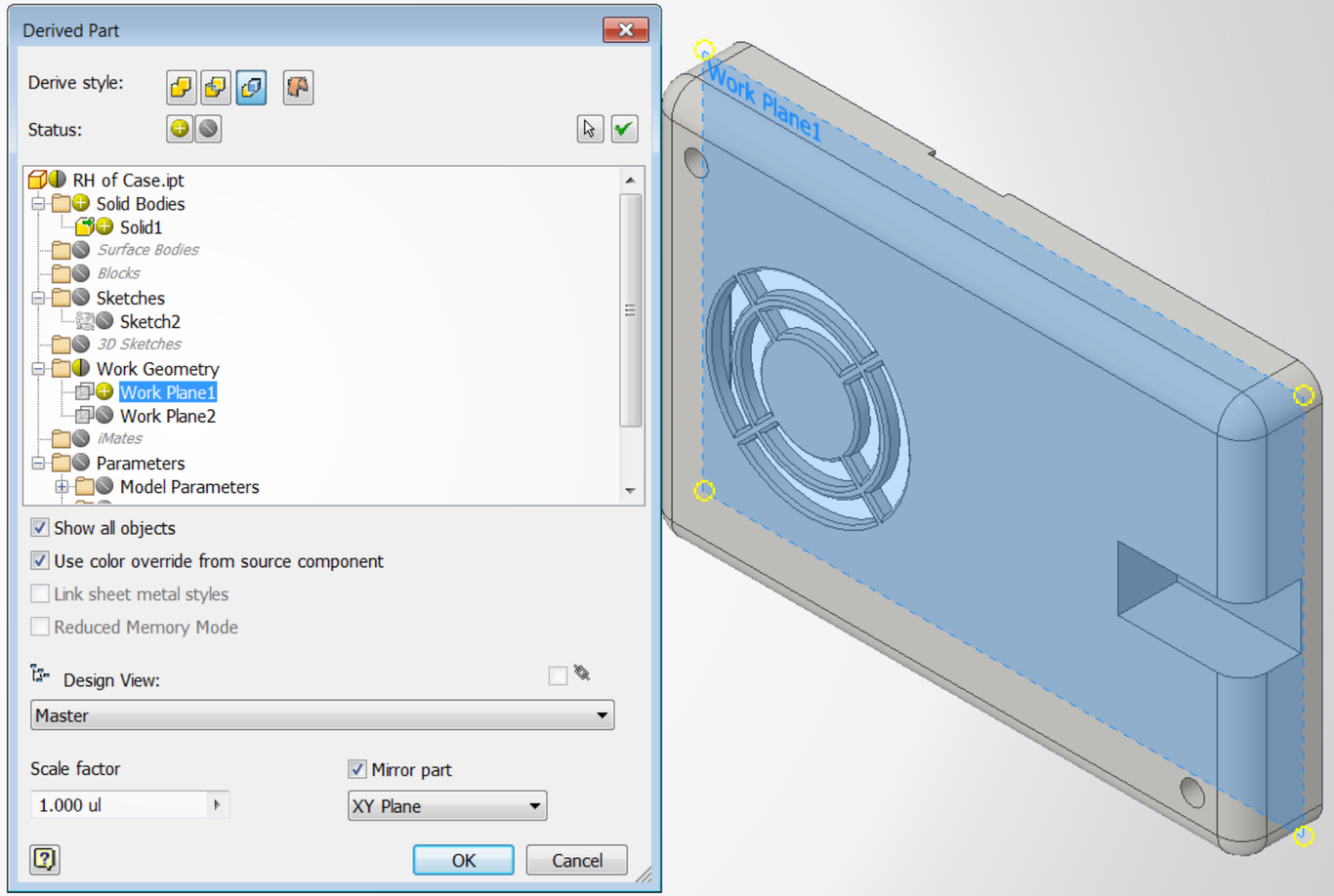
Injection Molded Plastic Part Challenge – Flexible Design

Our tools - Inventor

- Derived Part Workflows
  - Parent/child relationships between components
- Multi-body Part Design Workflow
  - Single part
  - Behaves like an assembly
  - No constraints
  - Separate into an assembly of parts when ready.

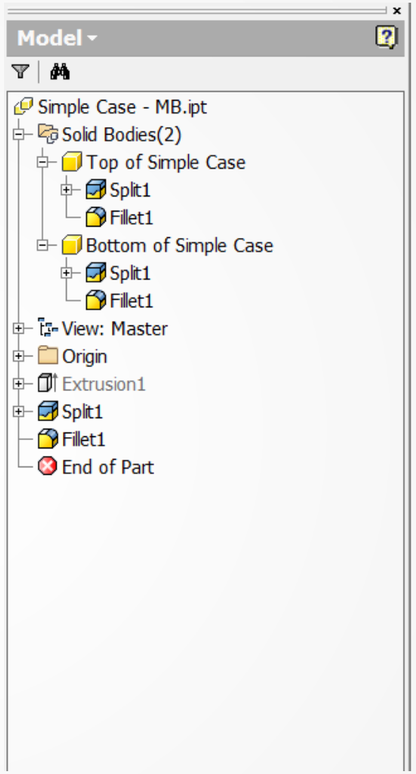
Our tools - Derived Parts

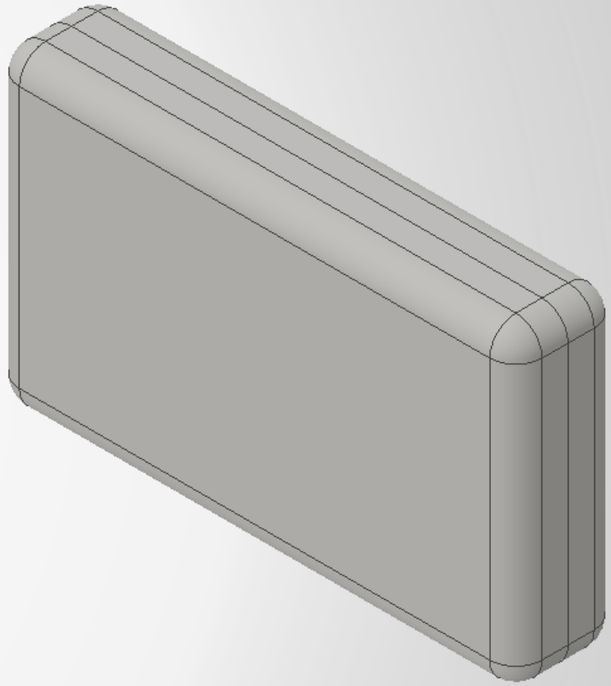
- Parts created from other parts or assemblies.
  - Solid Bodies
  - Sketches
  - Work Features
  - Parameters



Our tools - Multibody Parts

- Parts containing multiple solid bodies
  - Semi-independent bodies
    - Choose which bodies features will affect.
  - No assembly constraints
- Create assembly and parts from part and bodies
  - Derived from part
  - Assign material and BOM info





Our tools – Inventor Assemblies vs. Multibody Parts

Assemblies vs. Multibody Parts	Assemblies	Multibody Parts
Materials	Each part has its own material.	The entire part has the same material.
Colors	Parts can have individual colors.	Bodies can have individual colors.
Constraints	Assembly constraints, joints and other techniques develop relative positions by referencing geometric features.	Built in place. *Move Bodies* to relocate and reorient bodies. Relies on dragging and/or typed coordinates.
Tool bodies	N/A. Use Derived Part workflow for similar result.	*Combine* to join, cut and intersect existing bodies.

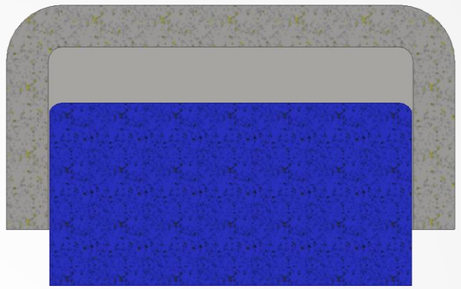
A quick look…

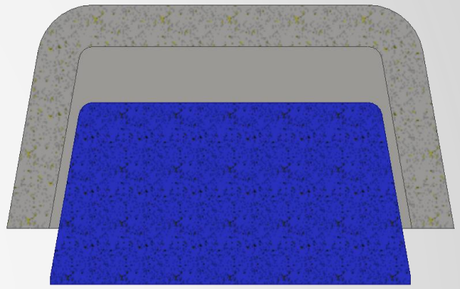
- Derived Part
- Multi-body Part

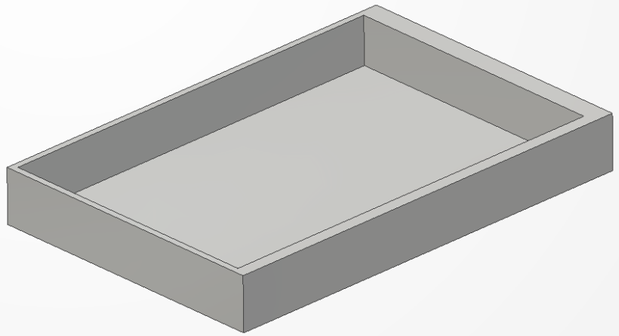
Injection Molded Plastic Part Challenges – Part 2

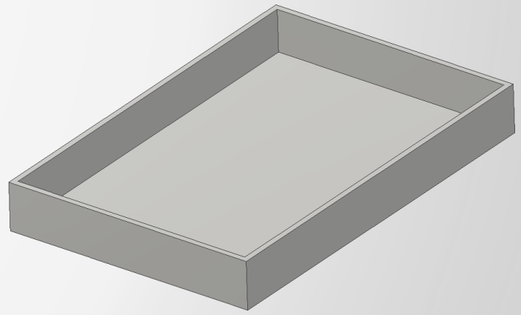
Plastic Part Design Guidelines: Design and Manufacturing Challenges

- Sufficient Draft
  - Ejection
  - Cooling time
  - Surface finish
  - Overall shape
- Uniform Wall Thickness
  - Filling time
  - Cooling time
  - Warpage



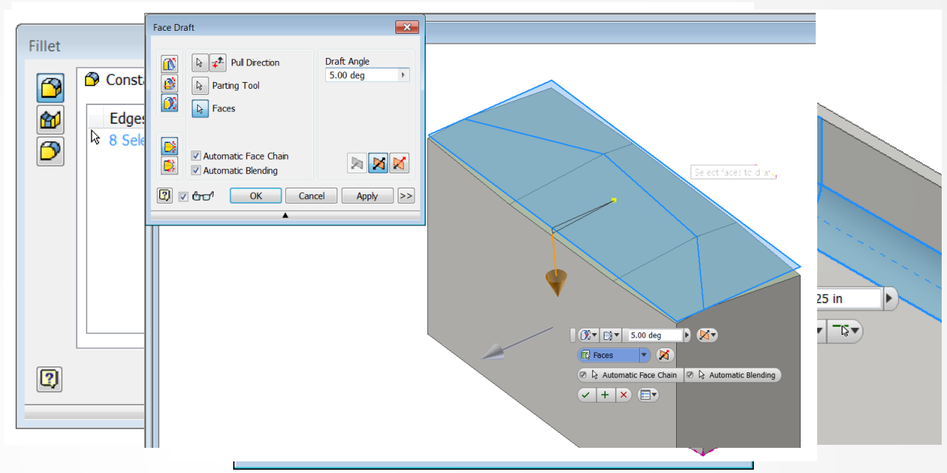


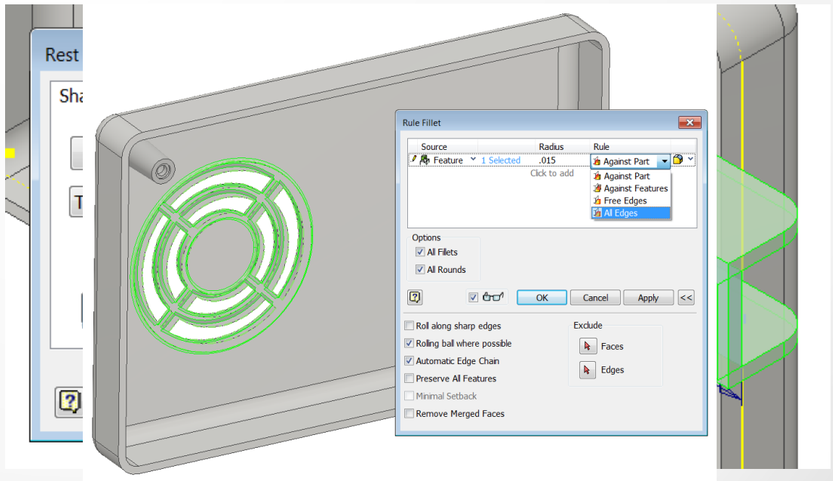




Our tools – Inventor Plastic Features

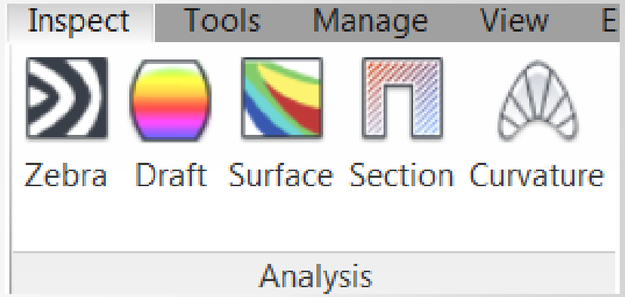
- Extrude – More tab
- Shell
- Fillet
- Split
- Draft
- Plastic Part Features:
  - Grill
  - Snap Fit
  - Boss
  - Ruled Fillet
  - Rest
  - Lip

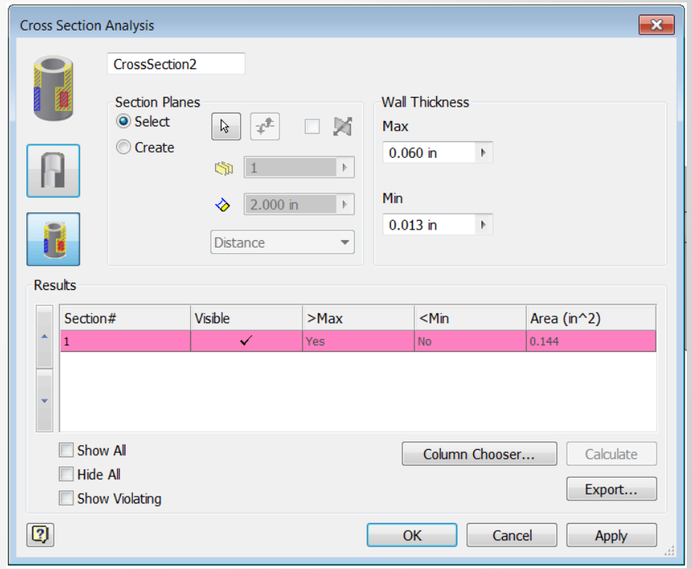




Our tools – Inventor Analysis

- Inventor's Analysis Tools:
  - Zebra – surface blending visualization
  - Draft – slope of faces
  - Surface – surface curvature by colors
  - Section – cross sections' areas and thicknesses
  - Curvature – surface curvature by whiskers





A quick look…

- Plastic Part Features
- Inspection Analyses

Our tools – Moldflow Design

- Mold filling and cost estimation

A quick look…

- Setting up Moldflow Design
- Using Moldflow Design

Our tools – Showcase

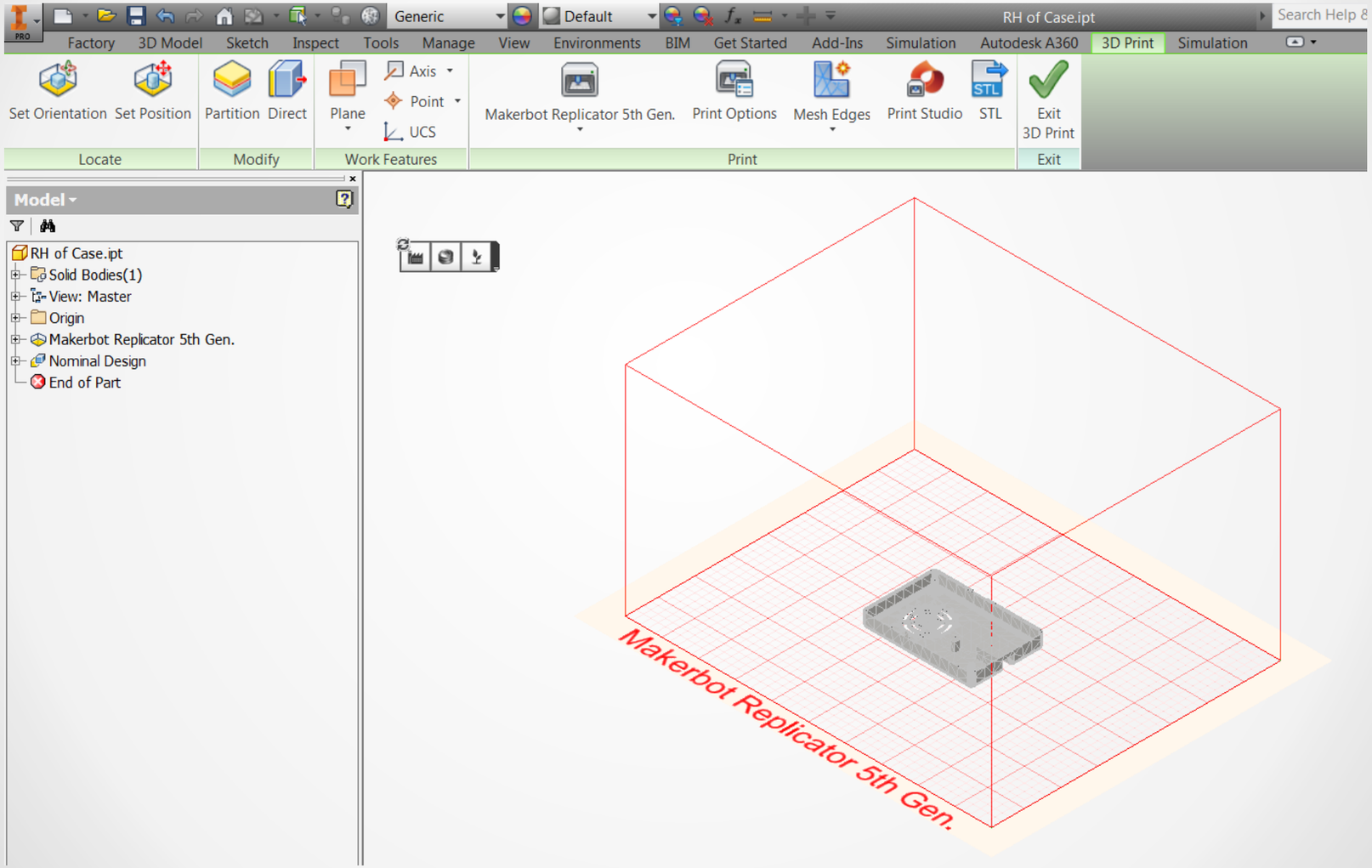
- Product presentation
- Design variations
- Color variations
- Some motion

Our tools - Showcase

A quick look…

- Importing into Showcase
- Assigning Materials

Our tools – 3D Print Environment



A quick look…

- Using the 3D Print Environment

If I'd had this software back then, my typical workflow would be…

- Develop basic rough shape.
  - Hold off on fillets, etc. for now
- Develop surfaces to split bodies.
- Shell bodies.
- Develop rough drafts
  - Often using same surfaces as splits.
  - Depending on needs these two may swap in order.
- Develop details and final aesthetics.
- Run Moldflow Design the whole time.
- Use Showcase for early reviews.
- Create 3D printed samples for final review.

In summary…

- Product Design Suite has a great selection of tools for injection molded, plastic part design.
  - Inventor's Plastic tools aren't on by default.
  - Inventor Professional has even more tools for plastics.
- Showcase is useful to present concepts and designs for approval.
- Moldflow Design can be added for real-time rule checking.

Questions?

- And thank you!

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