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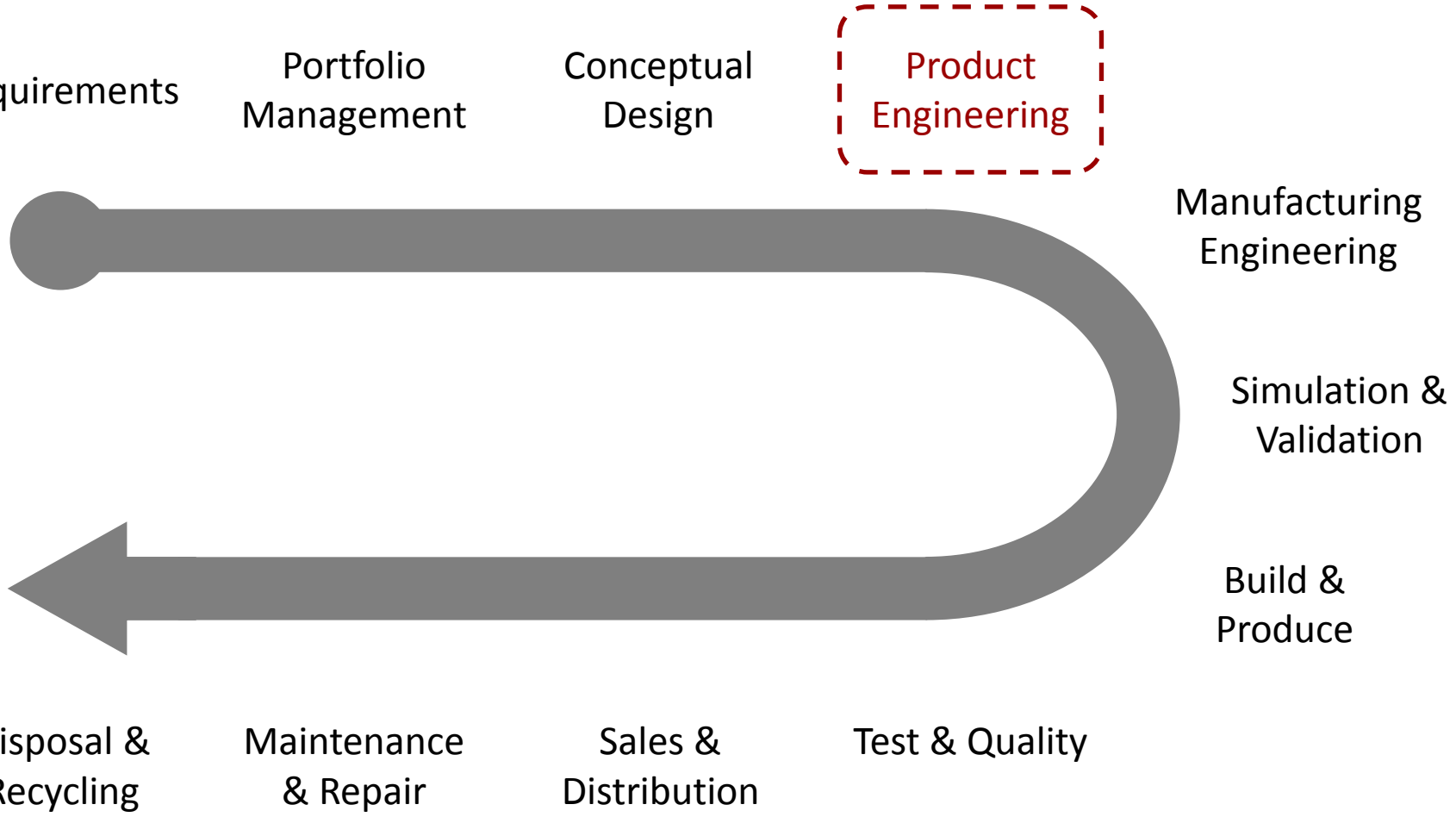
Week 3 - Lecture
Detailed Component Design

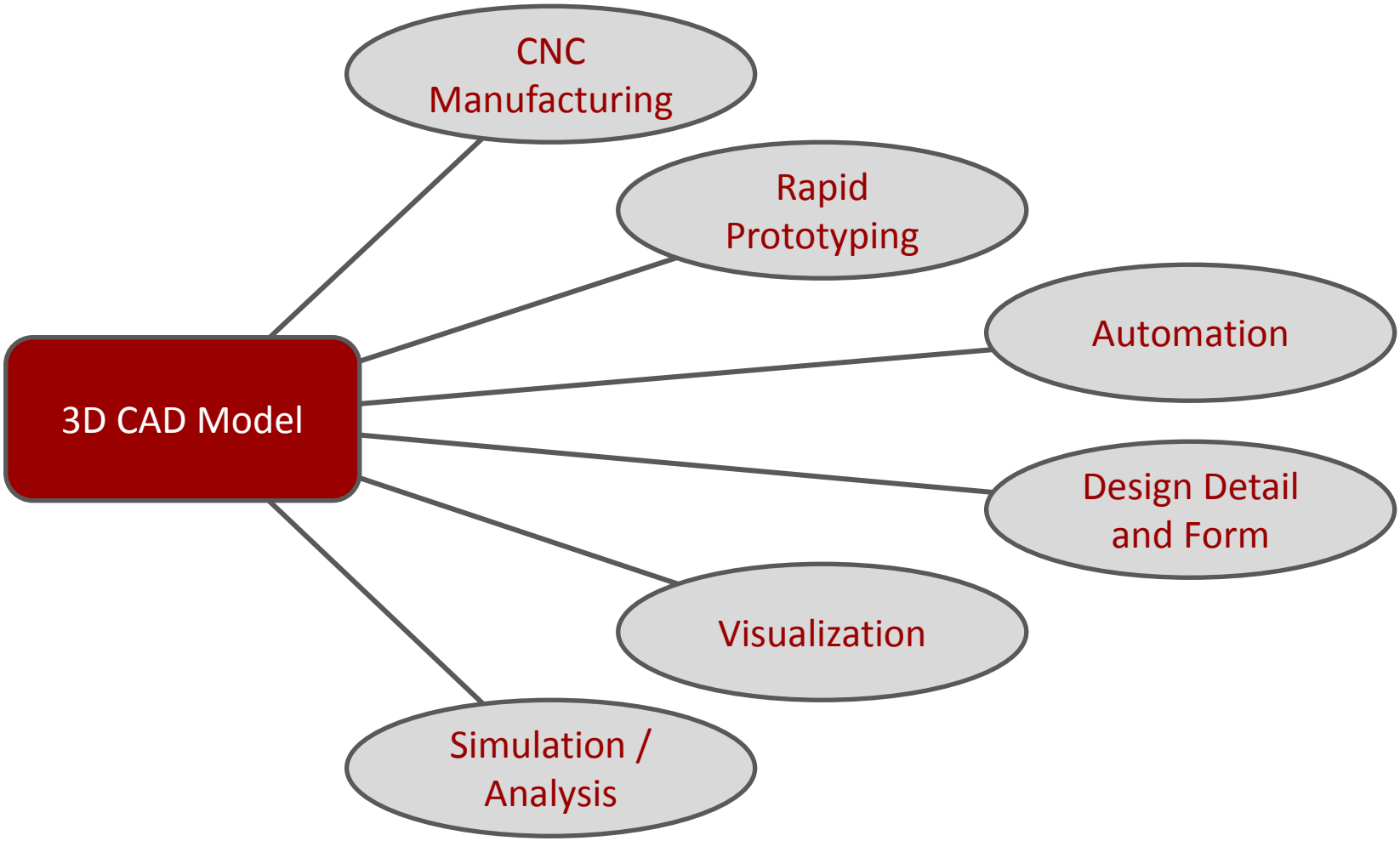
Lecture Topics

- Product Engineering Part 2
- Rapid Prototyping
- Designing for Manufacturing Intro
- Designing Styled Components
- Designing Plastic Components
- Case Study Examples

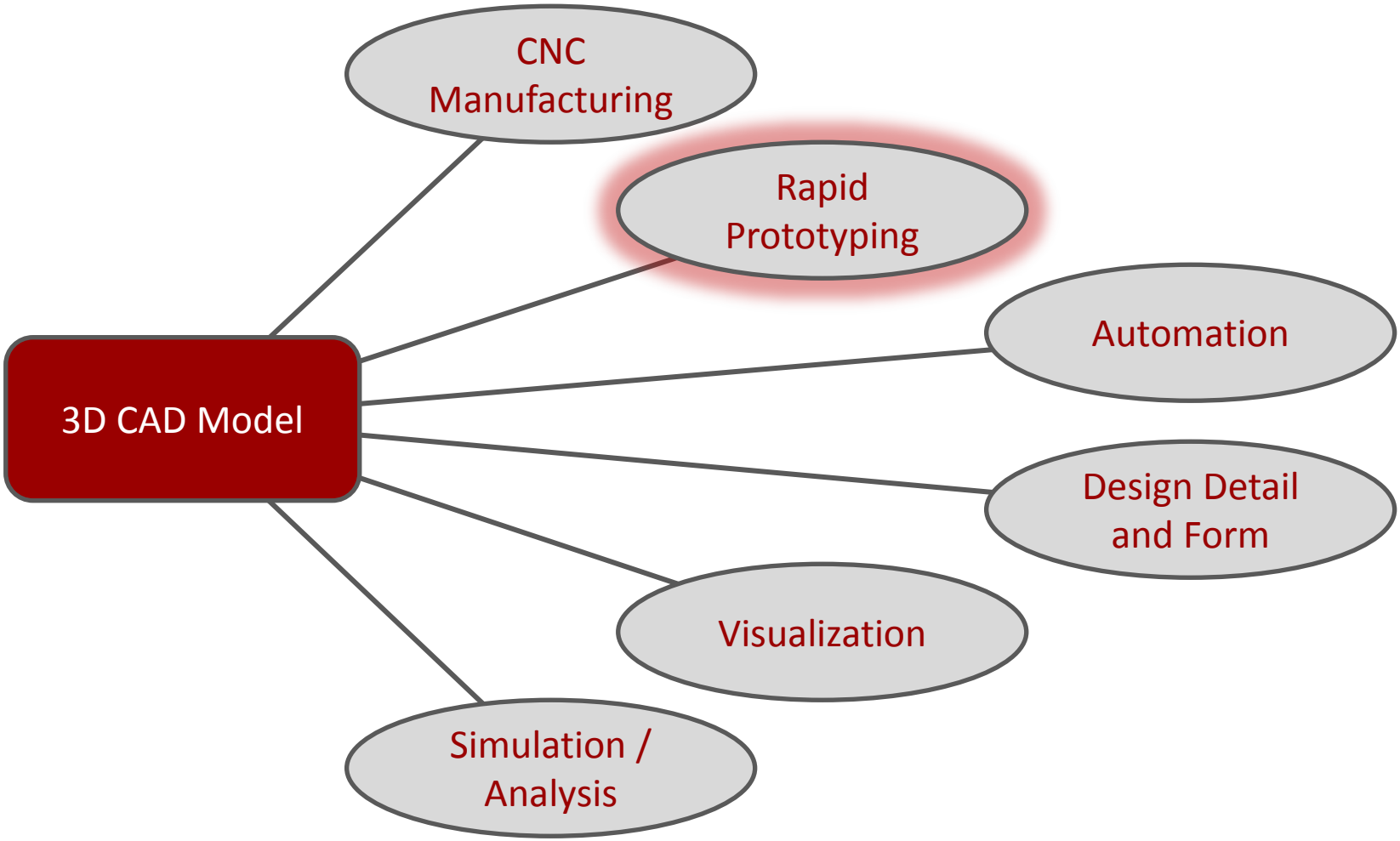
Product Lifecycle – Week 3



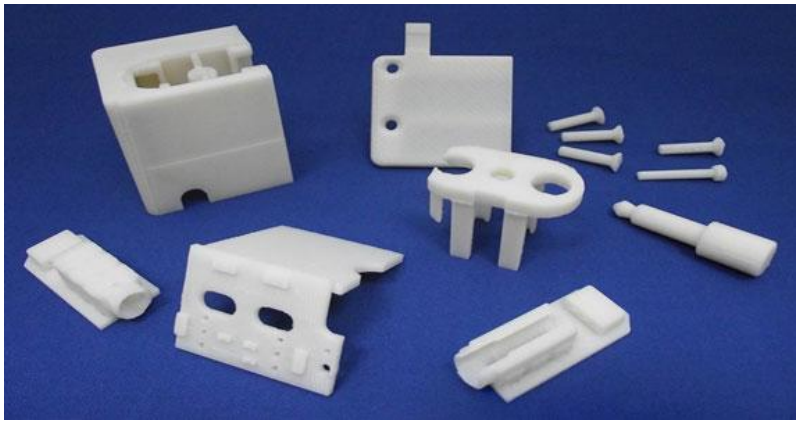
3D Design Use



3D Design Use



Common Terms



- Rapid Prototyping
  - General term for automatic construction of a physical prototype object on a machine.
- Rapid Manufacturing
  - General term for the automatic construction of a physical object that will be used as a production item.
- 3D Printing
  - Process for creating 3D objects from a materials printer. Generally more desktop and affordable machines.

3D Printing Applications

- Concept Models
  - Used to evaluate, optimize, and communicate your designs.
- Functional Prototypes
  - Allow you to test in real-world environments and make decisions.
- End-use Parts
  - Build small quantities of parts that are tough enough for production.

Benefits of Rapid Prototyping

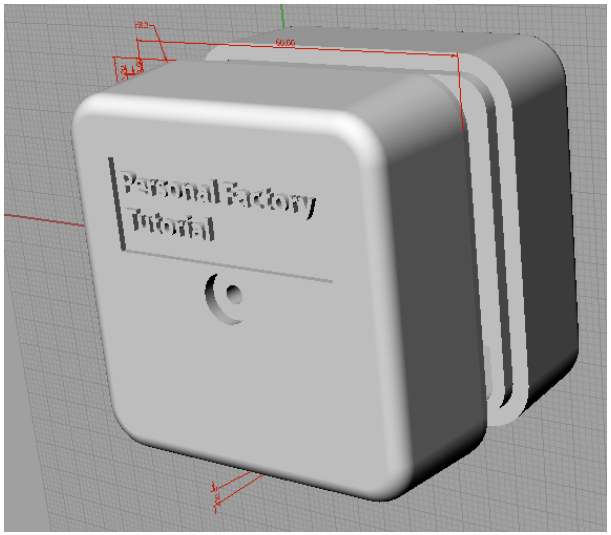
- Time Savings
  - Improve Design
  - Increase Visualization
- Cost Savings / Reduction
  - No prototype tooling and parts
  - Small Qualities
  - Detect design flaws early

Validate Design Form

Functional Prototypes

Considerations

- Tolerances
  - +/- 0.005 inch or +/- 0.0015 inch per inch whichever is greater
- Build Sizes
  - 15” x 14” x 15” (Average)
  - 36” x 24” x 36” (Large)
- Material Properties
  - Wax Based Materials
  - Plastic Based Materials (ABS, Polycarbonate)
  - Metal Based Materials (Newer)

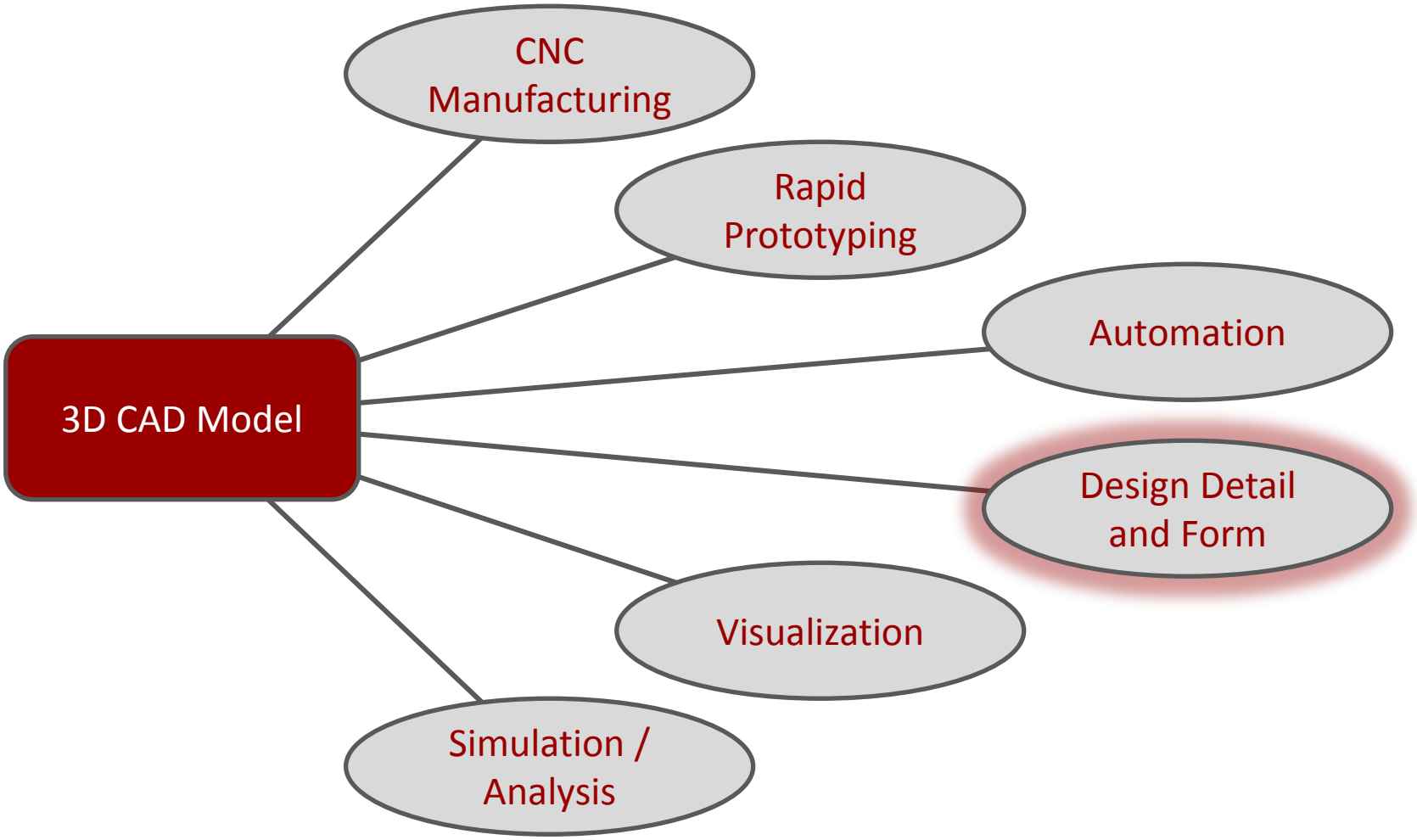


Companies

- Machine Providers
  - Stratasys = www.stratasys.com
  - 3D Systems = www.3dsystems.com
    - Cubify = http://cubify.com
  - Objet = www.objet.com

- On Demand Service Providers
  - Quickpart = www.quickparts.com
  - Proto Labs = www.protolabs.com
  - RedEye = www.redeyeondemand.com

3D Design Use

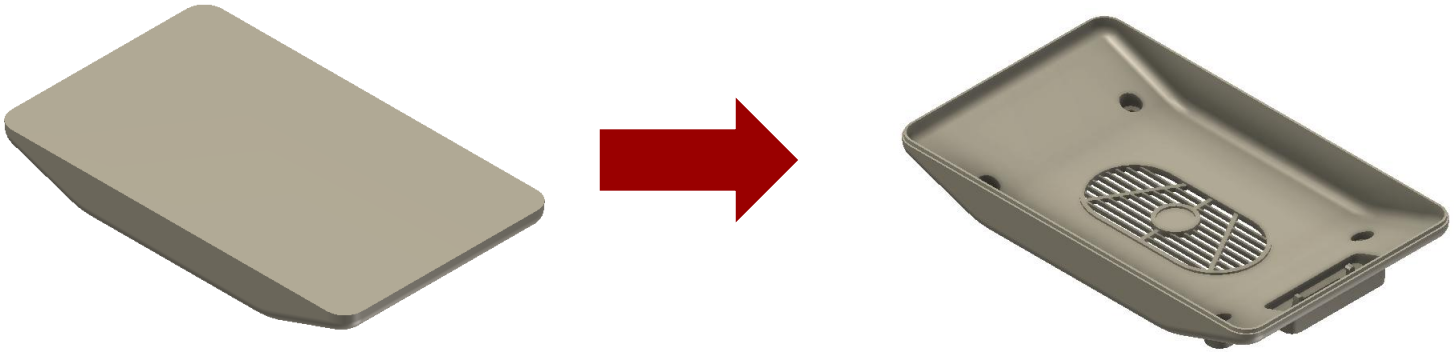


Design Detail and Form

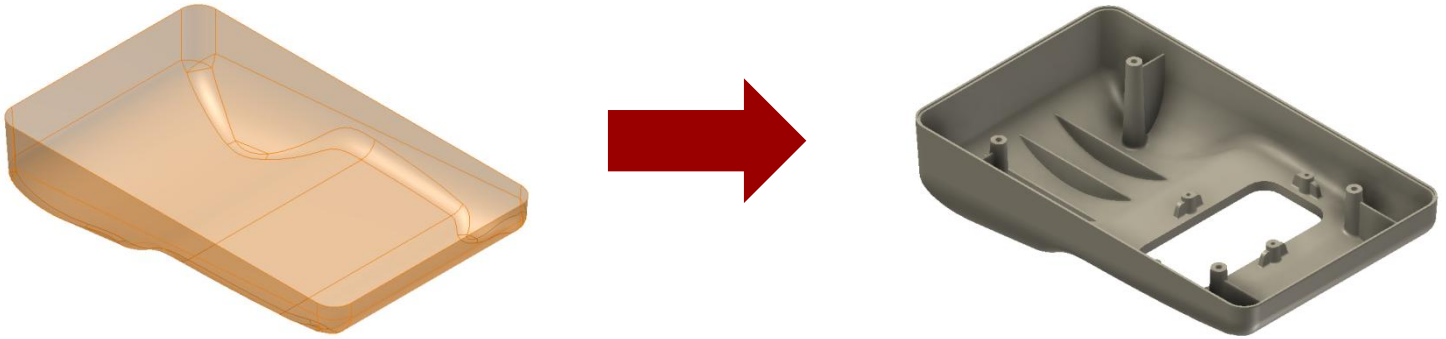
- Complex Parts and Styled Parts

Plastic Part Modeling Methods

- Solid Shell Method

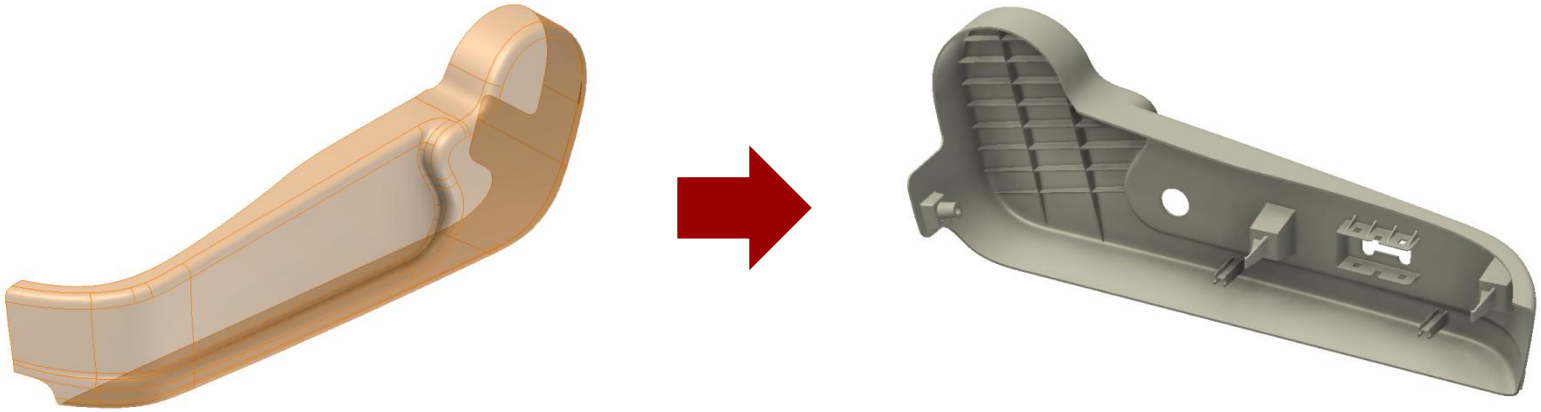


- Surface Thicken Method



Designing Styles Parts

- Industrial design products like Autodesk® Alias® support rapid creation and manipulation of complex surfaces and development of Class-A surfaces.

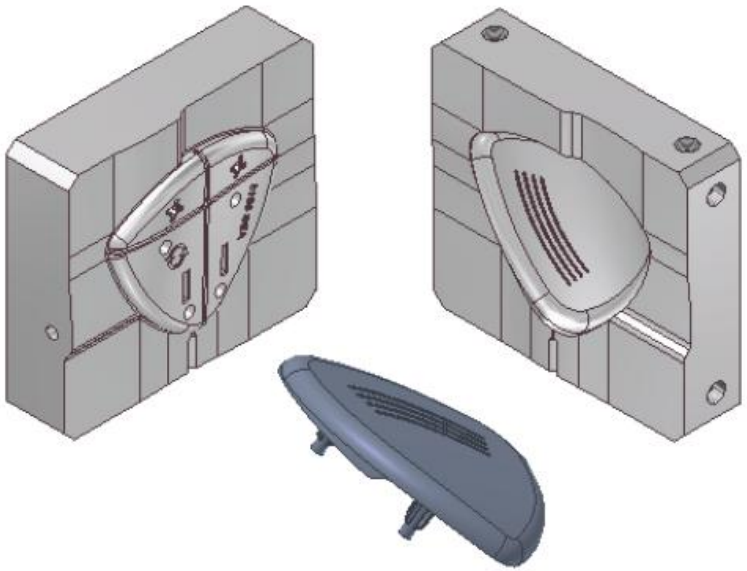


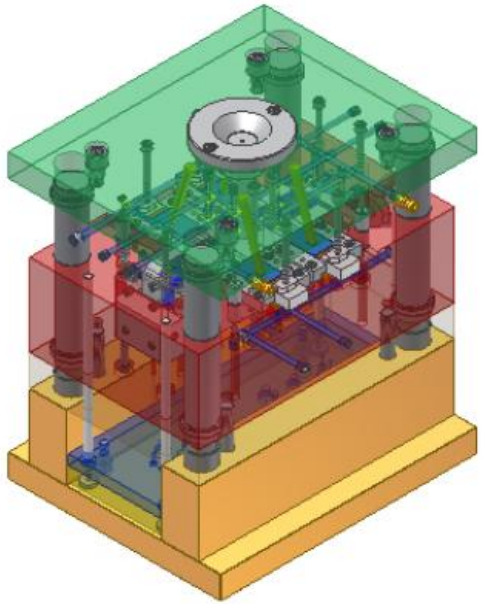
Design for Manufacturing (DFM)

- What is DFM?
  - DFM is the process of proactively designing products to optimize all the manufacturing functions to assure the best cost and quality.
- Why DFM?
  - Lower development cost
  - Shorter development time
  - Faster manufacturing start to build
  - Lower assembly and test cost
  - Higher quality

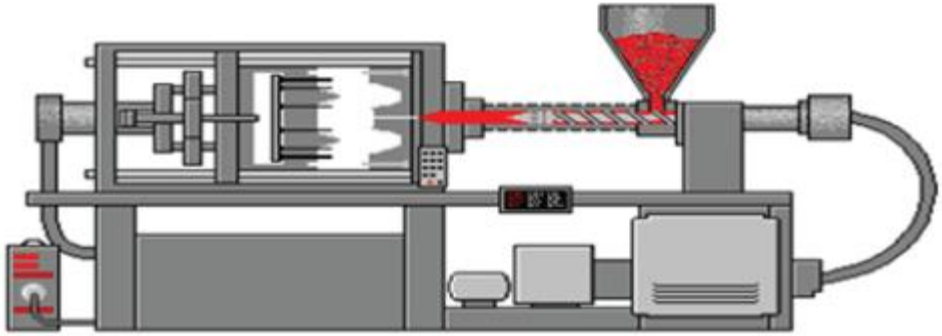
Injection Molding Manufacturing

- The process consists of a mold that normally has two halves that seal together for the filling of melted plastic.





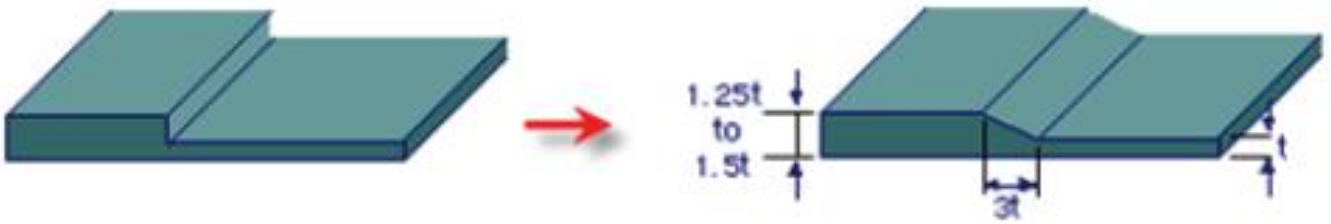
Injection Molding Machines

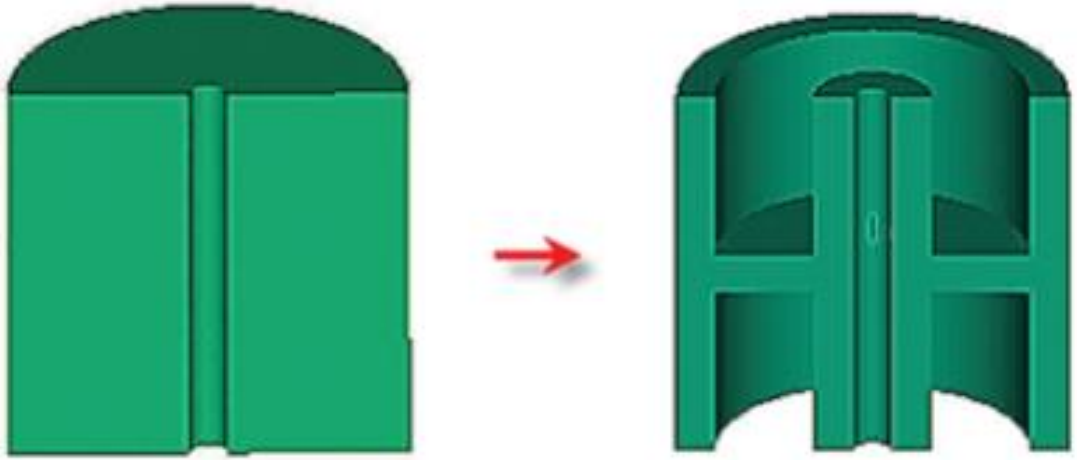


Good Plastic Injected Part Design

- Most critical factor is keep the part wall thickness uniform throughout part.
- Have proper draft angle on part to ease ejection from mold. (0.5 – 2.0 deg.)
- Avoid undercuts requiring slider cores when possible to avoid complexity.
- Avoid sharp corners by adding radius.

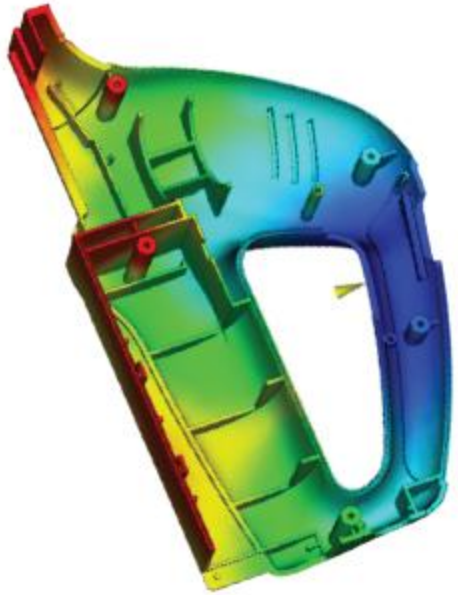
Examples

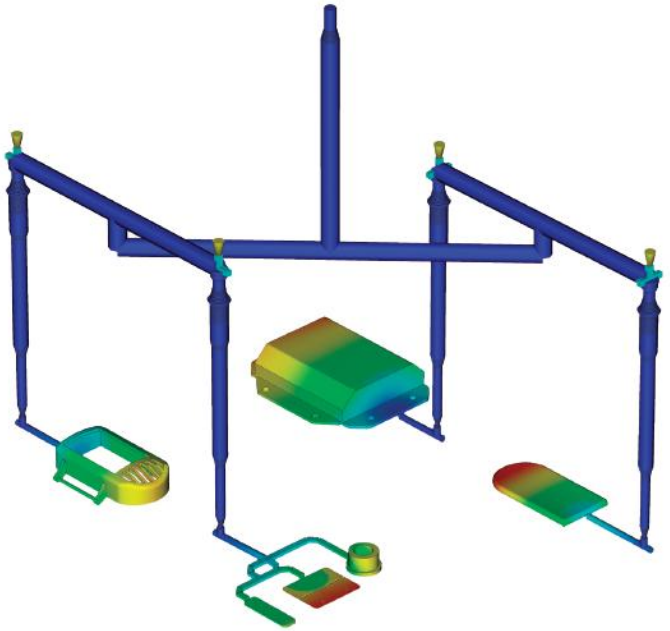




Mold Analysis

- Autodesk® Moldflow® allows you to simulate the filling of the injection molding process to predict the flow of melted plastic.





Moldflow Benefits

- Identify Possible Defects
  - Weld Lines & Sink Marks
  - Warpage & Shrinkage
- Optimize Manufacturing
  - Ensure Proper Injection Mold Design
  - Material Selection
- Simulation
  - Use as-manufactured material properties

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Computer-Cluster Projects (CP3)

Cluster Project 1

- Guides instructions for creation various fillet feature types.

Cluster Project 2

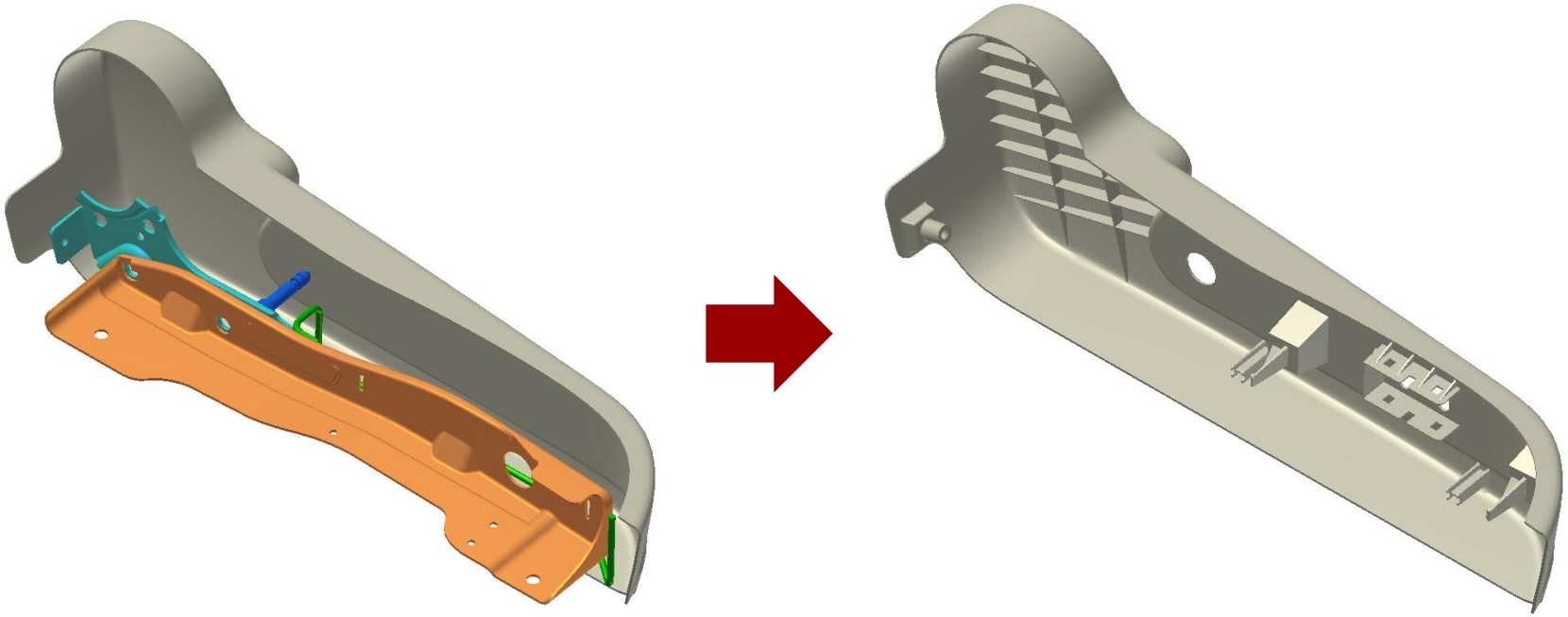
- Guided instructions for modeling plastic component case.

Cluster Project 3

- Guided instructions for modeling plastic component case.

Problem Set Assignment

- Model detailed plastic molded part with various features.



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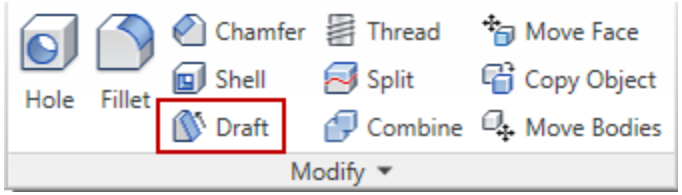
Demo Topics

Creating Draft Features

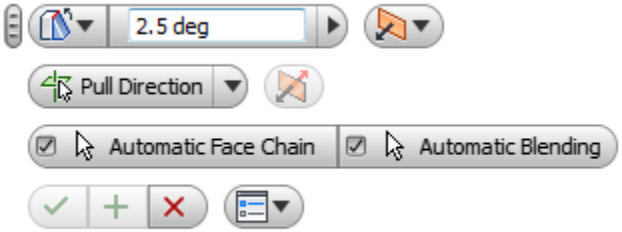
- **Draft**

  Ribbon: **Model tab | Modify panel | Draft**

  Keyboard Shortcut: **D**



- **Draft Mini-Toolbar Options**

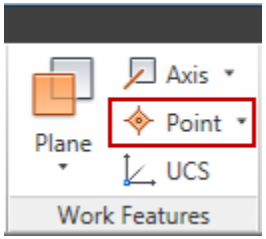


Work Features

- **Work Point**

  Ribbon: **Model tab | Work Feature| Point**

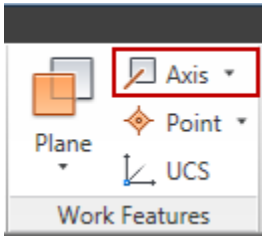
  Keyboard Shortcut: **.**



- **Work Axis**

  Ribbon: **Model tab | Work Feature| Axis**

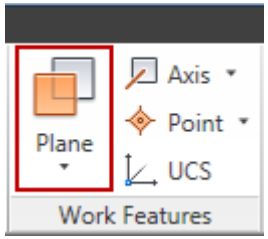
  Keyboard Shortcut: ***/***

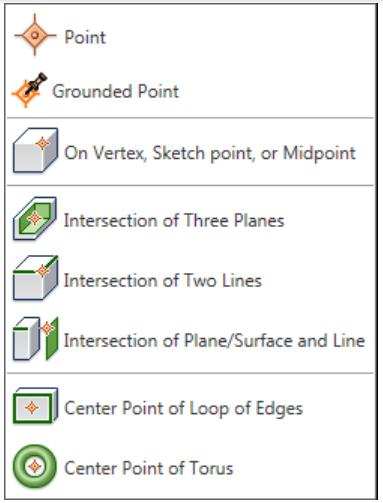


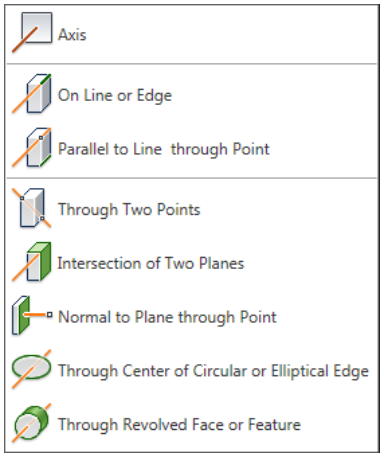
- **Work Plane**

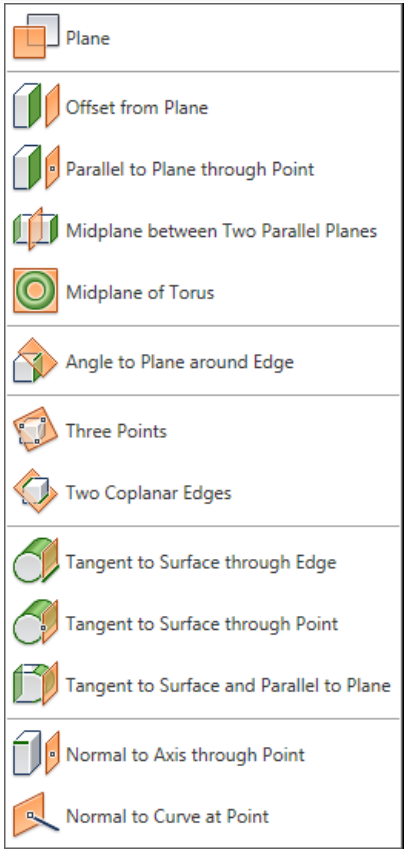
  Ribbon: **Model tab | Work Feature| Plane**

  Keyboard Shortcut: **]**





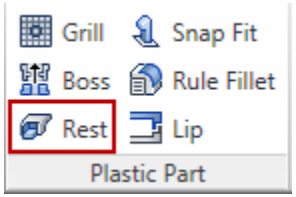


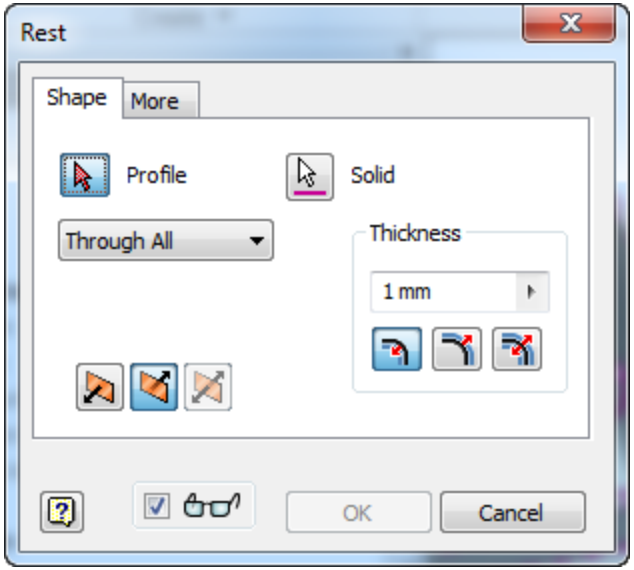


Creating Rest Features

- **Rest**

  Ribbon: **Model tab | Plastic Part | Rest**

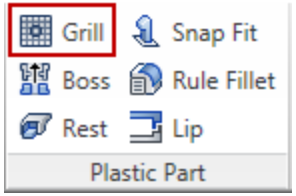


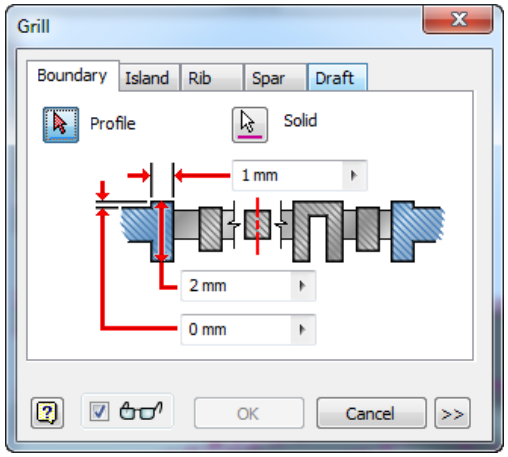


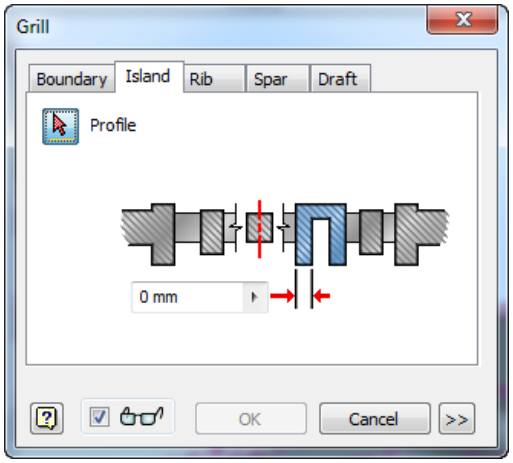
Creating Grill Features

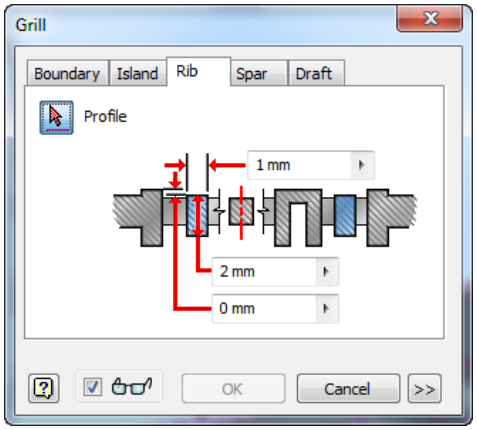
- **Grill**

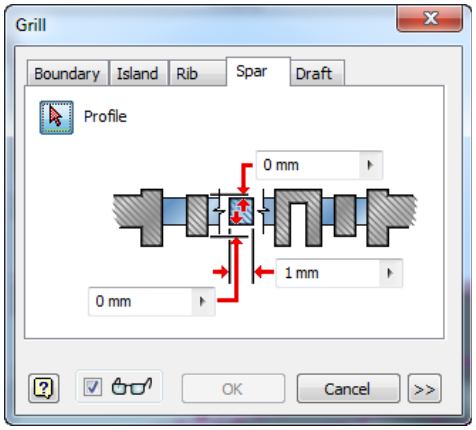
Ribbon: **Model tab | Plastic Part | Grill**

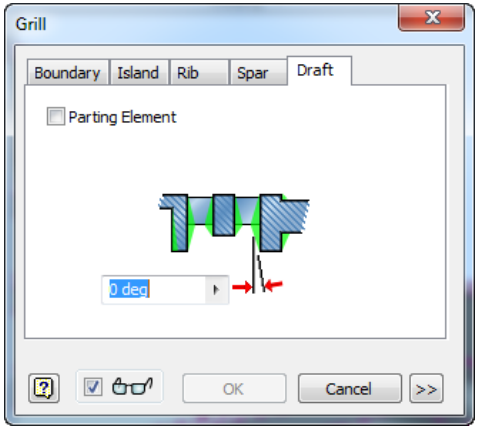








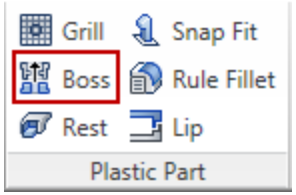


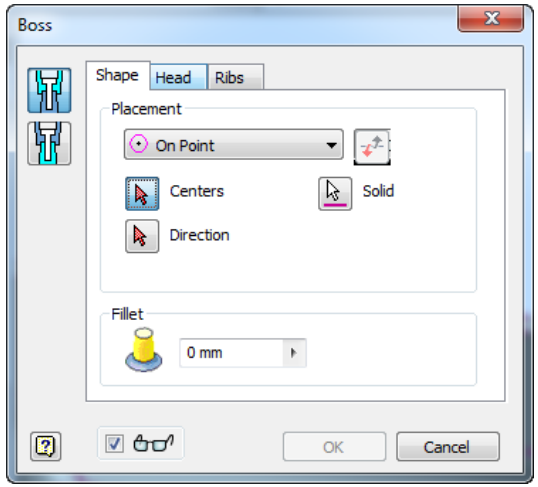


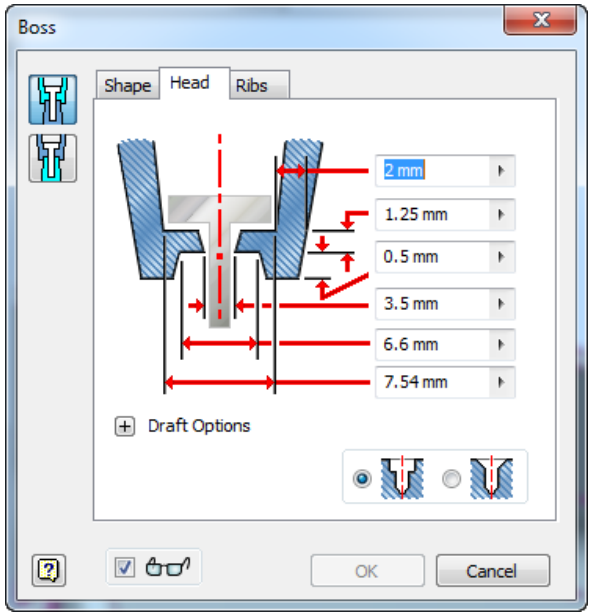
Creating Boss Features

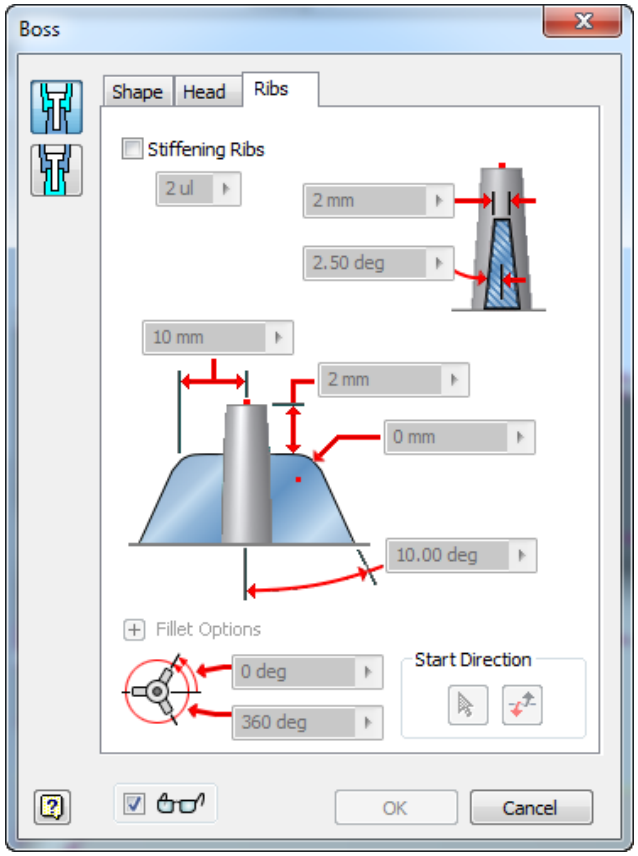
- **Boss**

  Ribbon: **Model tab | Plastic Part | Boss**





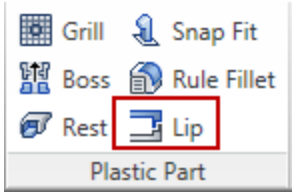


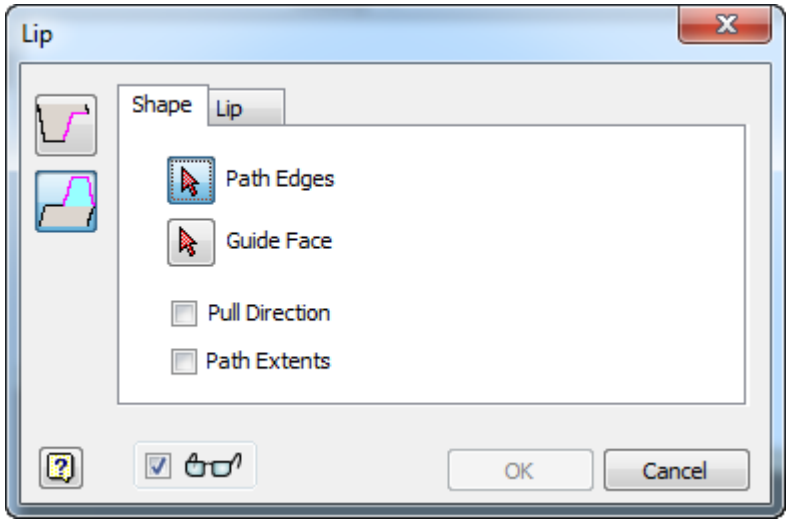


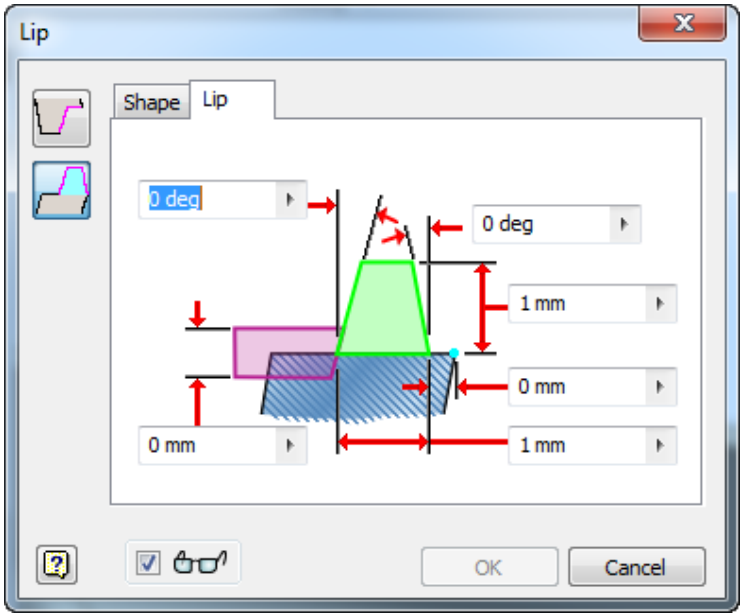
Creating Lip Features

- **Lip**

  Ribbon: **Model tab | Plastic Part | Lip**



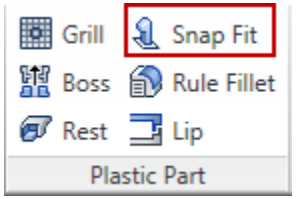


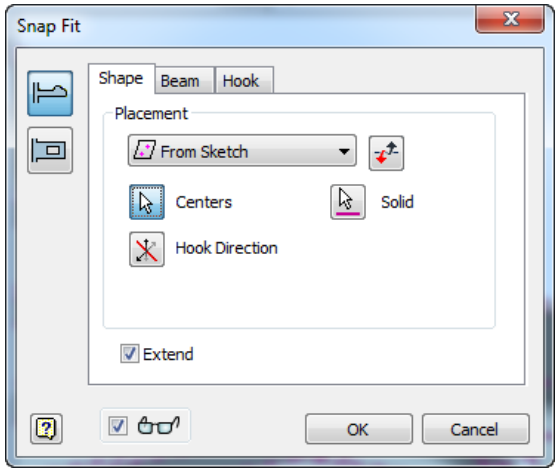


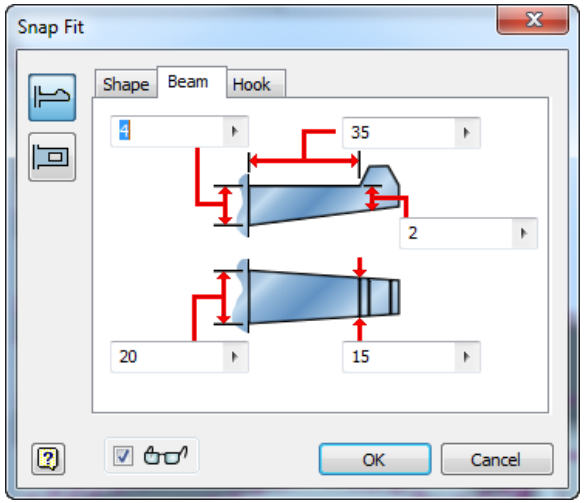
Creating Snap Fit Features

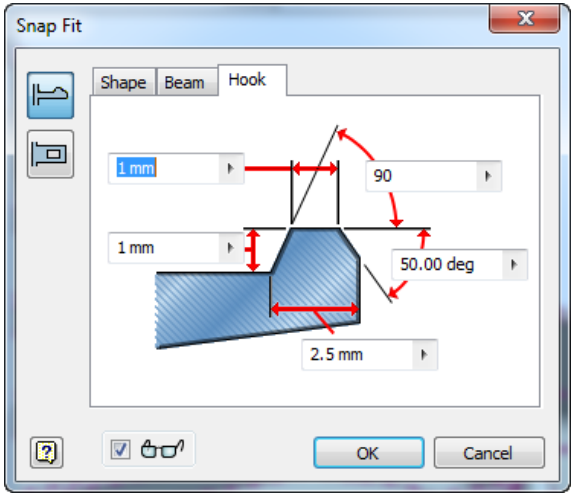
- **Snap Fit**

  Ribbon: **Model tab | Plastic Part |Snap Fit**







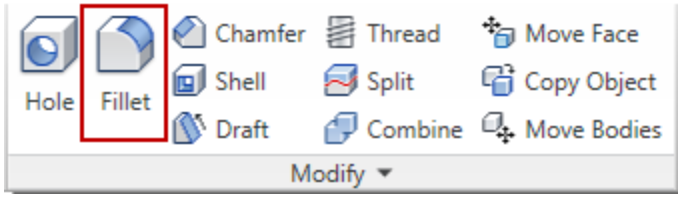


Creating Fillet Features

- **Revolve**

  Ribbon: **Model tab | Modify| Fillet**

  Keyboard Shortcut: **F**

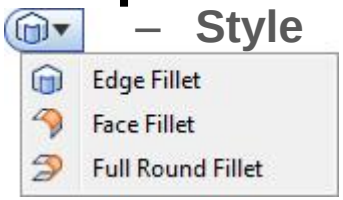


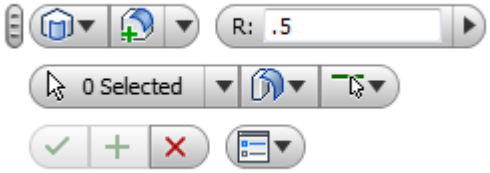
- **Extrude Mini-Toolbar Options**

  – **OK**

  – **Apply**

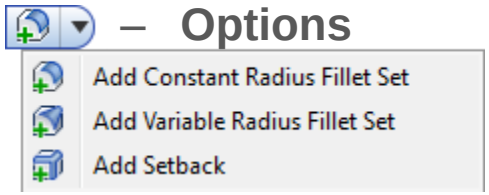
  – **Cancel**

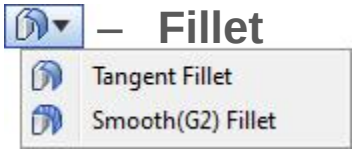




– **Selected**

– **Radius Value**

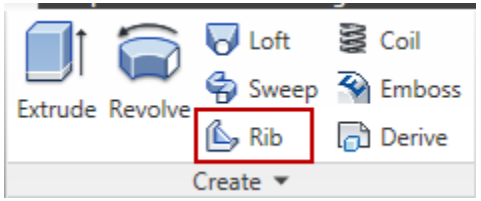


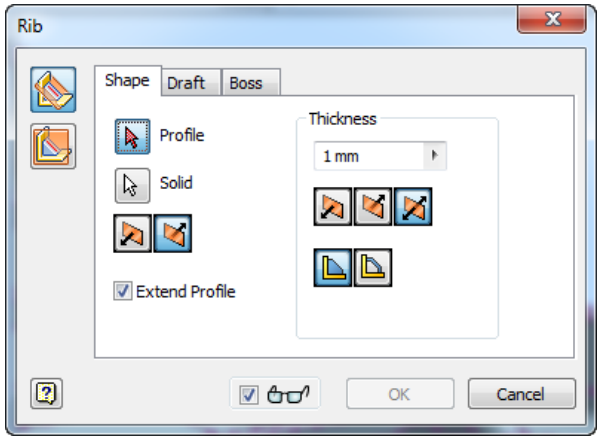


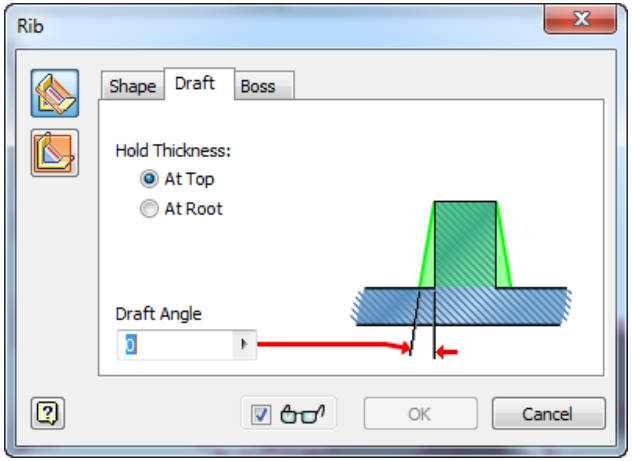
Creating Rib Features

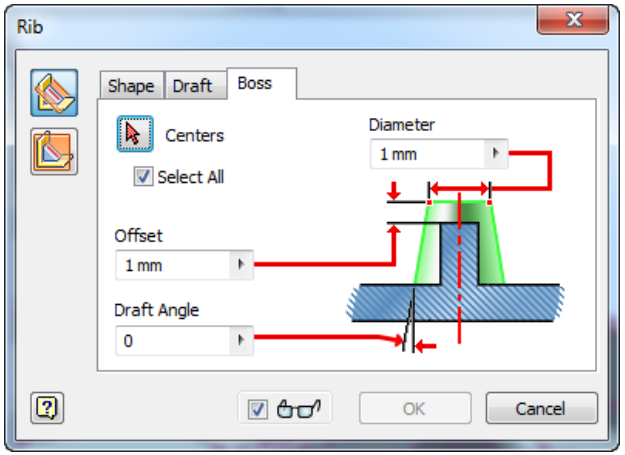
- **Rib**

  Ribbon: **Model tab | Plastic Part | Rest**









Solid Body Modeling

- Multi-body parts are a versatile and powerful approach to skeletal modeling.
- The versatility and power of multi-body parts is expanded with the ability to derive multiple bodies into a single part, conduct Boolean operations between solid bodies, split a solid body into two bodies, and move bodies within the part.