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

Requirements

Portfolio Management

Conceptual Design

Product Engineering

Manufacturing Engineering

Simulation & Validation

Build & Produce

Disposal & Recycling

Maintenance & Repair

Sales & Distribution

Test & Quality
3D Design Use

3D CAD Model

- CNC Manufacturing
- Rapid Prototyping
- Automation
- Design Detail and Form
- Visualization
- Simulation / Analysis
3D Design Use

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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

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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
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.
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**

![Rest Features Diagram](image-url)
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**

![Snap Fit Ribbon](image)

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ME 24-688 Introduction to CAD/CAE Tools
Creating Fillet Features

• Revolve

Ribbon: Model tab | Modify| Fillet

Keyboard Shortcut: F

• Extrude Mini-Toolbar Options

- OK
- Apply
- Cancel
- Selected
- Radius Value

- Fillet
  - Tangent Fillet
  - Smooth(G2) Fillet

- Style
  - Edge Fillet
  - Face Fillet
  - Full Round Fillet

- Options
  - Add Constant Radius Fillet Set
  - Add Variable Radius Fillet Set
  - Add Setback
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.