| Concept Design  
<table>
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<th>(in brief)</th>
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| 24-370 - Spring, 2011  
| Professor Steve Collins |

<table>
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<tr>
<th>First, some logistics</th>
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| • Skills and experience survey out  
|   — Turn in tonight, if possible |
| • TA office hours:  
|   — HH B129, Mon TBD & Tues 10:00-1:00 |
| • Email and web site  
| • SolidWorks software issues: solved.  
| • Book purchasing: Amazon anyone?  
| • Monday: honoring Dr. Martin Luther King Jr. |

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<tr>
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| • “First” stage in design process  
| • Gathering information  
| • Conceptualization/Brainstorming  
| • Refinement  
| • Review  
| • Iteration  
| • In practice, concurrent with detailed design, analysis, and manufacturing considerations |

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<th>Tools for Concept Design</th>
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| • Sketching  
| • Simple models  
| • Computer-Aided Engineering tools  
| • Other concept generation methods and tools  
| • Today: sketching and simple models |

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<th>Further materials</th>
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| • Optional reading: Dieter & Schmidt Ch. 1&6  
| • Covered in detail in Design II |
Sketching
Spring, 2011
Professor Steve Collins

Purposes of Sketching
• Develop ideas spatially
• Transfer ideas to others
• Refine your own thoughts
• Faster than with a computer
• More natural expression for humans

Sketch Examples

Keys to good sketching
• For brainstorming:
  – Don’t get hung up on accuracy
  – Simple, complete, representations
  – Iteration
• For communication
  – Proportions to suit goals
  – Detailing to draw emphasis
• To get better, simply practice

Sketching Exercise
• Two pieces of plain white paper, pencil
• Fold twice, to get four sections
• Name in the upper right corner of the front
• Doodle in the margins...
Sketching Exercise

Copy the image above:
- Top left panel: 30 seconds
- Top right panel: 15 seconds
- Bottom left panel: 60 seconds
- Bottom right panel: 15 seconds

Sketching Exercise

- Flip each piece of paper over
- Wrench, oriented horizontally:
  - Top left: shorter handle - 30 seconds
  - Top right: wider mouth - 15 seconds
  - Bottom left: cylindrical handle - 30 seconds
  - Bottom right: light-weight version - 2 minutes
- Hammer-pliers, oriented vertically:
  - Top left: no pliers - 15 seconds
  - Top right: bigger handle - 30 seconds
  - Bottom left: pivot closer to hammer - 60 seconds
  - Bottom right: luxury edition - 2 minutes

Sketching in Engineering Drawing Form

- More detailed description of 3D geometries
- Orthographic projections
  - Front, side, top views
  - 1/3/3/4 angle projections
- Axonometric projections
  - Isometric: at equal angles from normal views

First Angle Orthographic Projection

Third Angle Orthographic Projection

Sketching Exercise

- Two pieces of plain white paper, pencil
- Fold twice, to get four sections
- Orient horizontally (landscape)
- Name in the upper right corner
- Click your mechanical pencil...
Sketching Exercise

- 30 seconds each:
  - Lower left: front view
  - Lower right: right view
  - Upper left: top view
  - Upper right: iso

Sketching Exercise: check

Hidden Lines

- Used to locate features in views where they would be... hidden
- Dashed lines

Sketching Exercise

- 60 seconds each:
  - Lower left: front view
  - Lower right: right view
  - Upper left: top view
  - Upper right: iso

Sketching Exercise: Check

Tips for Isometric Sketching

- Keep parallel lines parallel
- Use tangent points on circles and arcs
- Three line weights:
  - Thick = silhouette
  - Medium = tangent discontinuity
  - Thin = curvature discontinuity
**Sketching Exercise: 3 minutes**

- Top
- Front
- Right

**Assemblies**

- Same ideas as for parts
- But, more complexity
- So, clear continuity is even more important
- Cross-sections can be handy
  - Bearing symbol

**Assembly Cross-section Examples**

**Cross-section Sketching: 3 minutes**

**Perspective**

**Engineering Drawings**

- Similar ideas to what we just covered
- But, precise and to scale
- Typically computer generated
- Dimensioned for perfect constraint
- Tolerances, surface specifications, etc.
- To be covered later...
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<th>Questions</th>
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<td>• 10 Minute break</td>
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Simple Models

As simple as possible, but no simpler. - Einstein
Abstractions that allow easier understanding and incorporation

Example: quicker understanding

Illustration: The Cow

What is the simplest useful model of a cow?
It depends on how you will use the model

Illustration: The Wrench Returns

What is the simplest model for:
- Load analysis (FBD)
- First-order stress analysis
- Jaw stresses
- Contact stresses
- Adjustment screw load
- Adjustment screw stress
Simple Models Sketching Exercise

- Take out one sheet of plain white paper
- Halve and halve again, to create 4 sections
- Name in upper right corner
- Think minimalist, a la Truitt...

Simple Model Sketching: Electric Motor

- Sketch simplest model of electric motor for:
  - Load analysis (30 s)
  - Shaft stresses (60 s)
  - Bearing load (2 min)
  - Motor constant (3 min)
  - Dynamic response (5 min)
  - Discuss results

Verbal models of spatial realities

- Precision of language is very important when describing engineering designs
- Draw the following:
  - A rectangle, with eight cylinders sticking out of one side and eight holes in the other side
  - A shaft, with a length 10 times its diameter, has three features added: a flat surface extending 10% of the length from one end, created by milling the shaft to a depth of half the diameter; two holes through the flat surface, each lying along the shaft axis, each with diameter half that of the shaft; one hole on the other end, perpendicular to both the shaft axis and the first hole set, with the same diameter.

Homework

- Covers sketching and simple models
- Online this evening
  - Email will be sent out when available
- Due in class next Wednesday
  - Late homework 10% off first week, 50% after
  - If late: turn in to Ginny Barry, SH 423

Questions