Concept Design
(in brief)

24-370 - Spring, 2011
Professor Steve Collins

First, some logistics

- 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.

Concept Design

- "First" stage in design process
- Gathering information
- Conceptualization/Brainstorming
- Refinement
- Review
- Iteration
- In practice, concurrent with detailed design, analysis, and manufacturing considerations

Tools for Concept Design

- Sketching
- Simple models
- Computer-Aided Engineering tools
- Other concept generation methods and tools
- Today: sketching and simple models

Further materials

- Optional reading: Dieter & Schmidt Ch. 1&6
- Covered in detail in Design II

Sketching

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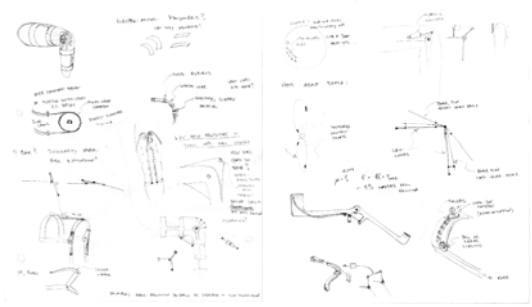
Purposes of Sketching

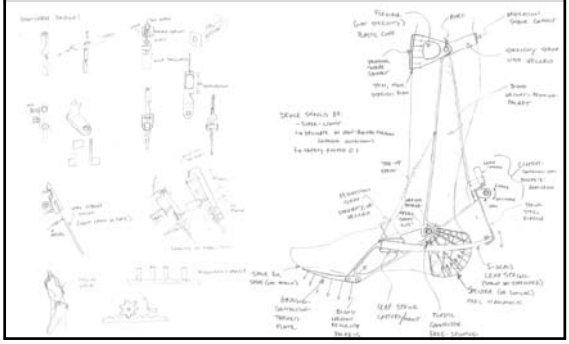
- Develop ideas spatially
- Transfer ideas to others
- Refine your own thoughts

- Faster than with a computer
- More natural expression for humans

Sketch Examples



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

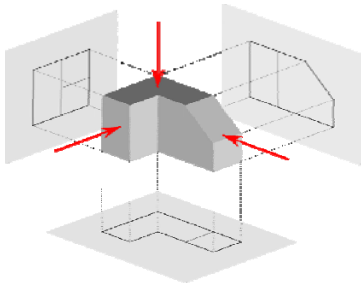
Sketching Exercise

- 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

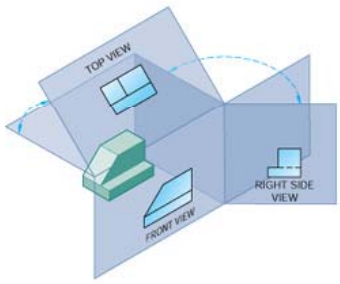
Sketching in Engineering Drawing Form

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

First Angle Orthographic Projection



Third Angle Orthographic Projection

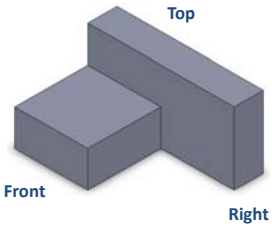


Sketching Exercise

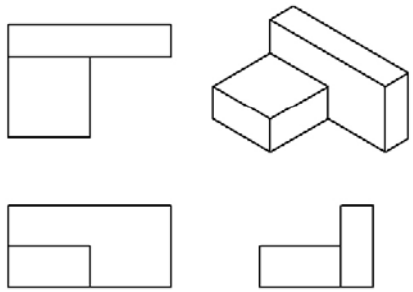
- Two pieces of plain white paper, pencil
- Fold twice, to get four sections
- Orient horizontally (landscape)
- Name in the upper right corner
- Click your mechanical pencil…

Sketching Exercise

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

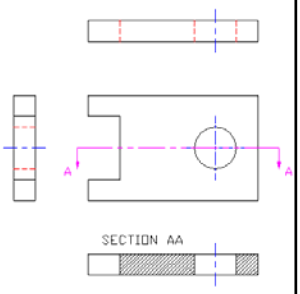


Sketching Exercise: check



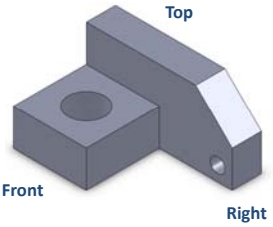
Hidden Lines

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

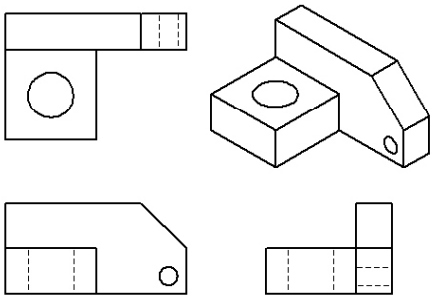


Sketching Exercise

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



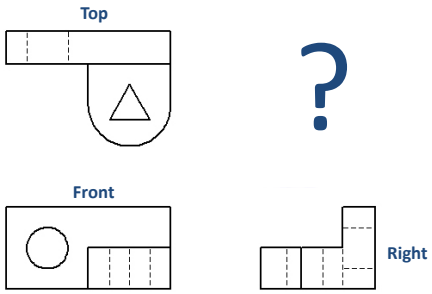
Sketching Exercise: Check



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

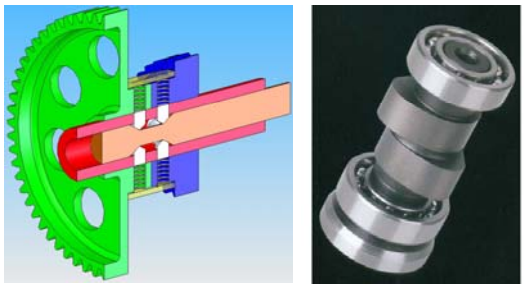
Sketching Exercise: 3 minutes



Assemblies

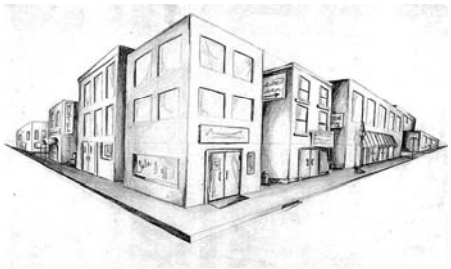
- Same ideas as for parts
- But, more complexity
- So, clear continuity is even more important
- Cross-sections can be handy
  - Bearing sybmol

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…

Questions

- 10 Minute break

Simple Models

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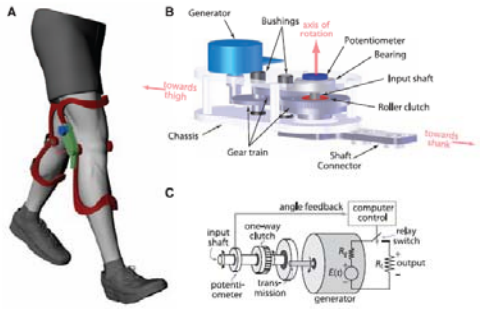
Simple Models

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

Example: quicker understanding



Simple Models

- As simple as possible, but no simpler. - Einstein
- Abstractions that allow easier understanding and incorporation
- Analytically useful
- Simplest that demonstrates phenomena
- Add complexity as transition to detail design
- Highly dependent on design/analysis goals

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 o ant when describing
- Draw the fo
  - A rectang g out of one side and e
  - A shaft, w eter, has three features a 10% of the length fro the shaft to a depth of h rough the flat surface, e each with diameter e on the other end, perp is and the first hole set, w

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