

Assignment 1: Sketching and Simple Models

24-370, Engineering Design I, Spring 2011 -- Due @ 12:30, Wednesday January 19th 2011

Name:

Part 1: Conceptualization Sketches



C-Clamp



Cam Shaft

1.a: Studies in 60 seconds

Divide a sheet of plain white printer paper into quarters. In the upper left quadrant, sketch your first impression of the C-Clamp. In the upper right quadrant, do the same for the Cam Shaft. In the lower left quadrant, sketch the C-Clamp so as to emphasize the function and purpose of each part. Concentrate on emphasizing the separateness of each element and the ways in which they interact. In the lower right quadrant, do the same for the Cam Shaft. Time yourself, and limit yourself to 60 seconds each.

1.b: Studies in 5 minutes

Flip the paper over. In the upper left quadrant, now develop a more realistic impression of the C-Clamp. Begin by quickly sketching the entire object, then fill in details, such as the ridges that create an I-beam cross section for the C portion. Try shading, for instance to indicate the curvature of the pin. In the upper right quadrant, do the same for the Cam Shaft. Repeat in the lower quadrants. Five minutes each.

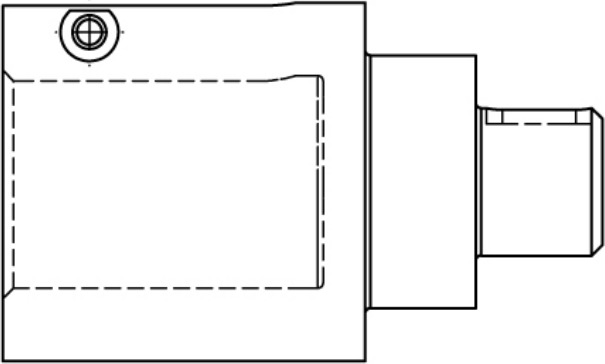
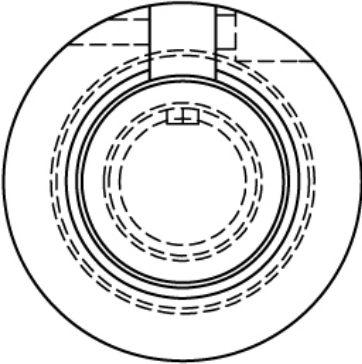
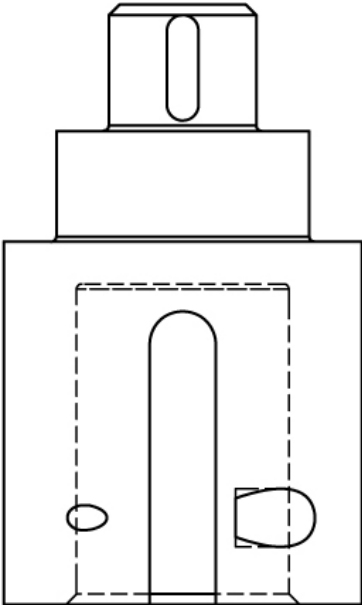
1.c: Variation studies in 60 seconds

Divide another sheet of plain white paper into quarters. On the front side of the sheet, sketch four variations of the C-Clamp design that might make it stronger, using exaggeration to emphasize differences from the original design. Between each variation, take a moment to evaluate the design and think about ways to improve upon it (either by tweaking or overhaul). Flip the paper over and do the same for the Cam Shaft, here working on designs that might have lower rotational inertia. Limit yourself to 60 seconds of sketching for each quadrant.

Part 2: Sketching Engineering Drawings

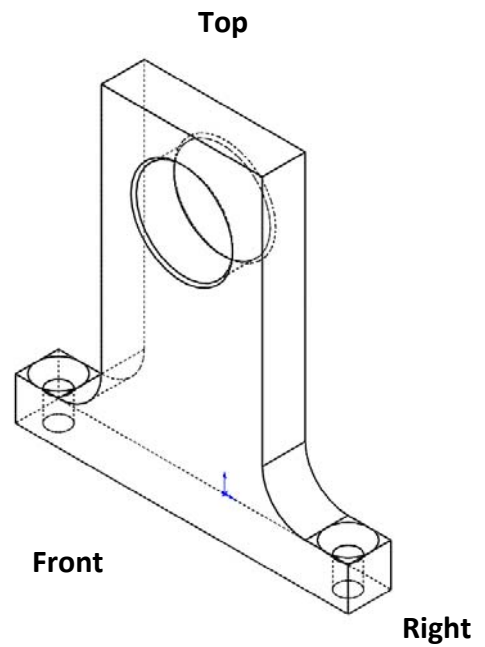
2.a: Fill in the blank

In the orthographic projections of a shaft coupler below, there are 5 line segments (all hidden lines) that are missing. Fill in the missing line segments.



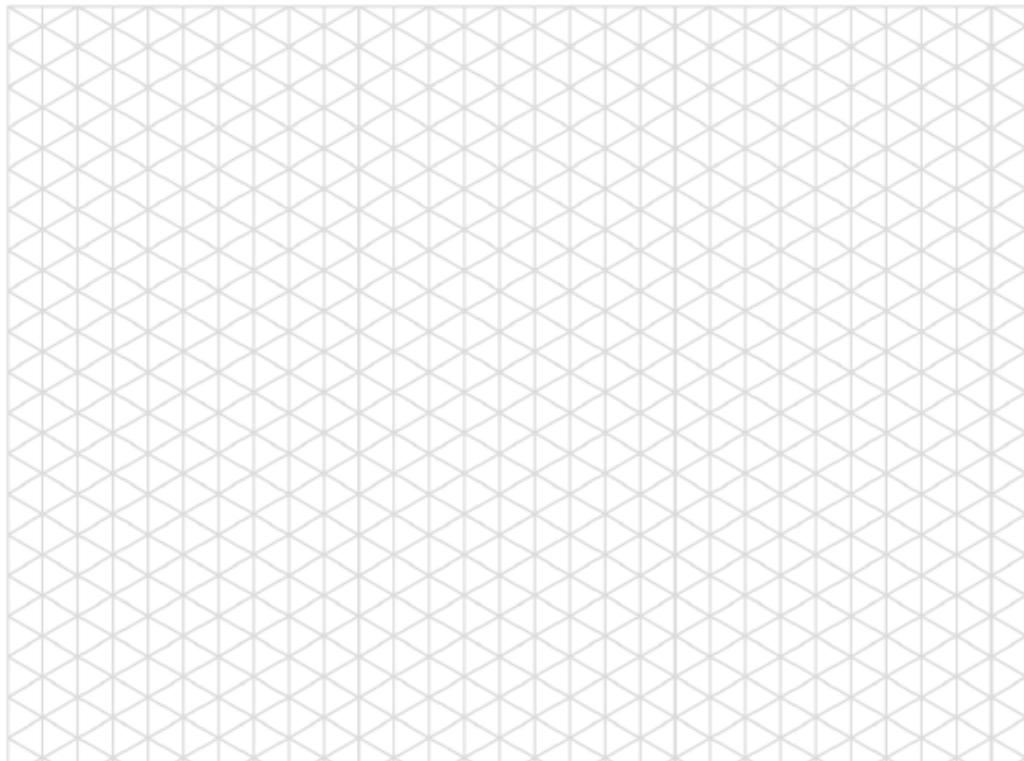
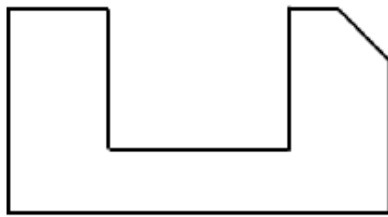
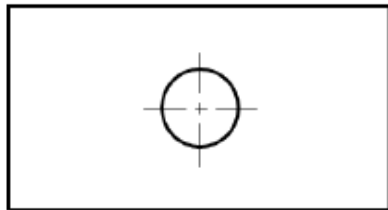
2.b: Three orthographic projections from an isometric view

Using the isometric view provided, sketch the front, right, and top views in the appropriate places (using third-angle projections). Hidden lines are provided here to avoid confusion.



2.c: Iso from ortho

Using the three orthogonal projection views, create the isometric view. Use the grid provided to help align your edges and tangents, and try the tricks we discussed in class (e.g. to keep circles circular). Do not show hidden lines.



2.d: Assembly cross-section



Bicycle Pedal

In the space below, draw the most interesting cross-section of the above bicycle pedal. Try to imagine what the pedal must look like inside, keeping in mind that the pedal shaft (upper right) is fixed to the crank while a person moves their legs. Use light cross-hatching to indicate cut surfaces, and symbols to indicate the presence of bearings where you guess they are.

Part 3: Simplified Models

3.a: Simplest screwdriver for...

Divide a plain white sheet of paper into quarters, then sketch the simplest possible model of a screwdriver for each of the following uses:

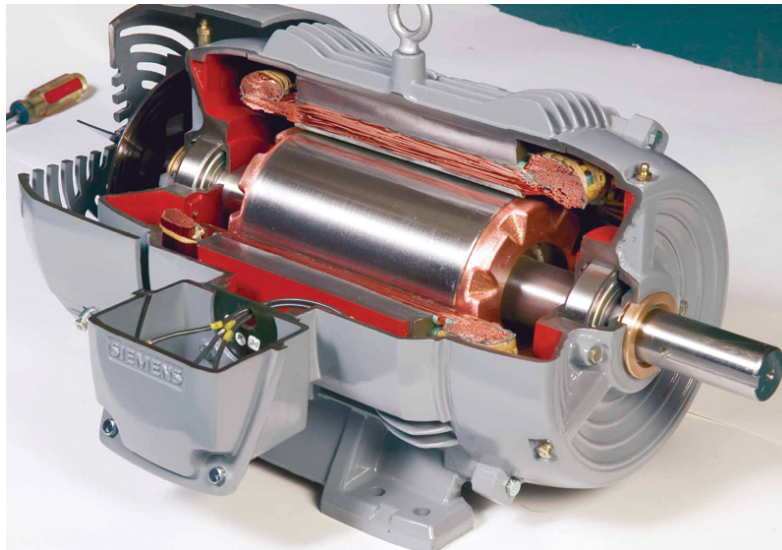
3.a.i - Load analysis (FBD). Draw the applied forces/torques and label any model parameters. Upper left quadrant.

3.a.ii - First-order stress analysis. Draw the simple model and describe it in 10 words or less. Upper right quadrant.

3.a.iii - More detailed stress analysis. What type of analysis tool might you use? Lower left quadrant.

3.a.iv - Contact stresses. Provide a brief description. What properties must be included in the model? Lower right quadrant.

3.b: Simple motor models



Electric Motor

Flip over the sheet of paper, and sketch the simplest models of an electric motor that could be used to evaluate the following:

3.b.i - Load analysis (FBD). Draw the applied forces/torques and label any model parameters. You may treat the entire motor as a single free body. Upper left quadrant.

3.b.ii - First-order stress analysis on the bearings. Draw the simple model and describe it in 10 words or less. Upper right quadrant.

3.b.iii - Dynamic system response in the presence of current. What type of analysis tools might you use? Lower left quadrant.

3.b.iv - Ballistic model, i.e. if dropped from an airplane. Lower right quadrant.