Design and Machining Best Practices

- Follow “K.I.S.” (Keep it Simple).
- Design for ease of fabrication.
- Understand the tradeoffs for different machining processes.
- Use standard components and stock material sizes available in the market.
- Use standard size hardware (Screws, Nuts, Bolts, Washers, etc.)

Design

- Draw rough sketches on paper while conceptualizing the design.
- Once the concept is clear, update the rough sketch by adding dimensions.
- Create a CAD model of the part once the concept has been finalized on paper.
- Dimension the CAD model with tolerances from a single reference point / datum.
- Select a material based on strength, weight, machinability, and price.

Machining

- Try to design the part so it can be machined on one machine tool only.
- Try to design the part so machining is not needed on unexposed surfaces.
- Design the part so that when in the work holding device, it is rigid enough to withstand the machining forces.
- Design the part so it can be machined without re-clamping.
- Try to design the part so that the machining sequence does not weaken the part.
- Make sure that during machining, the tool, tool holder, work piece and work holding device do not interfere with each other.
- Space holes in machined parts so they are not too close to edges and each other.
- Avoid generalized statements on drawings that are difficult for the machinist to interpret. Notes on drawings must be specific.
- Dimensions should be referenced from specific surfaces or points on the part and not from points in space.
- Dimensions should all be from a single datum line rather than from a variety of points.
- Use fillets and chamfers on machined parts to reduce stress concentrations.
- Parts should be designed so that as many operations as possible can be performed without repositioning the part. This will make a more accurate part.
- Mating parts need to be accurately machined so the parts will line up correctly.

- Parts must be properly squared up to provide accurate datums.
- Press fits, bearing fits, and sliding and rotating fits must be machined to a high level of precision.
- Parts that need to be aligned will need slots and/or oversize bolt clearance holes to allow for adjustment.
- Threaded holes should be through holes whenever possible. This makes them much easier to tap.

General Suggestions

- Start early – As it gets closer to your deadline, machine availability is more limited.
- Machining ALWAYS takes longer than you think, especially when training is needed. Plan accordingly.
- Send out your complex parts. The Colburn machine Shop is available, as well as several outside shops. The Student Shop is for simpler parts. Complex parts require a lot of training and machining time.
- Machine availability is better in the morning and earlier in the semester. The shop opens at 8am.
- A part that is nicely deburred, sanded, and/or painted will be will be much more impressive to others. A few minutes spent on finishing makes a much better first impression. Be proud of your work !