

Reading Assignment #2

Grace Wu

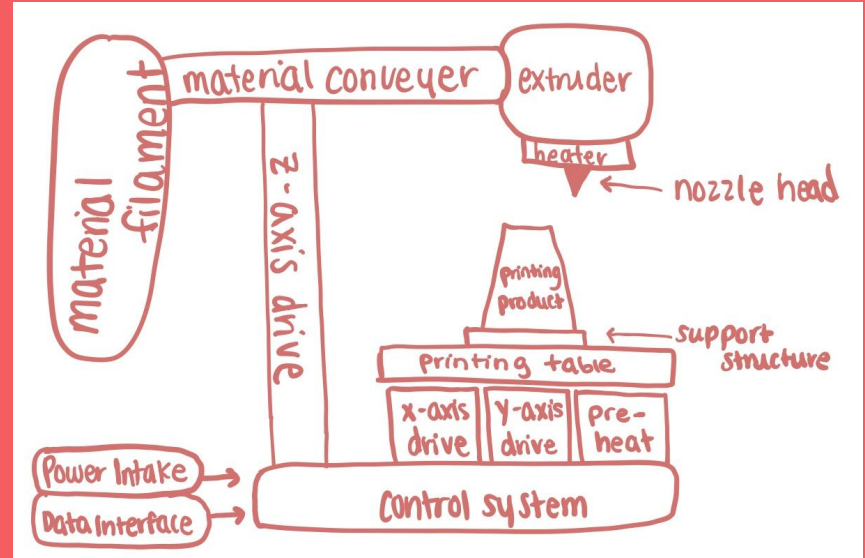
Reading Assignment #2 General

- Section 3 (pages 31-56)
- Reflection Questions

#1) Hand-Sketched Diagram

3D Printer

https://www.researchgate.net/figure/A-schematic-diagram-of-a-3D-printer-fig1_295241769



#2) Box Tube Construction

Define:

Box tubes are assembled to form a strong foundation on which other mechanisms are mounted. They can be attached using gussets, welding, and connecting blocks. Box tubes are relatively easy to use and are common in FRC Competitions.

#3) Versa Chassis

Define Chassis:

Chassis is the load-bearing support framework that structurally buttress the construction and function of the product being built.

CAD:

<https://cad.onshape.com/documents/e6cb06f79840b6b10965bdf8/w/10827aff5fec0ad820b33879/e/cd44a3592c93b1a2636528fc?renderMode=0&uiState=6173488ac306a94b93a3be03>

#4) Round Tube Construction

Define *round tube construction* and identify its *benefits*?

Round tubes are used to create a light and strong base.

Round tubes are stronger in torsion than box tubing, and are typically ~20% lighter than square tubing of the same size and thickness. They can be organized into complex arrangements.

Identify some of its *cons*:

However, round tubes tend to be weaker than box tubes when a bending force is applied. Round tubes are also more difficult to machine and interface with and to manufacture parts that are compatible with the multiple bends.

#5) Welding

Describe how welding works:

The different types of welding work in different ways. However, most methods use some sort of heating device (electrical arc, torch, or electrode) to melt a filler material that is carefully applied between the two pieces that are to be welded together.

#5) Welding Continued...

TIG Welding

- Better for the environment
- More precise and strong than MIG welding
- Requires welder to use one hand to feed the filler material through the filler rod while the other controls the torch; a foot pedal is used
- Better for thinner materials

VS

MIG Welding

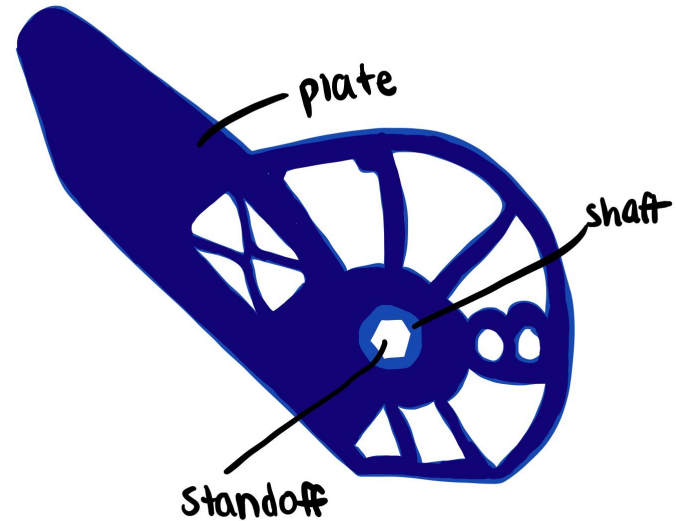
- Cheaper than TIG welding
- Takes less time and expertise than TIG welding
- Filler material is fed directly into the spool gun or feed wire
- Typically better for thicker materials
- Produces a little spatter and smoke

#6) Plate & Standoff Construction

What is plate and standoff construction:

Plate and standoff construction is most commonly used on gearboxes. Essentially, shafts are supported by plates and standoffs to build sturdy gearboxes.

Sketch an example assembly by hand:



#7) Standoffs & Spacers

When would you use standoffs:

Standoffs are threaded and typically have bolts going into them from both ends and can be used when you do not need to preload the assembly and when you need a threaded insert.

When would you use spacers:

Spacers are not threaded and typically have a single bolt going completely through them. They are helpful when you need to preload the assembly but also want the additional support of a metal bolt.

#8) Sheet Metal Bend Radius

When is the bend radius important when designing for sheet metal?

As a general rule, the bend radius should be equal to the thickness of the material that is being bent. When the bend radius is less than recommended, soft materials may have material flow problems and hard materials may have fracturing. Inaccurate bend radii can also cause overhang. Thus, for precise designing, it is important to use an unerring bend radius.

#9) Shrinking & Stretching

What is shrinking and stretching of metal:

The shrinking and stretching of material occurs when the inside of the part shrinks while the outside of the part stretches, leading to small cracks on the outside of a bend if the radius of the bend is too small or if the part is not bent with the grain of the material.

What is the K-factor and what is the equation for calculating K-factor:

The K-factor allows you to estimate the amount of stretch of a part without knowing what type of material it is made of.

Equation: $K\text{-Factor} = (\text{distance from neutral axis}) / (\text{thickness of sheet})$

#10) 3D Printing

When is 3D printing a useful manufacturing method:

3D Printing is useful for creating parts with complex geometry that is unable to be created on a mill. 3D Printing is also useful when trying to create customizable parts that would be difficult to make by hand.

#11) 3D Printing and Threading

What hardware should be used when threaded holes are needed in a 3D printed part:

Heat set inserts are helpful when you need threaded holes for 3D printed parts. They are brass threaded inserts that are pressed into the plastic with a soldering iron.

Link an example of this hardware from McMaster Carr:

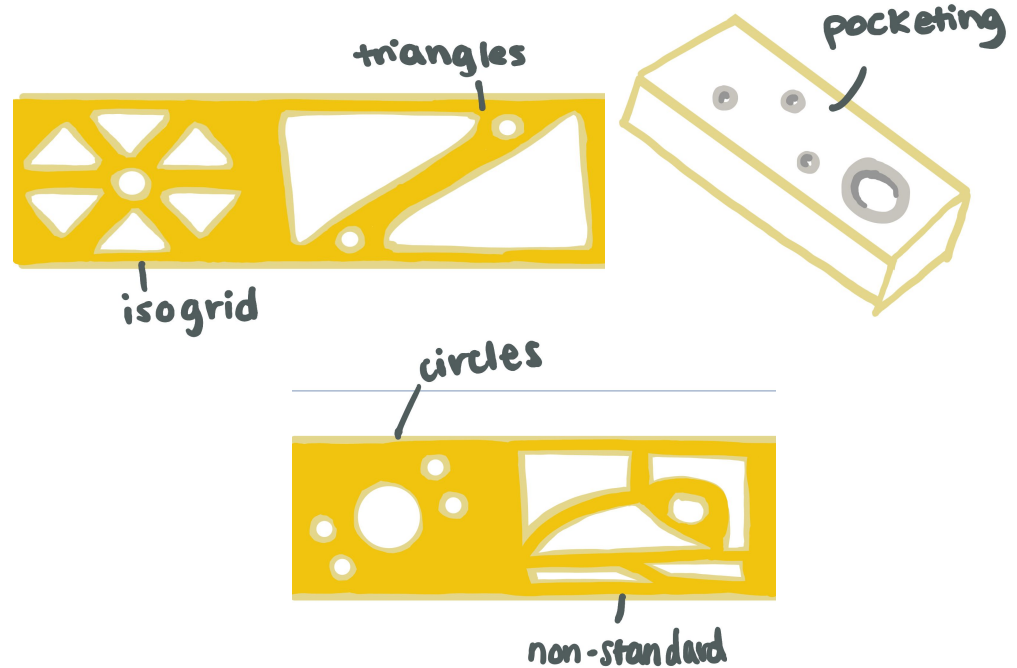
<https://www.mcmaster.com/heat-inserts/material~brass/>

#12) Lightning Patterns

List types of lightning patterns:

- Isogrid
- Triangles
- Circles
- Half Depth Cutting / Pocketing
- Non-Standard Parts

Create hand sketches of each style:



#13) Lightning Feature Script

Design a drivetrain tube in CAD and lighten it using the Lightning Pattern Feature Script:

<https://cad.onshape.com/documents/a705c69fa8d0529e7288719a/w/c7783cea85ac85afabb70801/e/55a63666c4592a644bbbde7a?renderMode=0&uiState=61795d12f2a4c56efc9c661b>