# Week 2 Submission Group: 19

Word limit=1000. Use bullet points and be concise. Cite reference

# Project Update: 1 point

1. What is the purpose and task in this step?

To generate concept designs based on the problem statement, constraints, and success criteria defined in week 1. We also need to create a DfMA checklist to check our concept designs with.

Following a DfMA checklist will make It easier to assemble and reduce hassle when manufacturing parts.

1. What did you achieve in this step? Show your concept designs (at least one concept design for each group member)

A checklist was created to act as a guideline for our concept designs. This checklist prioritised designs that make assembly and disassembly easy as this was a major criterion for the final product. This checklist also included further constraints on assembly and manufacturing to remain within our determined criteria and constraints.

Four concept designs of a CNC soldering machine were brainstormed and sketched as possible solutions for a prototype. These concept designs were to remain small enough to sit on a desktop as well as minimise the parts required as to reduce complexity and time when assembling. All these designs took our listed success criteria and constraints from week 1 into consideration when sketched.

# Homework: 1 point

1. Develop a checklist of DfMA and briefly describe how to use them in your project if suitable.

We want to design this desktop CNC soldering machine to be easily assembled and disassembled so that our end user can easily move it around if they desire. To do this we have to place emphasis on DfA (Design for Assembly). However, we should aim to adhere to both DfA and DfM (Design for Manufacturing) principles. This is because although we may be able to assemble complex parts more effectively, we should still try to make them as easy to manufacture as possible.

Design for assembly:

* Uniform screw type so that only one screwdriver type needs to be used.
* Easy to switch out different soldering iron heads.
* Have most parts be assembled vertically.
* Use standardised parts when possible.
* Design parts for fast and easy assembly and disassembly.

Design for manufacturing:

* Design parts to minimise screws: Ideally minimise the use of fasteners as well as using snap fits instead of screws where possible.
* Design parts to minimise cost of manufacturing.
* Use suitably strong materials for supporting parts e.g., brackets.
* Size: The CNC soldering machine must fit on a table and be disassembled into a small container.

A blueprint of a machine

Description automatically generatedDesign Concept 1:

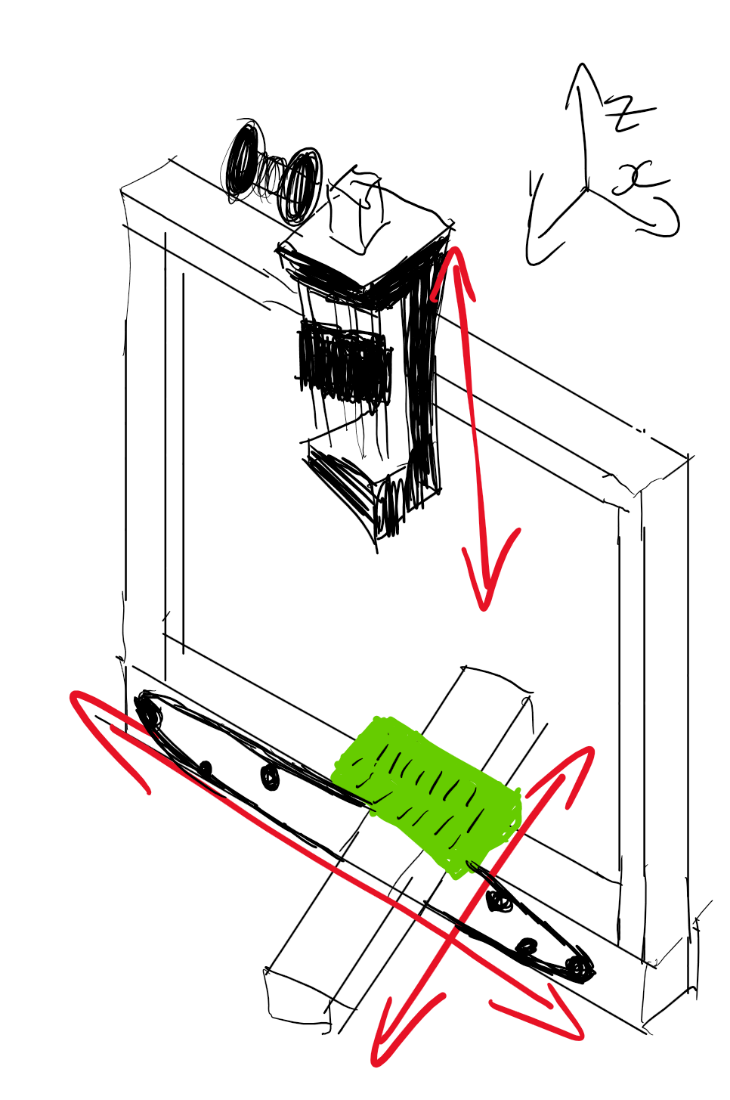
This concept uses the cylindrical co-ordinate system rather than the cartesian co-ordinate system. The motor attached vertically to the aluminium bar moves the soldering iron in the z-direction. The motor attached horizontally to the aluminium beam moves the soldering iron radially. The motor attached to the platform changes the platform’s angle to the soldering iron.

Design advantages:

* Minimal use of parts.
* High accuracy.
* Allows for complex movement.
* The soldering iron can reach it’s intended target from 2 different angles.
* Designed with vertical assembly in mind.

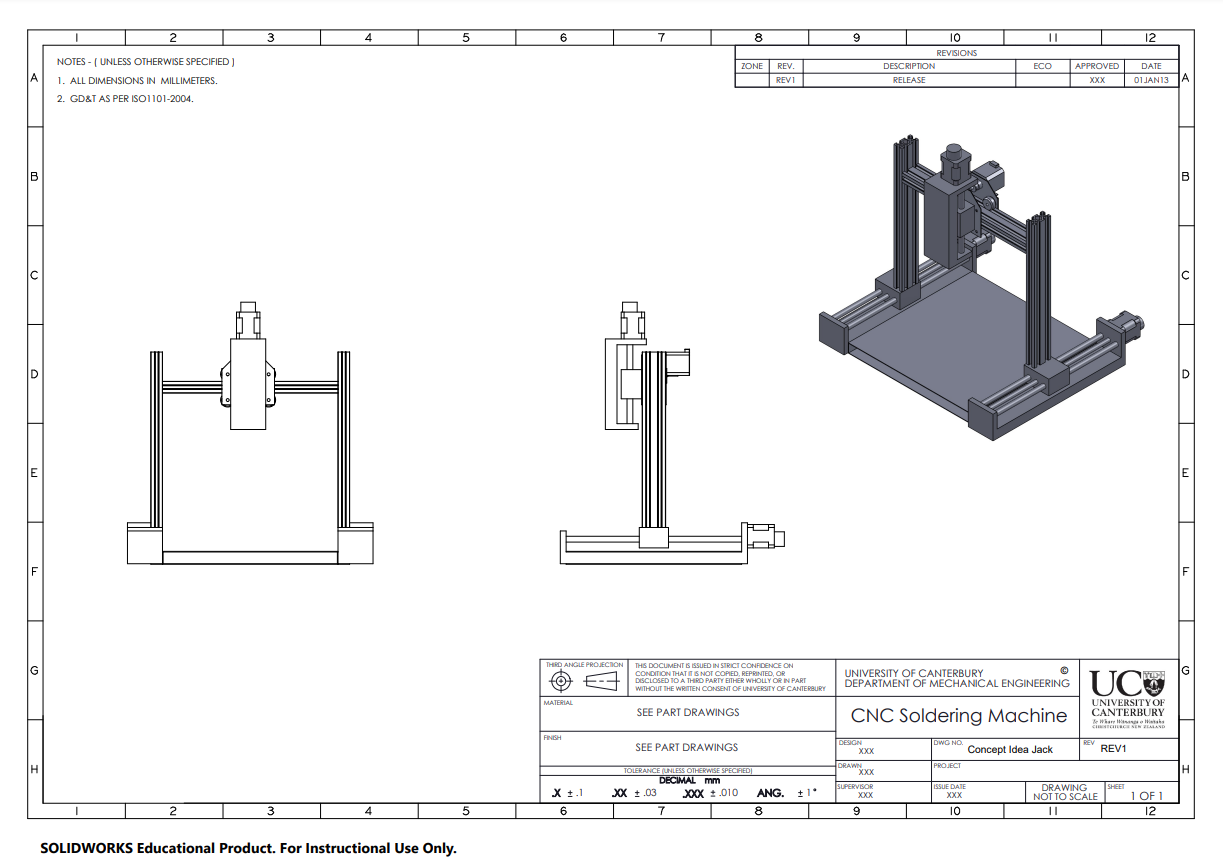
Design disadvantages:

* Requires complex use of G-code.
* Requires precise alignment.
* Custom parts must be manufactured.



Design Concept 2:

This design was made to have the PCB board move in two directions so that the soldering iron mount does not have to be moved. This would make it easier on the motors as having the aluminium rails and PCB move would be a lot lighter. However, from looking at this concept it could be difficult to get the top rail to move across the bottom rail accurately enough. Further designing needs to be done.



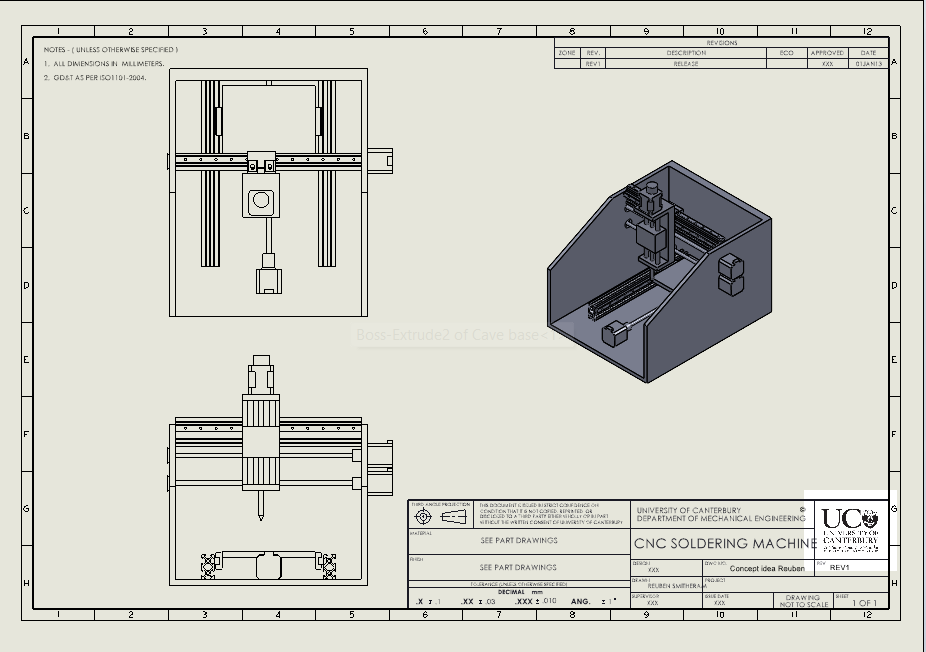
Design Concept 3:

This concept has the Soldering Iron move in 3 directions with the PCB staying stationary on the platform below. The motors attached to the bottom part of the machine controls the movement in the x-axis. The motor attached on top of the Soldering Iron mount controls the movement in the z-axis. The motor attached to the side of the Soldering Iron mount controls the movement in the y-axis.

This design would be able to use basic G-code to control the axes movement of the Soldering Iron to access all positions on a PCB. This design puts a lot of weight on the Soldering Iron mount which could lead to worse movement control which would need to be revised in later designs.

Design concept 4:

The final type of motion for the soldering iron was the two plus one axis motion – where the soldering iron itself moves along the y and z axes, but is fixed in the x axis. The PCB moves along the x axis.



Linear rails are used in order to support both the PCB mount as well as the soldering iron mount

A computer software design of a machine

Description automatically generated

A blueprint of a machine

Description automatically generated

These two designs showcase how the two plus one axis motion could be implemented in different ways by using different arrangements of the transmission systems and the base designs.

Advantages:

* Reduced load on the soldering iron mount
* High accuracy (lead screws)
* Simple

Disadvantages:

* 2/3 designs have relatively complex assembly procedures due to linear rails being at multiple angles
* Some of the above frames may exceed budget
* No easy way of securing pcbs of different sizes
* 2-3 custom parts to be manufactured
* Does not depict how the solder feeder will be used

References:

<https://ieeexplore.ieee.org/abstract/document/9936773?casa_token=lb7QVCwvwMMAAAAA:CygZNKYJWi6CY0wKqbceQyyt9kgsYv0c5cglxDMqGxzfJJCcJdbVLnooDyeGR5nkPPq8waC9qTZf>

<https://public.eng.fau.edu/design/fcrar2017/papers/SimpleSolder.pdf>

<https://learn.canterbury.ac.nz/pluginfile.php/6571161/mod_resource/content/4/Lecture%204%20DfMA.pdf> (ENMT221 Lecture 4 – DfMA)

<https://learn.canterbury.ac.nz/pluginfile.php/6571160/mod_resource/content/3/Lecture%202%20Engineering%20Design%20Process.pdf> (ENMT221 Lecture 2 – Engineering process)

# Weekly Individual Contributions

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Contributions | Mark | Signature |
| Reuben Smitheram | Created design concept 4, helped develop DfMA checklist | 2 | Reuben |
| John-Luke Fenn | Created design 2 and discussed options/plans with team | 2 | John-Luke Fenn |
| Lucas Kwan | Created Design Concept 1 and helped develop DfMA checklist. | 2 | Lucas |
| Jack Edwards | Created Design Concept 3 and discussed options/plans with team | 2 | Jack |
|  |  | Sum=2\*N |  |

N: number of group members. Every group member is expected to take part in the whole process, not just work on one part, for example, report writing only.