

To: *Armin Eilaghi*  
CC: *Connor Gaudette*

From: *CWC GEN*

Date: *8/30/2025*

Re: *Project Management*

## I. REFLECTION

### *A. Successes*

The following list will describe what we did successfully regarding project management and team communication last semester:

- Splitting work evenly
- Met deadlines despite roadblocks
- Use of simulations

### *B. Room for Improvements and Action Items*

The following list will describe, from most to least important, what we can improve. This regards project management and team communication from last semester, and how it can be corrected for this semester:

- Respect for others
  - **This will be corrected by remaining professional throughout this capstone experience. This will improve project management by ensuring we can all work together and finish this project efficiently (1)**
- Communicating for help
  - **This will be corrected by team members asking for help and others checking in on each other. This will improve project management by finishing tasks quickly, hence making the process smoother. (2)**
- Team meeting discussions
  - **This will be corrected by starting meetings off with open input from anyone. This will improve project management by having many ideas that can bring success to the project or tasks. (3)**

### *C. Remaining Design Efforts*

There are no remaining design efforts for the generator build since the final design has been established.

## II. GANTT CHART

### *A. Second Semester Project Planning*

To ensure the successful completion of our project in alignment with client expectations, course milestones, and any relevant competition deadlines, we have developed a detailed Gantt chart for the second semester. This chart outlines all major tasks and milestones, beginning in Week 14 and working backwards to Week 1 of the Fall

2025 semester. By starting from the finish line, we can ensure that all critical steps are planned with sufficient time and resources allocated.

B. Gantt Chart

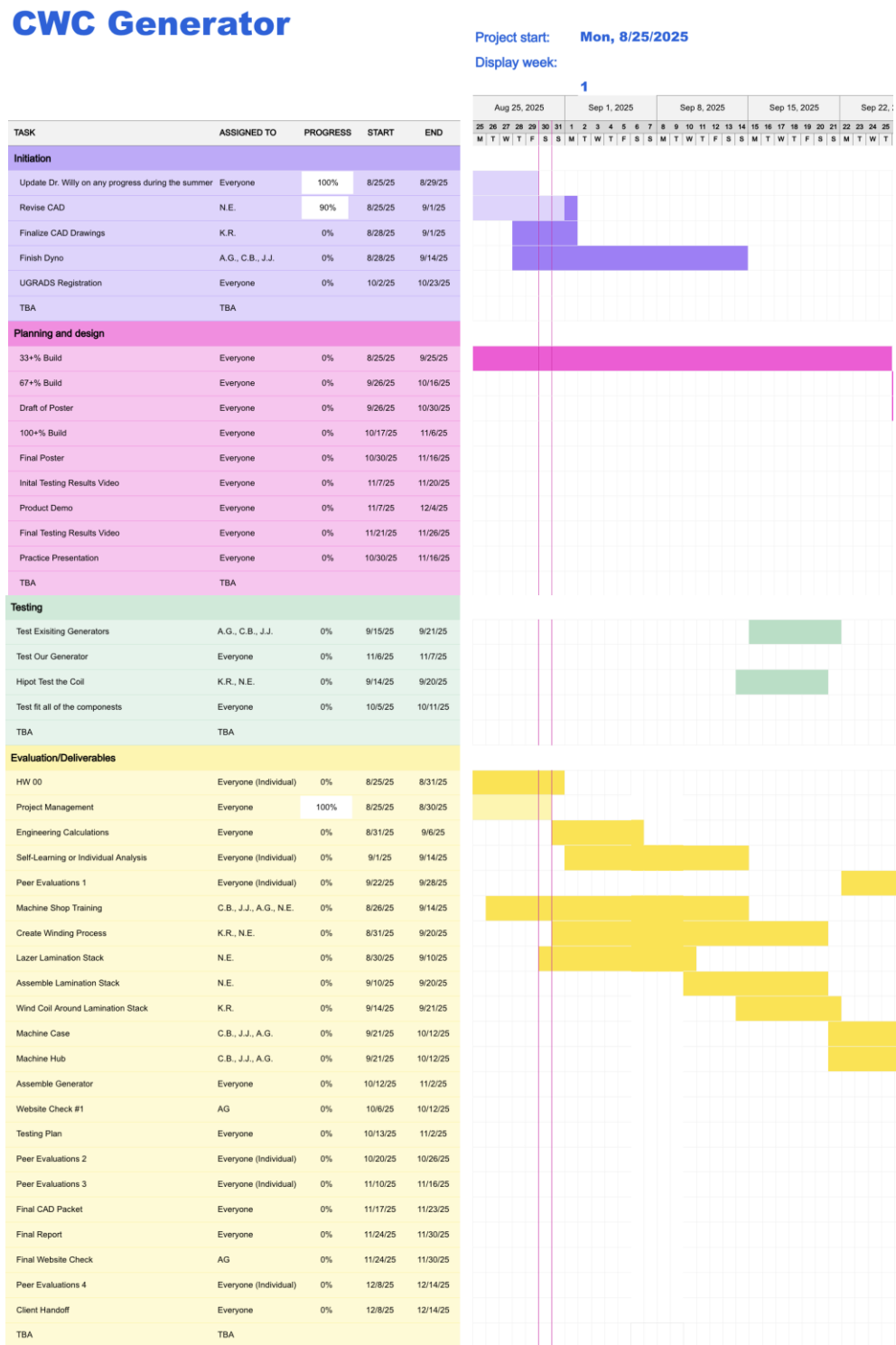


Fig. 1. Gantt Chart for Fall 2025

### C. Key Milestones and Work Breakdown Structure

In Figure 1, these deliverables can be listed by first hardware status to the beginning of Fall 2025:

- Assembly (Weeks 4 - 5)
  - Wind coils on stator
  - Finish manufacturing that wasn't done during preparation
  - Assemble new shaft with epoxy to dynamometer (dyno)
  - Calibrate dyno for torque measurements
- Preparation (Weeks 2 - 3)
  - Attend lab/shop training (if available)
  - Manufacture stator, shaft, casing, casing hub, and silicon steel
  - Practice winding coils on a 3D printed stator
  - Order wires, epoxy, bearings, and aluminum
  - Deconstruct and learn about the dyno's mechanisms
  - Rebuild dyno's shaft (and possibly 3D printed parts)
- Initialization (Week 1)
  - Assign roles and deadlines
  - Schedule lab/shop times
  - Confirm availability for tools and materials
  - Risk assessment and mitigation plan
  - Communication with the client

### III. PURCHASING PLAN

The list below details the materials already purchased and those still required for our design. Materials have been acquired online, with direct links provided, and some have been donated by the partnering company. Funding for these purchases came from our capstone budget of \$500 as well as \$150 raised through online donations and contributions from relatives, giving us a total of \$650 available for the duration of Fall 2025. All pending orders will be reviewed by our client, David Willy, before approval of purchase to ensure this aligns with the capstone budget and avoids unexpected purchases. Final purchases are scheduled for completion before September 22<sup>nd</sup>.

Table 1: Purchasing Plan

| Purchasing Plan |                 |                                                                   |         |                   |                      |
|-----------------|-----------------|-------------------------------------------------------------------|---------|-------------------|----------------------|
| Find No.        | Company:        | Description:                                                      | Cost:   | Part Status:      | Links:               |
| 1               | Harbor Freight  | 3pc Poxxy Glue                                                    | \$9.14  | Received          | <a href="#">Link</a> |
| 2               | Amazon          | 2pc Ball Bearings Bore 4mm OD 10mm ID 5mm                         | \$7.64  | Received          | <a href="#">Link</a> |
| 3               | Remington       | 1pc Magnet Wire, 23 AWG Enameled Copper 8oz                       | \$19.09 | Ordered           | <a href="#">Link</a> |
| 4               | McMaster-Carr   | 1pc - 2 1/2 inch diameter, 6 inches long. Part 9062K43 (Aluminum) | \$96.77 | Order in Progress | <a href="#">Link</a> |
| 5               | Elemental Motor | 14pc Magnets- donated                                             | \$-     | Received          |                      |

|   |                 |                                                                                                  |          |                   |                      |
|---|-----------------|--------------------------------------------------------------------------------------------------|----------|-------------------|----------------------|
| 6 | Elemental Motor | 1pc Silicon Steel Sheet - donated                                                                | \$-      | Received          |                      |
| 7 | McMaster-Carr   | 50 pc - Dowel Pin 5mm diameter, 16mm long. Part 91595A352 (52100 Alloy Steel)                    | \$17.63  | Order in Progress | <a href="#">Link</a> |
| 8 | McMaster-Carr   | 1 pc - Shim Stock 6 inches by 25 inches, 0.01 inch thick. Part 9011K125 (1008-1010 Carbon Steel) | \$9.02   | Order in Progress | <a href="#">Link</a> |
|   |                 | Total:                                                                                           | \$132.64 |                   |                      |

Table 2: Purchased Items Description

| Action Items |                 |                                                                                                                                                                                                                               |                                                                                       |  |
|--------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--|
| Find No.     | Company:        | Description:                                                                                                                                                                                                                  | Image:                                                                                |  |
| 1            | Harbor Freight  | <ul style="list-style-type: none"> <li>Attaching the magnets to the stator</li> </ul>                                                                                                                                         |    |  |
| 2            | Amazon          | <ul style="list-style-type: none"> <li>Distribute radial and axial load evenly</li> <li>Minimizes vibration and noise</li> <li>Help support Shaft stability</li> </ul>                                                        |  |  |
| 3            | Remington       | <ul style="list-style-type: none"> <li>Create current flow and captures magnetic fields</li> <li>Gauge helps with load capacity and minimizes overheating</li> </ul>                                                          |  |  |
| 5            | Elemental Motor | <ul style="list-style-type: none"> <li>Provides constant magnetic flux</li> <li>Strong magnets producing significant output</li> </ul>                                                                                        |  |  |
| 6            | Elemental Motor | <ul style="list-style-type: none"> <li>Silicon steel sheets concentrate the magnetic field efficiently</li> <li>Reduced eddy current losses</li> <li>Structural support for maintaining electromagnetic efficiency</li> </ul> |  |  |

#### IV. MANUFACTURING PLAN

The manufacturing plan lays out the different raw materials needed and the procedures for turning them into the required parts for the final product. This also helps delegate between the team members which parts they will be working on and what training or help they will need to get it done. The timing for getting parts manufactured is based on our current Gantt Chart.

Table 3: Manufacturing Plan

| Manufacturing Plan |                          |                                            |                                 |                                       |
|--------------------|--------------------------|--------------------------------------------|---------------------------------|---------------------------------------|
| Raw Material:      | What the item is for:    | Who is manufacturing the part:             | Where is it being manufactured: | How long will it take to manufacture: |
| Silicon Steel      | Lamination Stack         | Naomi Echo                                 | Elemental Motors                | 2 weeks, due by 9-22-25               |
| 832-C Epoxy        | Bonding Lamination Stack | Naomi Echo                                 | Elemental Motors                | 1 week, due by 9-22-25                |
| 23 AWG magnet wire | Coil                     | Kaitlyn Redman                             | Elemental Motors                | 2 weeks, due by 9-22-25               |
| Aluminum Stock     | Rotor                    | Christian Brown, Javan Jake, Alonso Garcia | NAU Machine Shop                | 3 weeks, due by 10-13-25              |
| Aluminum Stock     | Hub                      | Christian Brown, Javan Jake, Alonso Garcia | NAU Machine Shop                | 3 weeks, due by 10-13-25              |

#### Lamination Stack

To manufacture the lamination stack, a laser will be used to cut out each layer of the lamination stack. The lamination stack will be made from .007" thick silicon steel. The geometry and tolerances of the stator can be seen in Figure 2 below. To skew the stator by 2 degrees, a 3D printed fixture will be used to layer the silicon steel into create the shape. 832C-A epoxy will be used to adhere the silicon steel sheets together. This will also add another layer of insulation to help prevent the flow of eddy current through the lamination stack. In Table 2, seen above, it states that it will take 2 weeks to manufacture this part, it will be done by Naomi Echo at Elemental Motors.

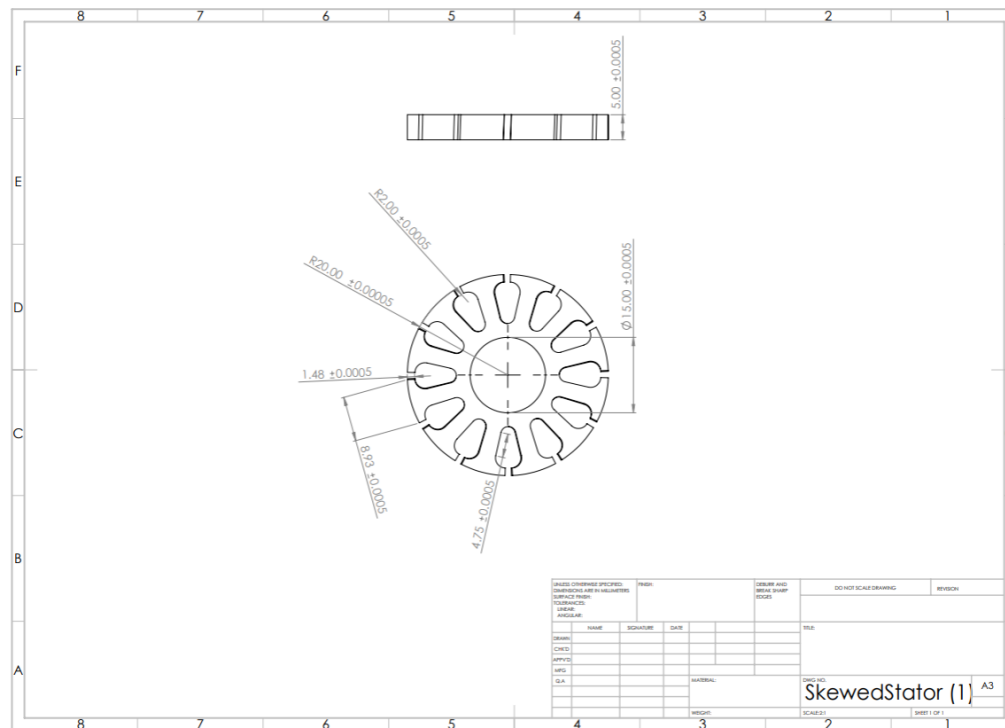


Fig. 2. Stator Drawing

## Rotor and Hub

The rotor and hub will be machined out of aluminum stock at the NAU Machine Shop as stated above in Table 2. Javan Jake, Christian Brown, and Alonso Garcia will be machining these parts within a 3-week time period. A manual lathe will be used to machine the bore of the rotor that will house the stator, as well as face the outer diameter of the rotor. These features can be seen in Figure 3 below. The next step will be to use a bandsaw to cut off the rotor from the aluminum stock. Once that is separated, the rotor will be put back in the lathe to face and cut off the numb feature of the front face of the rotor. The tolerancing in Figure 3 is accurate to the type of fits necessary within this design.

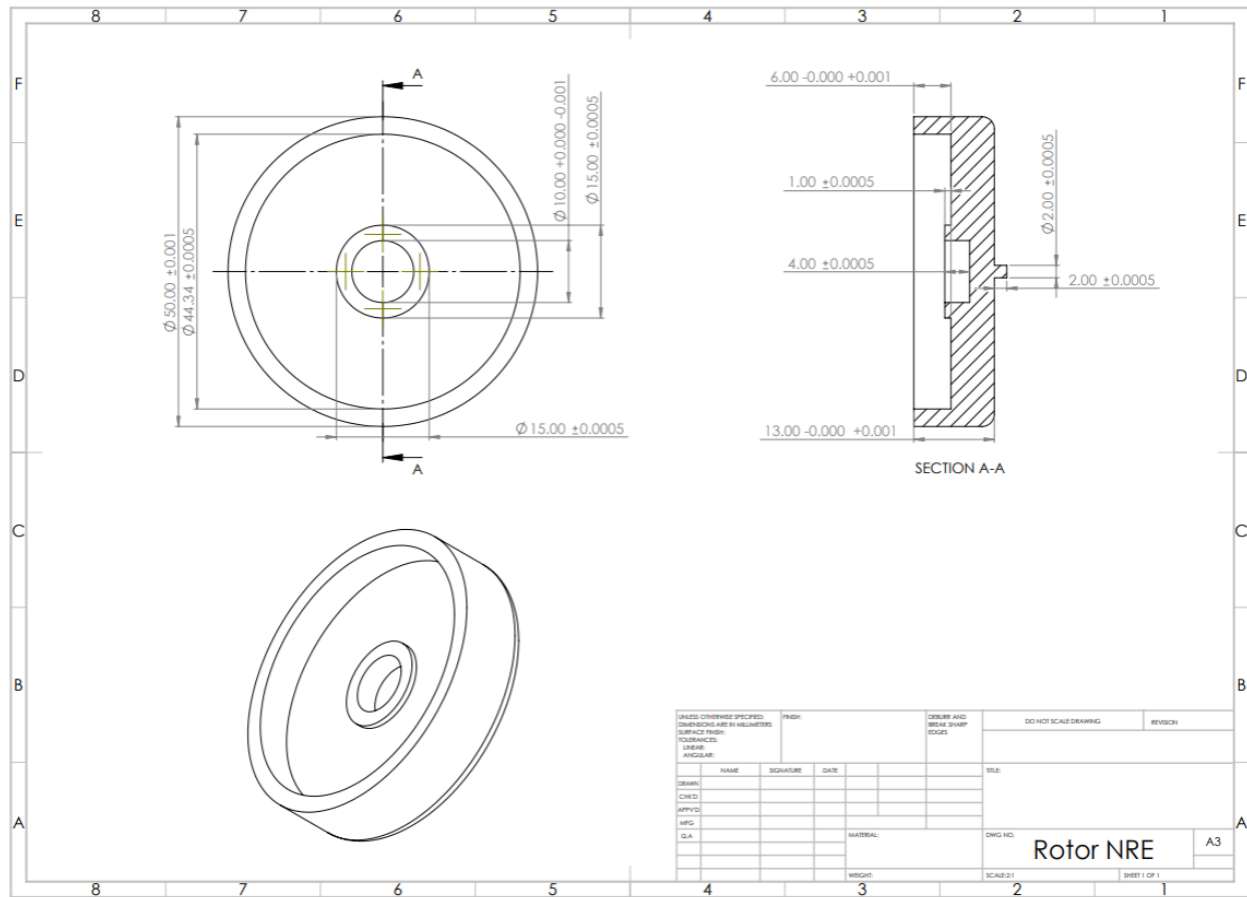


Fig. 3. Rotor Drawing

The hub will also be machined by using a manual lathe. First, the outer diameter and front face of the shaft portion of the hub will be machined. The shaft is the 7 mm long portion, which can be referenced in Figure 3 below. The lathe will also be used to machine the lip on the outer diameter of the shaft. A bandsaw will then be used to cut the part off the stock, leaving enough material to machine the other features. To machine the inner diameter of the hub, a vertical mill will be used to drill the 8 mm bore using an M8 drill bit. To create the 10 mm lip that the bearing sits on, a .25-inch endmill will be used, using the vertical mill as well. The 10 mm bore will be a press fit for the bearings. Figure 4 below shows the necessary tolerancing to achieve this. To achieve the 30 mm outer diameter that is 4 mm thick on the other end of the hub, a manual lathe will be used, as well as to face off the part. To drill out the

4 through holes, a vertical mill will be used, using a 2.5 mm drill bit.

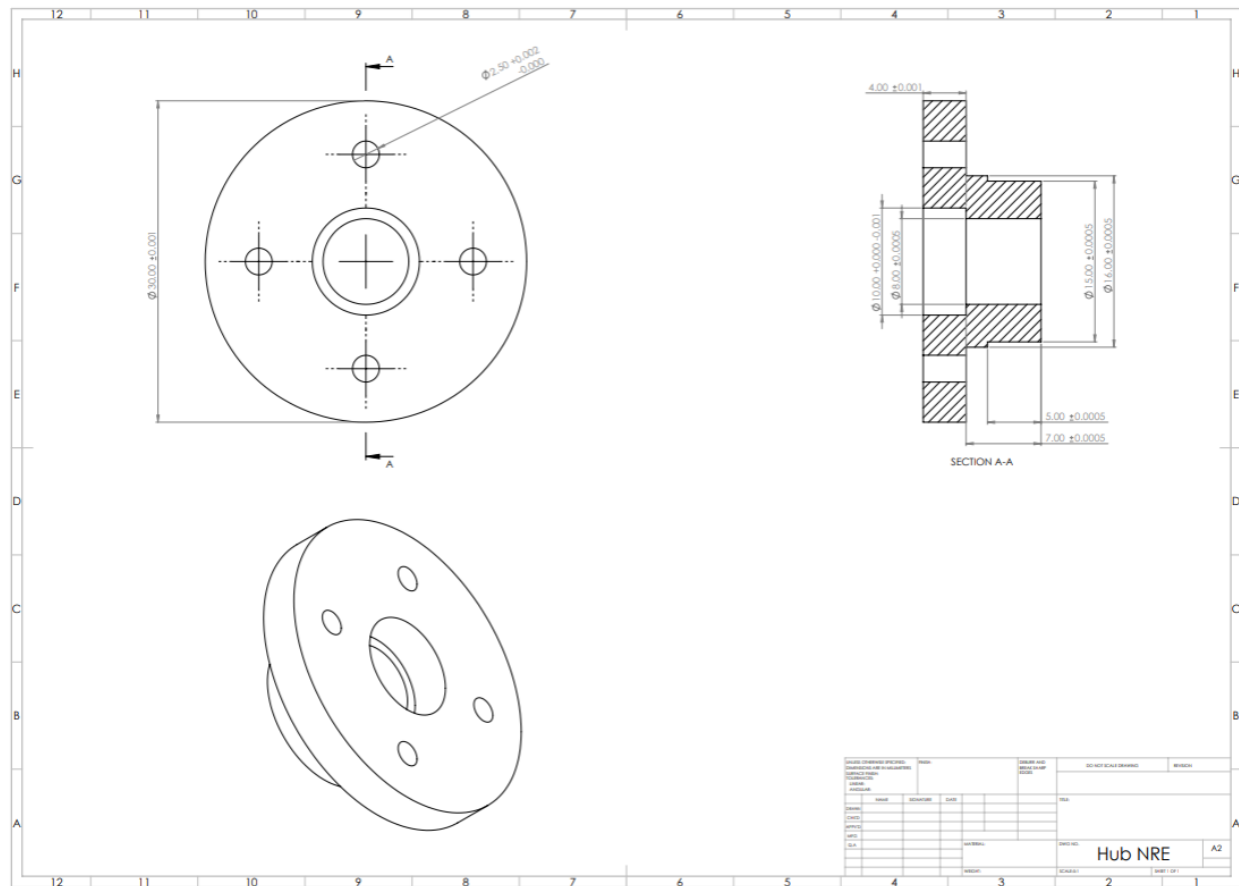


Fig. 4. Hub Drawing

## Coil

The coils will be wound around the stator in a delta circuit at Elemental Motors by Kaitlyn Redmen, as can be seen in Table 2 above. A tensioner will be used to create enough tension in the wire to be able to wind the 3 phases tightly to maximize the copper fill. The coil will be wound with 23 AWG copper magnet wire and will have 38 turns. Each phase of the coil will be HIPOT tested separately to ensure that it can withstand 300 volts. This task will be accomplished within a week.

## Assembly

The generator will be assembled in the Mechanical Engineering Capstone room by the entire team. It will take approximately a day to complete this task. Figure 5 shows how the components will go together. The steps of



assembly will be to glue the magnets onto the hub using 801 superglue. Then we will press fit the bearings into the hub and rotor, put the stator onto the hub, and then press fit the shaft into the bearings through the hub.

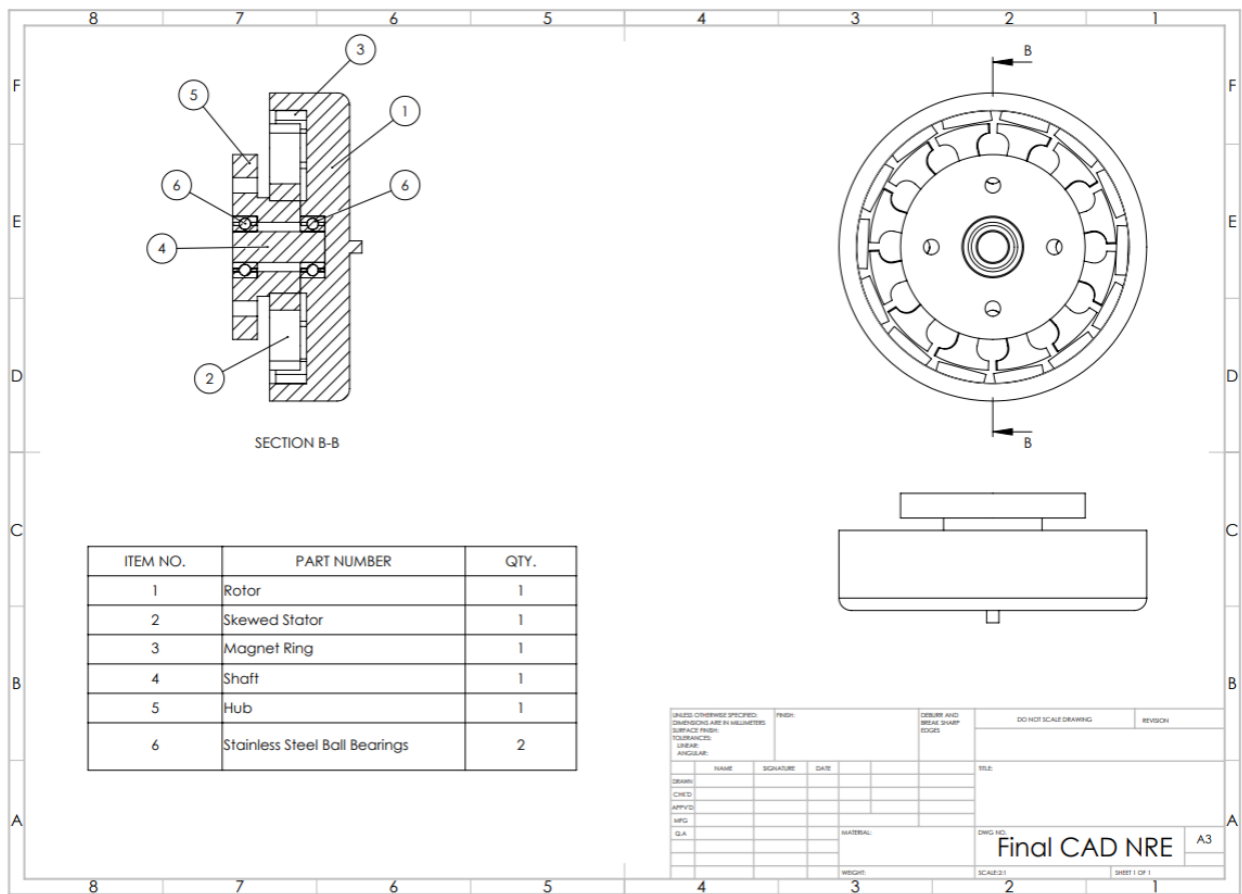


Fig. 5. Assembly Drawing