Engineering Design Portfolio

Mechanical Design Fundamental Studio 1

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1. Professional Persona

My name is Connor Lindsell, and I am pursuing a bachelor's degree in mechanical and Mechatronic Engineering at the University of Technology, Sydney (UTS). My academic journey is driven by a profound passion for innovation and a keen aptitude for solving complex problems. I possess a robust foundation in Computer-Aided Design (CAD), complemented by extensive experience in rapid prototyping and coding specifically tailored for mechatronic systems. My educational endeavours aim to leverage these competencies to contribute to advancements in the engineering field, with a particular interest in the integration of mechanical systems with electronic control.

My expertise lies in the adept translation of conceptual designs into detailed, functional models through the proficient use of CAD software, including but not limited to SolidWorks. I specialise in enhancing design efficiency by identifying and addressing potential weaknesses, and I further refine these designs through various simulations and testing methodologies to ensure optimal performance. Beyond CAD, I have developed a solid foundation in rapid prototyping techniques such as 3D printing, CNC machining, and laser cutting. My capability to swiftly iterate and refine prototypes facilitates streamlined development cycles, accelerating product innovation. My skill set is complemented by a strong proficiency in programming languages, including Python, C++, and MATLAB. This programming expertise has been instrumental in automating processes, analysing complex datasets, and developing sophisticated simulation models to enhance system performance and efficiency.

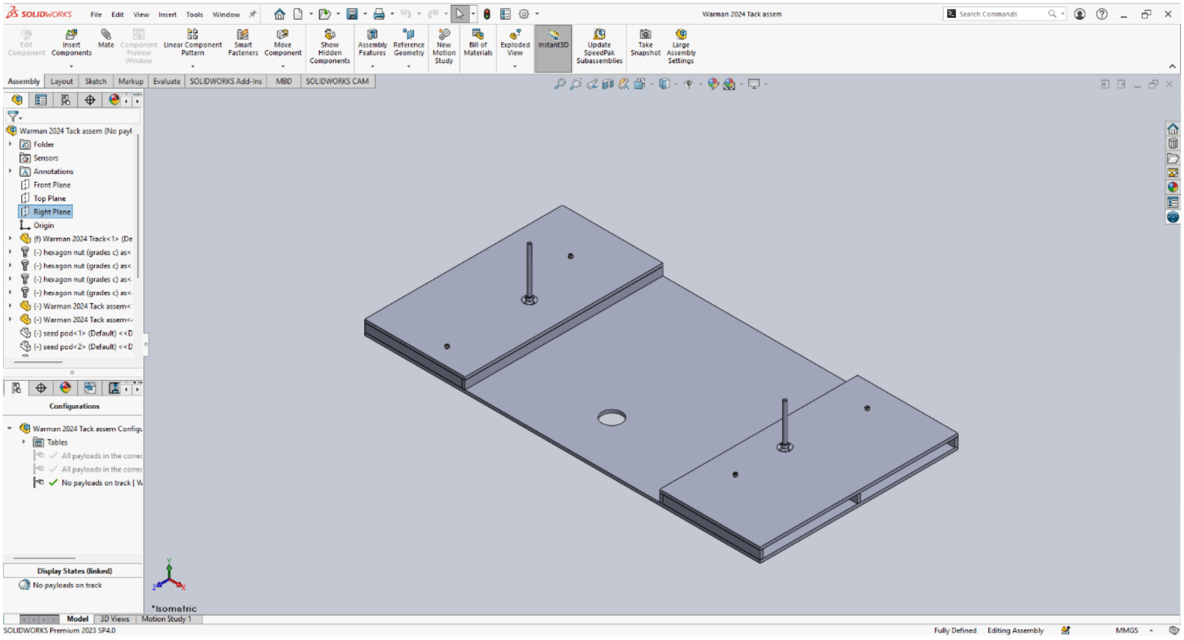
I am deeply motivated to enrol in this studio to refine my CAD design, prototyping, and programming expertise within a collaborative environment focused on real-world applications. My enthusiasm lies in utilising my technical skills to address complex challenges and significantly contribute to our project's progression. Through this experience, I anticipate the opportunity to participate in the construction of a robot, an Endeavor that promises to enrich my engineering capabilities and enhance my overall proficiency as an engineer. This studio represents a pivotal step in my professional development, offering a unique blend of practical learning and innovative problem-solving that will undoubtedly elevate my engineering acumen to new heights.

2. Artefact 1: Competition Track

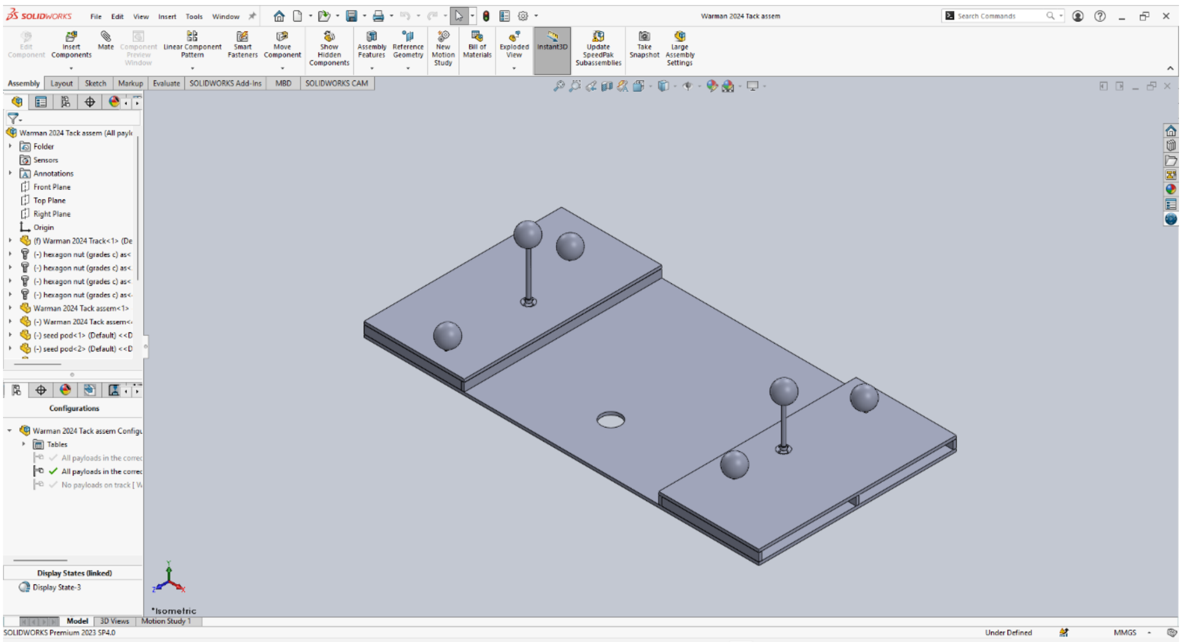
The assigned task deposition of six ‘seed pods’, each presenting a potential threat to the agricultural stability of Gondwana. The objective is to ensure the collection and disposal of these pods into the incinerator's, the hole in the middle of the track. In essence, the track requires the development of a robotic system capable of autonomously manoeuvring, retrieving, and accurately positioning each pod into the incinerator opening.

2.1. CAD Models

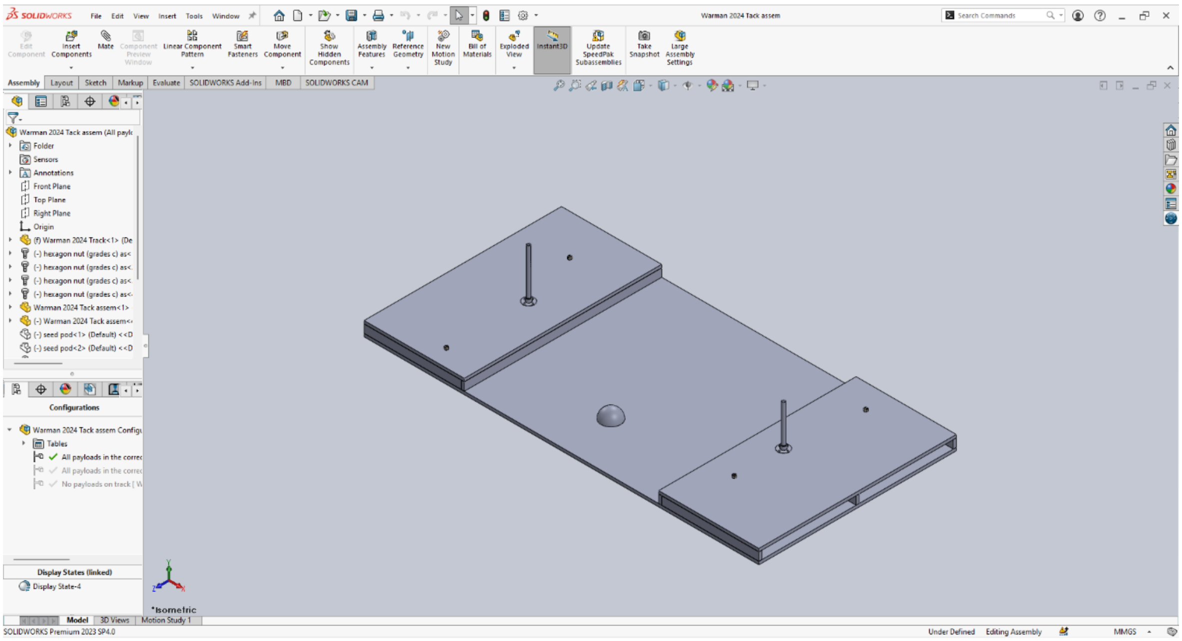
2.1.1. *No payloads on track*



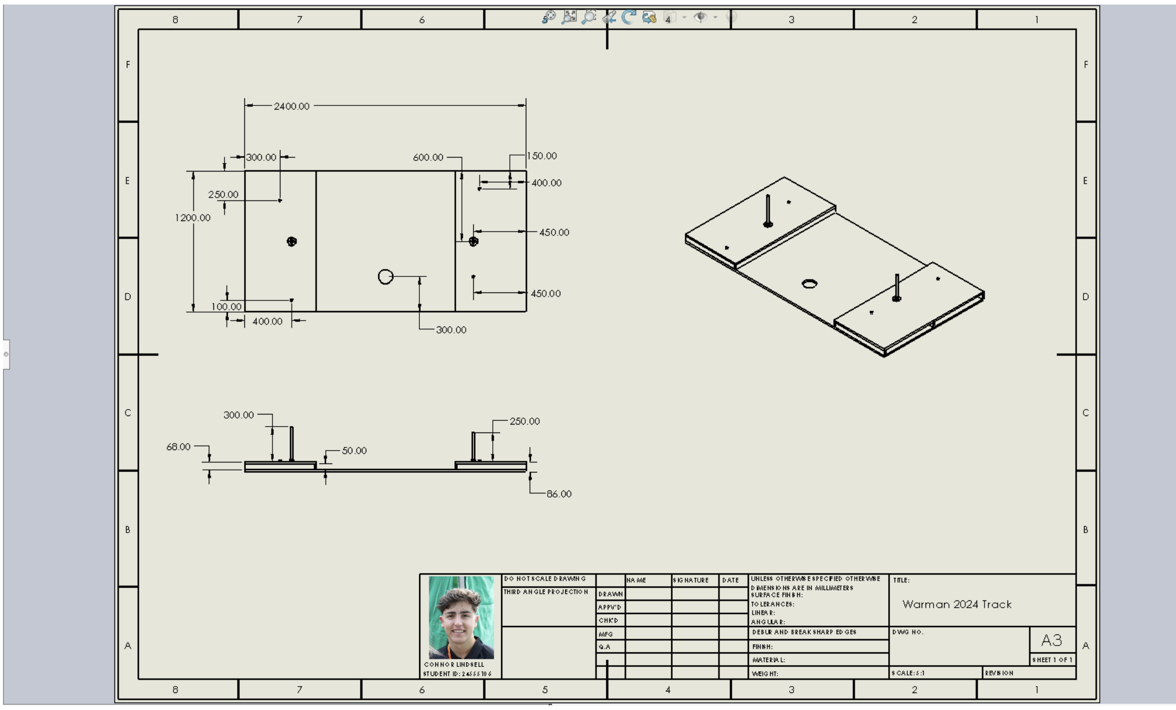
2.1.2. *All payloads in the correct starting areas*



2.1.3. *All payloads in the correct final area*



2.2. The General Assembly Drawing



2.3. Engineering Australia Code of Ethics

3. Artefact 2: Planetary Drive Actuator for Robotic Arm

3.1. Introduction to Planetary Drive Actuator (PDA)

For the 2024 Warman Challenge, our team is constructing a robotic arm where precision and efficiency in motion control are paramount. Given the constraints on weight and budget, utilizing large motors is not a feasible solution. Instead, we are employing a robotic actuator. The stacked planetary gearbox, known for its high torque and compact design, is an ideal choice for this application. This document explores the development and application of the stacked planetary gearbox.

The primary function of the stacked planetary gearbox is to adjust the motor's torque and speed to the levels necessary for the operation of the robotic arm. In robotics, maintaining a balance between speed and control is crucial; the gearbox facilitates this by efficiently converting high-speed, low-torque output from the motor into low-speed, high-torque output. This outcome is essential for the precise and steady movements of the robotic arm. The 16:1 ratio of our gearbox significantly amplifies the output torque, enabling the arm to handle heavier loads or perform more forceful movements with ease.

A planetary gearbox system includes several key components: the sun gear, planet gears, and ring gear. The sun gear at the centre transmits motion to the planet gears, which rotates within a fixed ring gear. A distinctive feature of the stacked planetary gearbox is its configuration of multiple planetary gear sets, or 'stages,' aligned along a common central axis. In our design, two sets of 4:1 planetary gears are stacked to achieve an overall gear ratio of 16:1. This arrangement allows each stage to multiply the torque output from the previous stage, thus significantly increasing torque while maintaining a compact footprint ideal for robotic applications.

The advantage of using planetary gears lies in their load distribution. The load is shared among multiple planet gears, which reduces wear and tear on individual components, enhances the lifespan of the gearbox, and ensures smoother operation. In robotic arms, the stacked planetary gearbox is directly connected to the arm's joints or actuators. Finely adjusting the output torque and speed from the motors ensures that the arm can execute precise and controlled movements, which is vital for success in tasks requiring high precision and reliability.

3.2. PDA Requirements

XXXX

3.3. Ideation

XXXX

3.4. Design Selection

XXXX

3.5. CAD Design and Manufacture Ready Drawings

3.5.1. CAD…

XXXX

3.6. Prototype and Test

XXXX

4. Artefact 3: Generative Designs for Robotic Arm

4.1. Introduction to Generative Designs

XXXX

4.2. Arm Components Requirements

XXXX

4.3. Ideation

XXXX

4.4. Design Selection

XXXX

4.5. CAD Design and Manufacture Ready Drawings

4.5.1. CAD…

XXXX

4.6. Prototype and Test

XXXX

5. Abstract

5.1. First Iteration of Planetary Gear Design

Xxxx

5.2. First Prototype of Planetary Gear Design (3D Print)

xxxx

5.3. First Iteration of Stacked Planetary Gear Design

Xxxx

5.4. Second Prototype of Stacked Planetary Gear Design (3D Print)

xxxx

5.5. Second Iteration of Stacked Planetary Gear Design

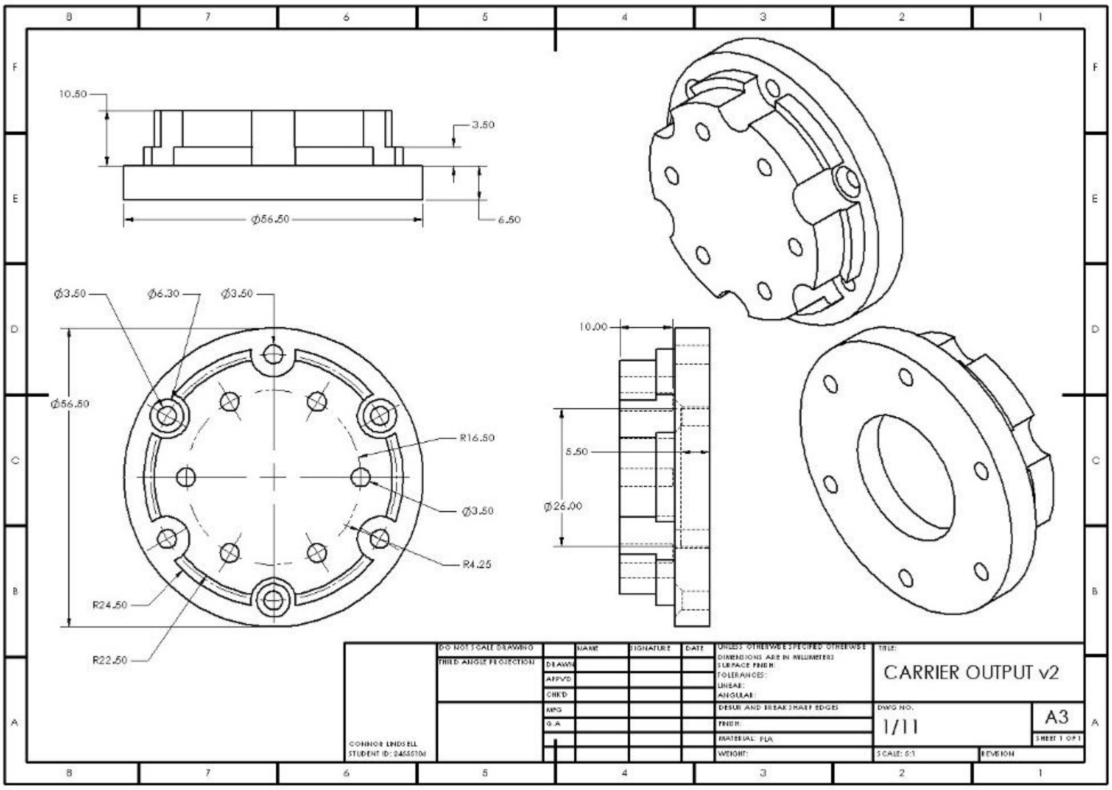
Xxxx

5.6. Third Prototype of Stacked Planetary Gear Design (3D Print)

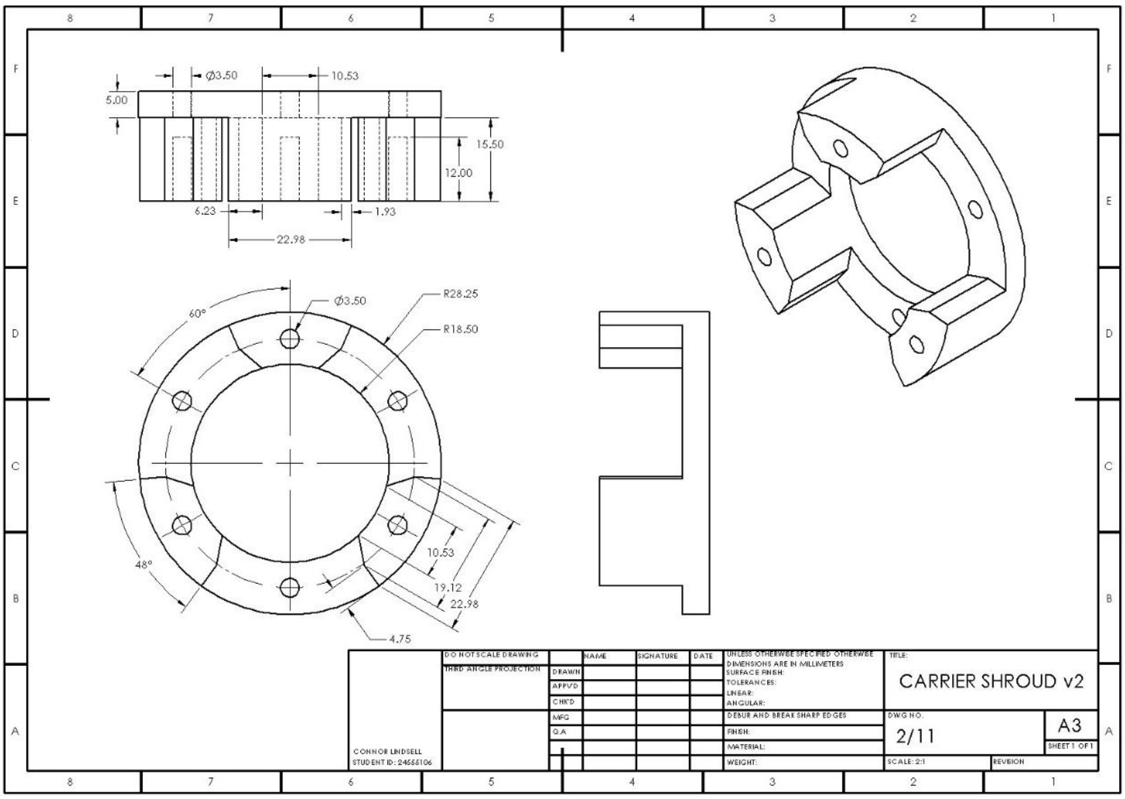
Xxxx

5.7. Drawings

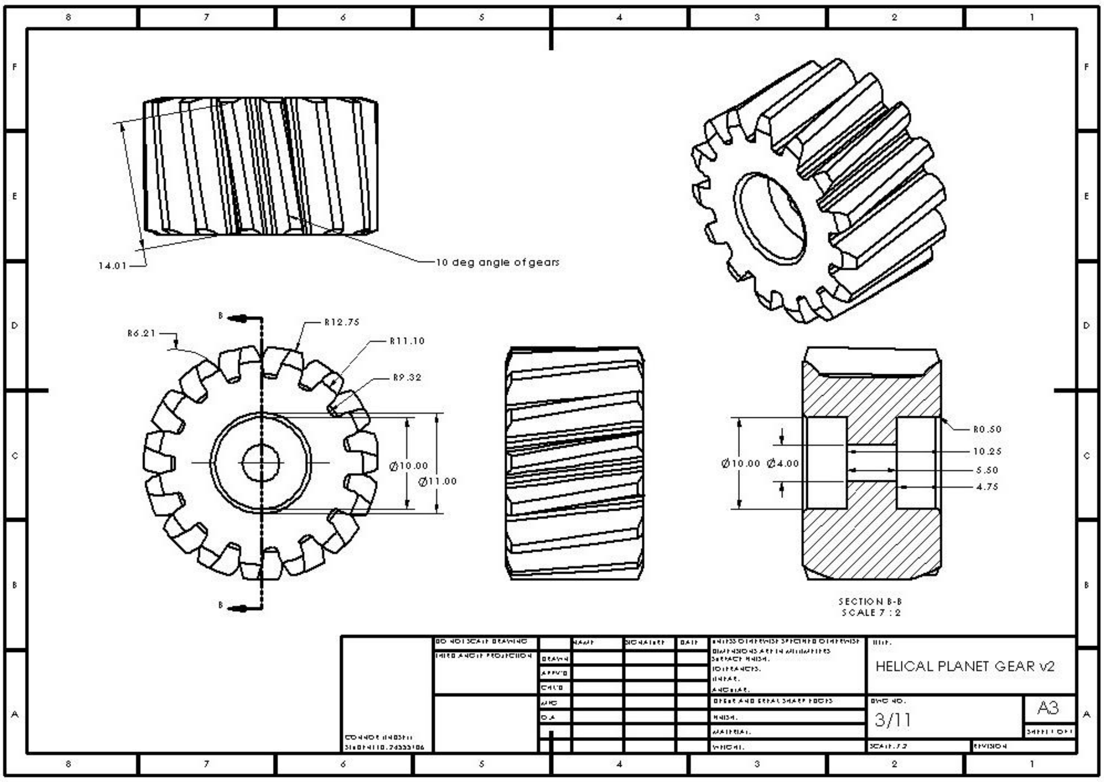
5.7.1. Carier Output v2



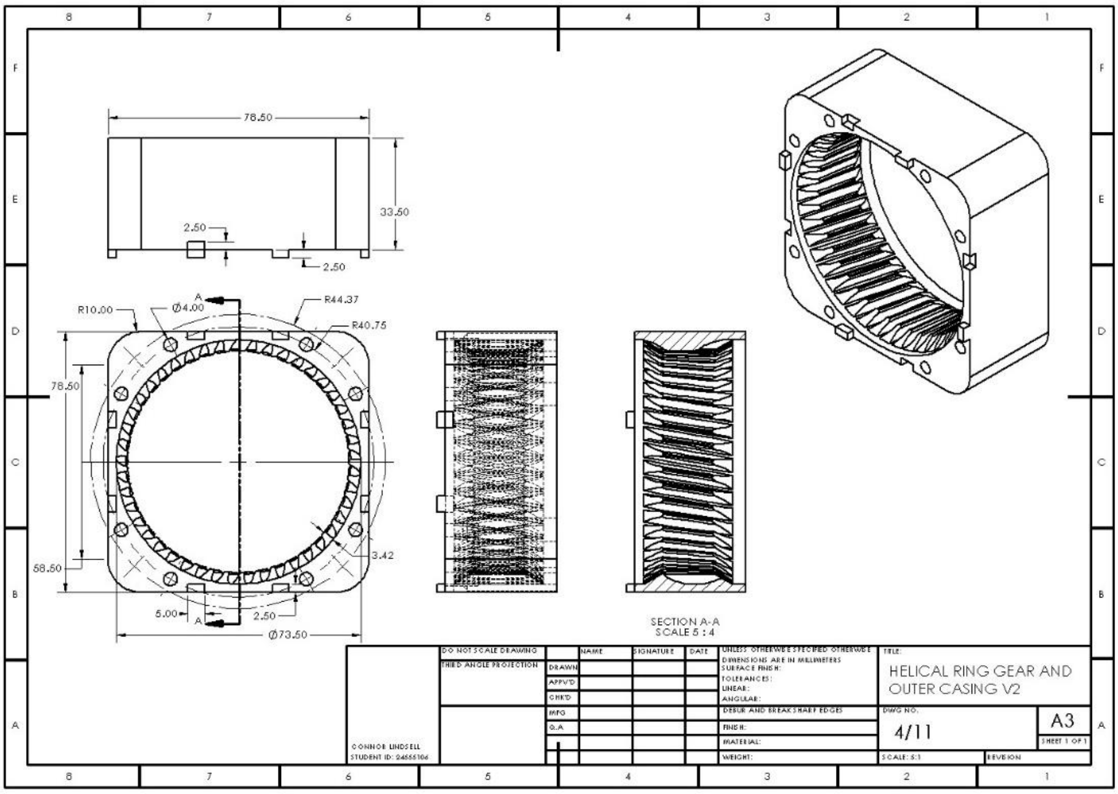
5.7.2. Carier Shroud v2



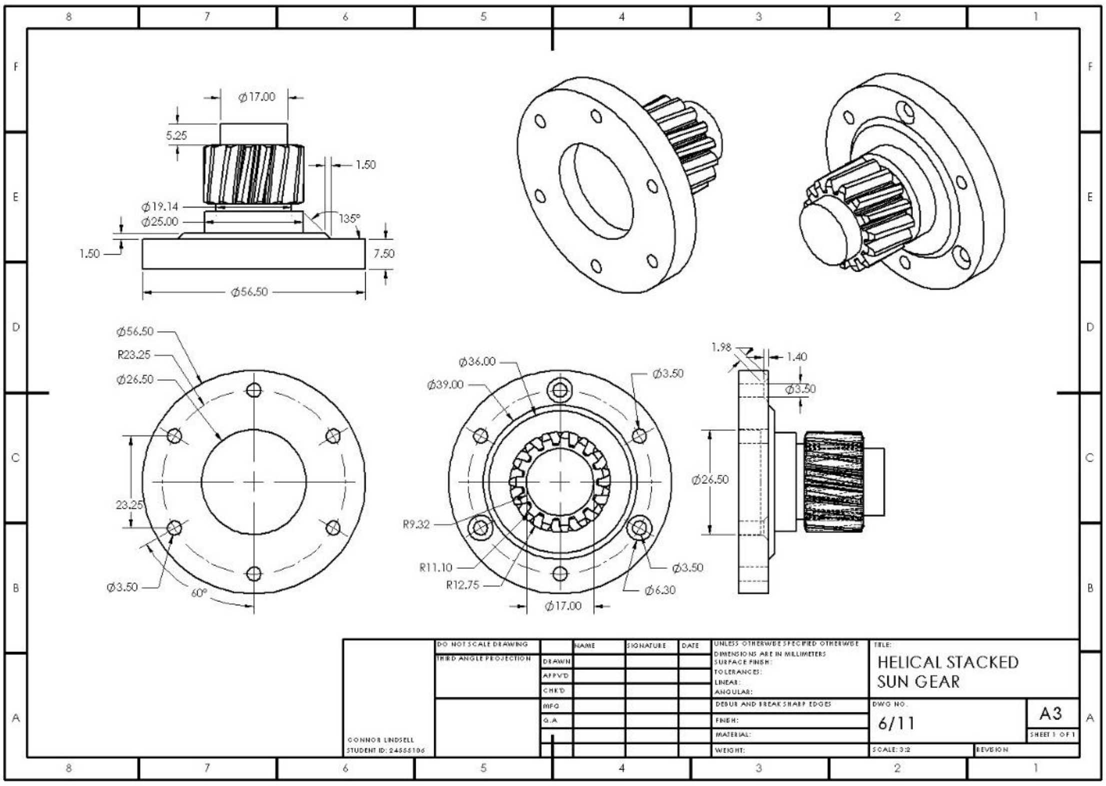
5.7.3. Helical Planet Gear v2



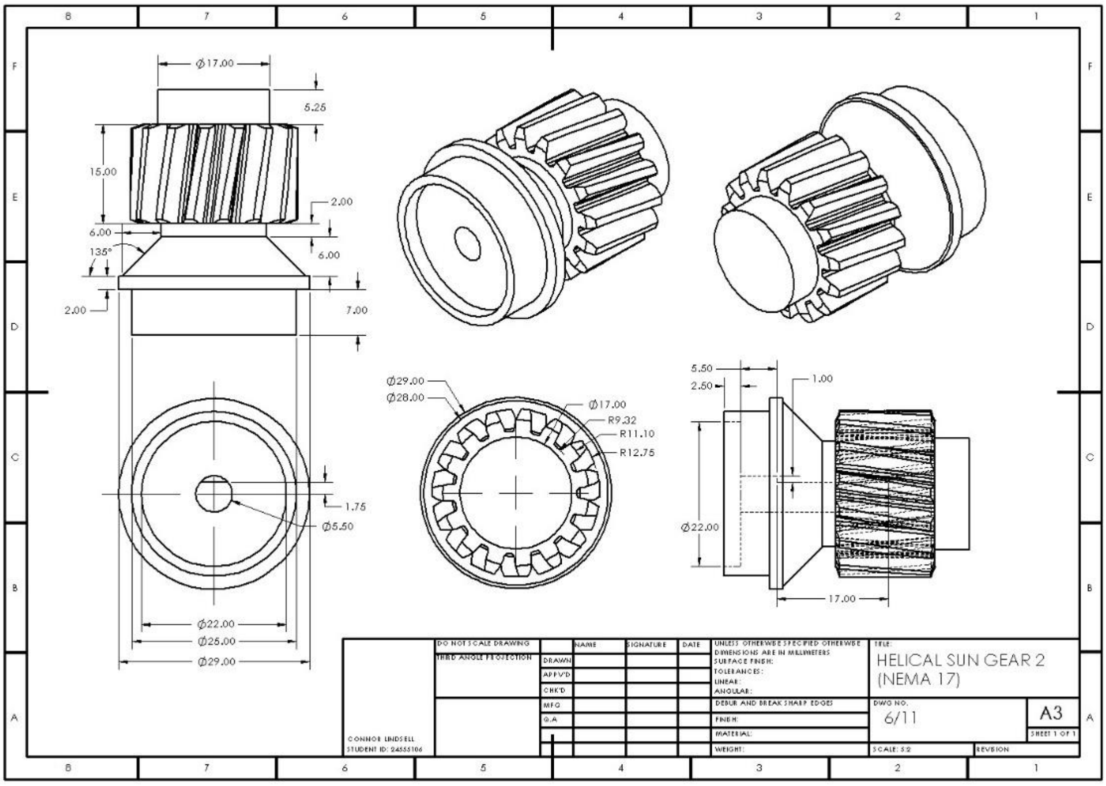
5.7.4. Helical Ring Gear and Outer Casing v2



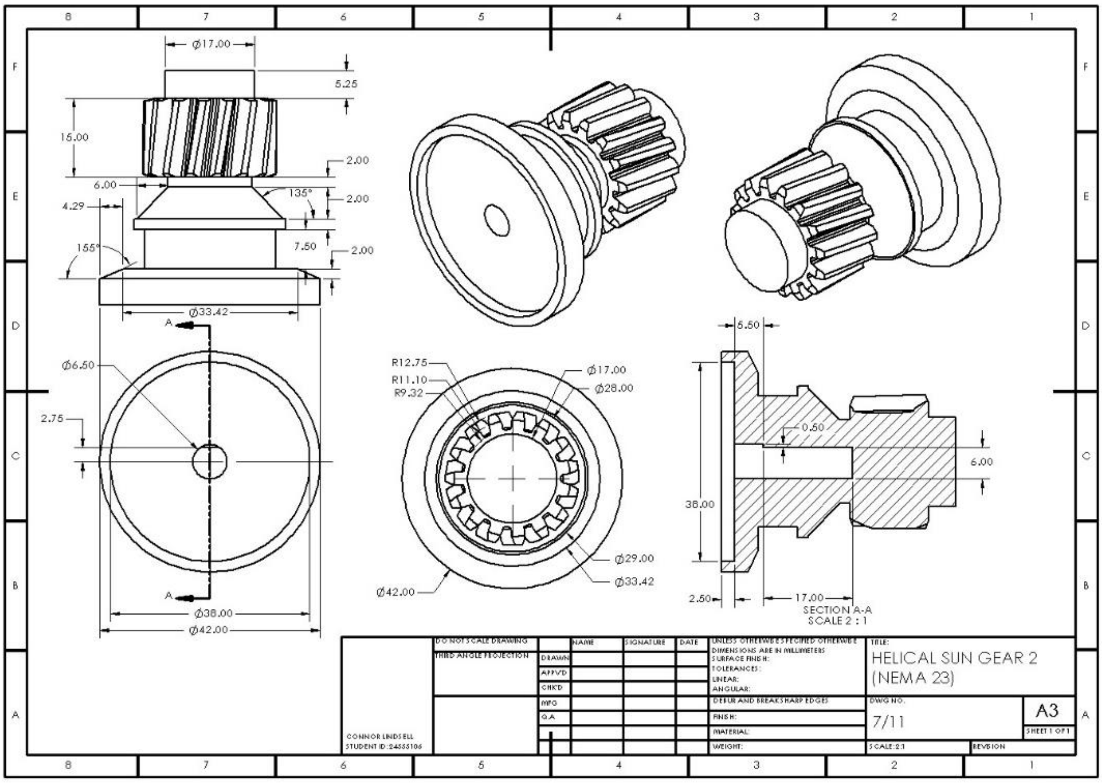
5.7.5. Helical Stacked Sun Gear v2



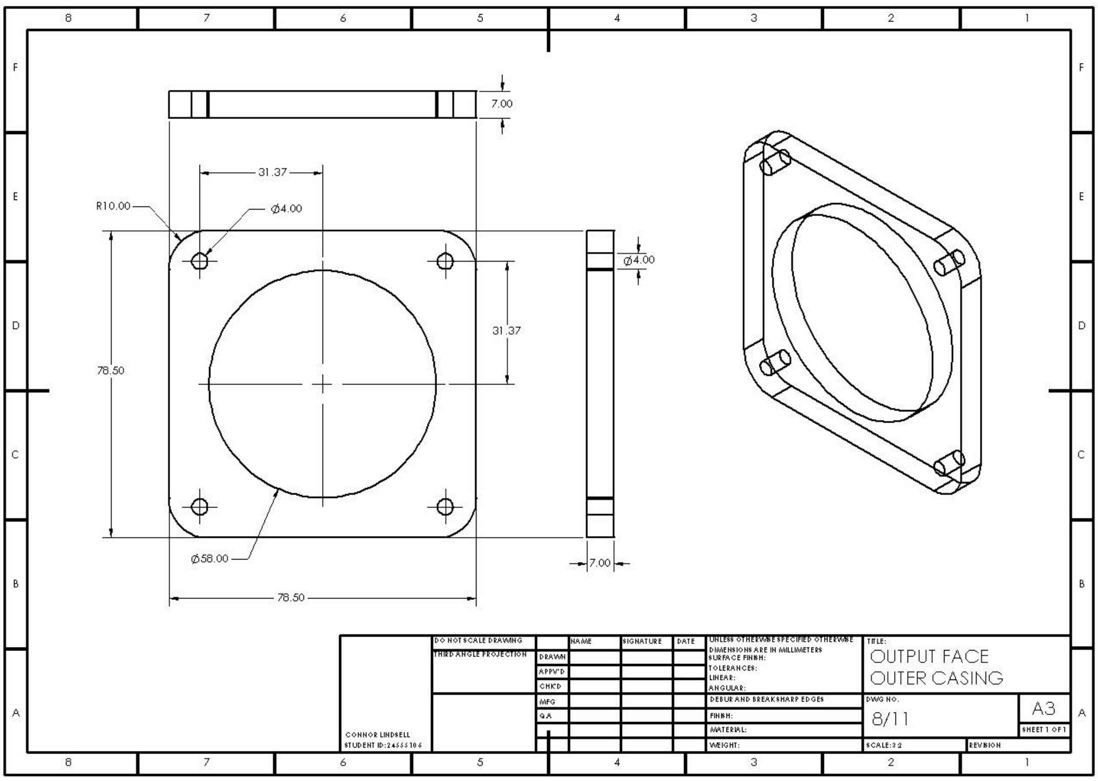
5.7.6. Helical Sun Gear 2 (NEMA 17)



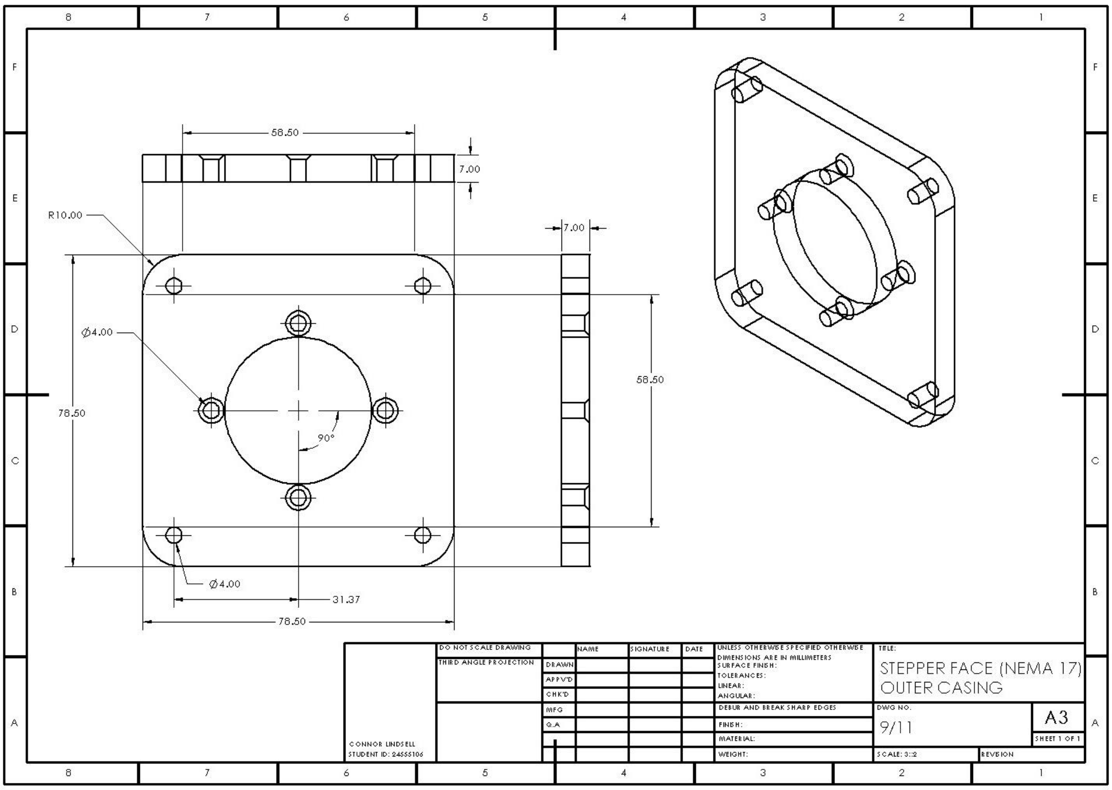
5.7.7. Helical Sun Gear 2 (NEMA 23)



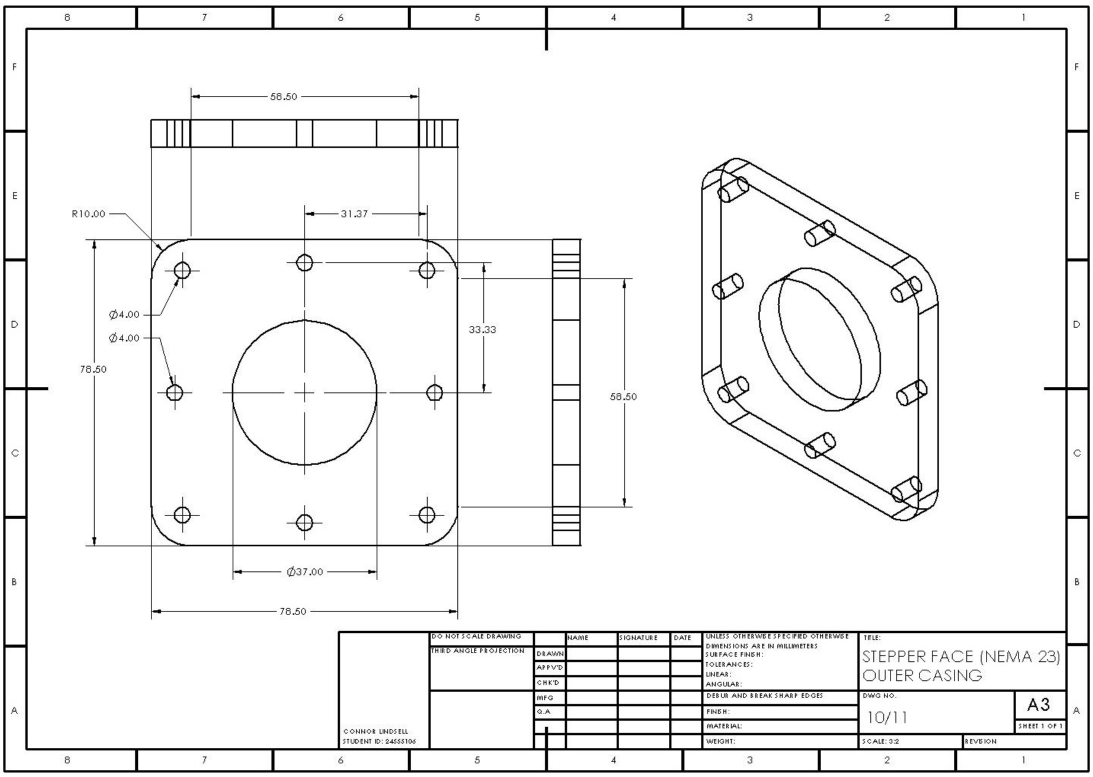
5.7.8. Output Face Outer Casing



5.7.9. Stepper Face (NEMA 17) Outer Casing



5.7.10. Stepper Face (NEMA 23) Outer Casing



5.7.11. Stepper Face (NEMA 23)