SE101 Final Design Project: Written Report

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SE 101: Engineering Graphics & Design

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Introduction

A farm tractor is a versatile vehicle designed to perform various agricultural tasks, such as plowing fields, planting and harvesting crops like corn, or towing heavy materials such as harvested wheat. These machines are crucial in modern farming, making labor-intensive tasks more efficient and manageable. This written report will explore the step-by-step process of dissecting and modeling a toy farm tractor. This process will focus on three main components: the structural design, the mechanical system, and the external features, providing a comprehensive understanding of its construction, functionality, and market influence. While this is not a real tractor, the model offers a simplified representation that helps illustrate the fundamental principles of a tractor's operation.

Function

The tractor consists of three main components, each with its assemblies. The model includes 61 unique parts. We will now break down the three main components and their subsystems.

Tractor

The first component is the tractor, consisting of three main subassemblies: the driver’s cabin, the main chassis, and the gearbox. The driver’s cabin, located on top of the main chassis, serves as the control center, where an operator would sit to operate the tractor. The main chassis acts as the structural frame of the tractor, providing support and housing key mechanisms such as the trailer hitch, wheel steering, drivetrain, and battery compartment. These elements will be explored in greater detail later.

Front-loader/Forklift

The second component, referred to as the frontloader or forklift (used interchangeably), functions as an attachment for the tractor. Its primary purpose is to lift and carry cargo. Subsequent sections will explain the mechanics and operation of this component further.

Trailer

The third component is the trailer, designed to hold and transport cargo. It connects to the tractor via a tail hitch located at the rear. The trailer includes functional features, such as the hydraulic system and rear door, which work simultaneously to unload the trailer from the rear. Details about the trailer's mechanics will also be discussed later in the report.

Mechanisms Involved

Stability and Steering

1. **Wide Tires**: Two wide tires provide stability and balance, preventing the toy tractor from tipping over when transporting a heavy load.
2. **Smaller Tires**: Two smaller tires are primarily designed for steering, offering a tighter turning radius to quickly navigate corners and change direction.

Connectivity and Mechanisms

1. **Hitch Mechanism**: The hitch is a secure connection between the toy tractor and the trailer. It ensures the trailer moves in sync with the tractor without detaching during operation.
2. **Hydraulic System**: Used for raising and lowering the trailer bed and moving the front loader up and down. While these movements are not remote-controlled, the user can manually operate them.

Front Loader Components

1. **Fork Attachments**: These attachments enable the lifting and transporting of small loads, aiding in scooping, pushing, and moving various materials.
2. **Bracket Assemblies**: These secure the fork attachments, ensuring they remain stable while lifting and carrying objects.

Hitched Trailer Features

1. **Trailer Bed**: The bed is essential for hauling cargo, such as plastic fruit and hay bales, supporting tasks like harvesting and material towing.
2. **Tow Hitch**: This component keeps the trailer securely connected to the tractor, allowing it to follow its movements seamlessly while turning or navigating.

This cohesive integration of stability, connectivity, and functionality ensures that the toy tractor system is versatile and user-friendly.

Scientific Principles Involved

Torque and Its Importance

Torque is a critical factor in allowing a battery-powered motor toy to move effectively. It provides the rotational force the toy requires to follow the command inputs and perform its intended tasks. Without sufficient torque, a functioning motor would fail to move the toy or accomplish its operations.

Key Mechanisms

1. **Gears**:

   Gears are vital in transferring power from the battery-powered motor to the wheels. By adjusting the speed and torque, the gear system ensures optimal performance. In this design, gears reduce motor speed to increase torque, enabling the toy to generate enough force to move. Without this reduction, the motor would run excessively high speeds, compromising the torque needed to drive the toy farm tractor.

2. **On/Off Switches**:

   These switches control the power flow from the battery to the motor, lights, and signal emitter. They allow the user to power the toy on or off as needed, essential for conserving battery life and maintaining energy efficiency.

3. **Rack and Pinion Mechanism**:

   This mechanism is used for steering the toy manually, providing precise control over the tractor's movements. By simulating real steering functionality, the rack-and-pinion mechanism enhances the toy's interactivity and realism.

Figure 1. The black box diagram of the toy farm tractor shows how battery power and manual control inputs result in tractor torque and control signals.

Product Story

The Toy Tractor with Trailer began as a vision to bring the magic of farm life into children's play. Designers started with detailed research, studying real tractors to create an authentic, scaled-down version. Every curve, wheel, and trailer hitch was carefully replicated to evoke the spirit of farm life while ensuring it was child-friendly and engaging.

Engineers transformed the designs into prototypes, emphasizing durability and ease of use. For interactive play, free-rolling wheels, a detachable trailer, and smooth edges were incorporated. Testing involved children of various ages, whose feedback shaped refinements, ensuring the toy was both fun and safe.

High-quality, non-toxic materials were chosen for safety and longevity. The vibrant colors were carefully selected to appeal to children while meeting strict safety regulations. The production process involved precise crafting, thorough assembly, and rigorous quality checks to ensure every tractor met the highest standards.

The final product balanced realism and playfulness, with movable parts and an intuitive design for easy handling. After reaching store shelves, the Toy Tractor with Trailer became more than just a toy—it became a tool for fostering imagination, motor skills, and joy in children everywhere.

Market Segment

This section examines the market segment for toy tractors, focusing on the target audience, how the product meets customer needs, its educational value, competition, and additional key factors we observed when dissecting this product.

Target Market

The target market for the farm tractor includes children aged 6-10, specifically focusing on those interested in agriculture or construction-themed play. Parents and caregivers looking for educational yet fun toys that provide motor skills development and interactive play will find this product appealing. Due to its engaging design and features, the product is also ideal for gift-giving occasions such as birthdays and Christmas.

Customer Needs

For the product to be successful, it needs to be able to fulfill certain customer needs. Listed below are what we observed and hypothesized could be the customer needs when looking for our product:

- **Interactive Play**
    - Children seek toys that allow them to interact with the product in multiple ways. The remote-control function and the detachable crops fulfill this need, providing an immersive farm-themed experience.
- **Educational Value**
    - Parents often look for toys that not only entertain but also teach. This toy introduces children to basic farming, construction, and machinery concepts, encouraging imaginative play.
- **Durability**
    - The plastic construction is durable enough to withstand normal indoor and outdoor use, and the rubber tires ensure that they do not wear out easily.

- **Safe & Easy to Use**
    - Parents prioritize safety. Therefore, the product uses rechargeable batteries and is made from non-toxic materials, making it safe for kids to handle. The simple control interface also ensures ease of use.
- **Affordability**
    - At $29.99 (retail price), it is an affordable option for parents and offers value for money thanks to its combination of features. Compared to premium brands that may charge significantly more for similar remote-controlled toys, this product provides a cost-effective solution without compromising on key interface elements, making it accessible to a broader range of consumers.
- **Demonstration Purposes**
    - Parents and educators may prefer toys demonstrating basic engineering principles such as hydraulics, weight distribution, or mechanical advantage. This meets the need for hands-on STEM education, where children can understand cause-and-effect, problem-solving, and the mechanics of moving machinery.

Competitors

The toy farm tractor competes with other remote-controlled toy vehicles, especially within the agricultural and construction toy segments. Major competitors include brands like John Deere, Bruder, and New-Ray, which also offer farm-themed remote-control toys and playsets. Listed below are the key competitors and features that the competitors' products had:

- **John Deere Remote Control Tractors**
    - These products often feature more detailed replicas of real tractors, and some come with additional features such as functional lights and sounds.

- **Bruder Farm Toys**
    - Known for their durability and scale accuracy, Bruder toys are often larger and have a more detailed design but typically do not include electronic or remote-controlled features.
- **New-Ray**
    - Their products offer similar remote-controlled farm vehicles but lack detachable crops and interactive features, as shown below.

		
John Deere	Bruder	New-Ray

Advantages of Our Product

- **Interactive Features**
    - The 2.4 GHz remote control allows for real-time interaction, a significant advantage over static toys or toys that lack electronic movement capabilities.
- **Affordability**
    - Compared to premium competitors like Bruder, this toy is much more affordable while providing a rich interactive play experience.
- **Educational Farm Play**
    - Including detachable crops and other farm accessories adds an educational layer, allowing kids to simulate farm operations.

- **Durability**
    - The ABS plastic and rubber tire construction makes it suitable for both indoor and outdoor use, making it a versatile option.

Disadvantages Compared to the Competitors

- **Limited Play Variety**
    - Competitor brands such as Bruder offer more extensive farm playsets that include multiple vehicles, figures, animals, and accessories, allowing children to engage in a wider range of imaginative scenarios. In contrast, the Toy Farm Tractor comes with only a single vehicle and trailer, limiting the diversity of activities and reducing the scope for more complex farm play.
- **Short Battery Life**
    - The Toy Farm Tractor has just 30 minutes of playtime before needing a recharge, which may disrupt the play experience. Many competitors are non-electronic, allowing for continuous, uninterrupted play without batteries, which is convenient for users.
- **Simplified Design**
    - While the Toy Farm Tractor is functional and engaging, its design is less detailed than that of premium competitors, which produce highly realistic farm machinery models. These competitors often feature intricate, lifelike details, which make their toys more visually appealing for children who appreciate realism and for collectors looking for accurate replicas.

Documentation

Dissection Sequences and Process

Figure 1 - Fully Assembled Tractor

Figure 1.1a - Lower sub-assembly of the tractor

Figure 1.2a - Top sub-assembly of the tractor

Figure 1.1b - Lower sub-assembly completely disassembled

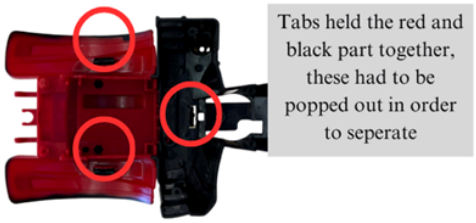


Figure 1.2b - Underside of top sub-assembly of the tractor

Figure 1.2c - Completely disassembled top sub-assembly of the tractor

Figure 1.1c - Inner-workings of the gearbox

Trailer and Front Loader Dissection

Figure 1 - Fully Assembled Front Loader

Figure 1.1a - Mount Sub-assembly

Figure 1.2a - Rack Sub-assembly

Figure 1.1b - Rack Frame

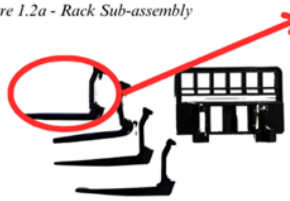


Figure 1.2b - Complete Dissection of Rack Sub-assembly

Figure 1.1c - Completed Dissection of Moving Mount Sub-assembly

Figure 1 - Fully Assembled Hitched Trailer

Figure 1.1a - Trailer with the bed raise to show the hydraulic lift

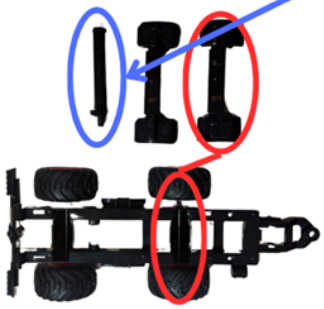
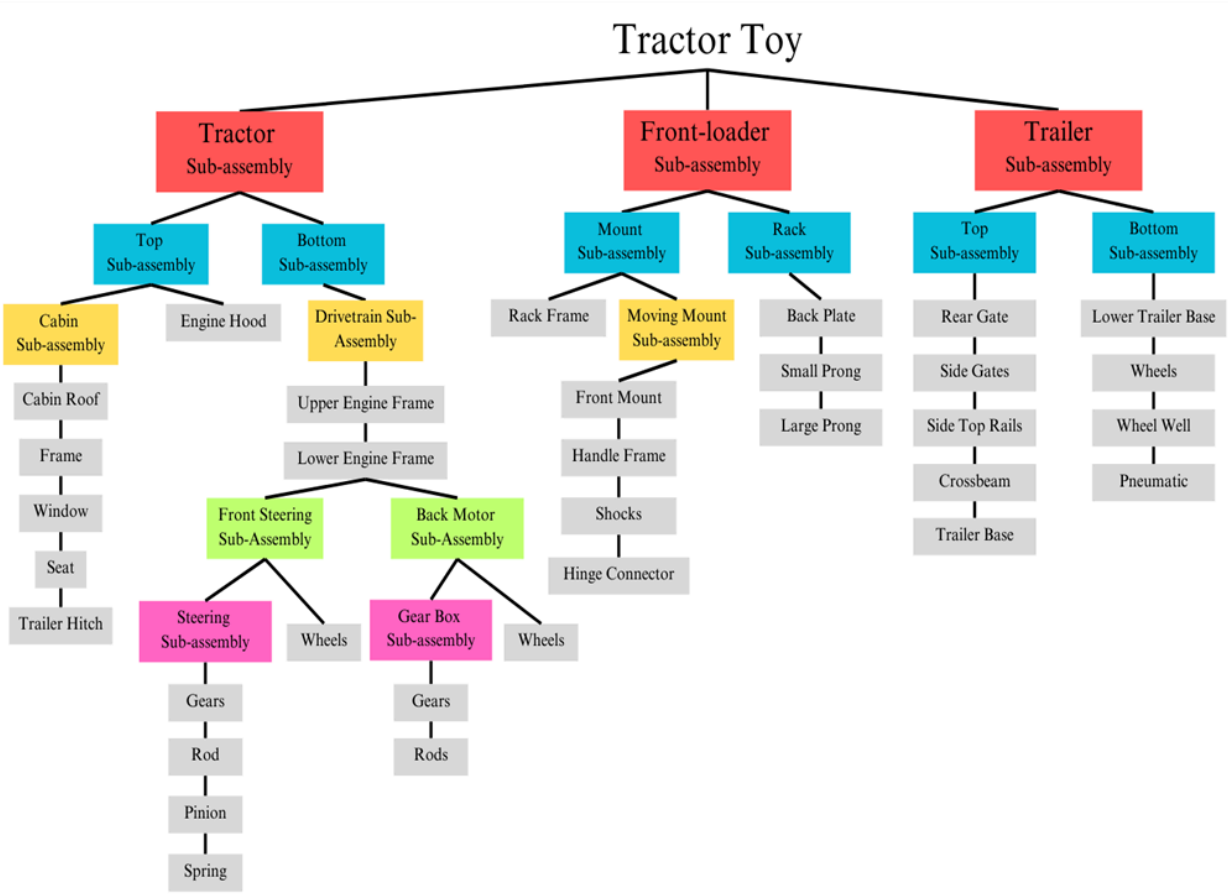


Figure 1.2a - Bottom Sub-assembly

Figure 1.1b - Fully Disassembled Top Sub-assembly

Product Decomposition Diagram



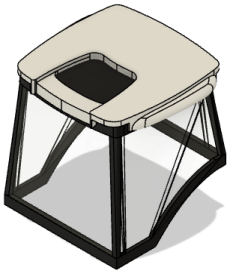
3D Modeling

Description of Problems Encountered

Due to the lack of proficiency in modeling at the initial stage, modeling certain complex parts presented the major challenges we encountered. The following three parts are the most time-consuming ones.

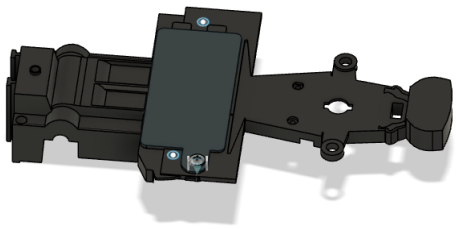
1. Glass cabin

   The glass cabin seems to present a straightforward structure. However, due to the irregular features on the sides and the



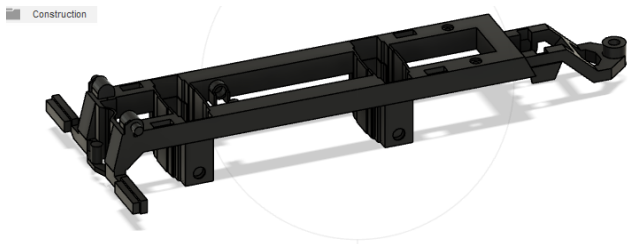
difficulty in fitting the glass precisely into the cabin's rims, the part took longer than expected.

2. Main chassis



The main chassis holds all the gearboxes and motors. It also needs to fit with the upper part of the chassis in all the pins to avoid interference. Therefore, precision in modeling appears to be a major challenge for the part.

3. Chassis of the trailer



Similar to what was described for the main chassis, the trailer's chassis also presents a major challenge due to the requirement for precision in modeling these parts so that they fit closely together with the upper part and connect with the rest of the parts.

Aside from the modeling difficulties, many challenges are also encountered in the assembly process. Since our team divides all the components into several subassemblies, the discrepancy in modeling is not avoidable. It takes time to fit all the subassemblies into a holistic part with no or minor interference and realize all the motion studies that can be realized with the actual tractor.

Lessons Learned

When creating designs and models, it is crucial to maintain organization by assigning each part to a separate file. This approach streamlines the design process, enhances clarity, and ensures

easy access during modifications. Moreover, organizing parts into individual files allows for smoother collaboration and integration into larger assemblies.

Another essential step is checking how parts fit together early in the process. This proactive measure helps identify potential issues during the assembly phase, such as misalignments or dimension mismatches, thereby saving time and resources. Early fit assessments ensure that the final assembly proceeds smoothly without unexpected challenges.

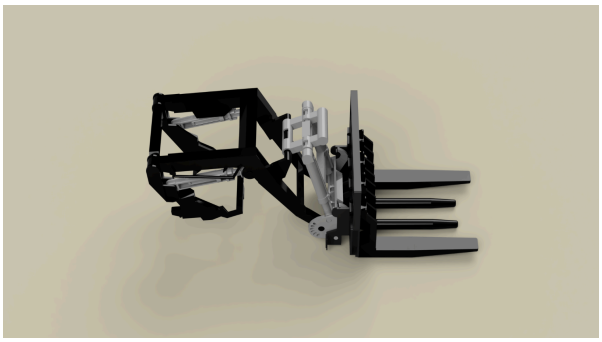
Testing movements and animations incrementally is a best practice in design workflows. Analyzing movements step by step makes it easier to pinpoint specific issues and address them immediately. This methodical approach avoids compounding errors and leads to more refined and functional designs.

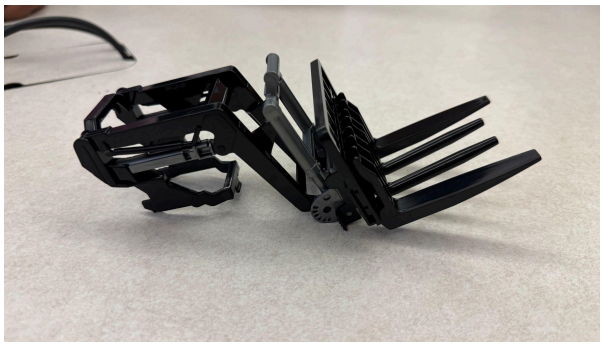
Regular reviews of the design can significantly reduce errors and prevent unnecessary delays. Revisiting the design at key milestones allows for the identification of overlooked details, ensuring that the final product meets the intended specifications and performance criteria.

Finally, leveraging tools within the design software to check for overlaps or incorrect fits is an indispensable practice. These tools provide insights into potential design flaws that may not be visually apparent, enabling designers to correct errors efficiently. Together, these practices contribute to a more efficient, reliable, and organized design process.

Render Images with Comparison to Actual Photos

Component 1: Forklift





For the forklift, we have covered all the features shown for the actual parts that can move. With the rendering generated and highlight scenario applied, the rendered image looks similar to the actual photo.

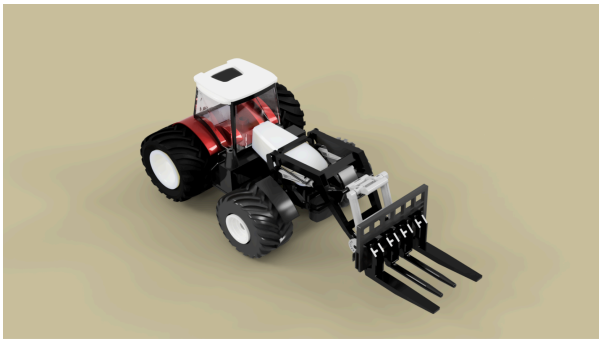
Component 2: Trailer

Despite the color difference due to limited lighting in the library, the rendered image looks very similar to the actual photo in most of the features, including all the fenders and the hydraulic feature.

Component 3: Tire

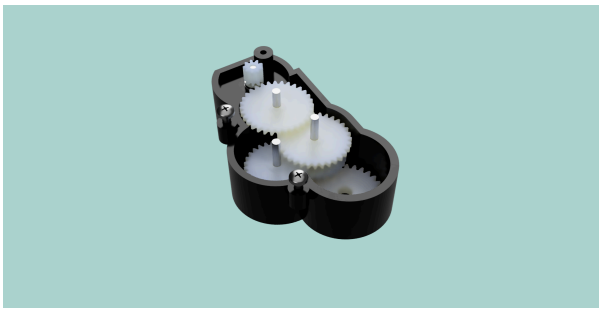
The rendered image looks very similar to the actual photo. The carvings on the wheel and the wheel rim match the features in the actual photo.

Component 4: Tractor



The rendered image of the tractor is very similar to the actual photo with the forklift attached to the body of the tractor.

Component 5: Gear Box



The gearbox looks the same as the actual photo. All the gears match the features, and the interaction between all the gearboxes enables the tractor to move.

Function Analysis

The toy tractor's overall function is to simulate a tractor's basic functions for educational and recreational purposes. It allows the user to understand the mechanical movements and basic controls using various components. To understand the primary functions and key elements of the toy tractor, it is important to identify and evaluate how each part contributes to the overall system.

Primary Functions of the Tractor

- Movement
    - The ability for the tractor to move forward and backward
    - Input: The user manually pushes or remote-controls the tractor
    - Output: Wheels rotate
- Parts Needed for Movement to Function

    - Wheels: allows it to roll over surfaces. They are designed for traction for various types of terrain and they simulate a real tractor's stability.
    - Axle: The axle connects the wheels and helps with their rotation. It is an important connection with the wheels to ensure smooth movement.
    - Motor: When powered, the motor drives the wheels via the axle. It allows for controlled forward and backward movement based on user control.
    - Battery: Power to the motor, allowing remote-controlled movement possible. A rechargeable or removable battery is used to maintain efficiency when the battery dies or runs low.
- Load Lifting (Front Loader)
    - The ability of the tractor to lift small objects or material
    - Input: The user manually operates or uses a control mechanism
    - Output: The loader moves vertically, which simulates lifting material
- Parts Needed for Load Lifting to Function
    - Small and Long Prongs: Prongs act as the main lifting arms, providing stability and balance when carrying material.
    - Frame: Secures the prongs and connects them to the main body, providing a sturdy base for load-lifting actions. The frame is adjustable so that the prongs can be closer or farther away.
    - Lever: Allows the user to operate the loader mechanism, either manually or by a control system. It's an essential part of ensuring controlled movements.
- Steering Control
    - The ability for the tractor to steer left or right

    - Input: The user applies force manually or through remote-controlled buttons
    - Outputs: Wheels turn to adjusted direction
    - As shown in Figure 1, our functional decomposition diagram shows the input steering control and the parts that require this input to provide electrical signals to the main control board.
- Parts Needed for Steering to Function
    - Steering Wheel: The steering wheel connects to the wheels or a control board, directing them to rotate as the user intends.
    - Gears: These gears convert user input into wheel movement.
    - Control Board: Receives the user's input and translates it into electrical signals to control the direction of the wheels.

Secondary Functions of the Tractor

- Power source:
    - It provides the motor energy for movement
    - Input: Battery or power
    - Outputs: Energy supplied to the wheels, loader, and/or lights
        - As shown in Figure 1, our functional decomposition diagram shows the input power and the parts that require this input to provide the necessary output.
- Parts needed for Power source:
    - Battery: The primary source of energy, rechargeable.
    - Power Circuit: Connects the battery to different parts. Distributes the energy as needed.

    - Motor: Converts electrical energy from the battery into mechanical energy, powering movement, and loader functions.
    - Electrical Wires and Connectors: Connects the battery to the motor and control board, allowing for efficient flow of power to all essential parts.
- Stability
    - It ensures that the remains stable during movement
    - Inputs: Weight distribution and width
    - Outputs: Stable base
        - This is important in the functionality of a real tractor as well because when a big tractor turns, it needs the distribution of weight and the adjusted placement of the wheels to prevent tipping.
- Parts Needed for Stability
    - Wide Base: It has a stable base design, which ensures balanced movement.
    - Weight Distribution: Precisely placing the battery, motor, and other parts for stability, and doing this prevents tipping during turns or when lifting.
    - Supportive Frame: A solid frame structure to keep all components aligned and ensure durability. Likewise, it allows for balanced movement as well.

Important Pieces for the Functions

- Wheels and Axle:
    - The wheels are key to ensuring that the tractor's primary function of movement is plausible. Furthermore, the axles are equally important because they connect the wheels and allow for smooth rolling.

- They are a fundamental part of mobility, which is one of the core functions of the tractor.

- Motor and Battery:
  - The tractor can be manually operated, and it will be easy to push and pull. To optimize the usage and simulate the most accurate tractor fully, the remote-controlled toy tractor has all the functions of a real tractor in one controller. The tractor needs the power source to move, lift, and load.
  - The power is essential for powering the motor, allowing the tractor to receive signals from the electrical components.

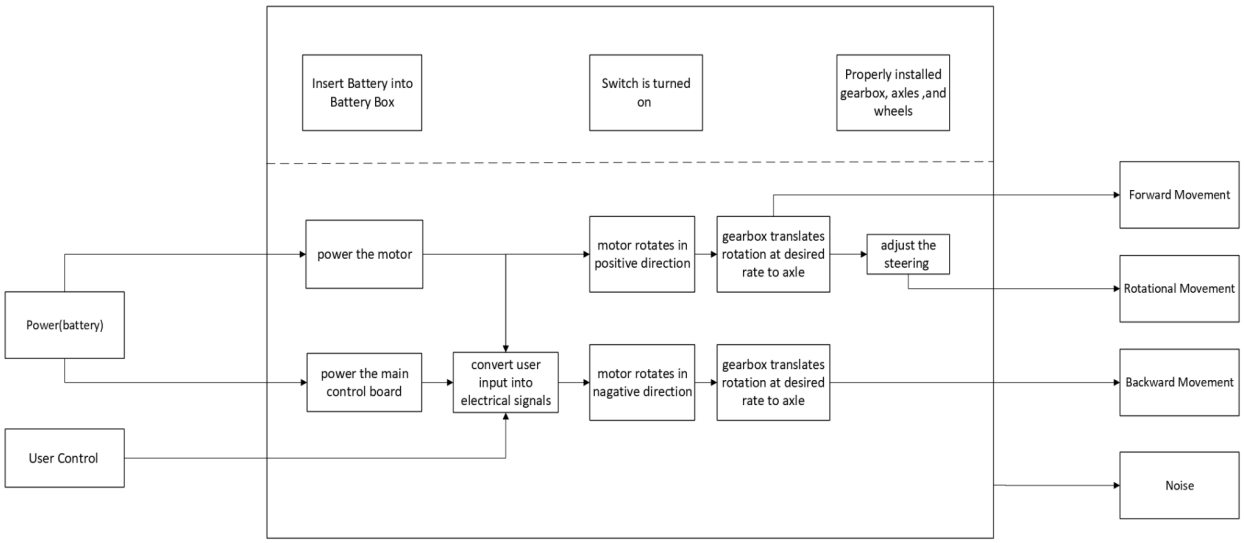
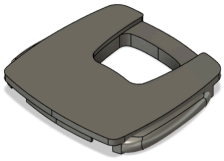


Figure 1. Functional Decomposition Diagram (Power and User control inputs give Movement, Sound, Light, and Noise by various mechanics)

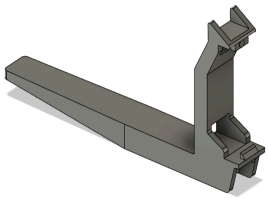
Modeling Progress

Description: This is the top of the cabin on the main tractor body.

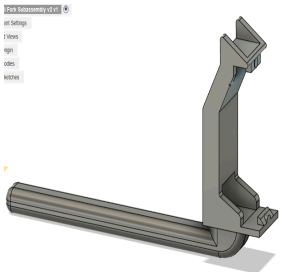


Description: This is a tire. One model covers all four tires except for two of them, which have different sizes.

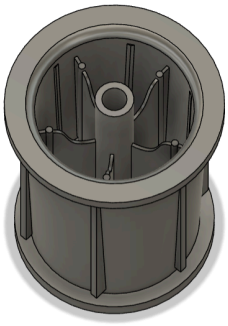
Description: This is a large prong used in the front loader to pick up farm harvests and any heavy material. There are two of these prongs.



Description: This is a small prong used on the front loader, designed to assist the larger prong in picking up farm harvests and heavy materials. There are two of these prongs for added support.

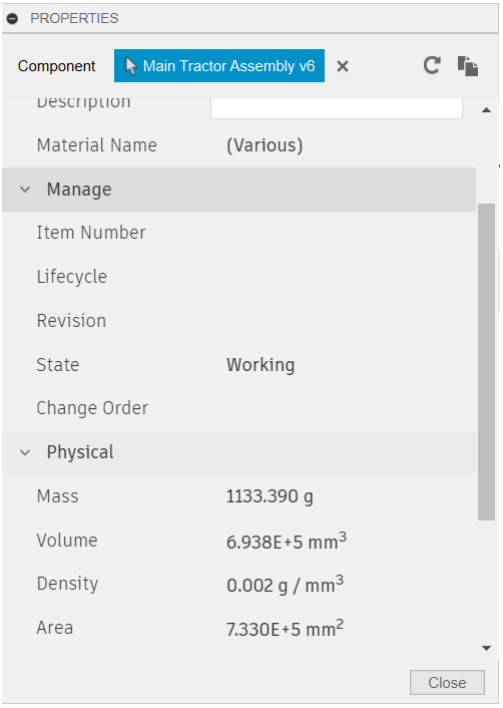


Description: This is the rim of the tractor. Four rims are the same in every way, except two are larger than the others.



Weight Estimationtion

The weight estimation of our model is shown on the graph labeled PROPERTIES on the right. The mass of the model is 1133.390 g, while the mass of the actual model is 700 g. The discrepancy occurs due to the density of the material we applied to the model. Since no material option is available with the same density as the actual tractor, ABS plastic is selected as a replacement despite the minor difference in density.



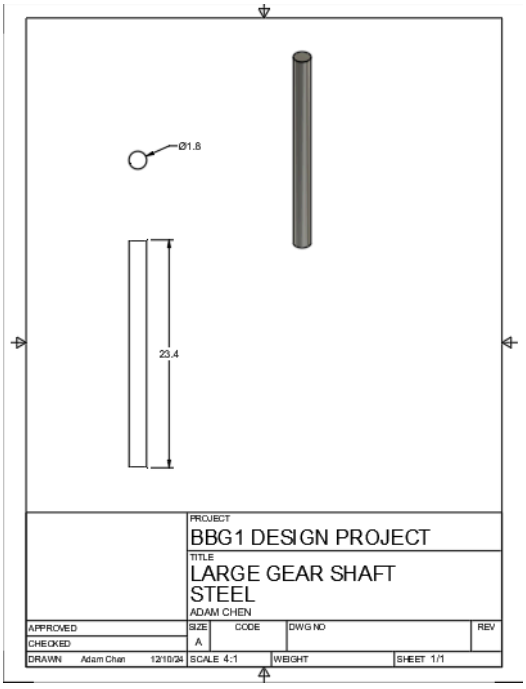
Tolerance Analysis

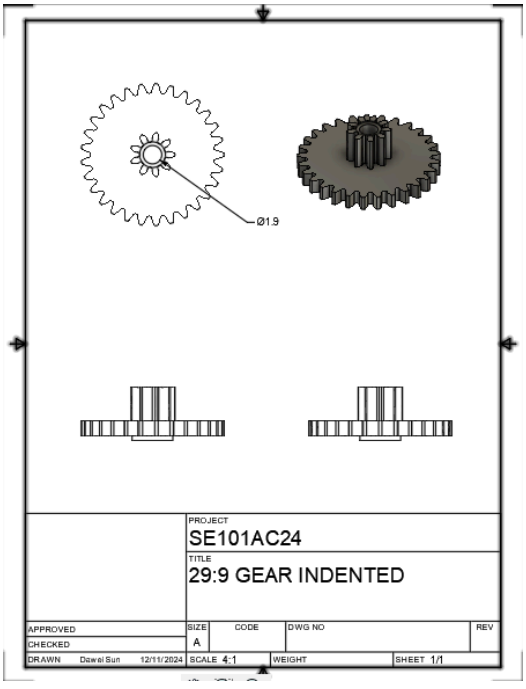
A tolerance analysis aims to evaluate and ensure that the components of a mechanical system will fit and function properly. Tolerances define the allowable variations in the dimensions of parts, accounting for manufacturing imperfections while ensuring compatibility between mating components. The two parts to be analyzed are one of the gears steering the tire and the bottom of the tractor's cabin. They represent different tolerances; proper identification is needed to guarantee an appropriate fit and function.

Instance 1: Gear mounted on a shaft

Function: This component transmits rotational motion through the gear mounted on the shaft. This gear is designed to interact with other gears or mechanical elements.

Critical Tolerances: This section highlights tolerances for the shaft diameter and bore diameter, as they directly affect the assembly's functionality and reliability.

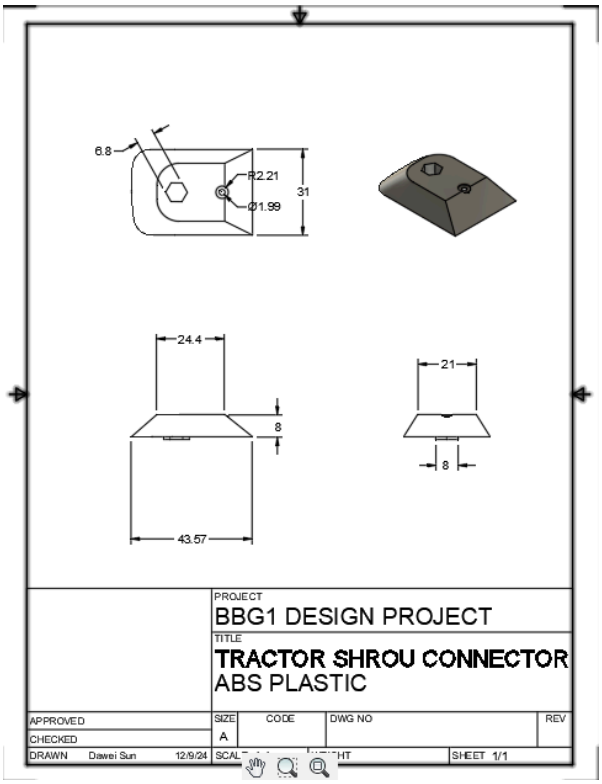


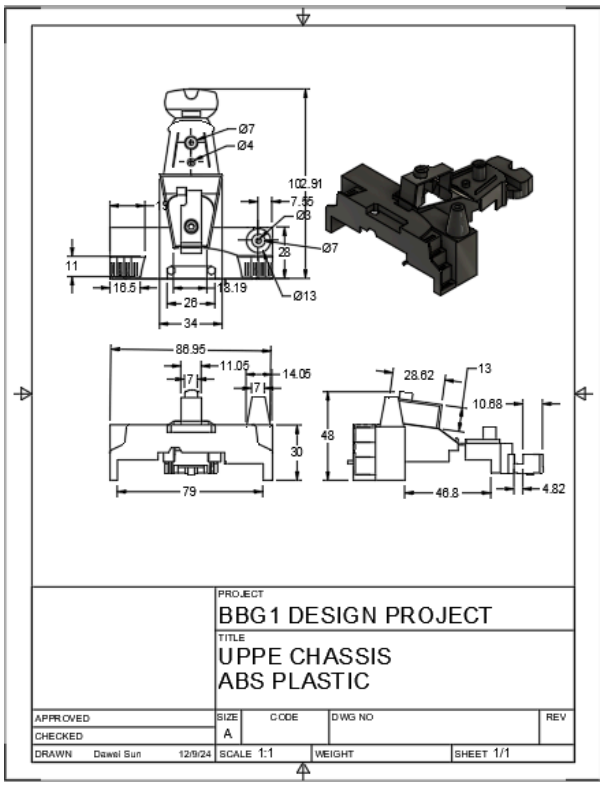


As can be seen from the above drawings, the left-hand side is the shaft, which is **1.8 mm in size**, and the right-hand side is the hole, which is **1.9 mm in size**. The maximum clearance is **0.1 mm**. Since the shaft is smaller than the hole, it is a **clearance fit**. The tolerance type allows easy assembly and potential relative motion between the shaft and the gear and is suitable for applications requiring rotation or sliding of the shaft.

Instance 2: Bottom of cabin

Function: the bottom cabin acts as the foundation and structural support for the assembly. It provides mounting points for shafts, fasteners, or other mating components to ensure the stability and functionality of the entire system.

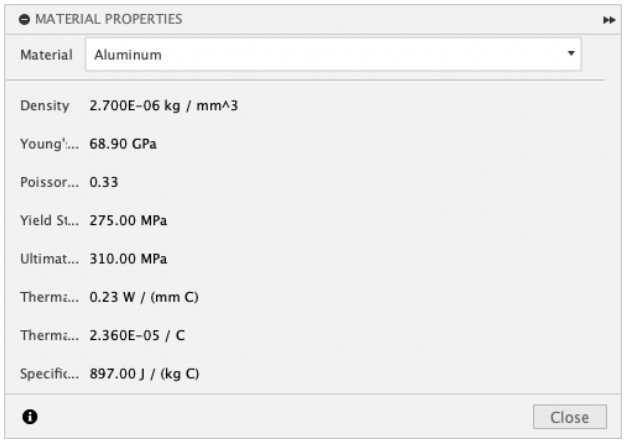
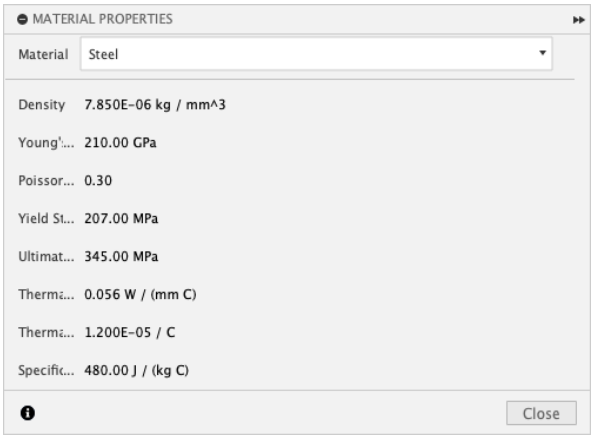
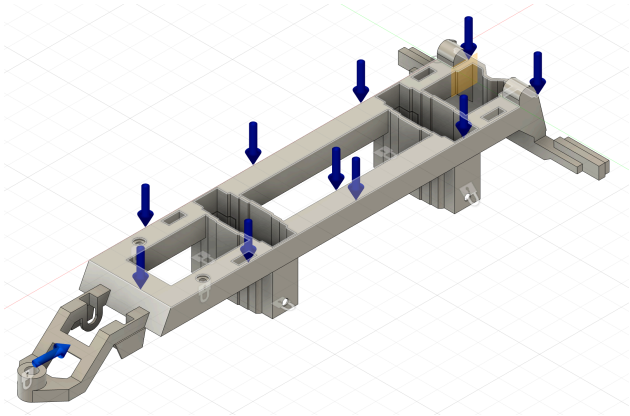
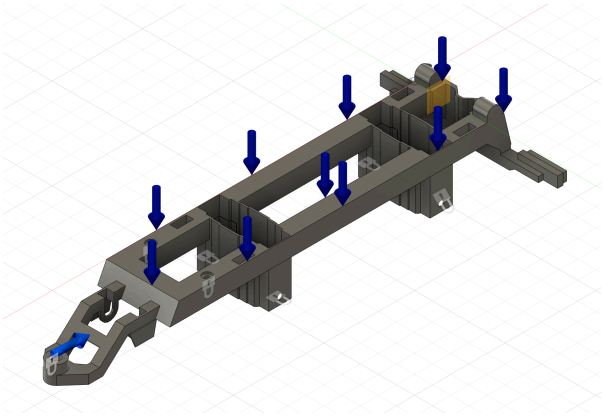




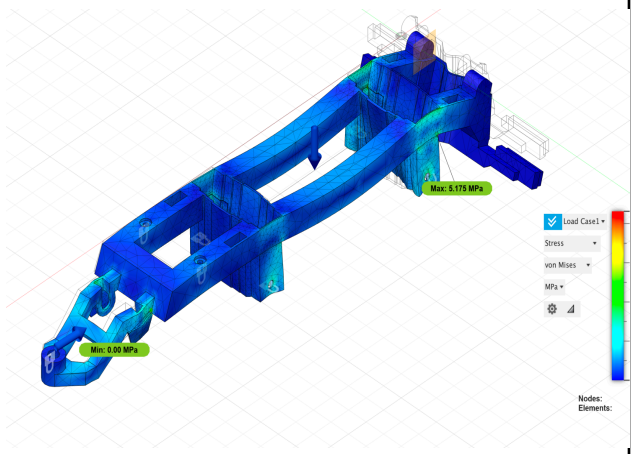
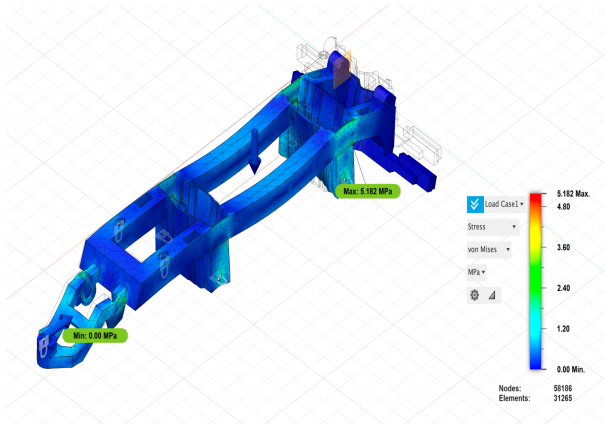
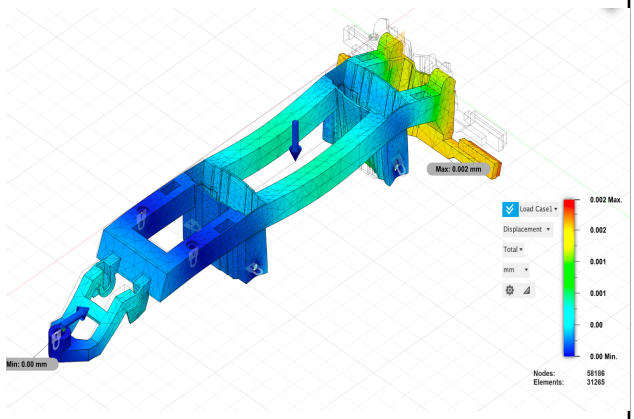
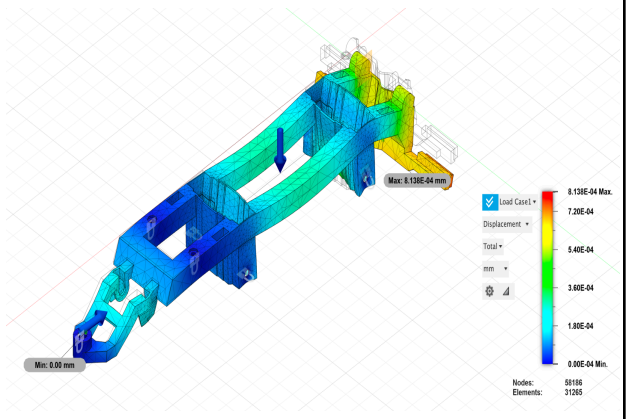
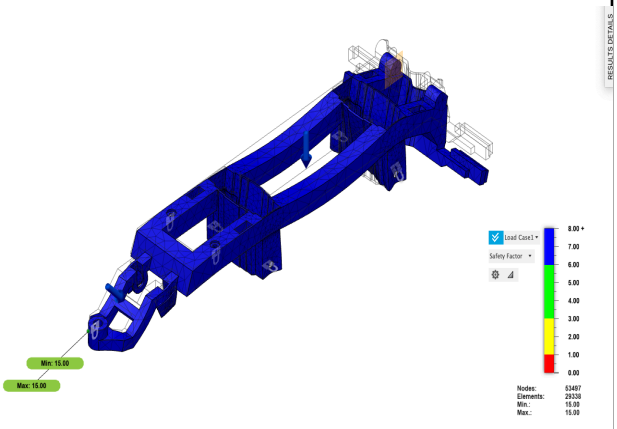
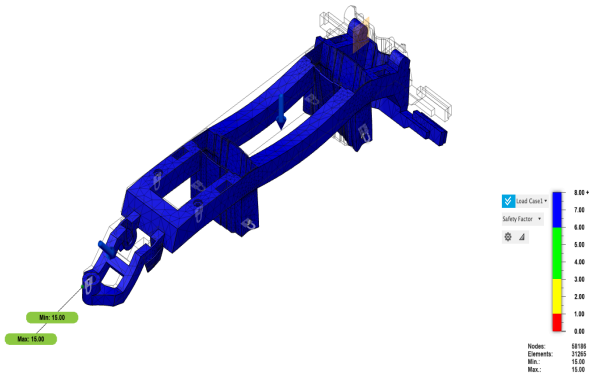
As can be seen from the above drawings, the right-hand side is the shaft, and the shaft size is **7 mm**. The left-hand side is the hole, and the hole size is **6.8 mm**. The maximum interference is **0.2 mm**. Since the shaft is larger than the hole, it is an **interference fit**. The interference fit

ensures a rigid and secure connection between the shaft and the hole. This fit is ideal for applications where the shaft needs to transmit torque or stay fixed relative to the hole. The connection will resist loosening due to vibrations or external forces.

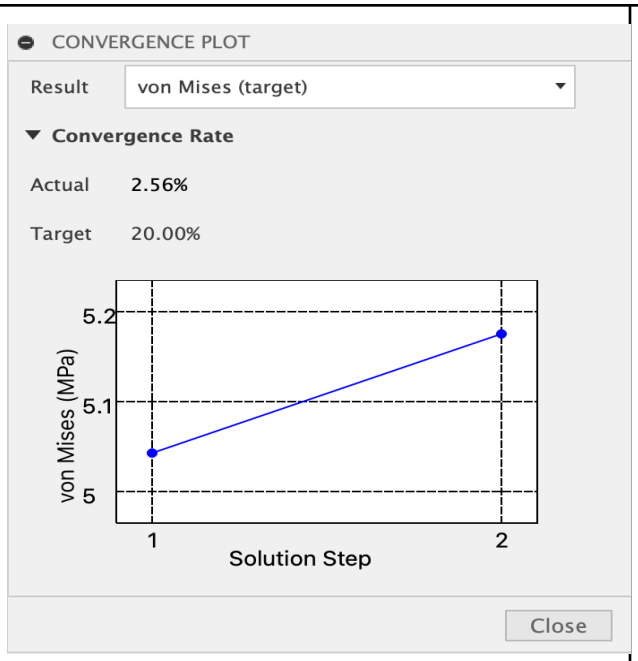
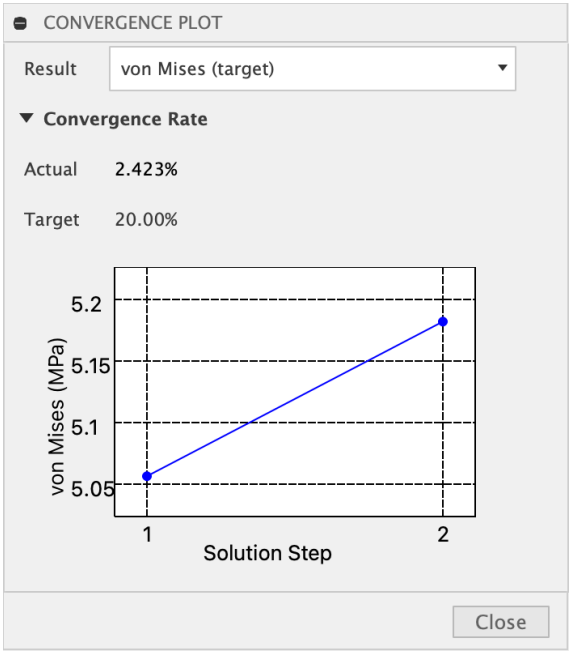
Stress Analysis

Material	Aluminum	Steel
Material Property		
Load and Constraints		

The truck's chassis is selected to conduct the stress analysis because it is subject to both the downward weight from the truck body and the forward dragging force from the tractor. The materials selected for comparison are aluminum and steel for their relatively lower density and high strength, as shown by the graphs in the above table. The weight of 30 N is represented as a

Material	Aluminum	Steel
Von Mise Diagram		
Displacement Diagram		
SoF Diagram		

distributed downward force exerted on the upper side of the chassis, while a single horizontal force of 18 N represents the dragging force. The results are shown in the following table.

Convergence Plot		

Based on the results of the stress analysis, conclusions can be drawn by comparing the two materials. The Von Mises Diagram shows that aluminum experiences a higher level of stress, as indicated by the color gradient in the stress diagrams, than aluminum. The pattern demonstrates its superior strength and ability to withstand higher loads without approaching failure, making steel more suitable for applications where high stress is critical. The displacement diagram highlights that steel undergoes less deformation than steel when subjected to the same loading condition, which shows that steel is stiffer and less prone to bending or warping. The property makes the steel more favorable for maintaining structural integrity under heavy loads. The factor of safety analysis further supports the advantages of steel over aluminum. Aluminum exhibits a lower safety factor, suggesting it operates closer to its failure limits under applied stress. Finally, both materials achieve convergence at similar rates, with steel showing slightly better performance due to its inherently stronger properties and lower stress and displacement under equivalent conditions. While steel offers superior strength,

stiffness, and reliability, aluminum may still be preferred in applications where weight reduction and ease of handling are prioritized as it has much lower density. Considering that the price of steel is significantly lower than aluminum, for the product that we are analyzing, a toy tractor, where the weight is not a significant factor, steel should be considered preferable to aluminum.

Product Improvement

Product Maturity

- **Early Toy Tractors:**

Early toy tractors were simple, handmade models crafted from wood or metal. Designed without moving parts, they featured basic shapes that mimicked the general appearance of real tractors, serving primarily as tools for imaginative play rather than detailed replicas.

- **Rolling Wheels Added:**

The addition of rolling wheels made toy tractors more interactive, allowing children to push them around and simulate farm work in play scenarios. Although still simple in design, these toys were often made from durable materials like tin or plastic, enhancing both their functionality and appeal.

- **More Realistic Design:**

By the mid-20th century, toy tractors became more realistic, featuring detailed molds that closely resembled real tractors. Farm attachments like trailers and plows were introduced, enriching imaginative play, while the use of plastic allowed for vibrant colors and intricate details.

- **Motorized Toys:**

Motorized toy tractors brought new excitement with battery-powered features like lights, engine sounds, and simple movements. Pull-back mechanisms were also introduced, enabling the tractors to “drive” forward when released, adding a sense of realism and fun for children.

- **Modern Features:**

Modern toy tractors have advanced to include remote-controlled models with precise steering and speed control, offering an engaging experience for kids. Smart toys with app integration now allow for programmable movements and interactive play. Additionally, high-detail collector models have become popular among adults, emphasizing scale accuracy and intricate design.

Product Improvement

Problem Statement

Our current toy tractor faces several mechanical and product issues that limit its performance and user enjoyment:

- Hydraulic Mechanism Failure:
    - A hydraulic mechanism failure occurs when the system cannot maintain its intended position, making it unreliable during play. The weight of the components causes the hydraulic piece to collapse, failing to hold steady as designed.
- **Jerky Movements:**
    - Movements in the hydraulic system and other moving parts are not smooth but rather clicky and inconsistent.

- **Lack of Automation:**
    - The toy tractor heavily relies on manual user input and has limited automatic or powered functionality, which makes it less engaging than modern interactive toys.

Improvement Ideas

While disassembling our toy tractor, we identified opportunities to optimize materials, simplify manufacturing, and improve modularity with other company products. We'll discuss key findings and ideas for product development and improvement.

Identifying Where Improvements Could Be Made

To improve our product, we focused on three key factors: user control, manufacturing efficiency, and cost. Using these criteria, we identified several potential enhancements and narrowed our focus to the four most impactful ideas, each developed with these factors in mind.

- ***Idea 1: Modularity in Accessories***
    - During disassembly, we identified an opportunity to improve modularity in our toy tractor. Currently, while the tractor includes a detachable forklift and trailer, each attaches differently: the trailer connects easily with a hitch, allowing for simple removal, while the forklift is more challenging to attach and detach. This led us to develop a universal attachment system, allowing easy integration of multiple accessories, such as trailers, forklifts, and scoops. A standardized connection would simplify user assembly, increase product versatility, and encourage customers to invest in additional compatible accessories, leading to greater brand loyalty and long-term engagement with the company's products.
- ***Idea 2: Reducing the Amount of Unique Parts***

    - The tractor has many unique features that increase production complexity and cost. For instance, the sunroof on the cabin and the lights on the front are not necessary for the core function. Removing these unique parts would streamline production, reduce manufacturing costs, and simplify inventory. By doing so, we would make the product more affordable for families, increasing the consumer base.

- ***Idea 3: Improving the "Hydraulic" Lift***
    - While disassembling the trailer, we noticed that while the trailer could be tipped upwards to "dump" the load, the hydraulic system struggles to support the tractor's weight. This is because it comprises simple teeth that can glide down easily. We would incorporate a click-locking mechanism into the existing design to improve the product further. It would consist of teeth along the length of the lift and a spring-loaded pawl. As the trailer is lifted, it would be locked at the specific teeth segments, allowing it to stay in place instead of falling randomly.
- ***Idea 4: Getting Rid of All Motor Functions***
    - One of our more unconventional ideas was eliminating the tractor's remote control function entirely. While an unusual idea, this approach aligns with our criteria. Removing all motorized functions can significantly reduce the material used, resulting in lower manufacturing costs. The assembly process also becomes simpler, as motors, gears, and batteries are no longer needed, streamlining production. However, this change would alter the tractor's core function, likely requiring a rebranding or renaming of the product to better reflect its new, simplified design.

Extra Improvements

- **Smoother Movement**
    - Use ball bearings or high-quality bushings in the moving parts to reduce friction and create smoother, more realistic motion.
    - Refine the tolerances of movable parts to eliminate the clicky or jerky feel and ensure consistent, fluid movements.
- **Increased Automation**
    - Add small motors to power the hydraulic movements, allowing for automated lifting and lowering with a switch or remote control.
    - Include a feature to let users adjust the movement speed for enhanced play control and realism.
    - Equip the toy with pre-programmed movements, like lifting a load or adjusting.
- **User-Friendly Enhancements**
    - Introduce simple buttons or levers for kids to control the hydraulics without complex manual input.

These improvements address the specific problems of our toy tractor and enhance its functionality, making it more appealing, engaging, and competitive in the modern toy market.

Conclusion

Project obstacles and resolutions

- Parts Created in the Same File.

    - Problem: Some parts were made in one file instead of separate files, which caused issues when putting everything together. Parts couldn't move or work properly in the assembly.
    - Solution: Create new, separate files for each part to make them easier to manage and assemble. We also named each file clearly to avoid confusion.
- Issues Joining Parts Together
    - Problem: Parts didn't connect correctly in the assembly, leading to gaps or overlapping areas.
    - Solution: Fixed how the parts fit together by adjusting the connections. Made adjustments in modeling and used the fusion tool to check for overlaps and fix them.
- Problems with Motion and Animation
    - Problem: I couldn't get parts to move smoothly or show proper animations. Missing or incorrect constraints made the movements look wrong.
    - Solution: Checked and corrected how parts were connected to allow proper movement. Simplified the setup by focusing on one movement at a time. Tested animations step by step to fix any errors.
- Interference Issues
    - Problem: Some parts overlapped or clashed with each other, causing problems in the assembly.
    - Solution: I used an interference check to find where parts overlapped and adjusted their size or position, or I reworked the models themselves for a more accurate fit.
- Redesign Delays

- Problem: Errors in the initial design caused delays because parts needed to be redesigned.
- Solution: Review designs regularly to catch mistakes early. Use a checklist to ensure parts are correct before proceeding to the next step.

New Product Recommendations

Introducing the New and Improved Smart Hydraulic Toy Tractor. Our upgraded toy tractor improves on the previous model's issues and introduces new key features.

- Reinforced Hydraulic System
  - Locking mechanism to keep attachments firmly in place, even under heavy loads.
  - Integrated springs: smooth lifting and lowering
  - Durable, Lightweight Materials
- Precision Movement
  - Bearings and more precise joints provide realistic motion.
  - Users can control the movement speed for precision tasks, such as lifting, loading, or plowing.
- Automated Features
  - Automated lifting and lowering with a simple button press for effortless interaction.
  - Perform tasks like picking up and dropping loads or moving attachments with pre-set motion sequences.
- Improved Weight Balance
  - Counterweights: Ensures stability during use, preventing the hydraulic components from falling due to their weight.

- Enhanced Interactivity
    - A kid-friendly remote allows precise control of movement, hydraulics, and additional features.
- Eco-Friendly and Durable Design
    - Built using recycled and biodegradable plastics to reduce environmental impact.
    - Designed to withstand outdoor play in various conditions, ensuring long-lasting enjoyment.

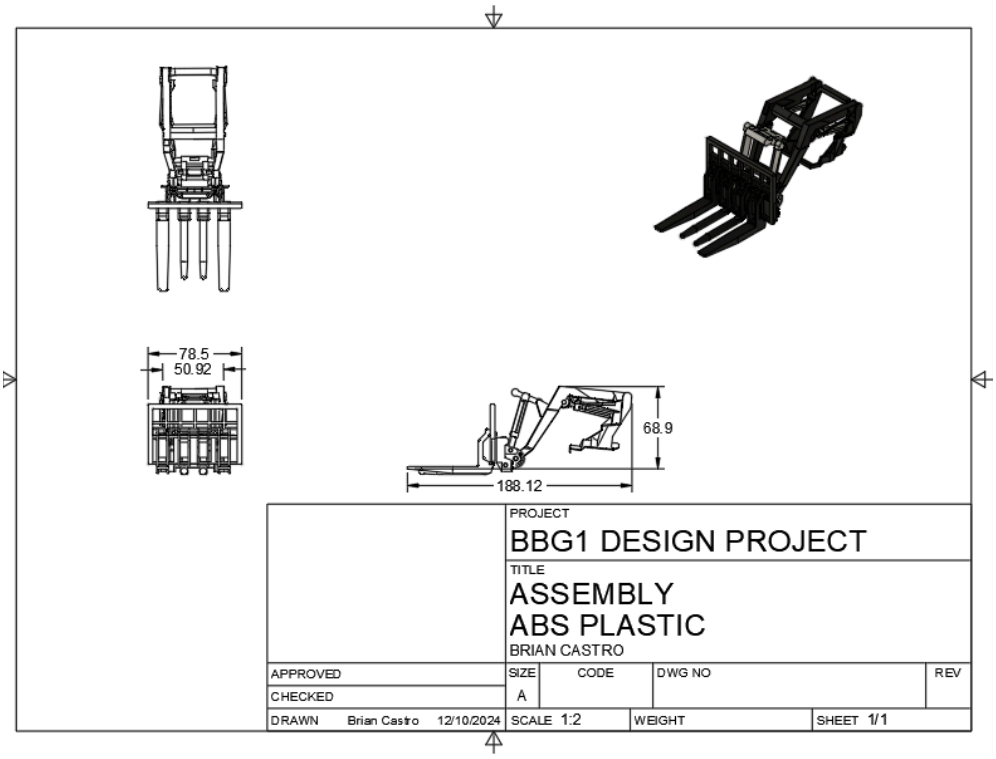
Why It's Improved

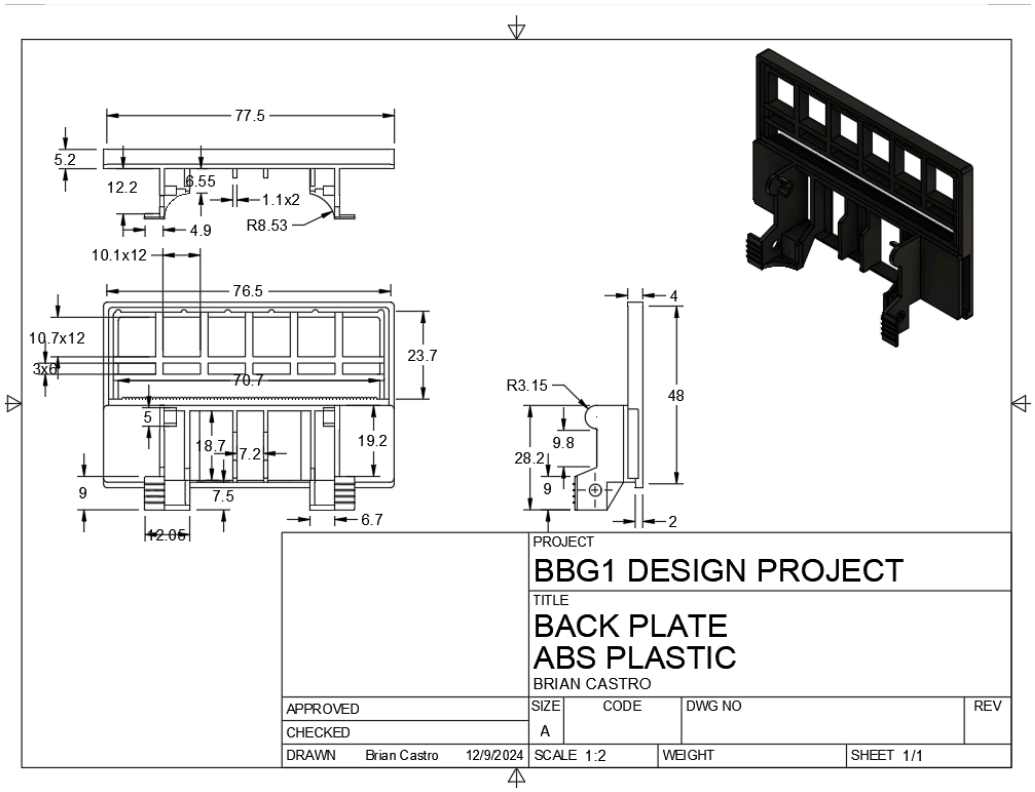
The Smart Hydraulic Toy Tractor offers a perfect blend of durability, realism, interactivity, and education. By addressing key issues of the previous model and adding advanced features, it provides a next-level experience for children and anyone.

Appendix A

Assemblies and Part Drawings

A. Forklift/Front Loader

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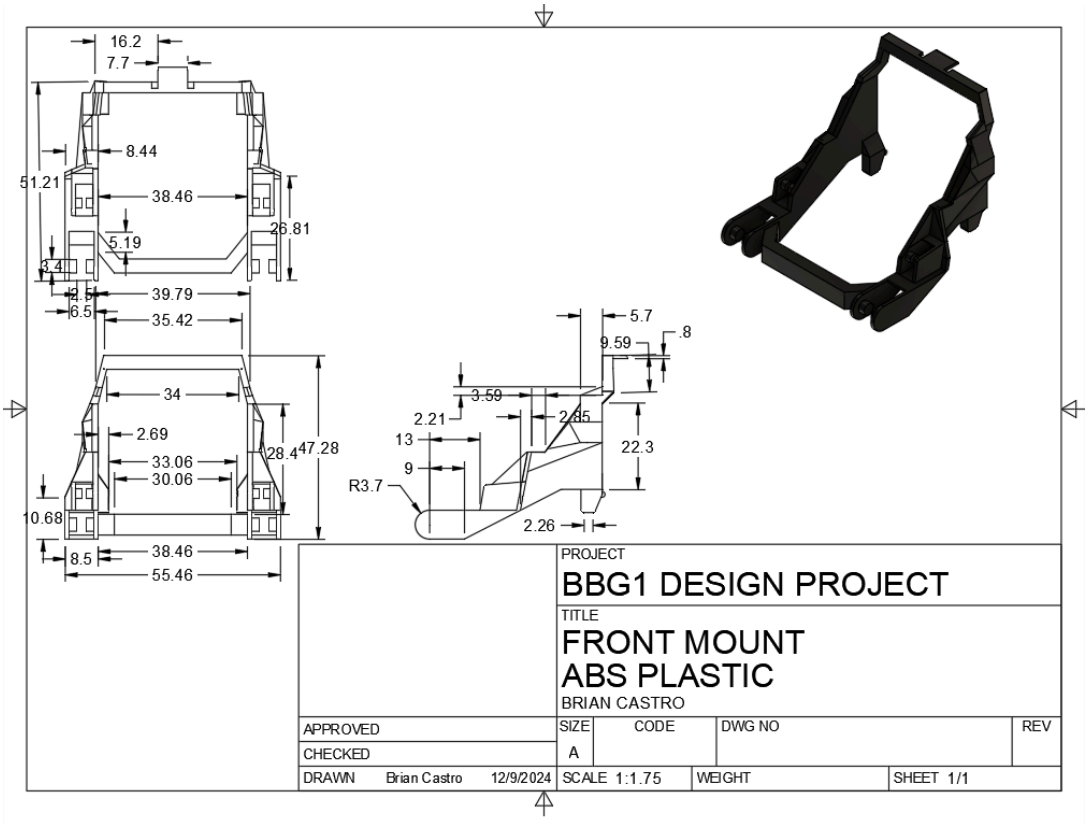
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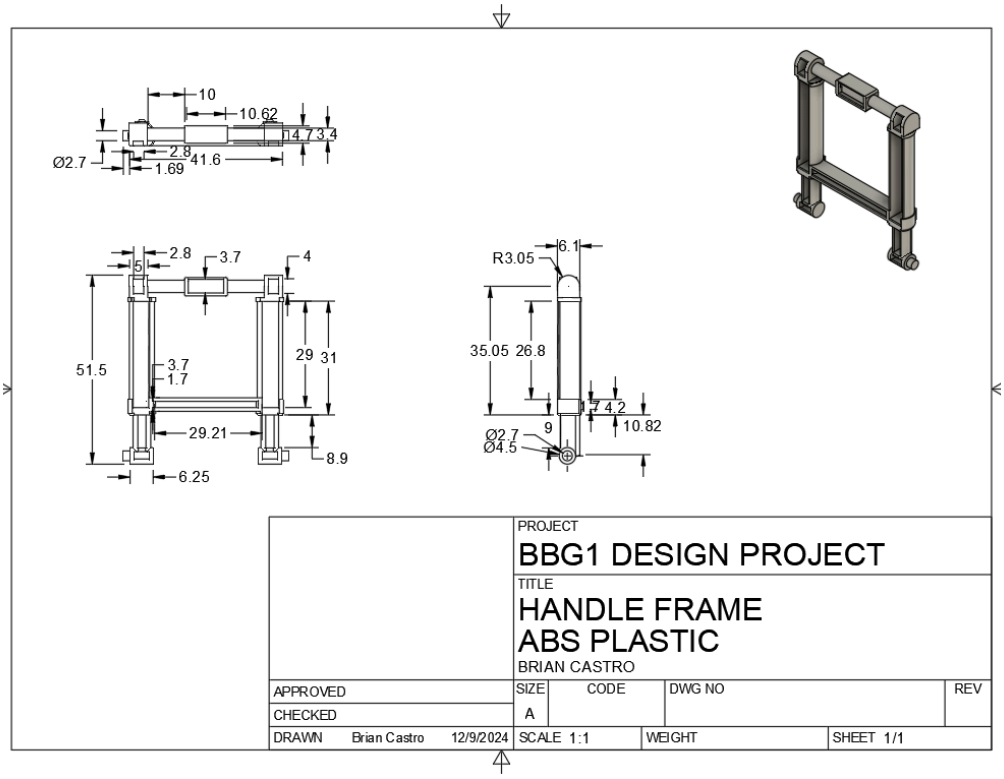
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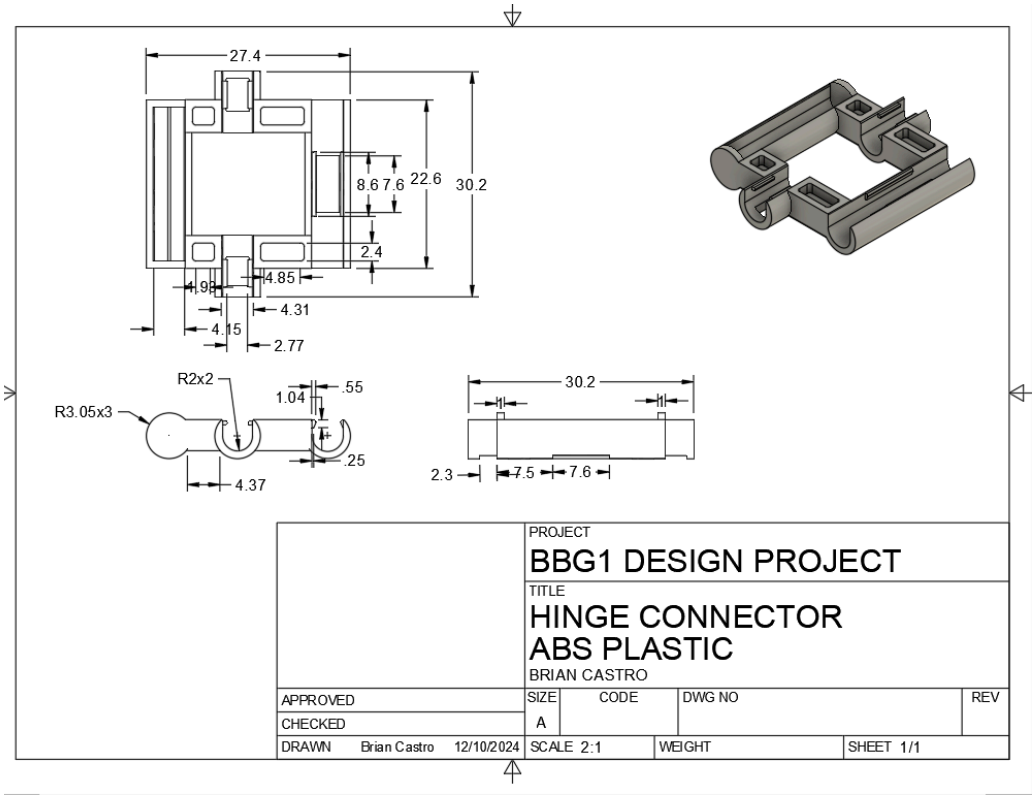
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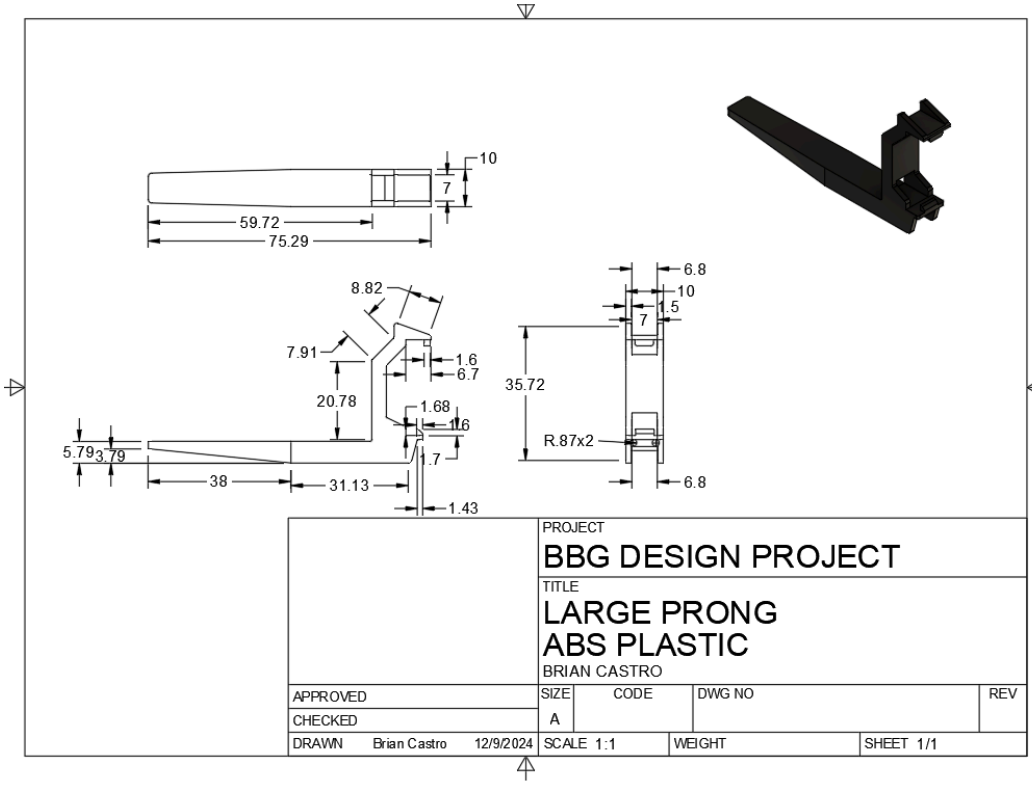
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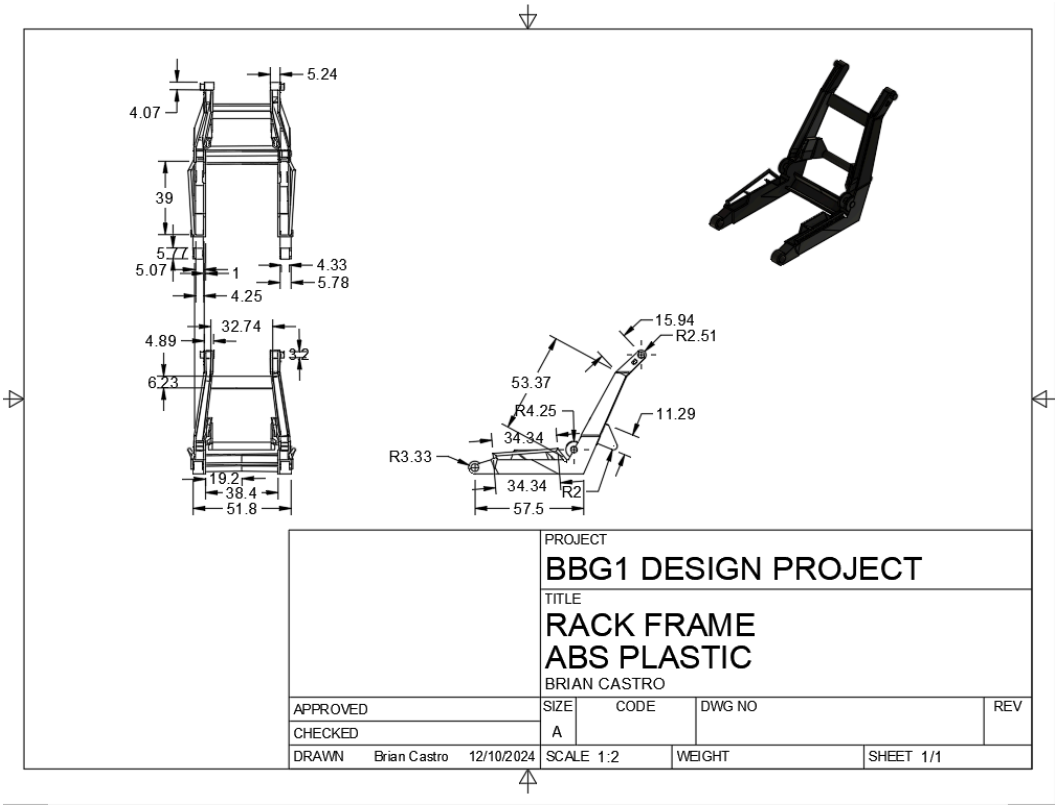
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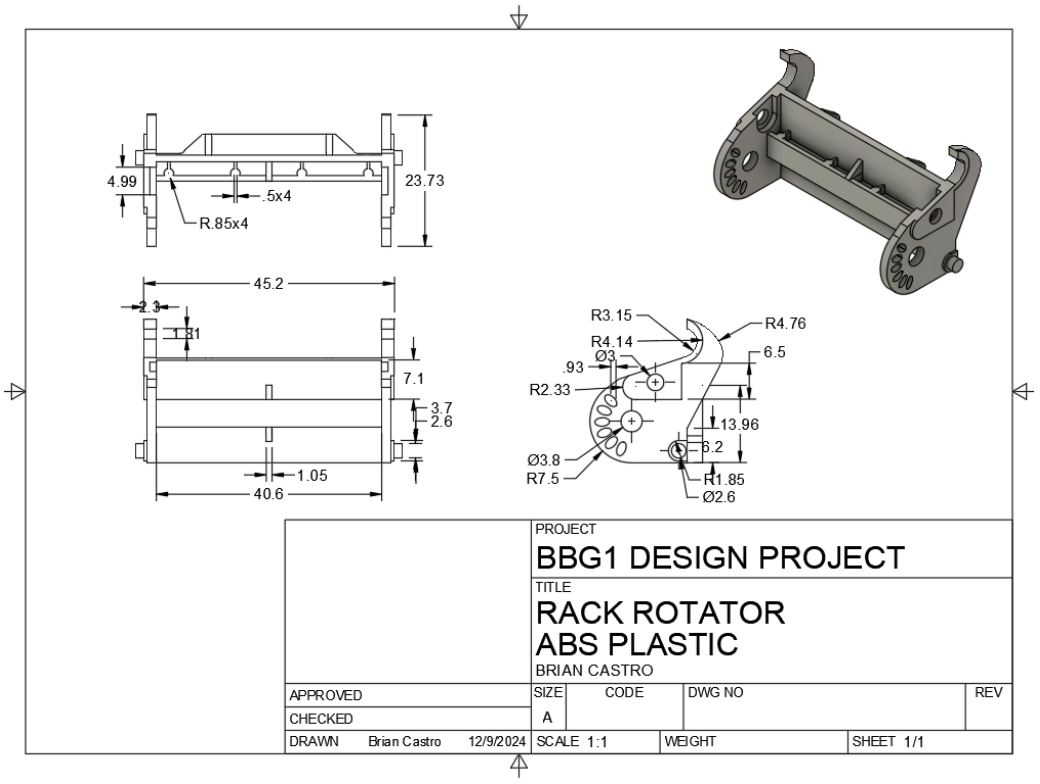
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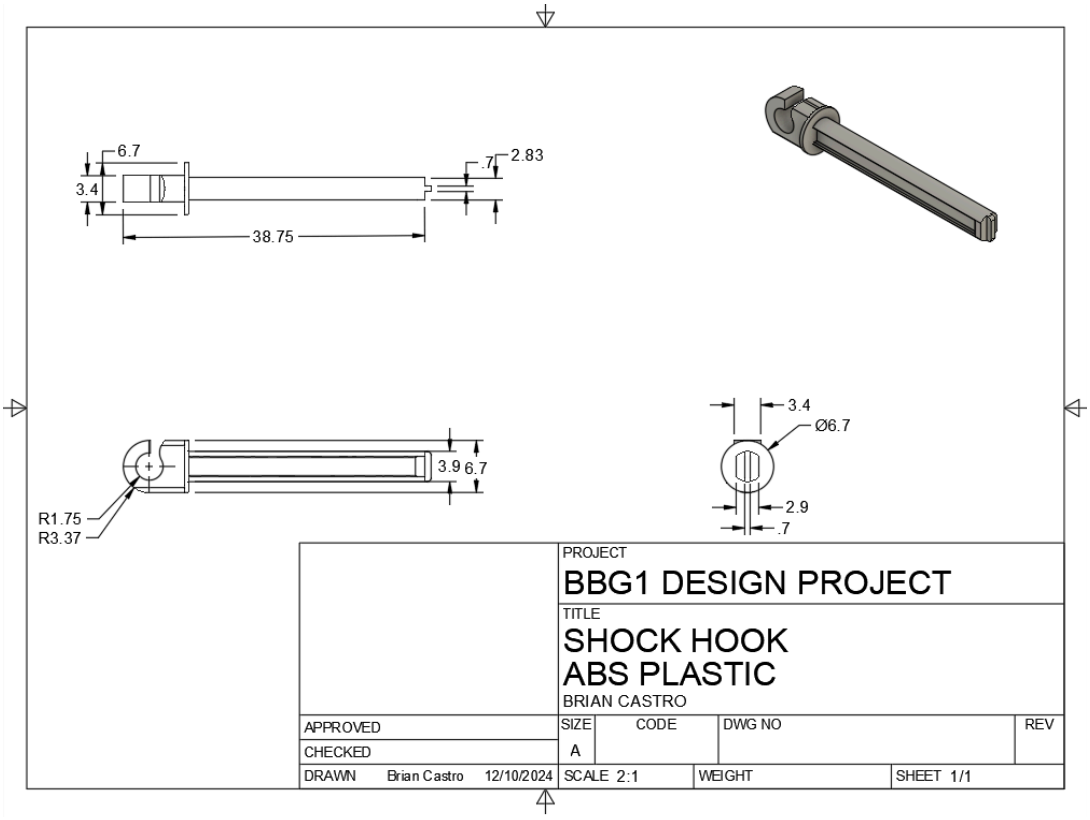
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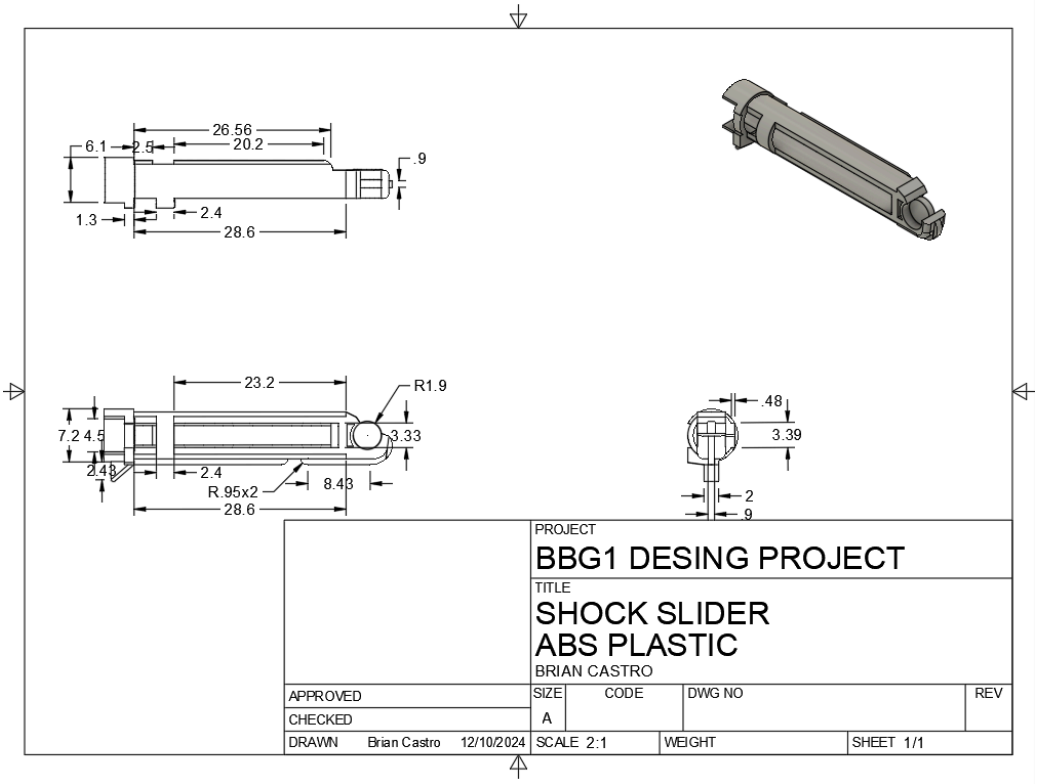
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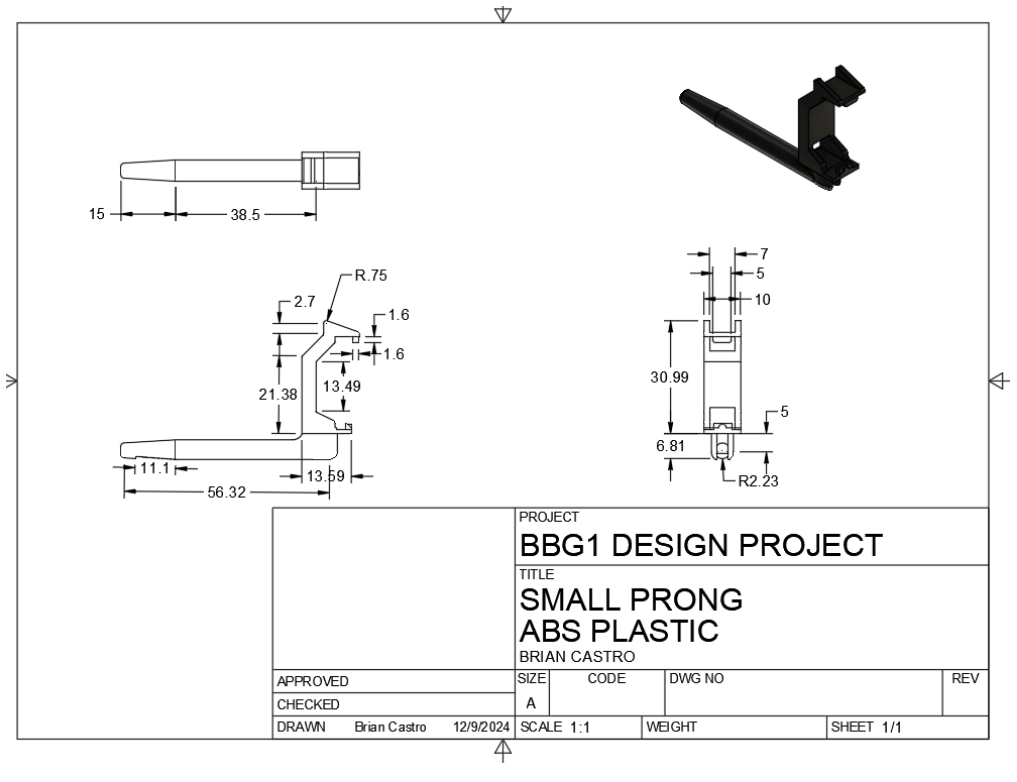
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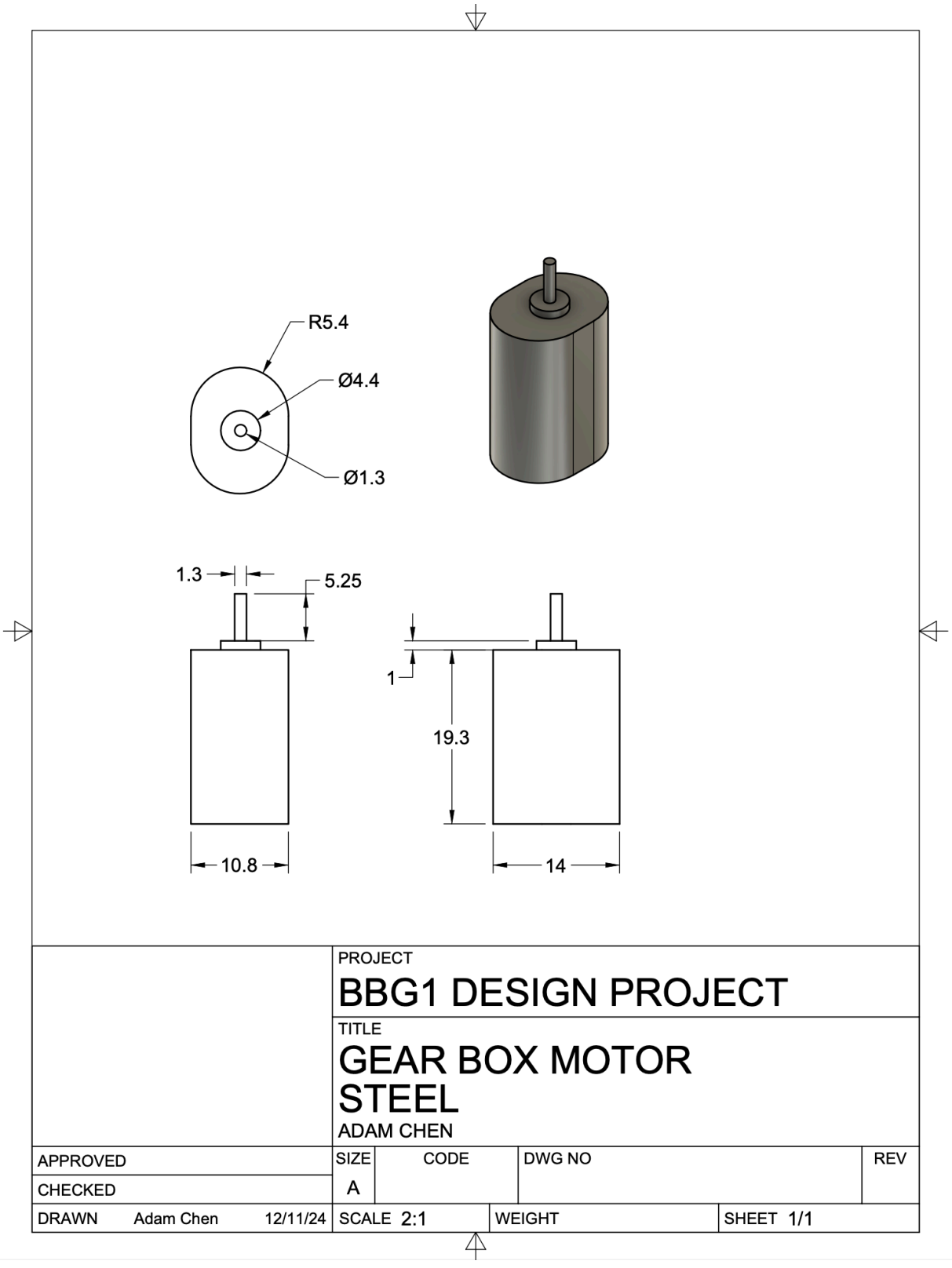
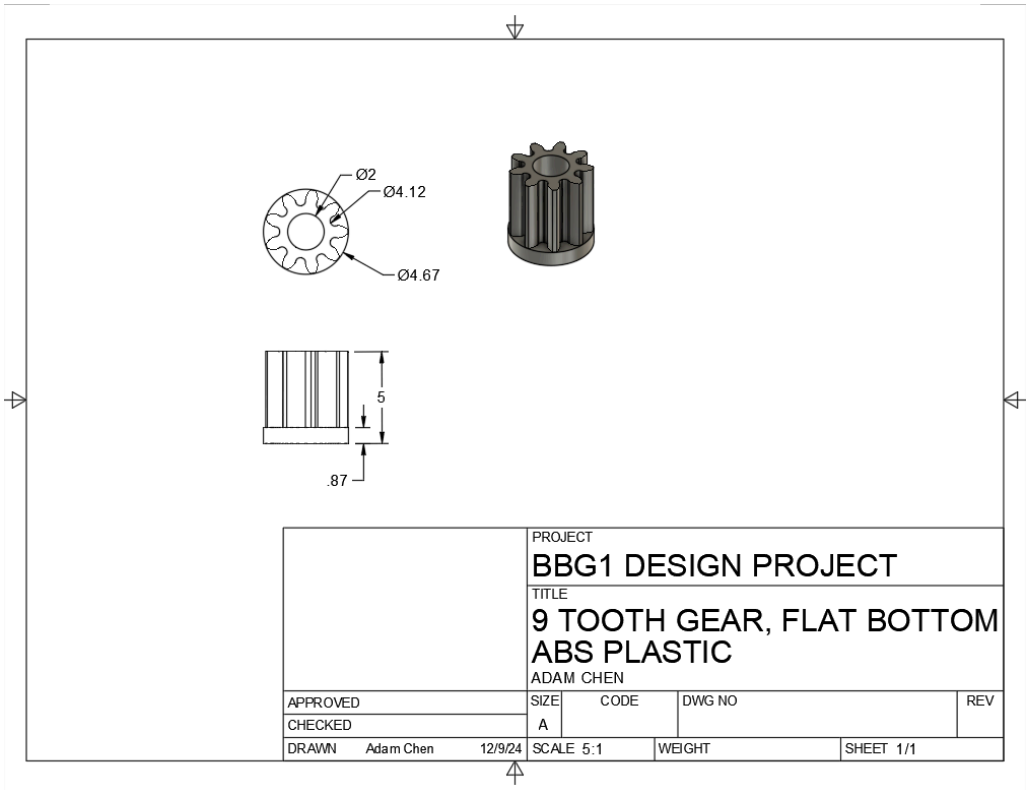
B. Gear Box, Cabin, and Tires

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APPROVED
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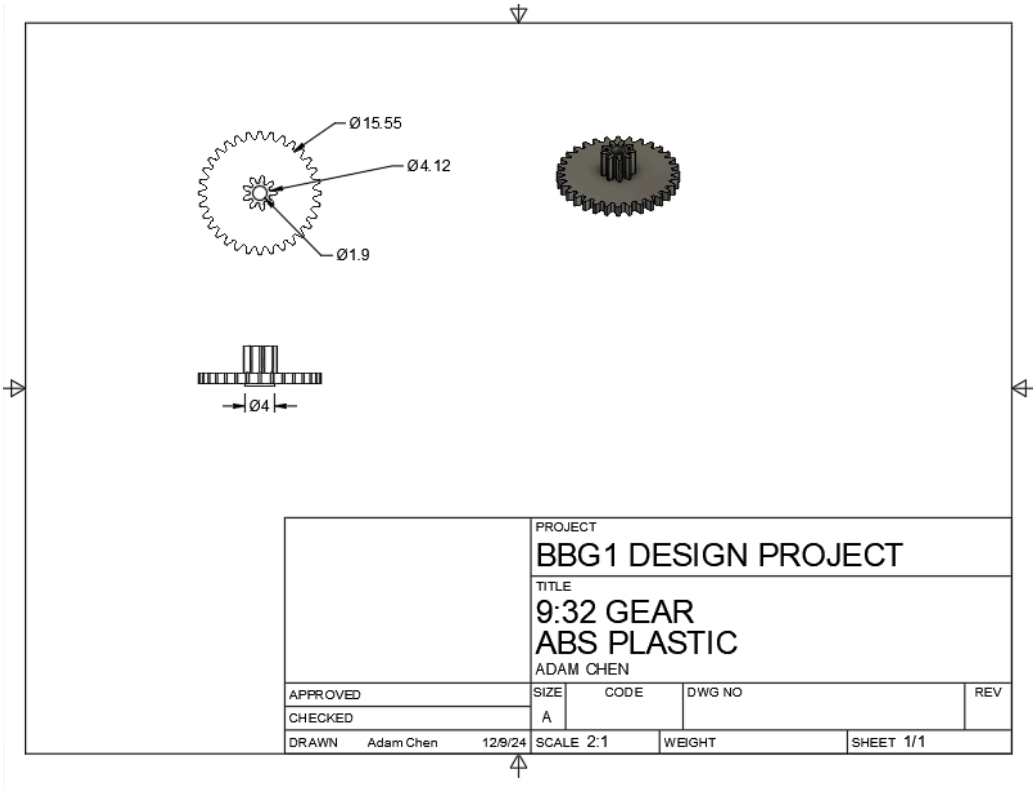
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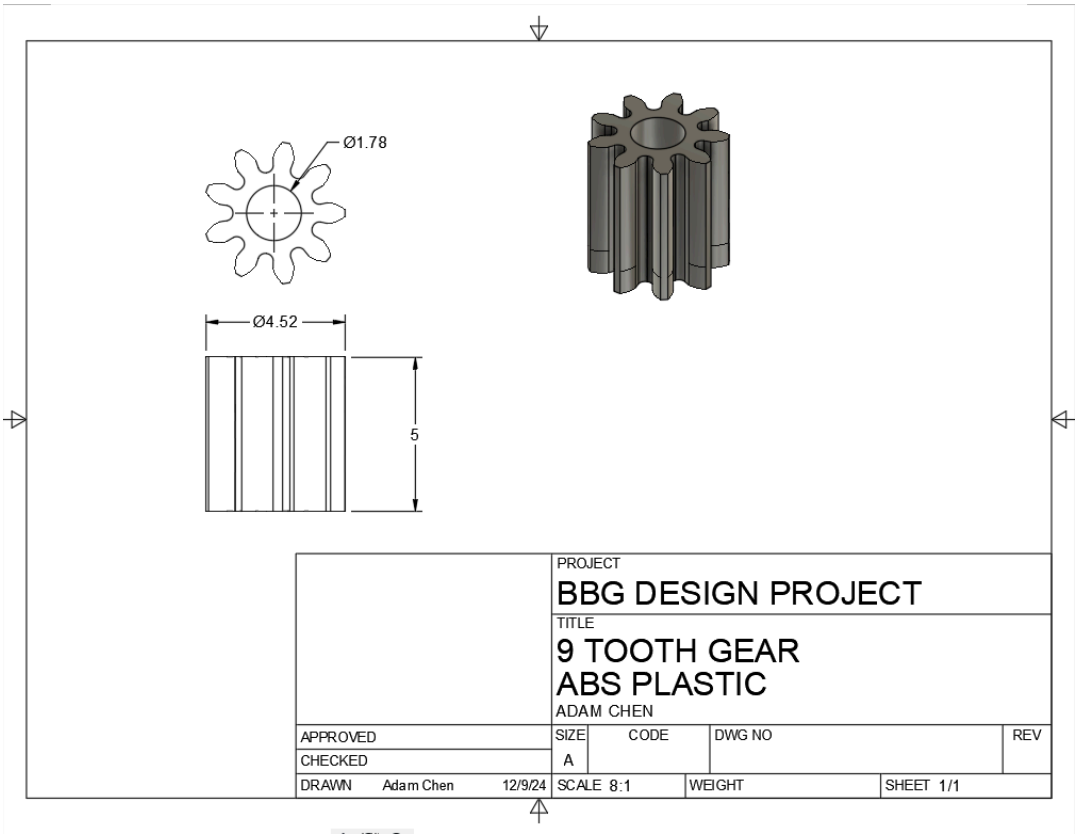
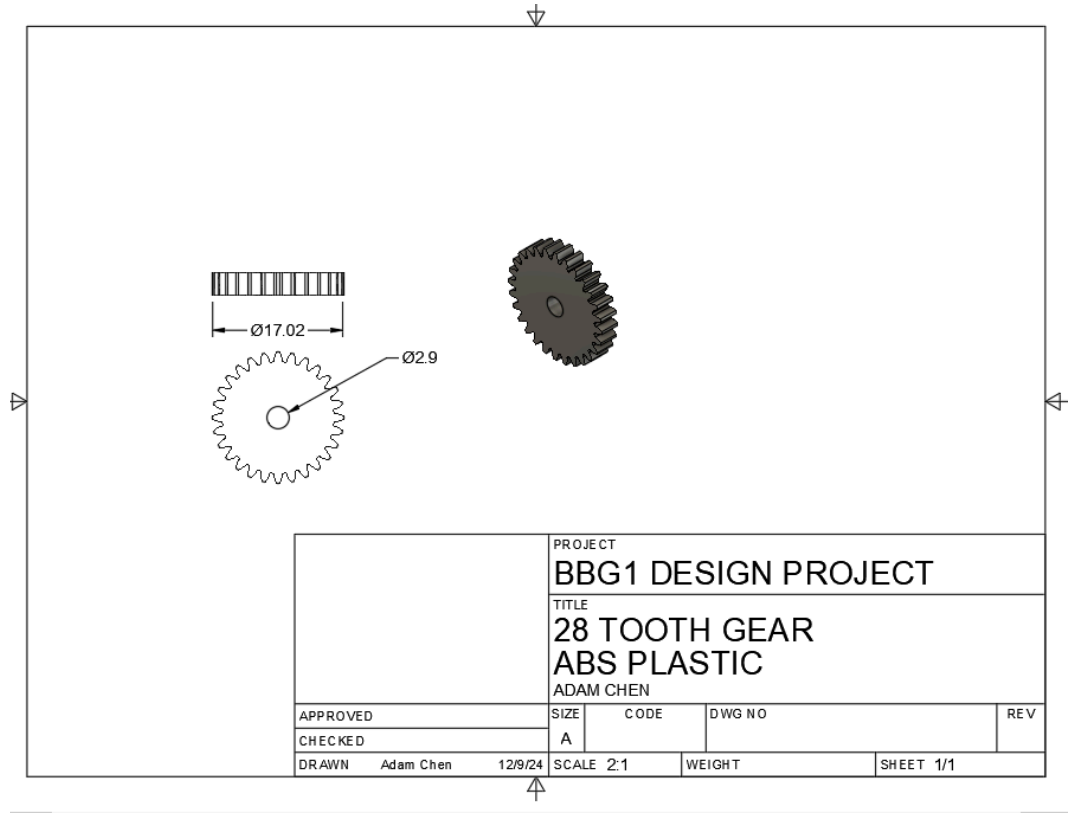
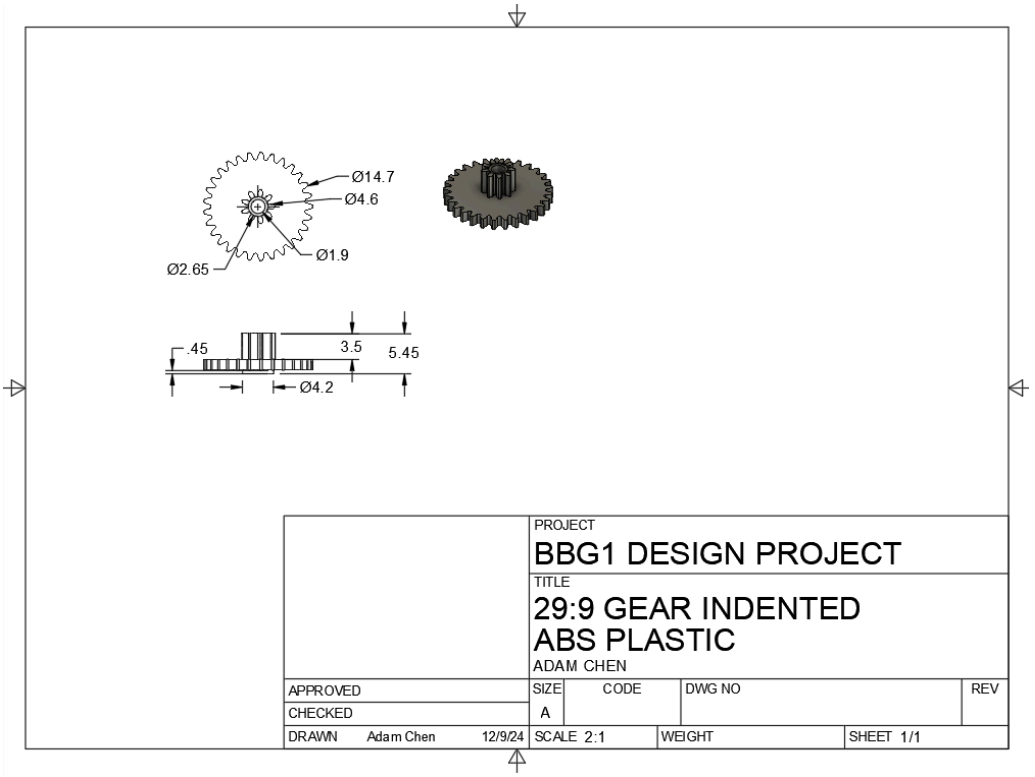
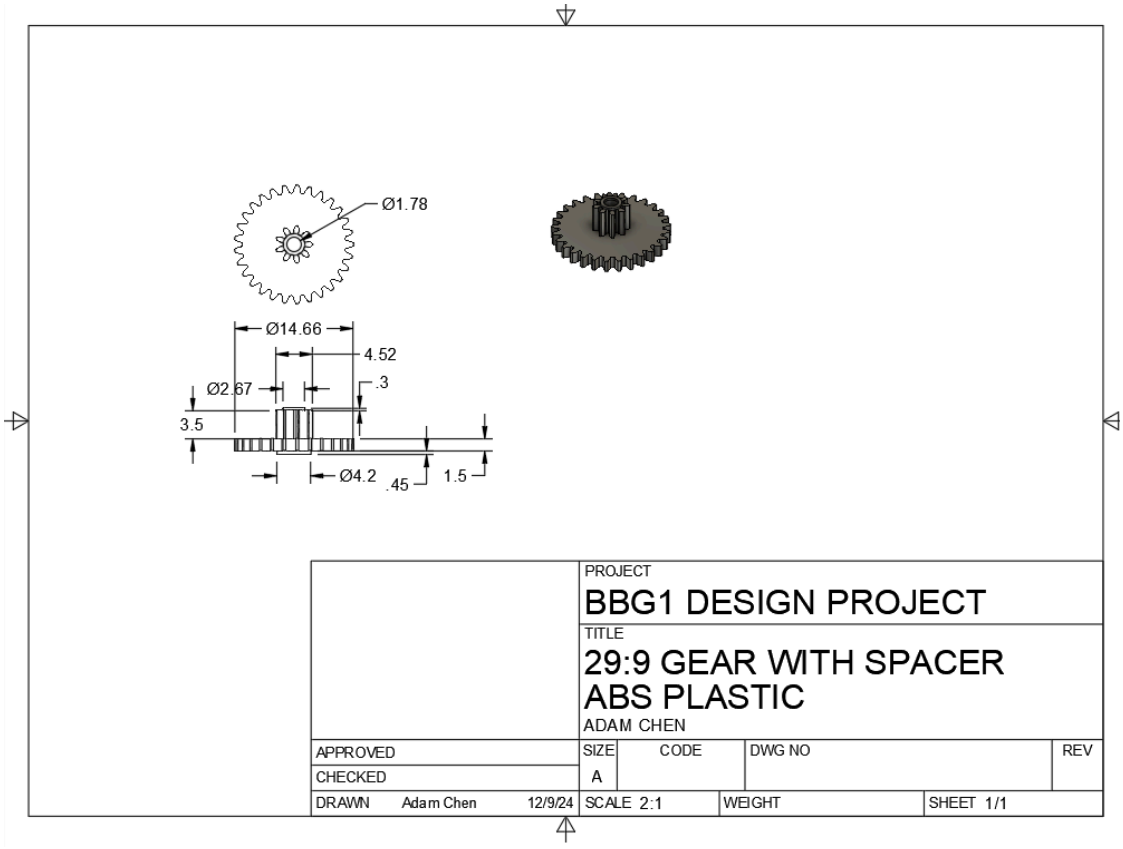
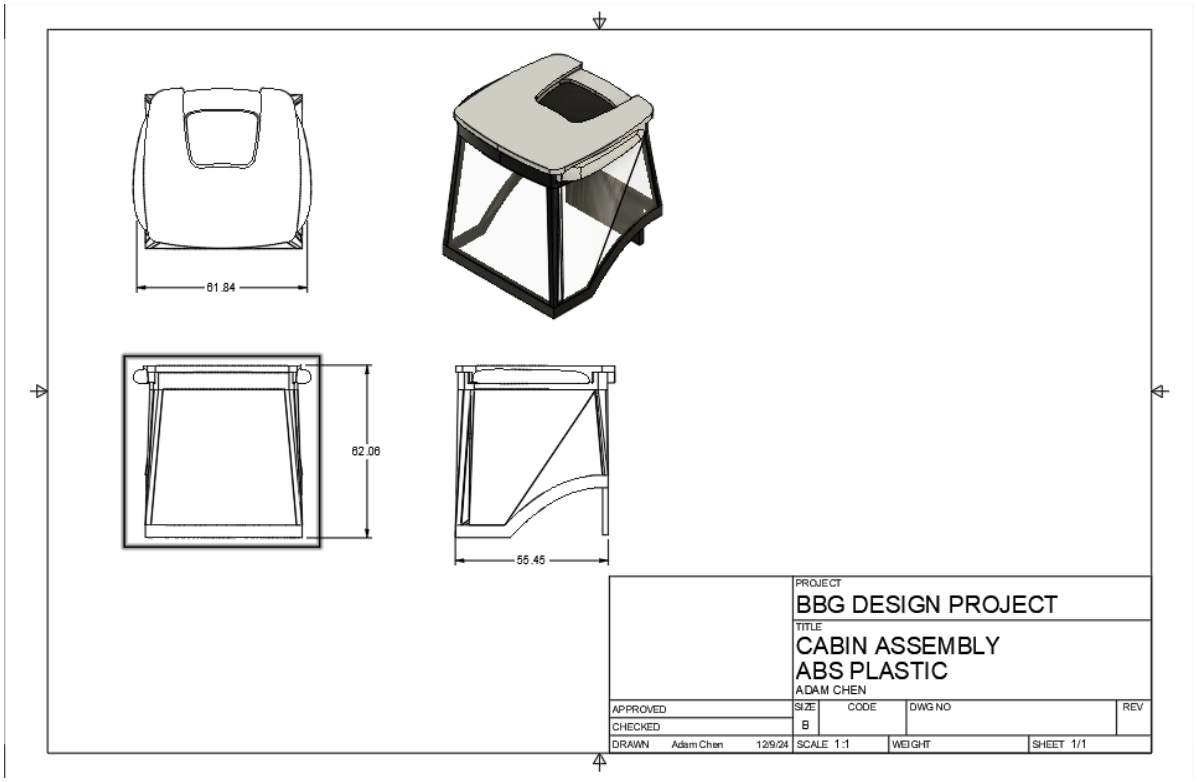
Ø4.12
Ø1.9
Ø4
PROJECT
BBG1 DESIGN PROJECT
TITLE
9:32 GEAR
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Adam Chen 12/9/24
SIZE A
CODE
DWG NO
REV
SCALE 2:1
WEIGHT
SHEET 1/1

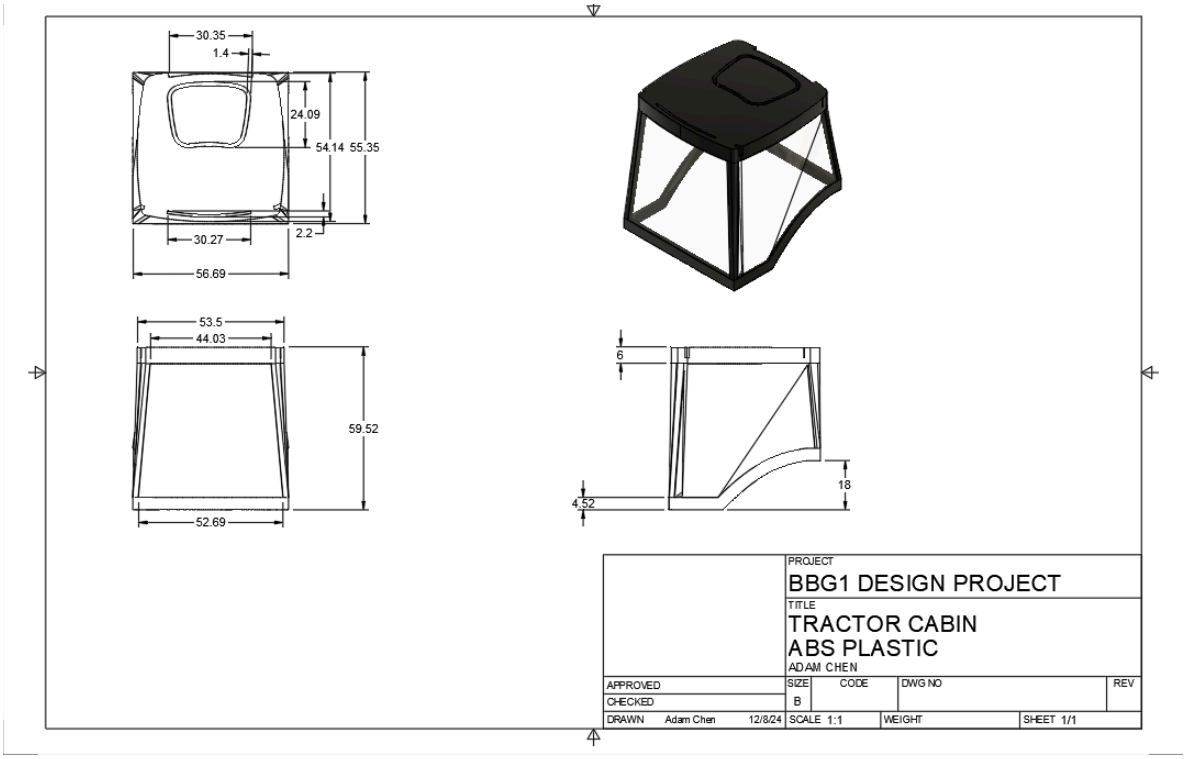

Ø1.78
Ø4.52
5
PROJECT
BBG DESIGN PROJECT
TITLE
9 TOOTH GEAR
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Adam Chen 12/9/24
SIZE A
CODE
DWG NO
REV
SCALE 8:1
WEIGHT
SHEET 1/1

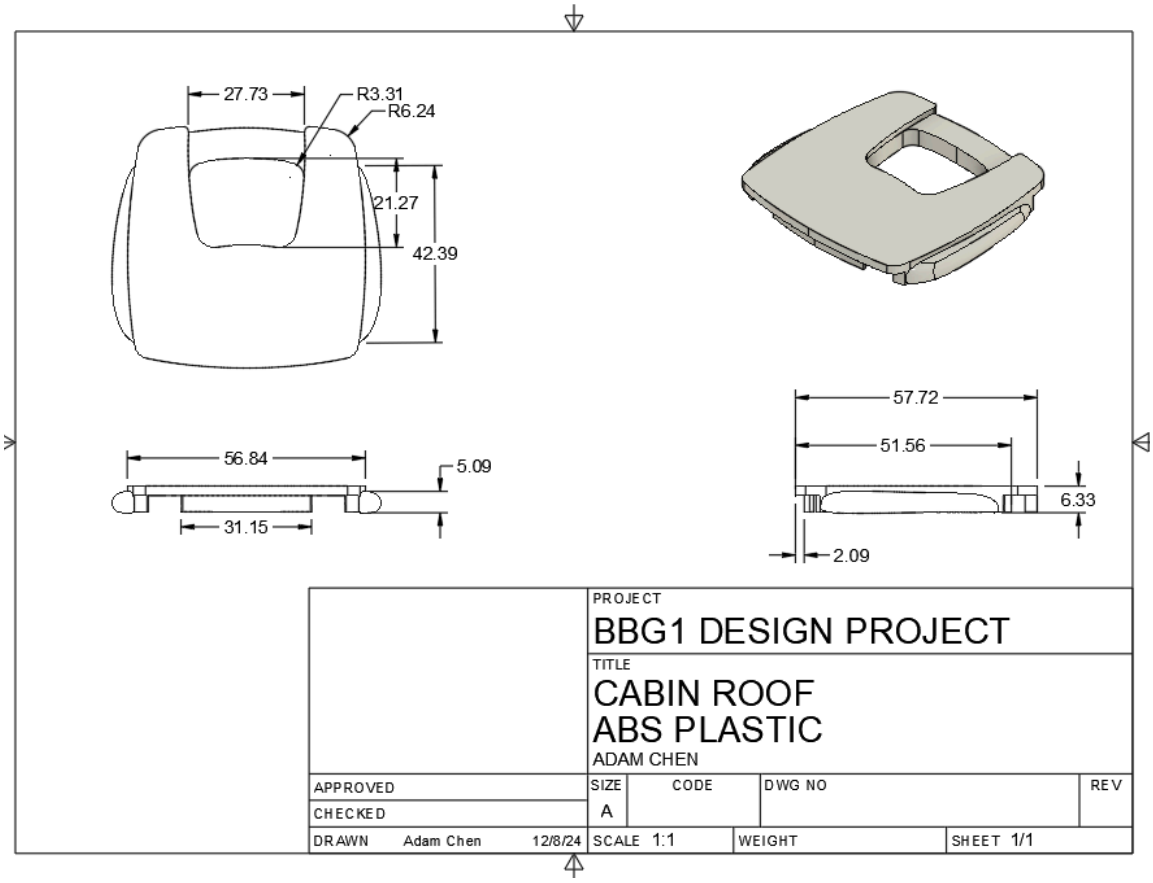

Ø17.02
Ø2.9
PROJECT
BBG1 DESIGN PROJECT
TITLE
28 TOOTH GEAR
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Adam Chen 12/9/24
SIZE A
CODE
DWG NO
REV
SCALE 2:1
WEIGHT
SHEET 1/1

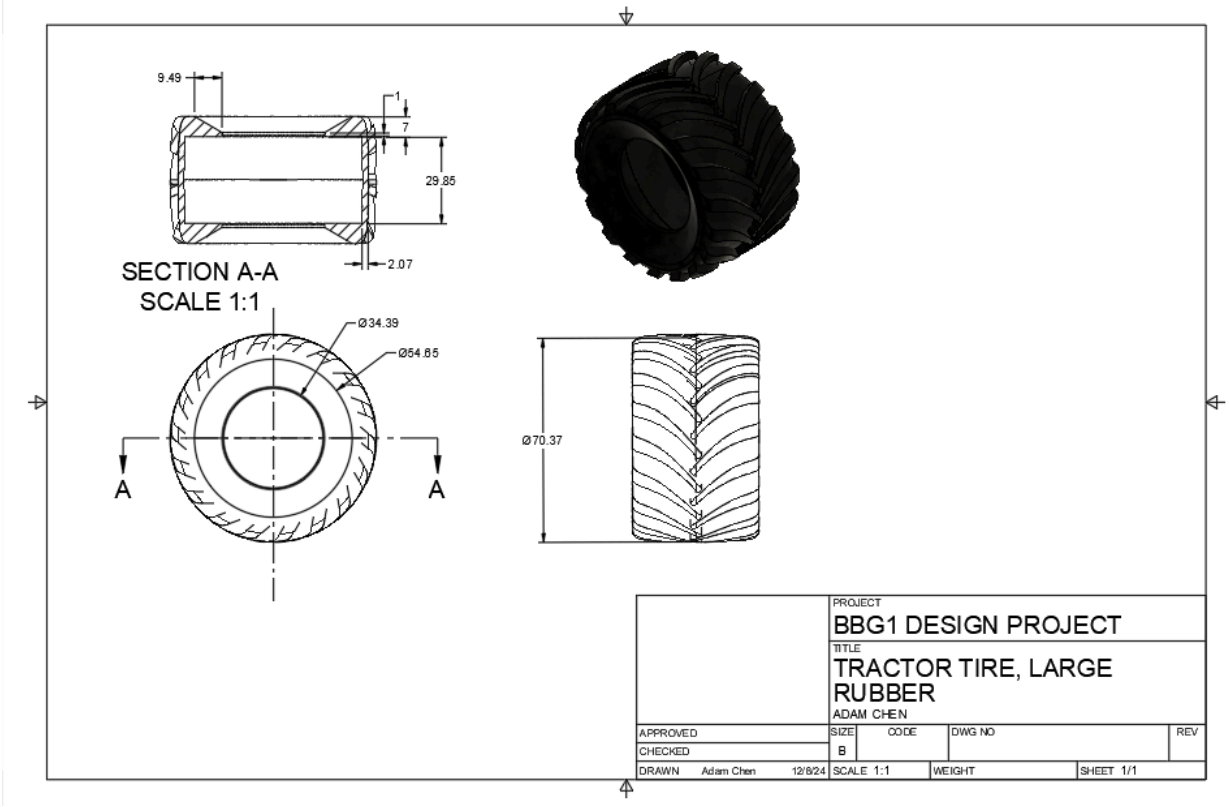

Ø14.7
Ø4.6
Ø1.9
Ø2.65
.45
3.5
5.45
Ø4.2
PROJECT
BBG1 DESIGN PROJECT
TITLE
29:9 GEAR INDENTED
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Adam Chen 12/9/24
SIZE A
CODE
DWG NO
REV
SCALE 2:1
WEIGHT
SHEET 1/1

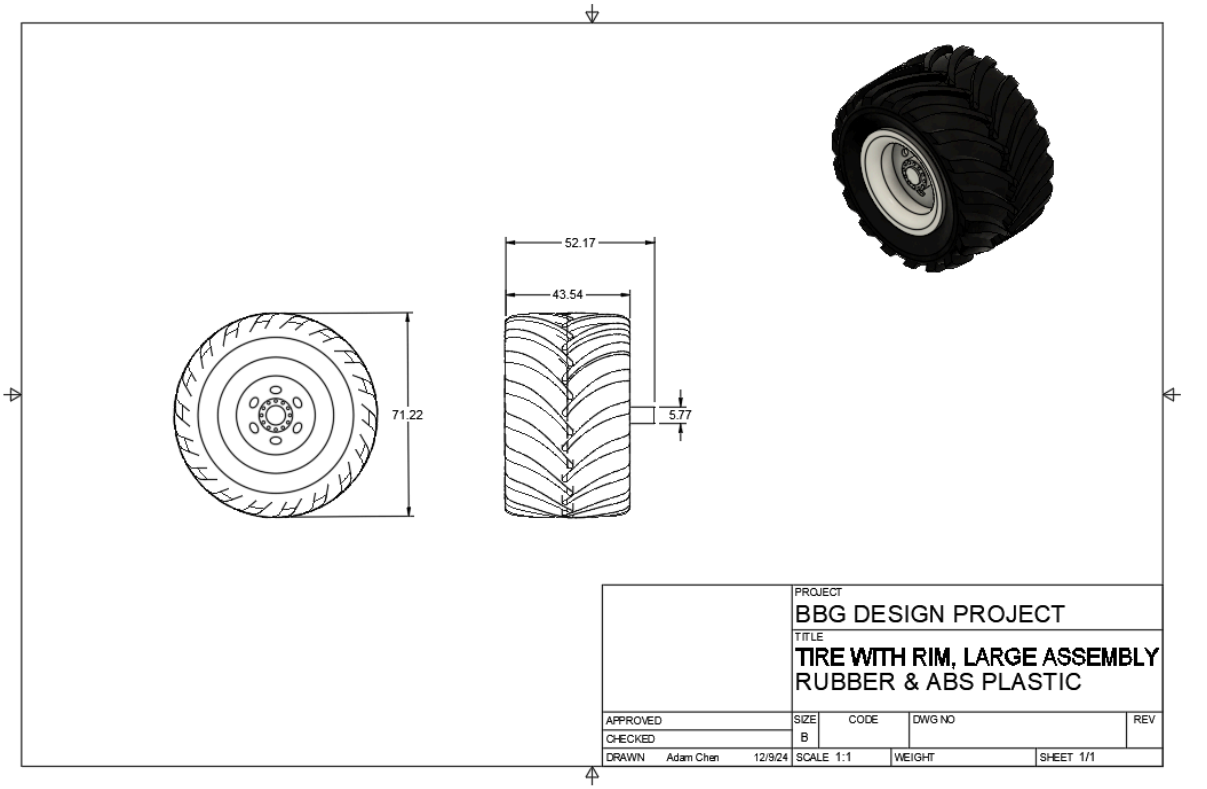

Ø1.78
Ø14.66
4.52
Ø2.67
.3
3.5
Ø4.2
.45
1.5
PROJECT
BBG1 DESIGN PROJECT
TITLE
29:9 GEAR WITH SPACER
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Adam Chen 12/9/24
SIZE A
CODE
DWG NO
REV
SCALE 2:1
WEIGHT
SHEET 1/1

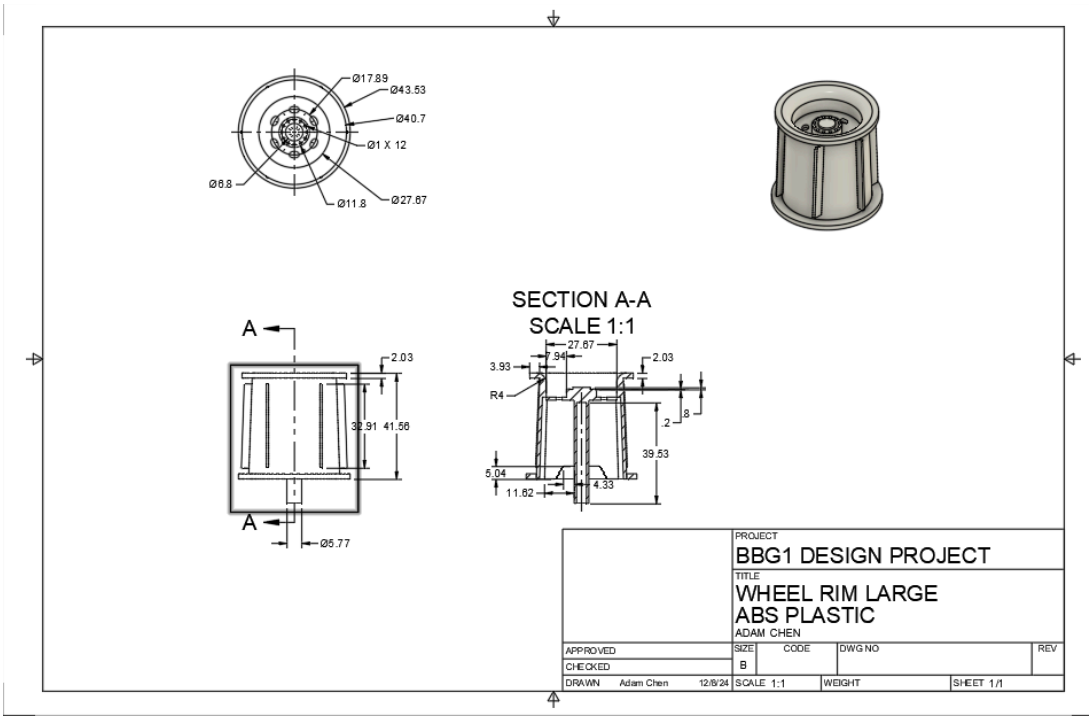

61.84
62.06
55.45
PROJECT
BBG DESIGN PROJECT
TITLE
CABIN ASSEMBLY
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Adam Chen 12/9/24
SIZE B
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1

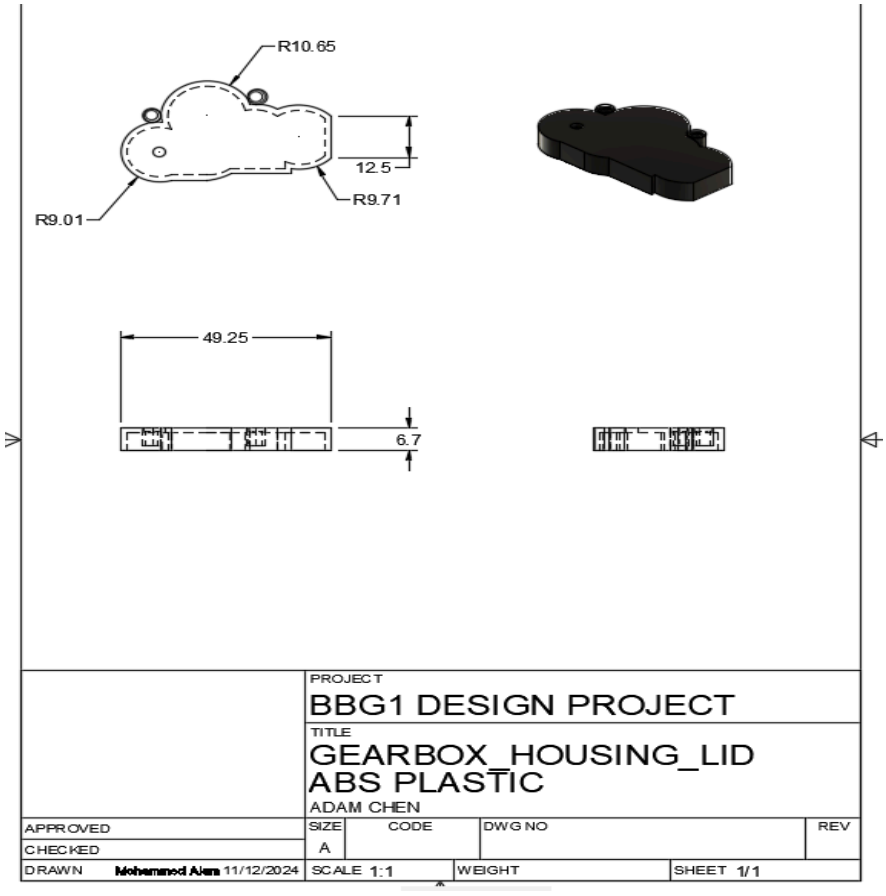

30.35
1.4
24.09
54.14
55.35
2.2
30.27
56.69
53.5
44.03
59.52
52.69
6
18
4.52
PROJECT
BBG1 DESIGN PROJECT
TITLE
TRACTOR CABIN
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Adam Chen 12/8/24
SIZE B
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1

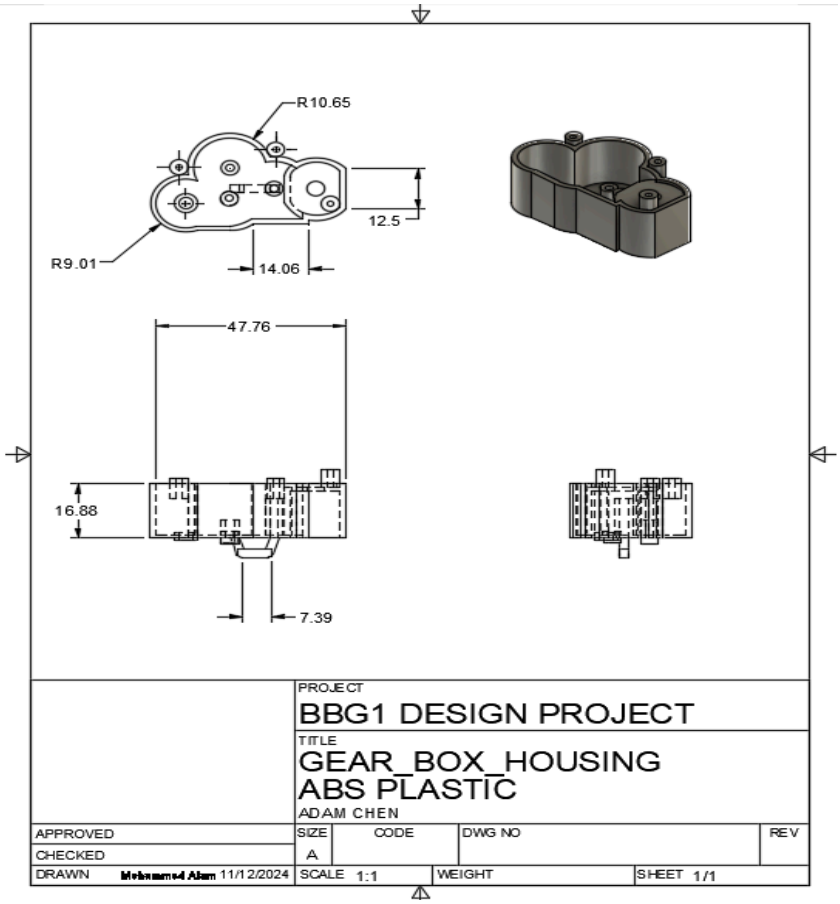

27.73
R3.31
R6.24
21.27
42.39
56.84
5.09
31.15
57.72
51.56
6.33
2.09
PROJECT
BBG1 DESIGN PROJECT
TITLE
CABIN ROOF
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Adam Chen 12/8/24
SIZE
A
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1

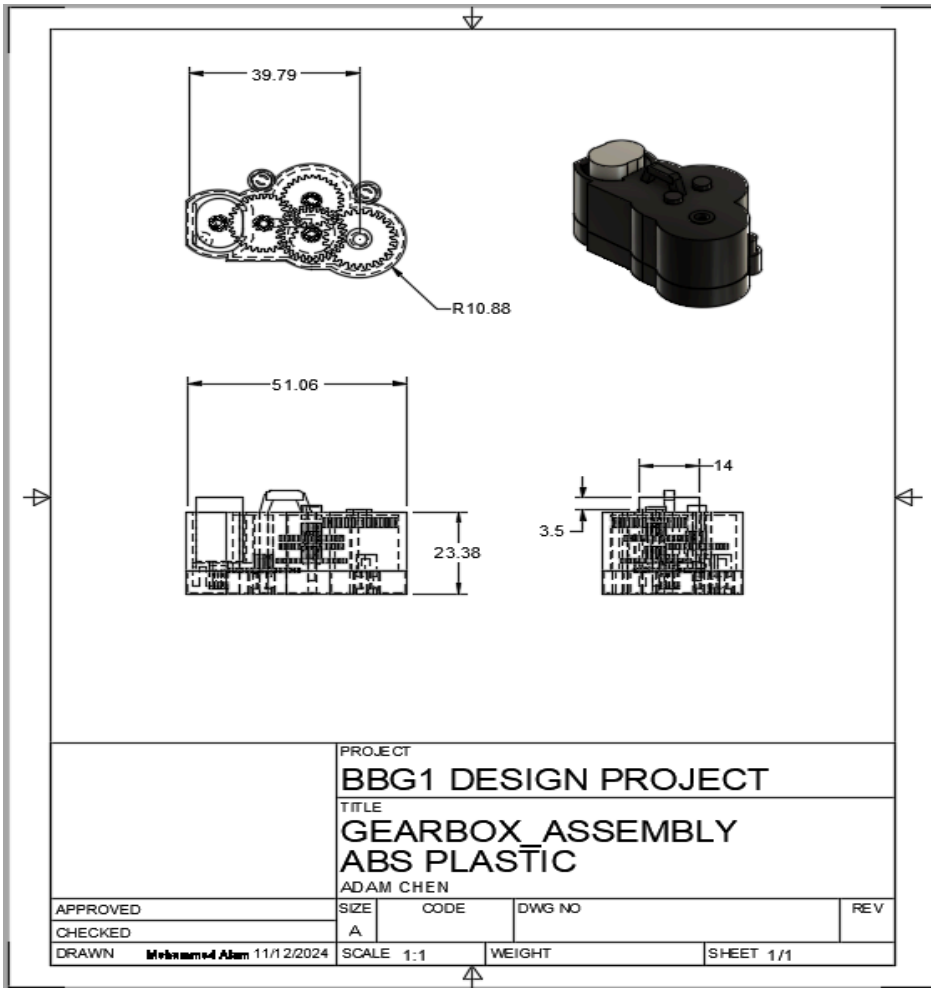

9.49
1
7
29.85
2.07
SECTION A-A
SCALE 1:1
Ø34.39
Ø54.85
A
A
Ø70.37
PROJECT
BBG1 DESIGN PROJECT
TITLE
TRACTOR TIRE, LARGE RUBBER
ADAM CHEN
APPROVED
CHECKED
DRAWN Adam Chen 12/8/24
SIZE B
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1


52.17
43.54
71.22
5.77
PROJECT
BBG DESIGN PROJECT
TITLE
TIRE WITH RIM, LARGE ASSEMBLY
RUBBER & ABS PLASTIC
APPROVED
CHECKED
DRAWN Adam Chen 12/9/24
SIZE B
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1

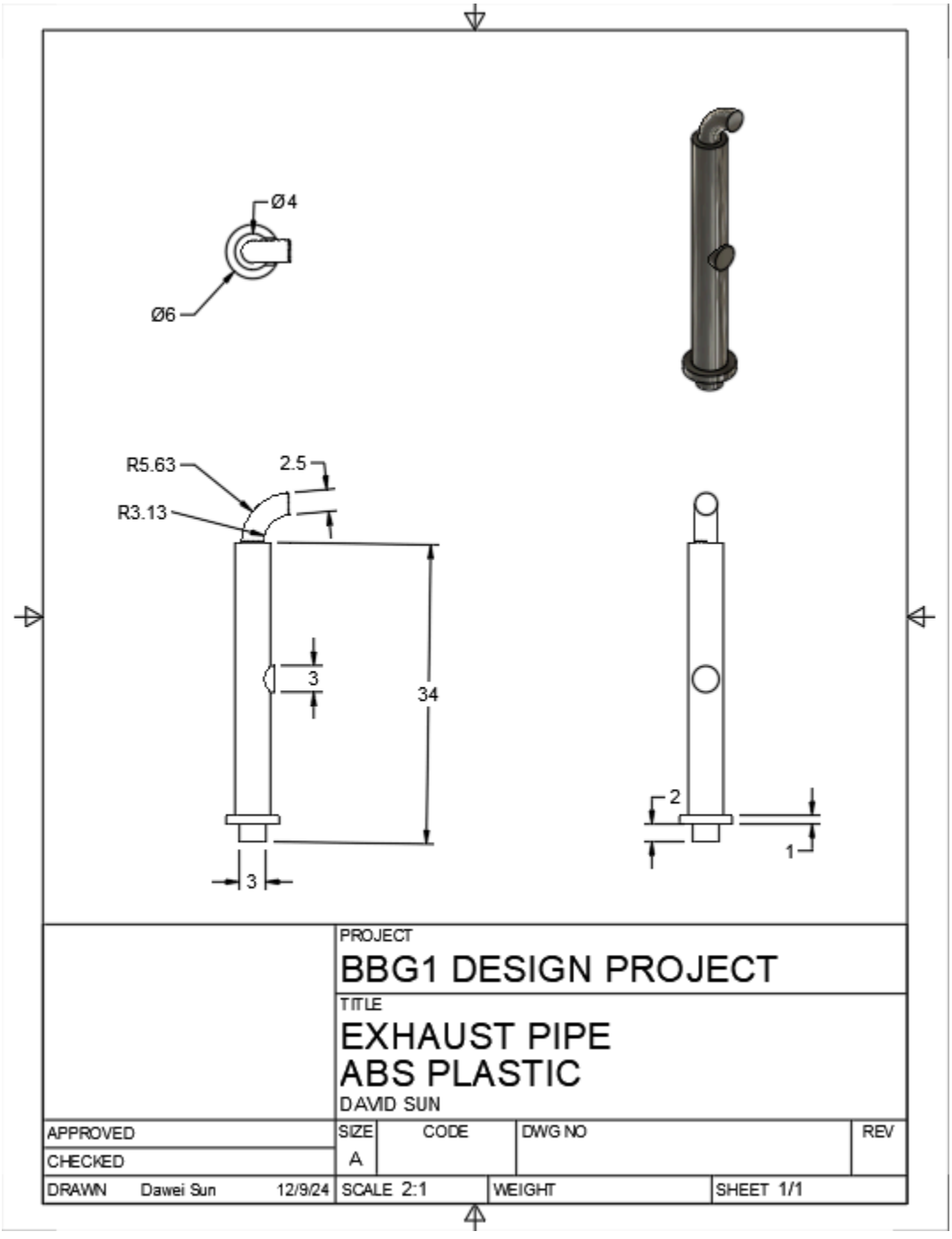

Ø17.89
Ø43.53
Ø40.7
Ø1 X 12
Ø6.8
Ø11.8
Ø27.67
SECTION A-A
SCALE 1:1
A
A
2.03
32.91
41.56
Ø5.77
27.67
7.94
3.93
R4
2.03
.2
.8
39.53
5.04
11.62
4.33
PROJECT
BBG1 DESIGN PROJECT
TITLE
WHEEL RIM LARGE
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Adam Chen 12/8/24
SIZE B
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1

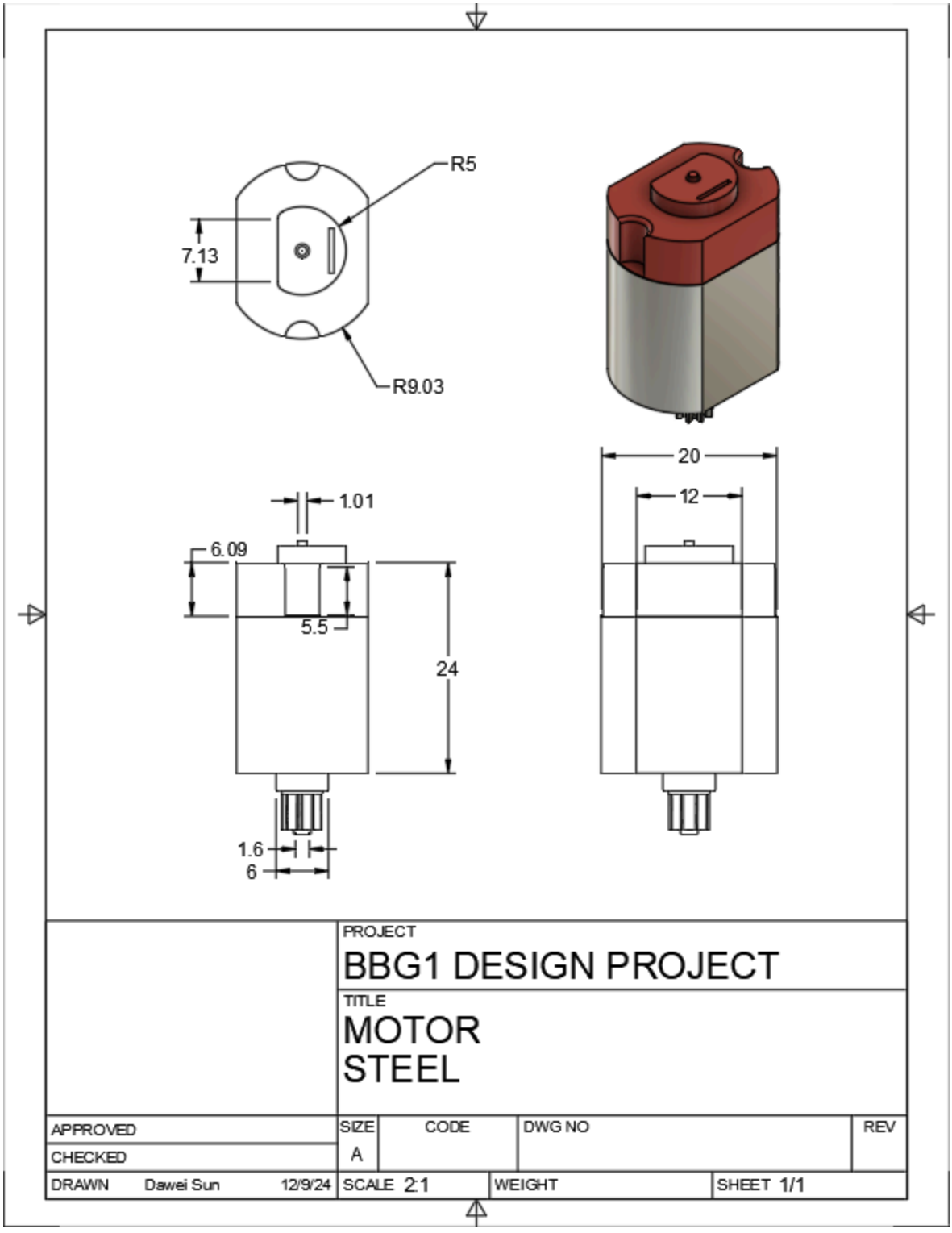

R10.65
12.5
R9.71
R9.01
49.25
6.7
PROJECT
BBG1 DESIGN PROJECT
TITLE
GEARBOX_HOUSING_LID
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Mohammed Alam 11/12/2024
SIZE A
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1

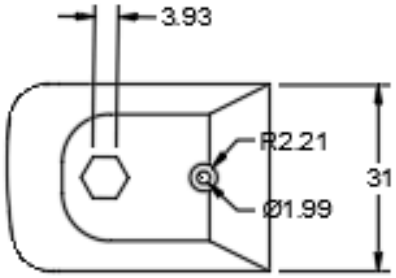

R10.65
12.5
R9.01
14.06
47.76
16.88
7.39
PROJECT
BBG1 DESIGN PROJECT
TITLE
GEAR_BOX_HOUSING
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Mohammed Alam 11/12/2024
SIZE A
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1

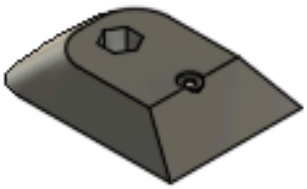

39.79
R10.88
51.06
23.38
14
3.5
PROJECT
BBG1 DESIGN PROJECT
TITLE
GEARBOX_ASSEMBLY
ABS PLASTIC
ADAM CHEN
APPROVED
CHECKED
DRAWN Mohammed Alam 11/12/2024
SIZE
A
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1

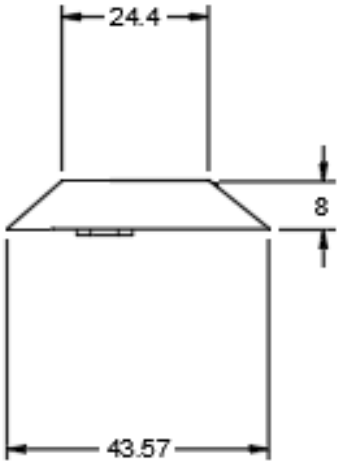
C. Exhaust/Battery/Top Tractor



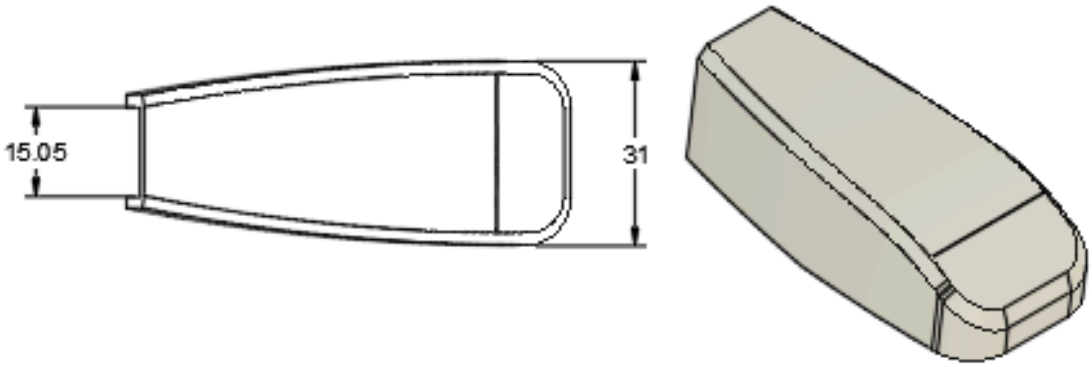

R5
7.13
R9.03
20
12
1.01
6.09
5.5
24
1.6
6
PROJECT
BBG1 DESIGN PROJECT
TITLE
MOTOR
STEEL
APPROVED
CHECKED
DRAWN Dawei Sun 12/9/24
SIZE
A
CODE
DWG NO
REV
SCALE 2:1
WEIGHT
SHEET 1/1

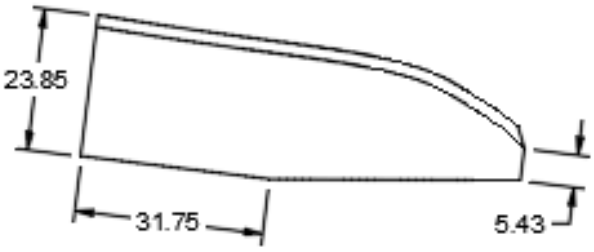






	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: TRACTOR SHROU CONNECTOR ABS PLASTIC DAVID SUN			
APPROVED APPROVED_BY APPROVED_DATE	SIZE: A	CODE: CODE	DWG NO: DWG_NO	REV: REV
CHECKED CHECKED_BY CHECKED_DATE				
DRAWN: Dawei Sun 12/9/24	SCALE: 1:1	WEIGHT: WEIGHT	SHEET: 1/1	



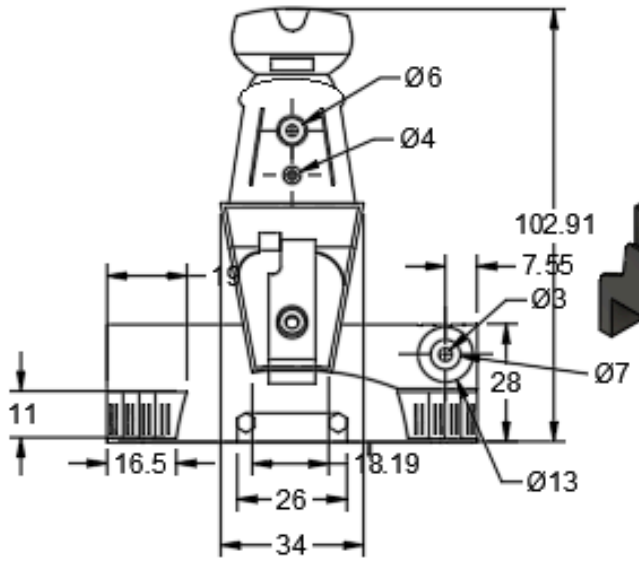


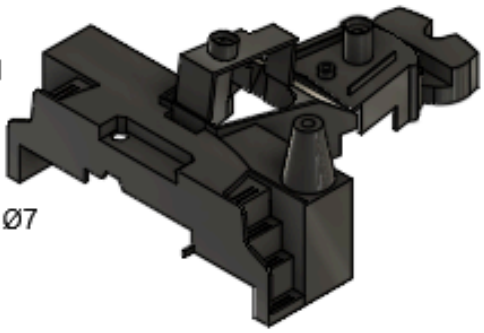
PROJECT
BBG1 DESIGN PROJECT

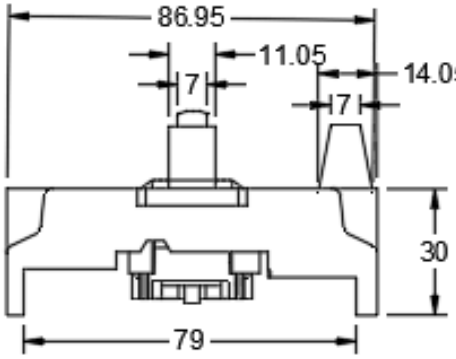
TITLE
TRACTOR SHROUD
ABS PLASTIC

DAVID SUN

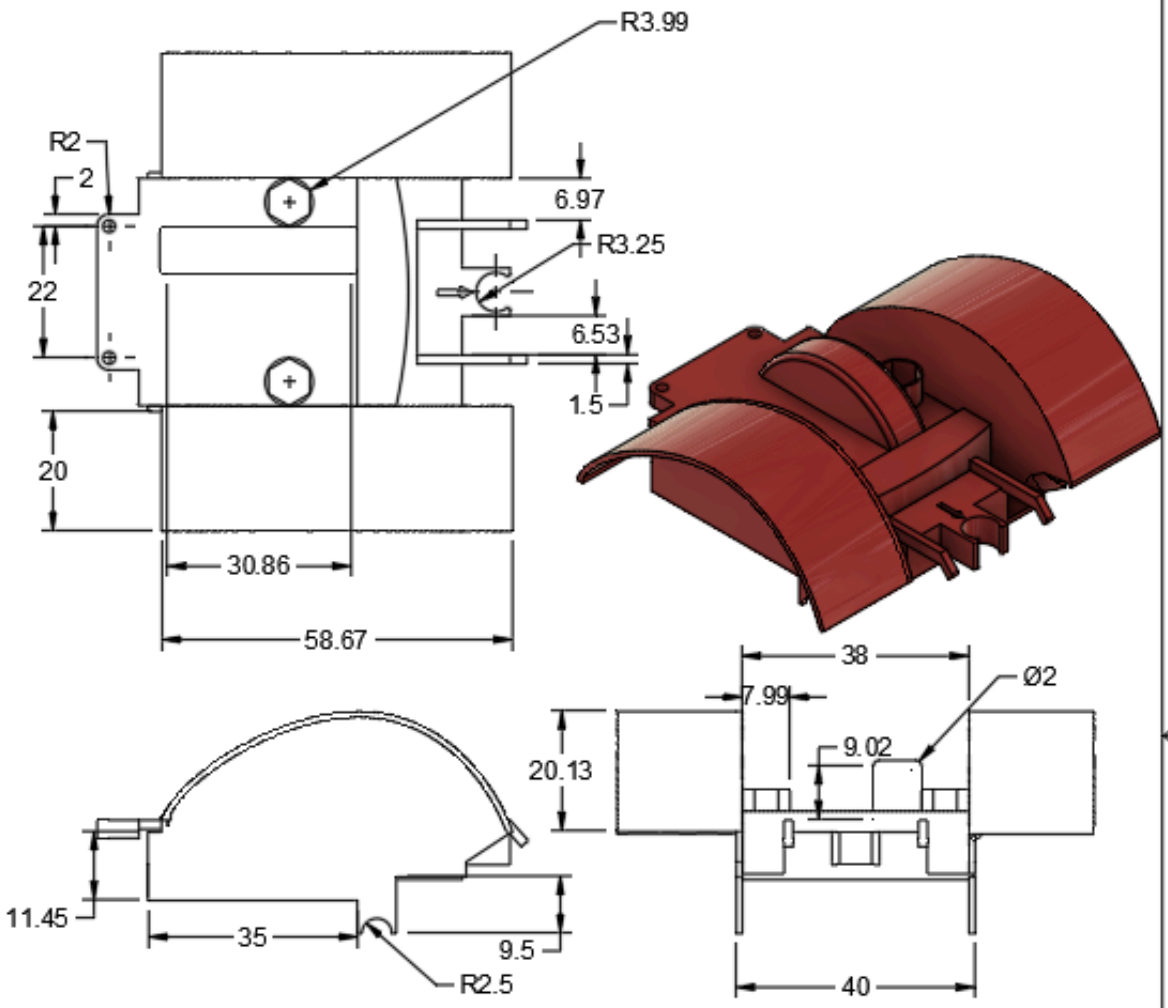
APPROVED APPROVED_BY APPROVED_DATE	SIZE	CODE	DWG NO	REV
CHECKED CHECKED_BY CHECKED_DATE	A	CODE	DWG_NO	REV
DRAWN Dawei Sun 12/9/24	SCALE 1:1	WEIGHT WEIGHT	SHEET 1/1	





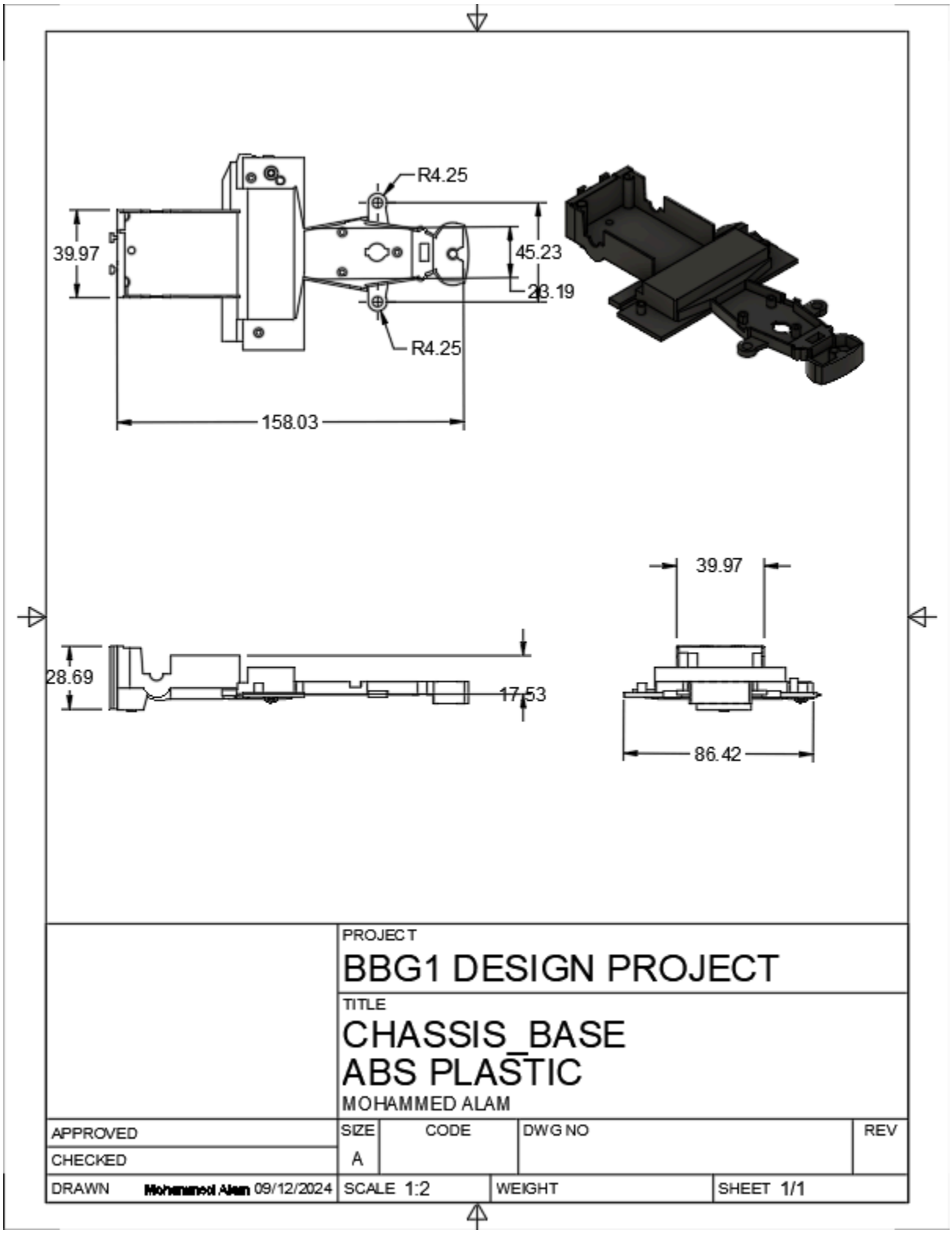


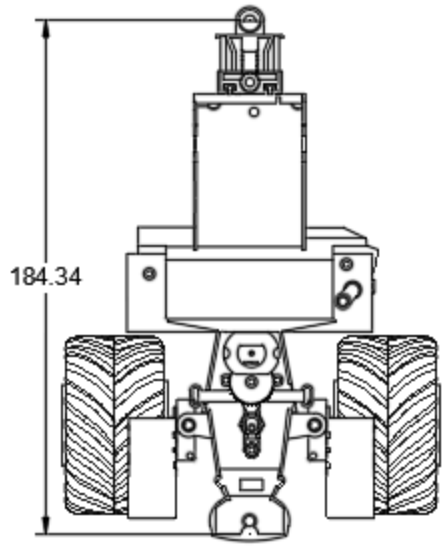
	PROJECT BBG1 DESIGN PROJECT				
	TITLE UPPE CHASSIS ABS PLASTIC				
APPROVED	SIZE	CODE	DWG NO		REV
CHECKED	A				
DRAWN Dawei Sun 12/9/24	SCALE 1:1	WEIGHT		SHEET 1/1	

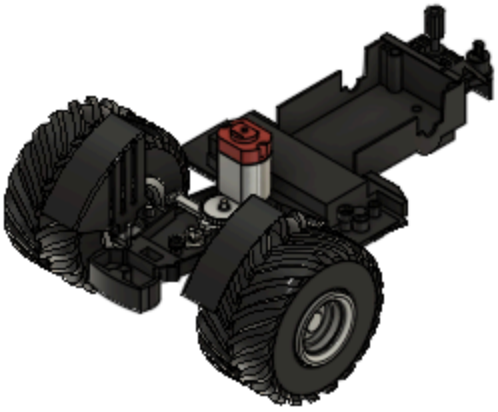


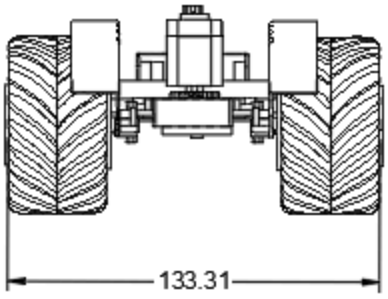
	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: WHEEL WELL ABS PLASTIC			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Dawei Sun 12/9/24	SCALE 1:1	WEIGHT	SHEET 1/1	

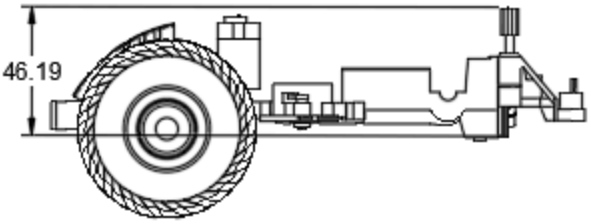
D. Tractor Bottom



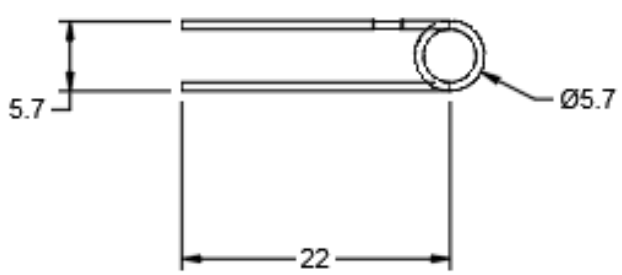


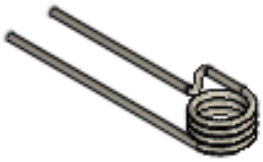


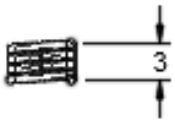




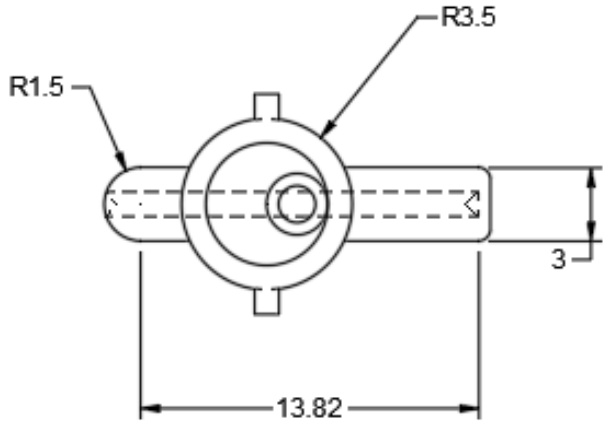
	PROJECT: BBG1 DESIGN PROJECT				
	TITLE: CHASSIS_SUBASSEMBLY RUBBER/ABS PLASTIC MOHAMMED ALAM				
APPROVED	SIZE: A	CODE	DWG NO		REV
CHECKED					
DRAWN Mohammed Alam 10/12/2024	SCALE 1:2	WEIGHT		SHEET 1/1	

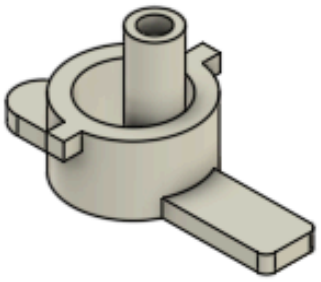


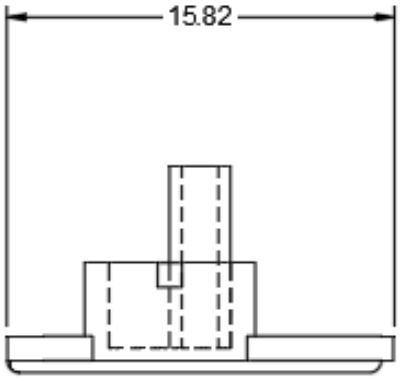


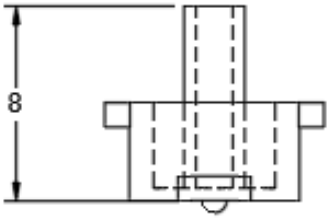


	PROJECT: BBG1 DRAWING PROJECT			
	TITLE: COIL METAL MOHAMMED ALAM			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Mohammed Alam 11/12/2024	SCALE 2:1	WEIGHT	SHEET 1/1	

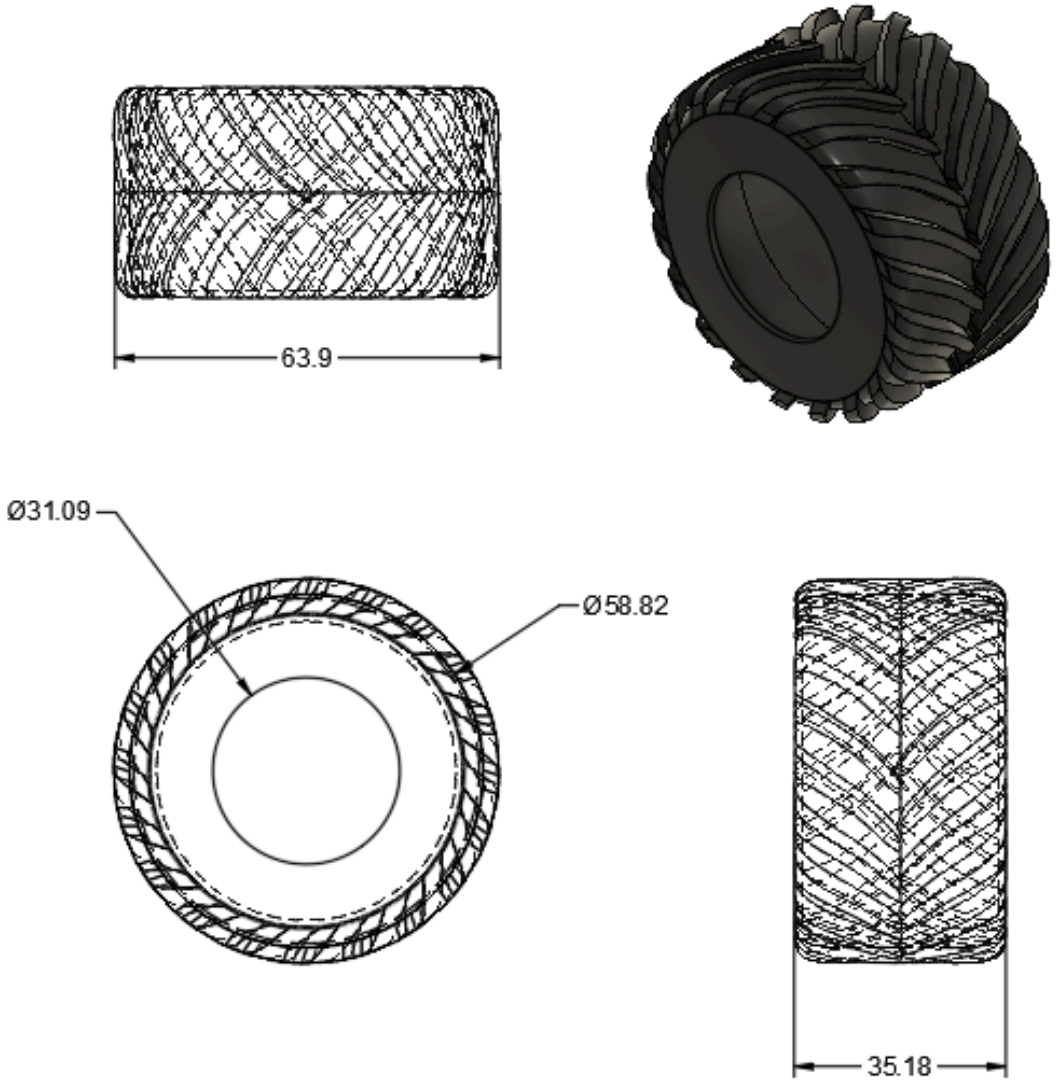




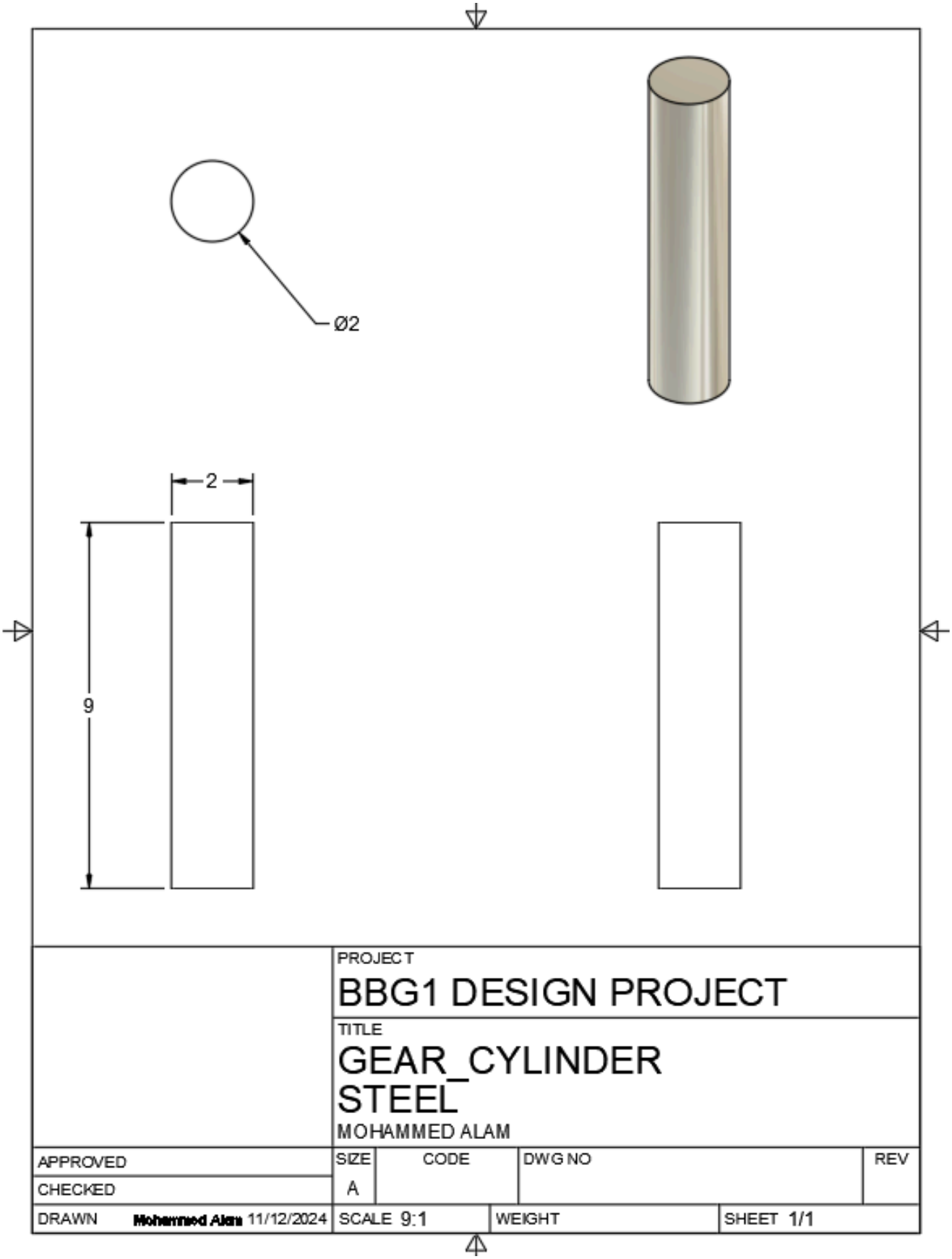




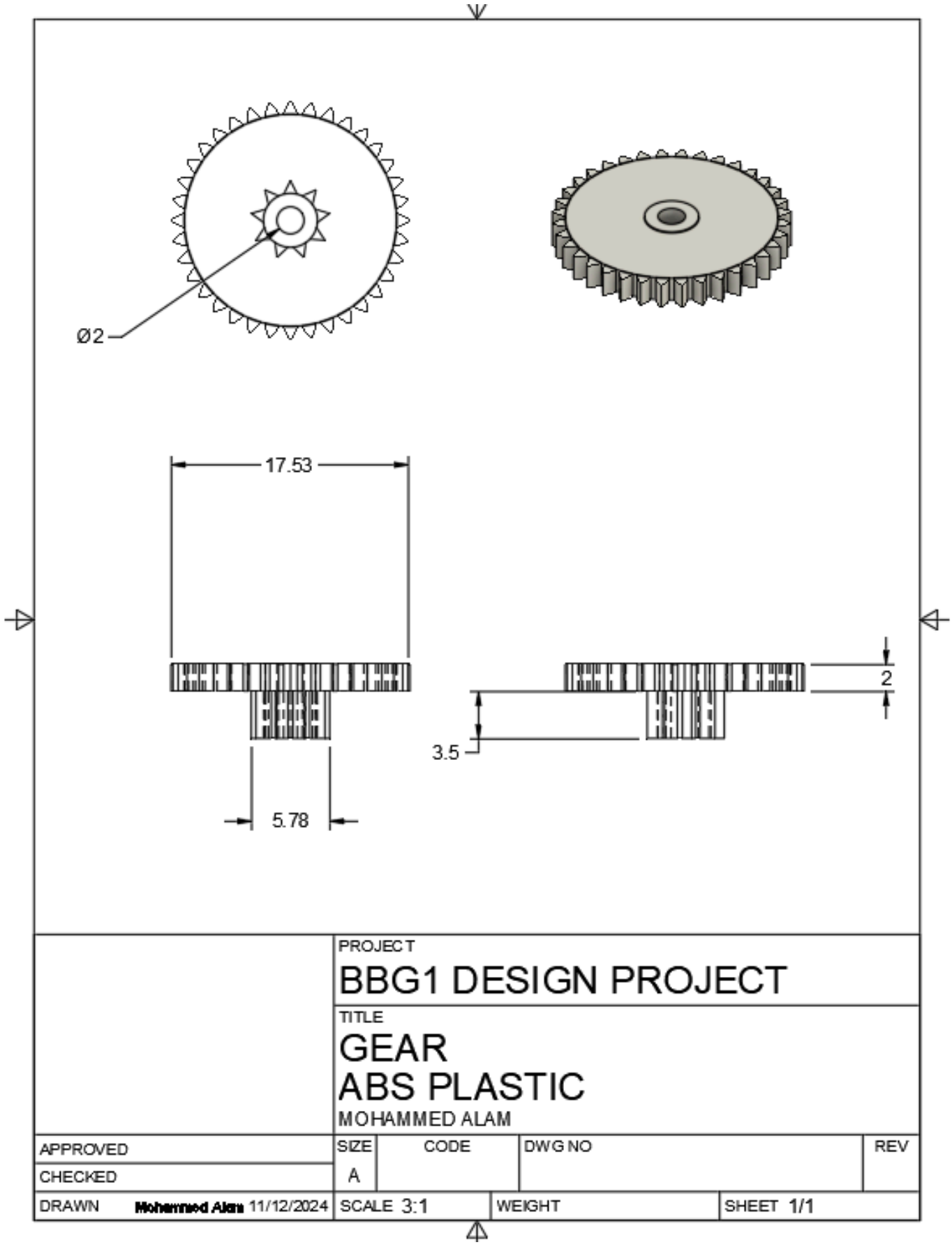
	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: DRIVETRAIN_COMPONENET ABS PLASTIC			
	MOHAMMED ALAM			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN: Mohammed Alam 11/12/2024	SCALE: 4:1	WEIGHT	SHEET: 1/1	



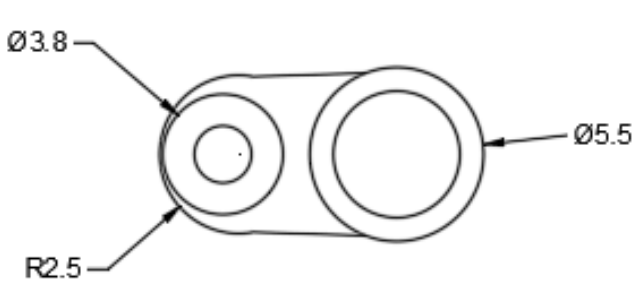
	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: FRONT_WHEEL_DRAWING RUBBER			
	MOHAMMED ALAM			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN: Mohammed Alam 10/12/2024	SCALE: 1:1	WEIGHT	SHEET: 1/1	

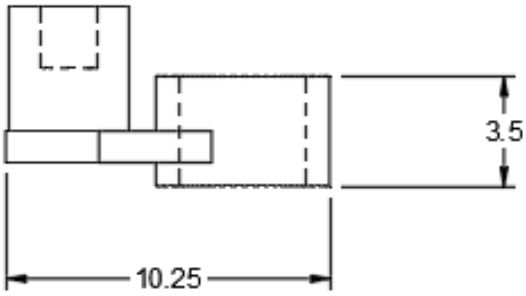


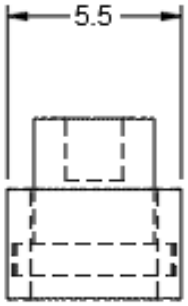
	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: GEAR_CYLINDER STEEL MOHAMMED ALAM			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Mohammed Alam 11/12/2024	SCALE 9:1	WEIGHT	SHEET 1/1	



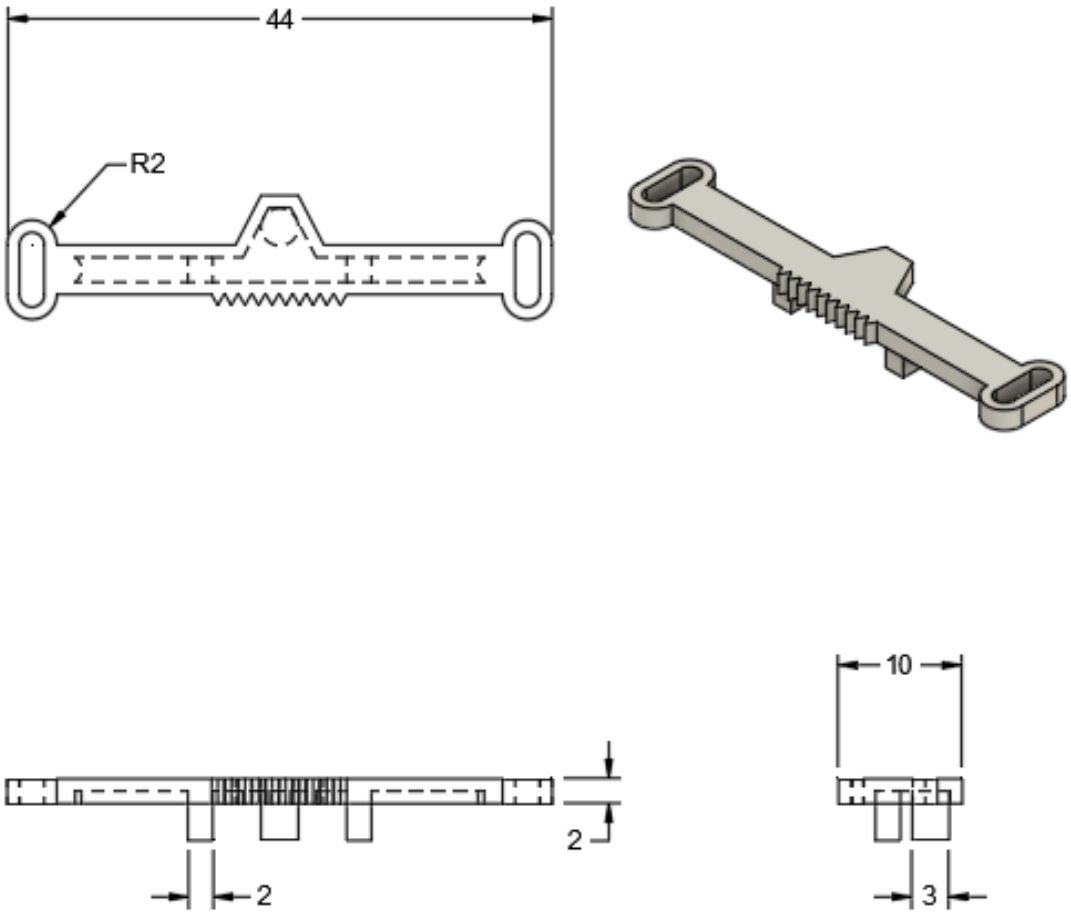
	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: GEAR ABS PLASTIC MOHAMMED ALAM			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Mohammed Alam 11/12/2024	SCALE 3:1	WEIGHT	SHEET 1/1	



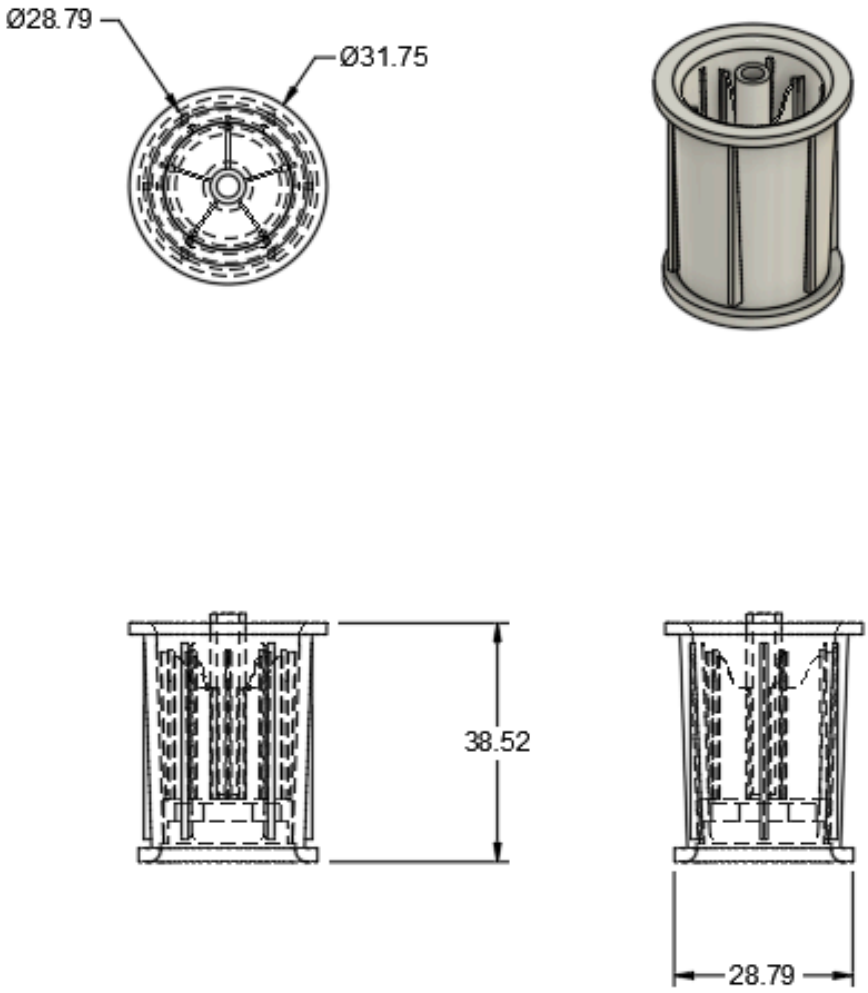




	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: SCREW_COVER ABS PLASTIC MOHAMMED ALAM			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Mohammed Alam 11/12/2024	SCALE 5:1	WEIGHT	SHEET 1/1	



	PROJECT BBG1 DESIGN PROJECT			
	TITLE STEERING_PINION ABS PLASTIC MOHAMMED ALAM			
APPROVED	SIZE A	CODE	DWG NO	REV
CHECKED				
DRAWN Mohammed Alam 11/12/2024	SCALE 2:1	WEIGHT	SHEET 1/1	



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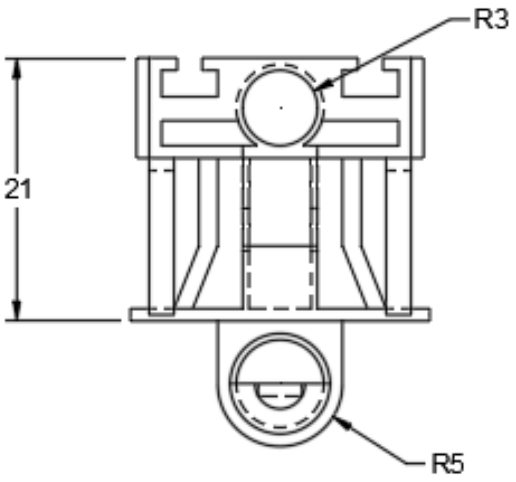
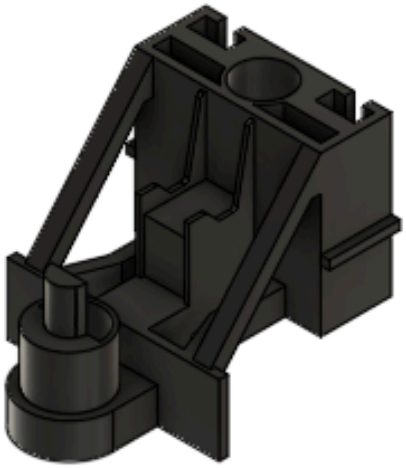
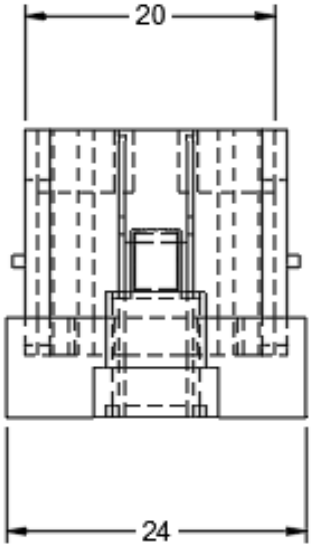
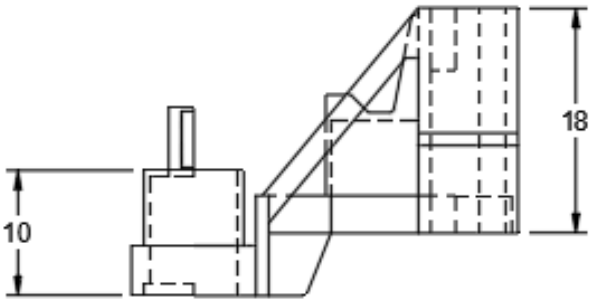
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Mohammed Alam 10/12/2024	SCALE 1:1	WEIGHT	SHEET 1/1	

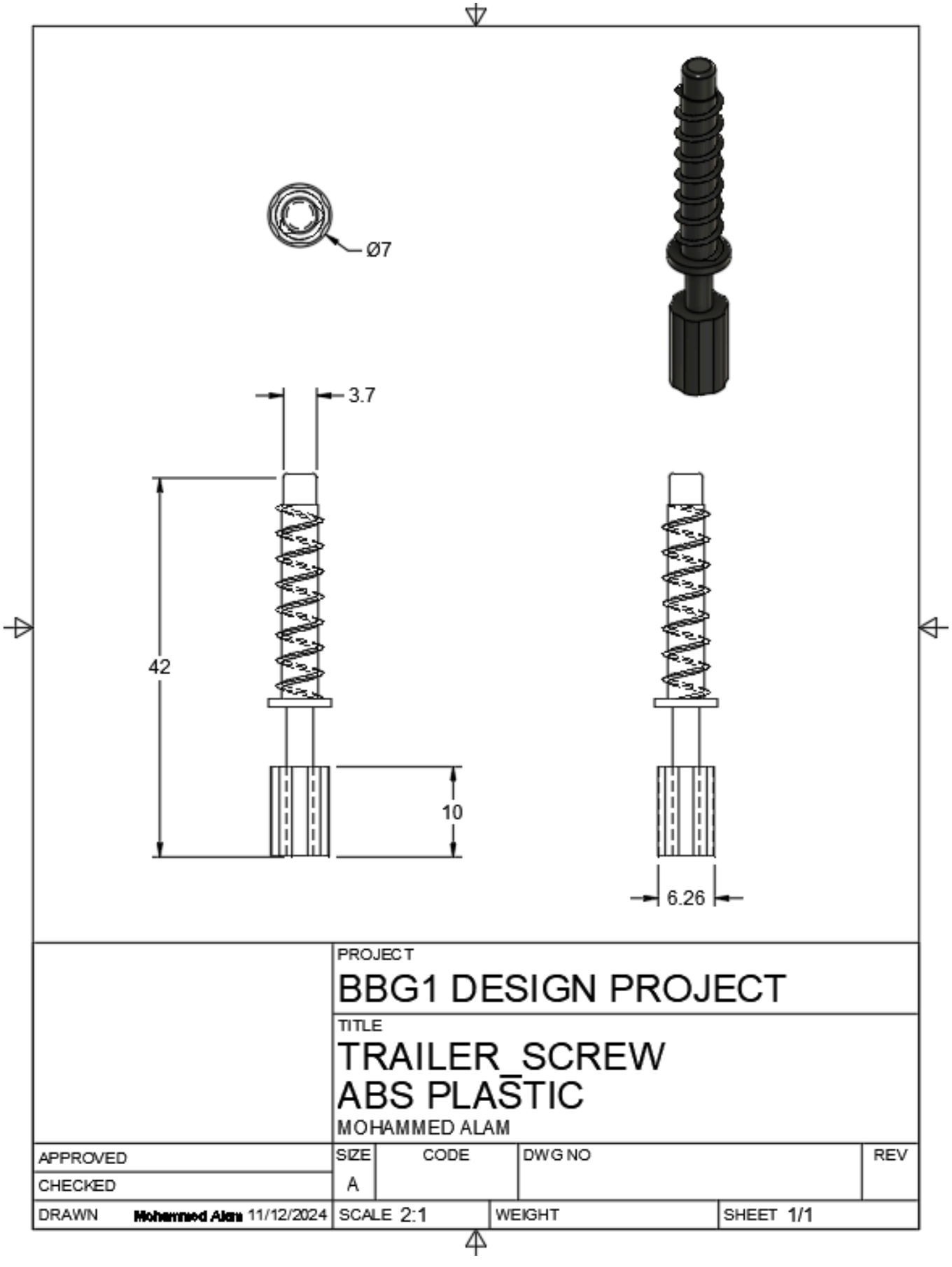




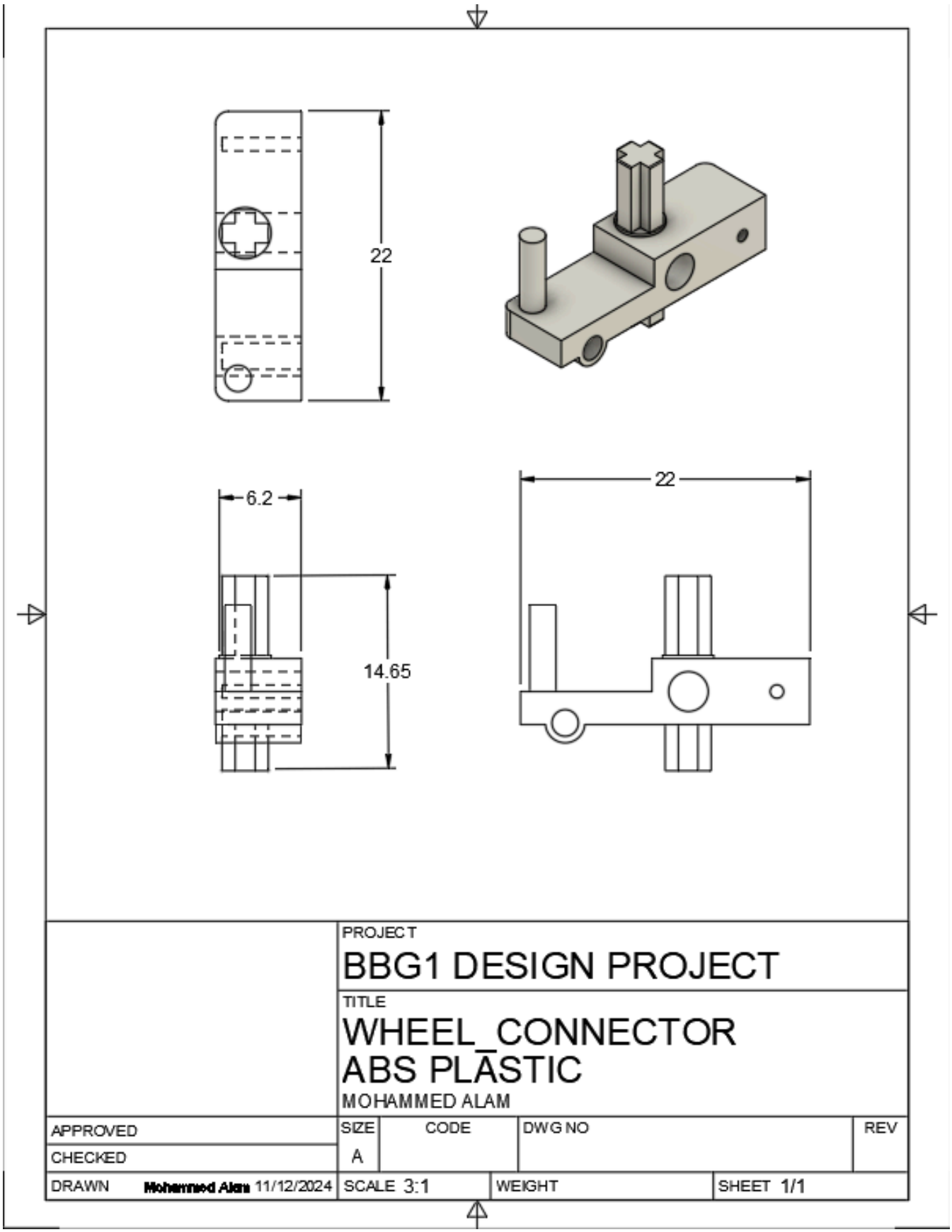




	PROJECT BBG1 DESIGN PROJECT			
	TITLE TRAILER_HITCH ABS PLASTIC MOHAMMED ALAM			
APPROVED	SIZE A	CODE	DWG NO	REV
CHECKED				
DRAWN Mohammed Alam 10/12/2024	SCALE 2:1	WEIGHT	SHEET 1/1	



	PROJECT BBG1 DESIGN PROJECT			
	TITLE TRAILER_SCREW ABS PLASTIC MOHAMMED ALAM			
APPROVED	SIZE A	CODE	DWG NO	REV
CHECKED				
DRAWN Mohammed Alam 11/12/2024	SCALE 2:1	WEIGHT	SHEET 1/1	



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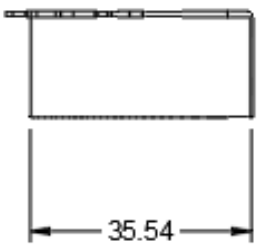
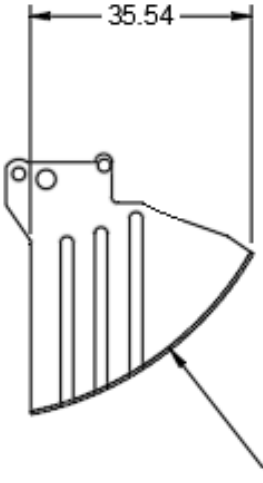
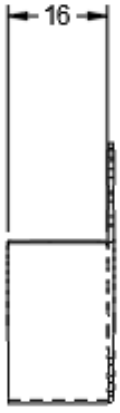
	MOHAMMED ALAM			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Mohammed Alam 11/12/2024	SCALE 3:1	WEIGHT	SHEET 1/1	

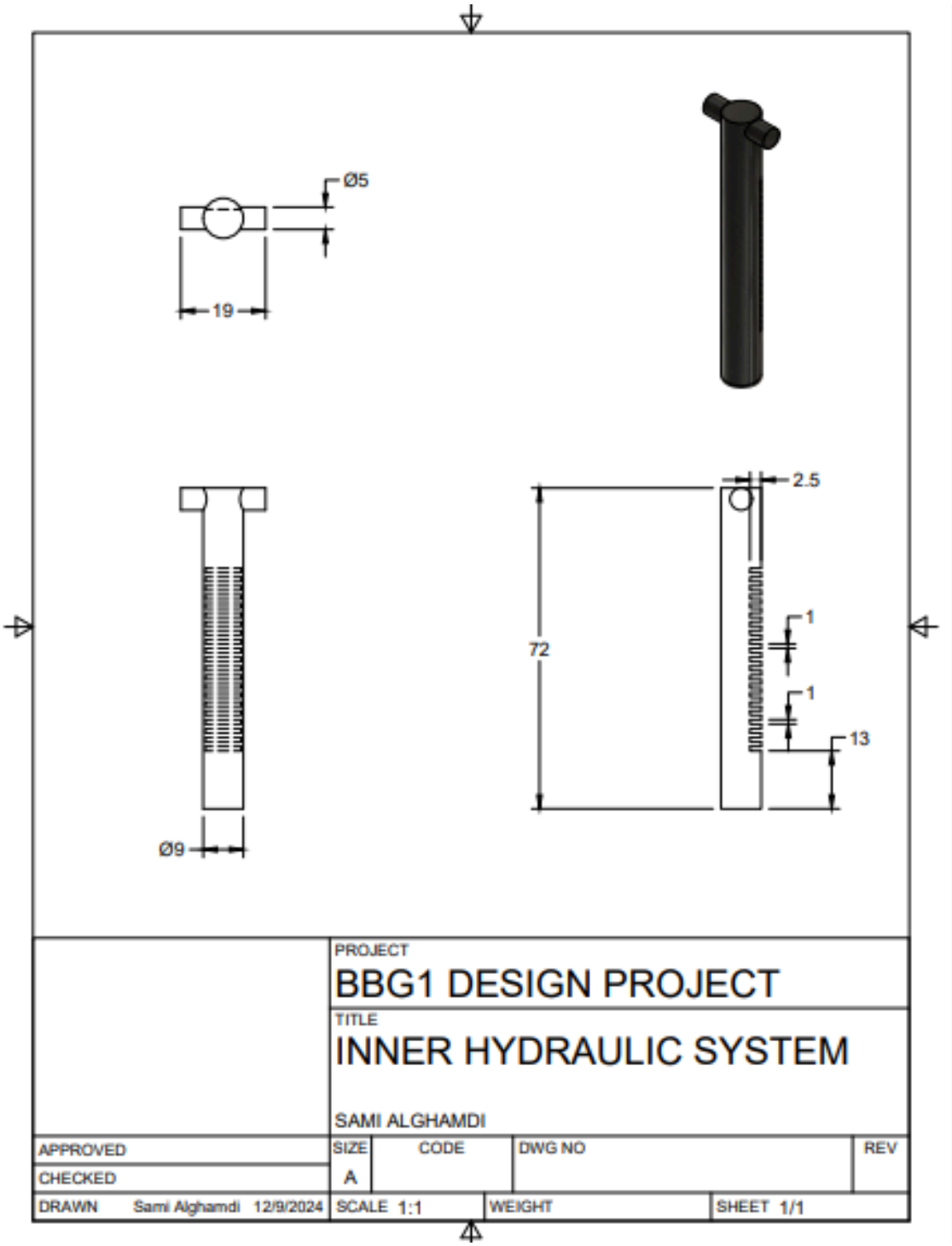






	PROJECT BBG1 DESIGN PROJECT				
	TITLE WHEEL_COVER ABS PLASTIC MOHAMMED ALAM				
APPROVED	SIZE A	CODE	DWG NO		REV
CHECKED					
DRAWN Mohammed Alam 11/12/2024	SCALE 1:1		WEIGHT	SHEET 1/1	

E. TRAILER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19
Ø9
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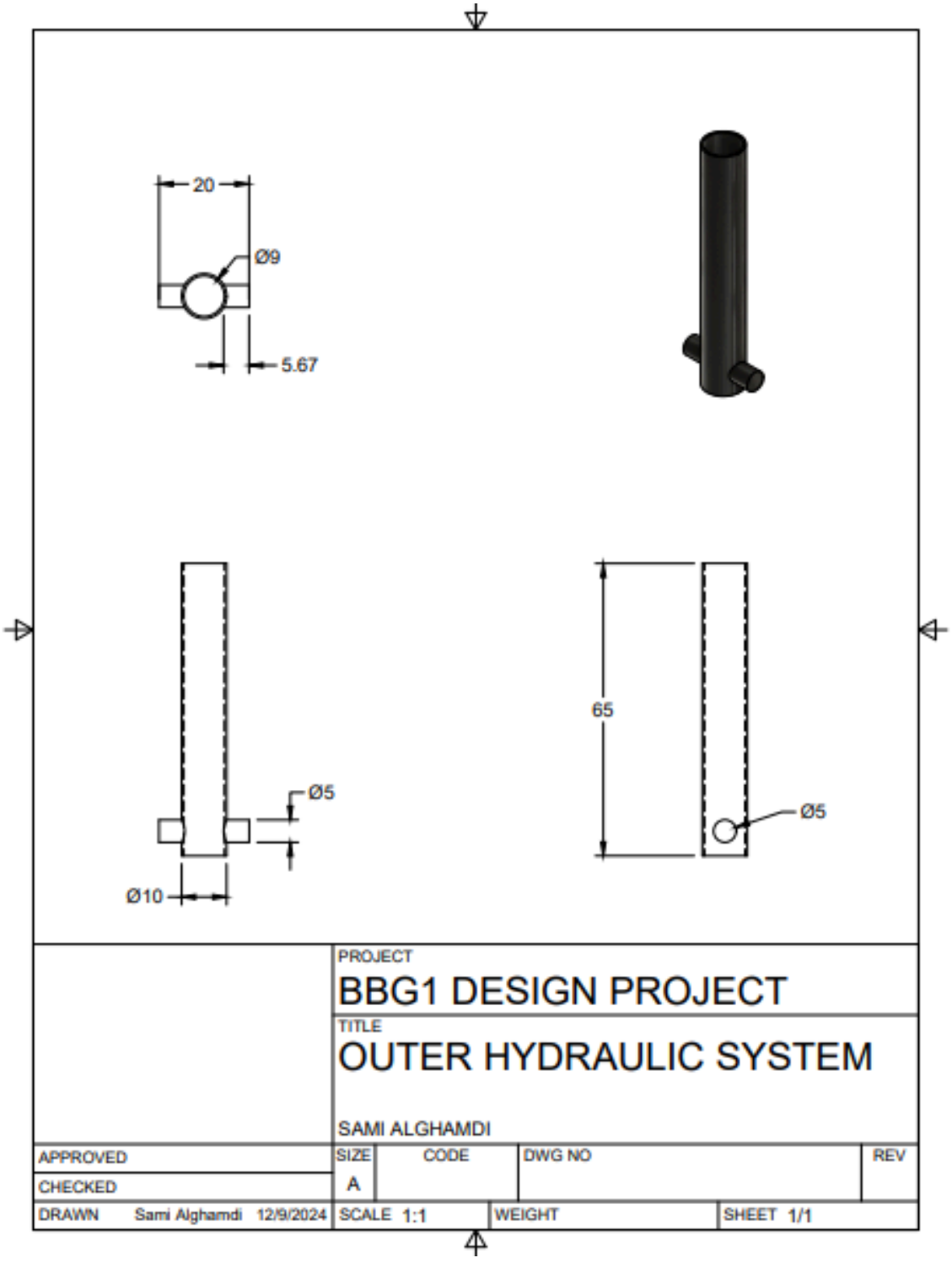
72
1
1
13
PROJECT
BBG1 DESIGN PROJECT
TITLE
INNER HYDRAULIC SYSTEM
SAMI ALGHAMDI
APPROVED
CHECKED
DRAWN Sami Alghamdi 12/9/2024
SIZE
A
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1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Ø5
Ø10
65
Ø5
PROJECT
BBG1 DESIGN PROJECT
TITLE
OUTER HYDRAULIC SYSTEM
SAMI ALGHAMDI
APPROVED
CHECKED
DRAWN Sami Alghamdi 12/9/2024
SIZE
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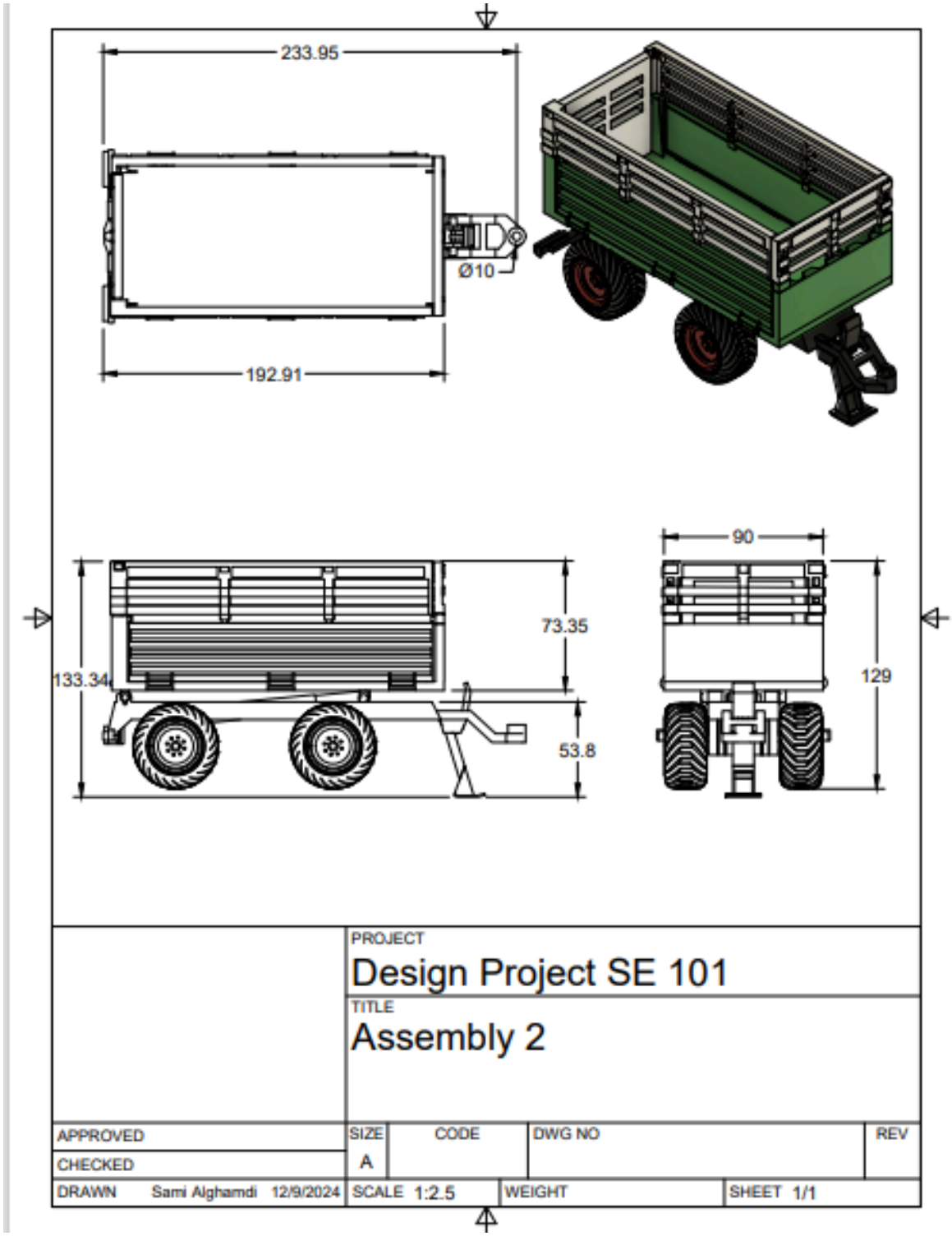
CODE
DWG NO
REV
SCALE 1:1
WEIGHT
SHEET 1/1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Ø10
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90
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53.8
PROJECT
Design Project SE 101
TITLE
Assembly 2
APPROVED
CHECKED
DRAWN Sami Alghamdi 12/9/2024
SIZE
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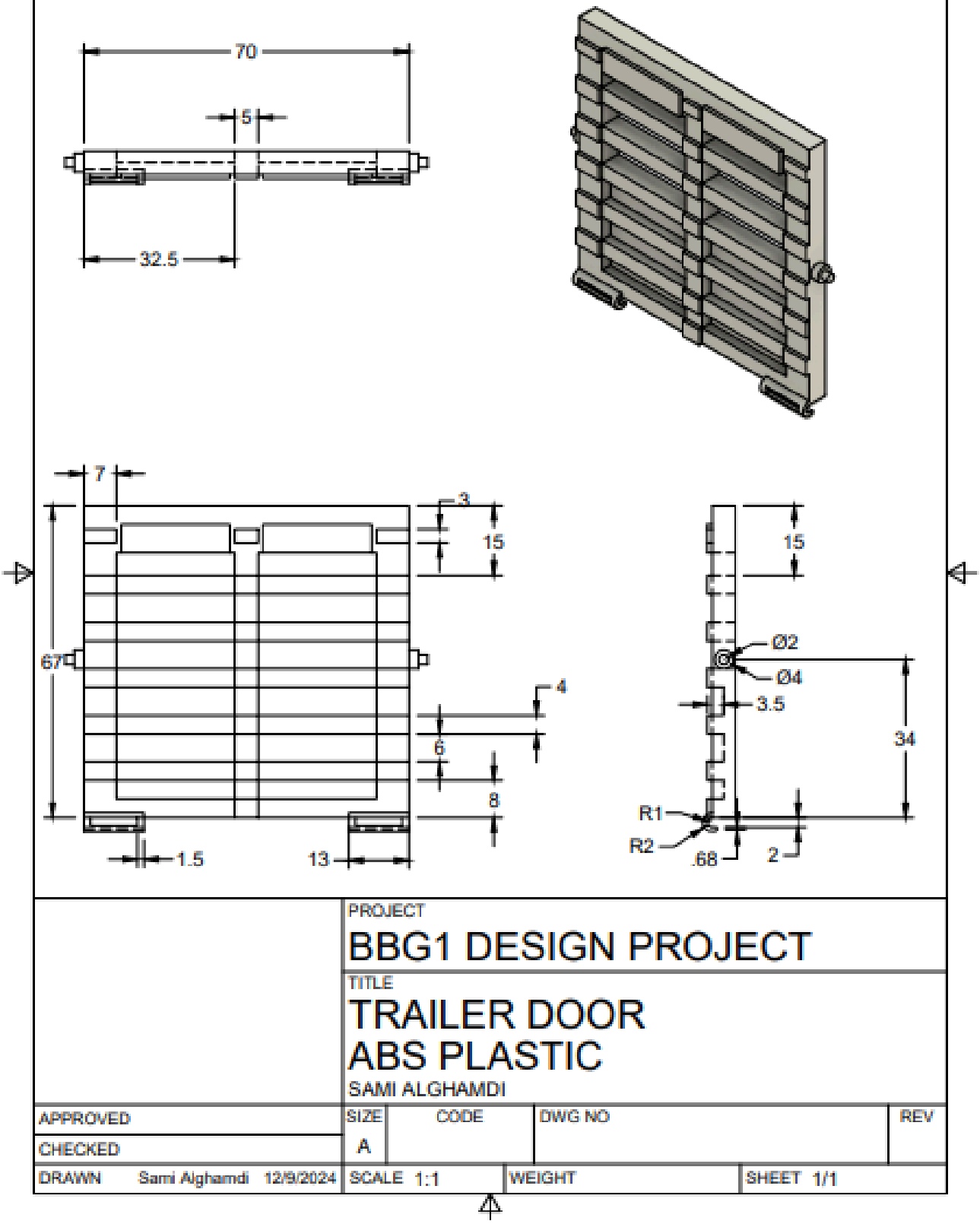
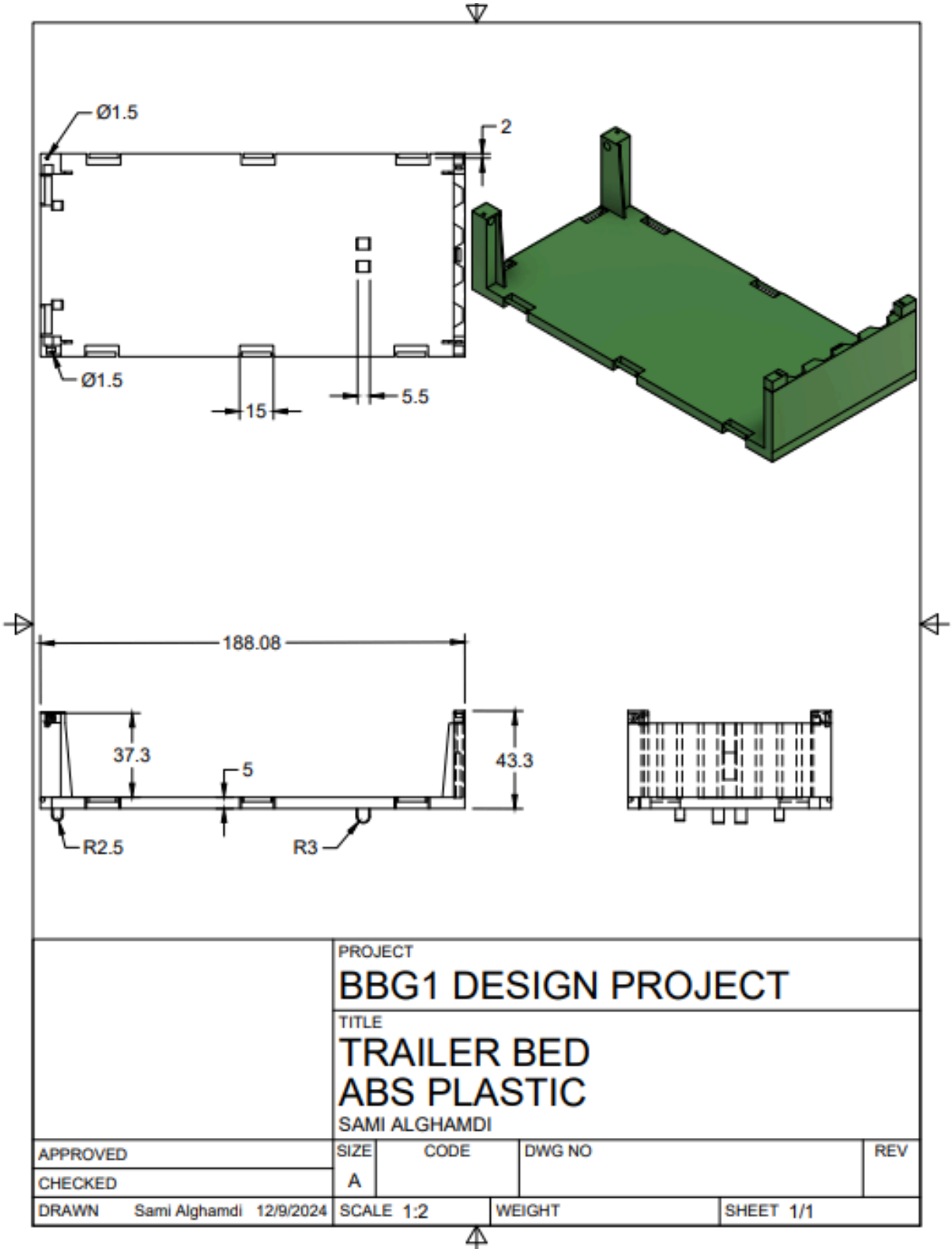
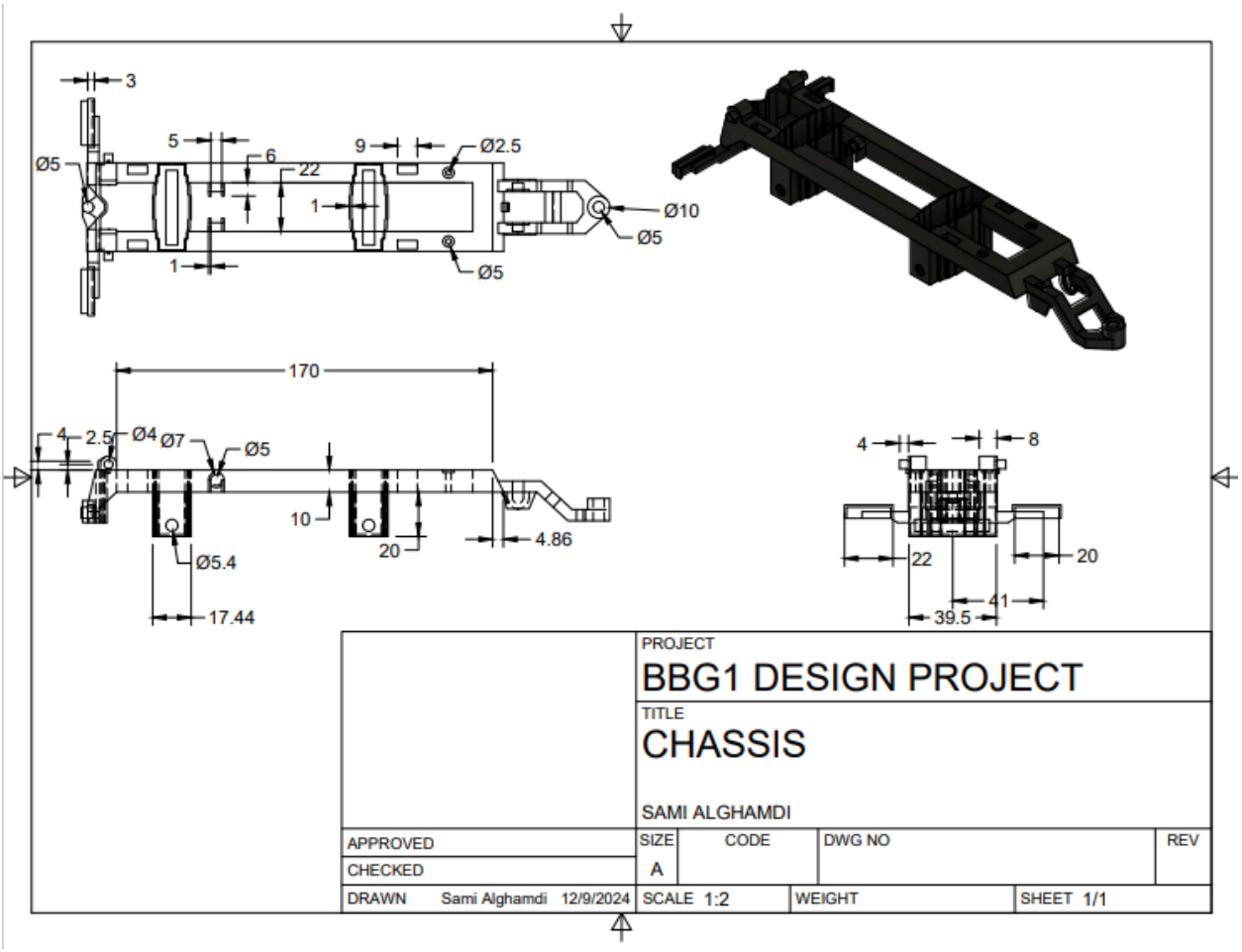
CODE
DWG NO
REV
SCALE 1:2.5
WEIGHT
SHEET 1/1



	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: TRAILER DOOR ABS PLASTIC			
	SAMI ALGHAMDI			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN: Sami Alghamdi 12/9/2024	SCALE: 1:1	WEIGHT	SHEET: 1/1	



	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: TRAILER BED ABS PLASTIC SAMI ALGHAMDI			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN: Sami Alghamdi 12/9/2024	SCALE: 1:2	WEIGHT	SHEET: 1/1	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Ø7
Ø5
10
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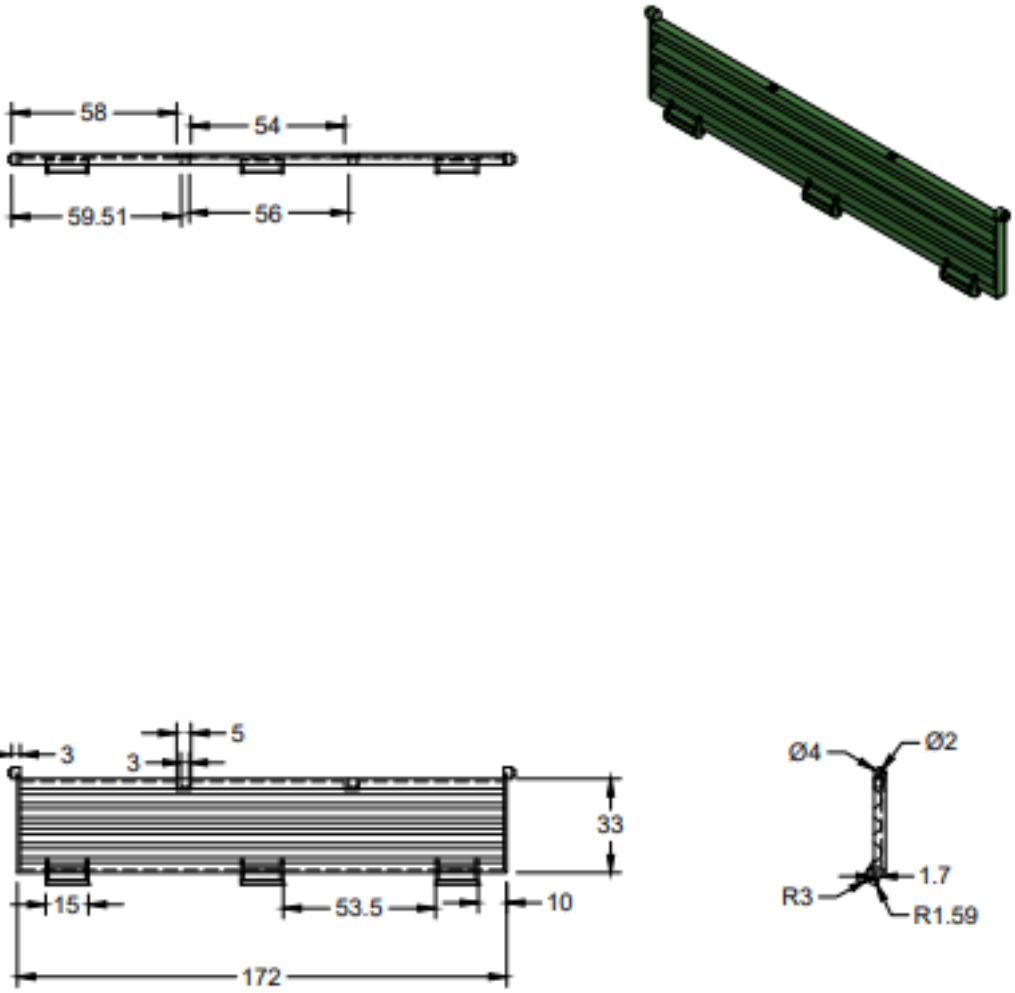
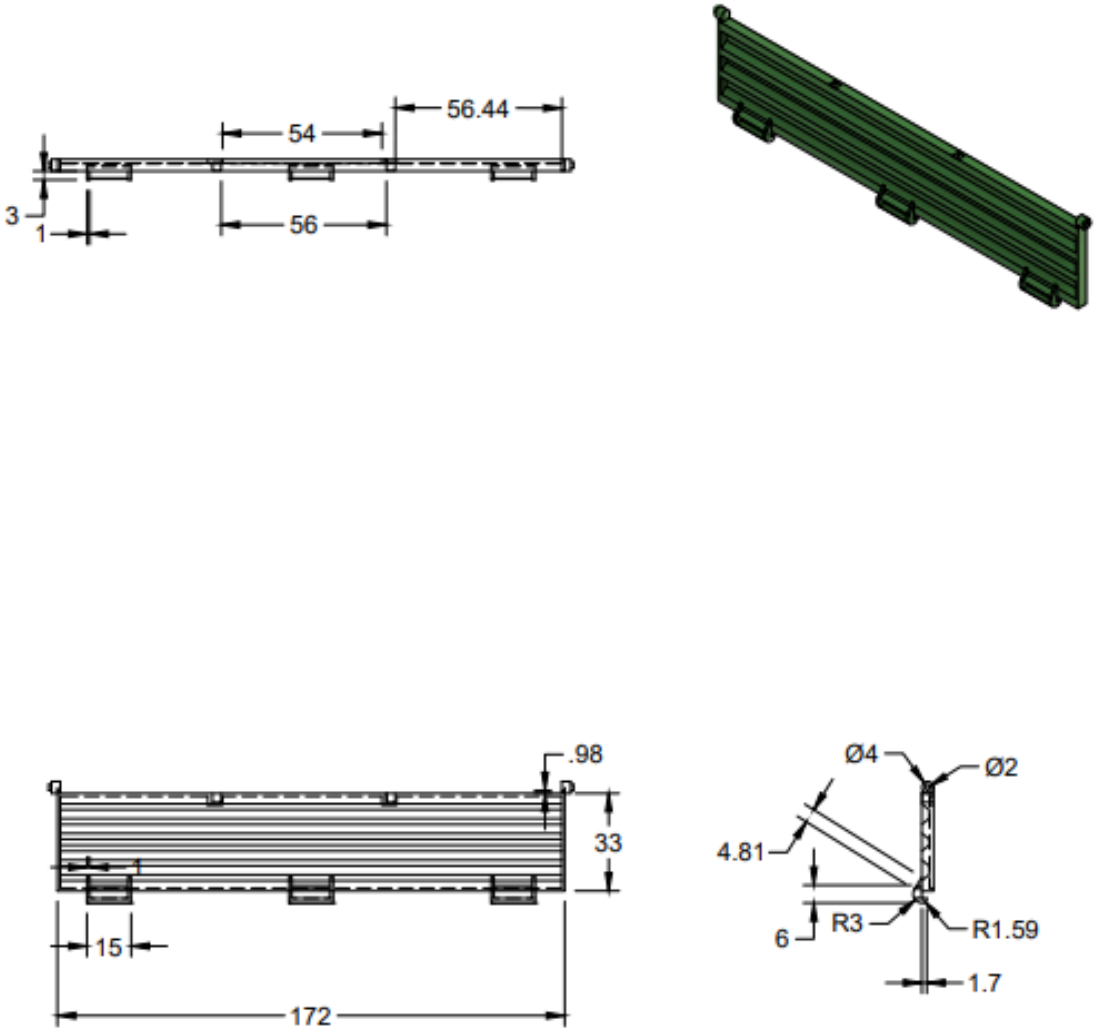
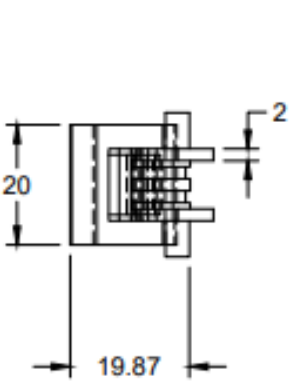
4.86
Ø5.4
17.44
4
8
22
20
41
39.5
PROJECT
BBG1 DESIGN PROJECT
TITLE
CHASSIS
SAMI ALGHAMDI
APPROVED
CHECKED
DRAWN Sami Alghamdi 12/9/2024
SIZE
A
CODE
DWG NO
REV
SCALE 1:2
WEIGHT
SHEET 1/1

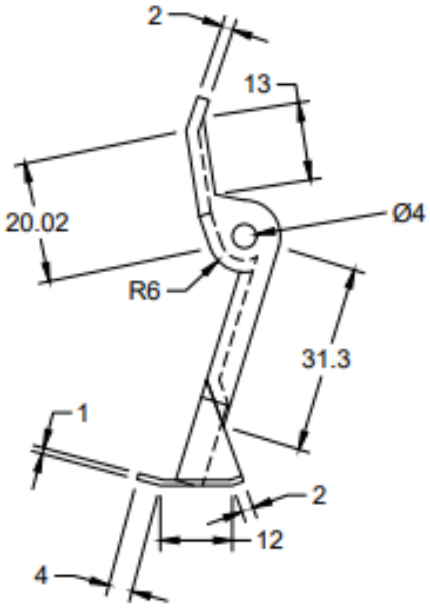


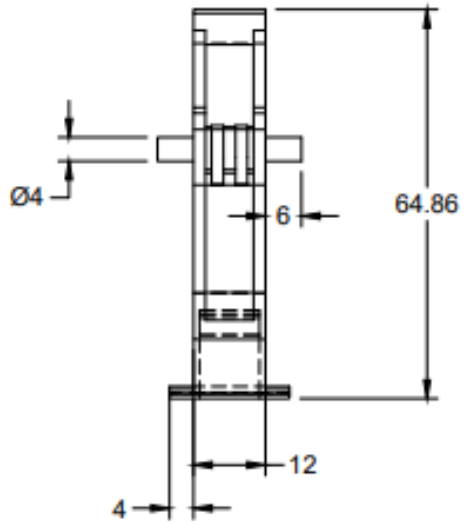
	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: GREEN TRAILER WALL 2 ABS PLASTIC SAMI ALGHAMDI			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN: Sami Alghamdi 12/9/2024	SCALE: 1:2	WEIGHT	SHEET: 1/1	



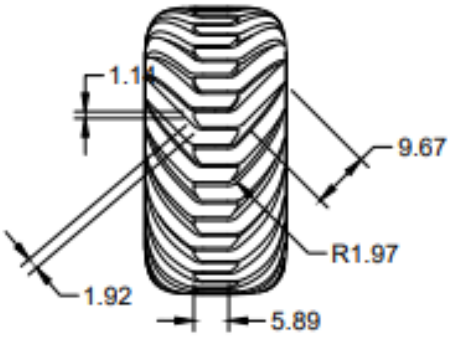
	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: GREEN TRAILER WALL 1 ABS PLASTIC SAMI ALGHAMDI			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Sami Alghamdi 12/9/2024	SCALE 1:2	WEIGHT	SHEET 1/1	

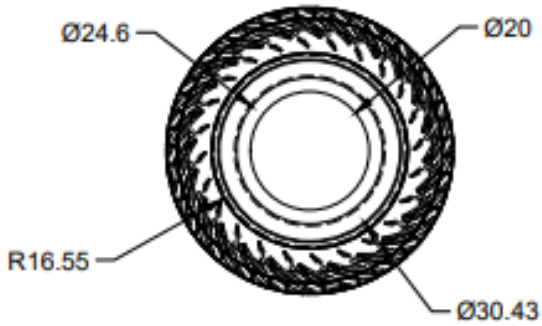




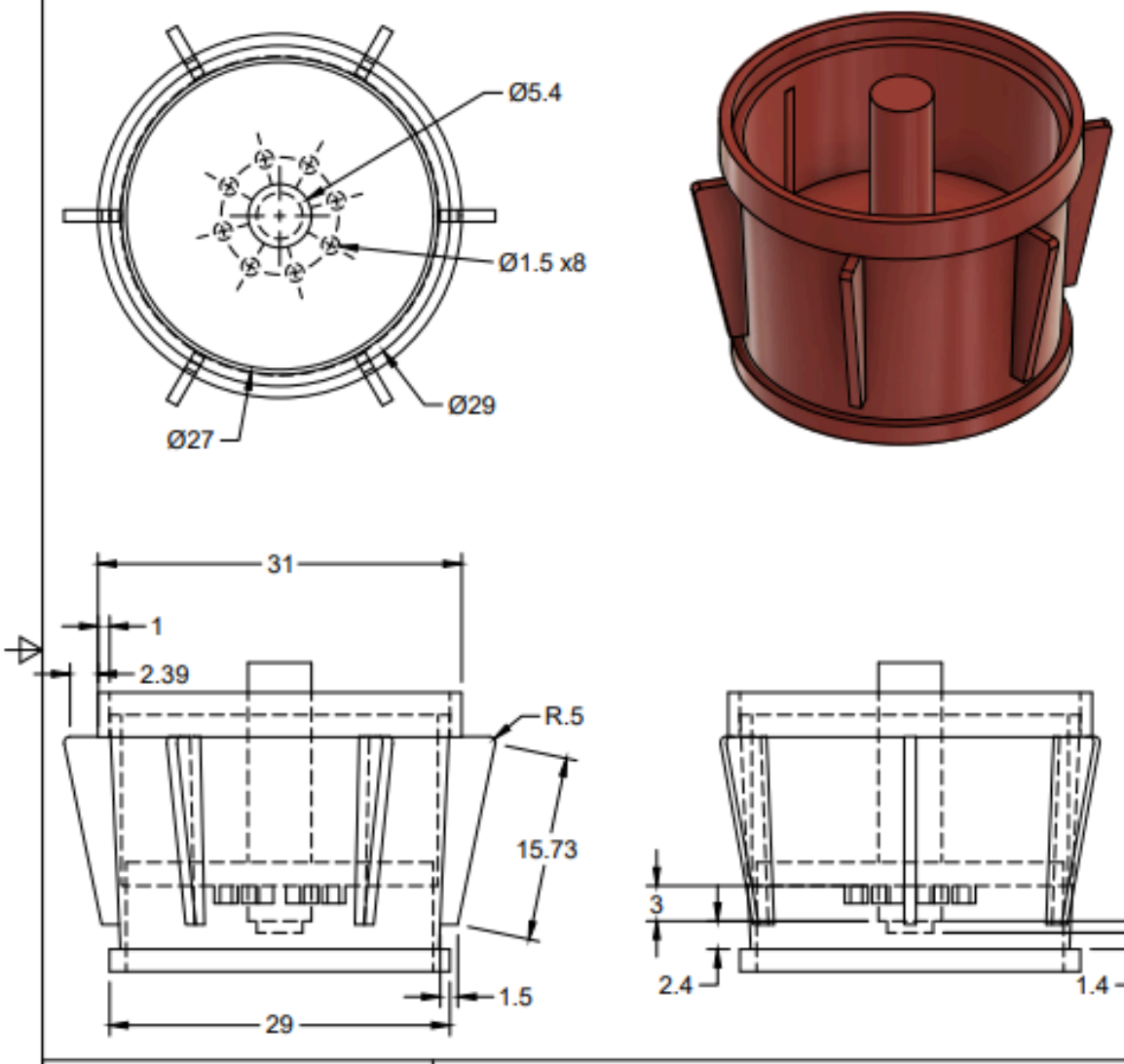


	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: TRAILER MOUNT ABS PLASTIC SAMI ALGHAMDI			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Sami Alghamdi 12/9/2024	SCALE 1:1	WEIGHT	SHEET 1/1	

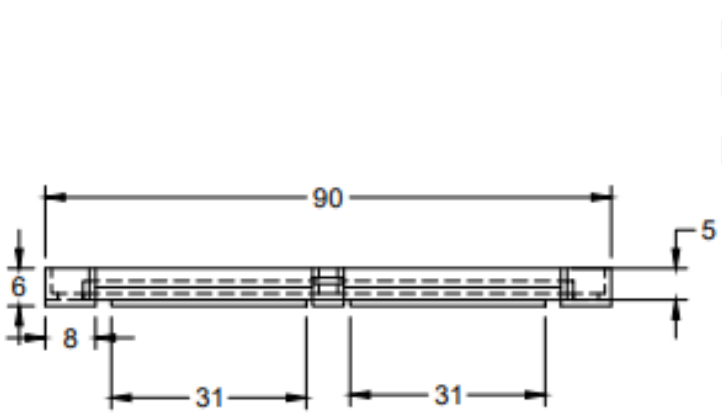


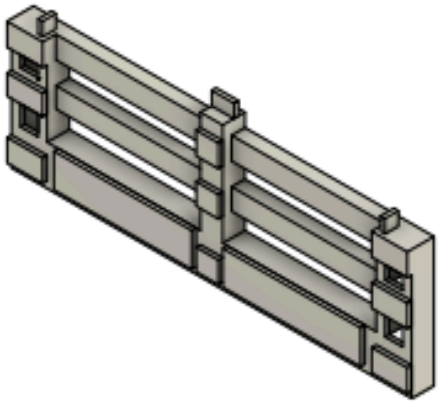


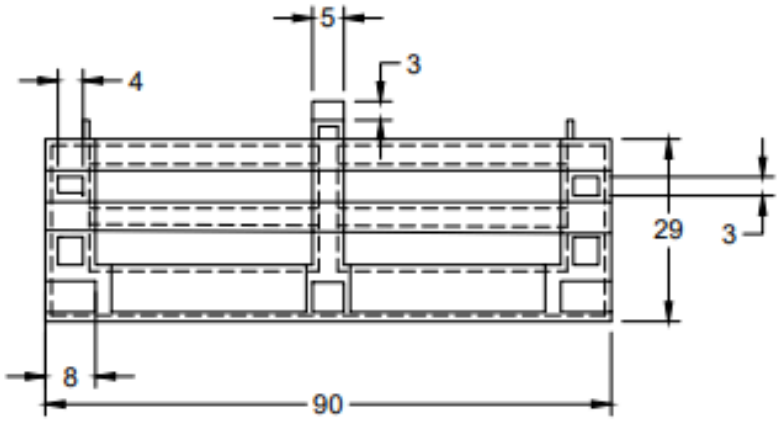
	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: TIRE RUBBER SAMI ALGHAMDI			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN: Sami Alghamdi 12/9/2024	SCALE: 1:1	WEIGHT	SHEET: 1/1	

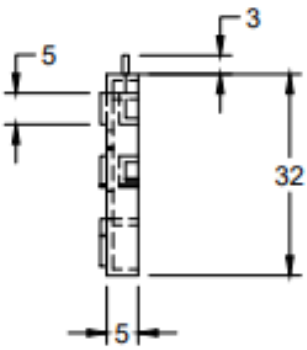


	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: TRAILER RIM			
	SAMI ALGHAMDI			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN: Sami Alghamdi 12/9/2024	SCALE: 2:1	WEIGHT	SHEET: 1/1	

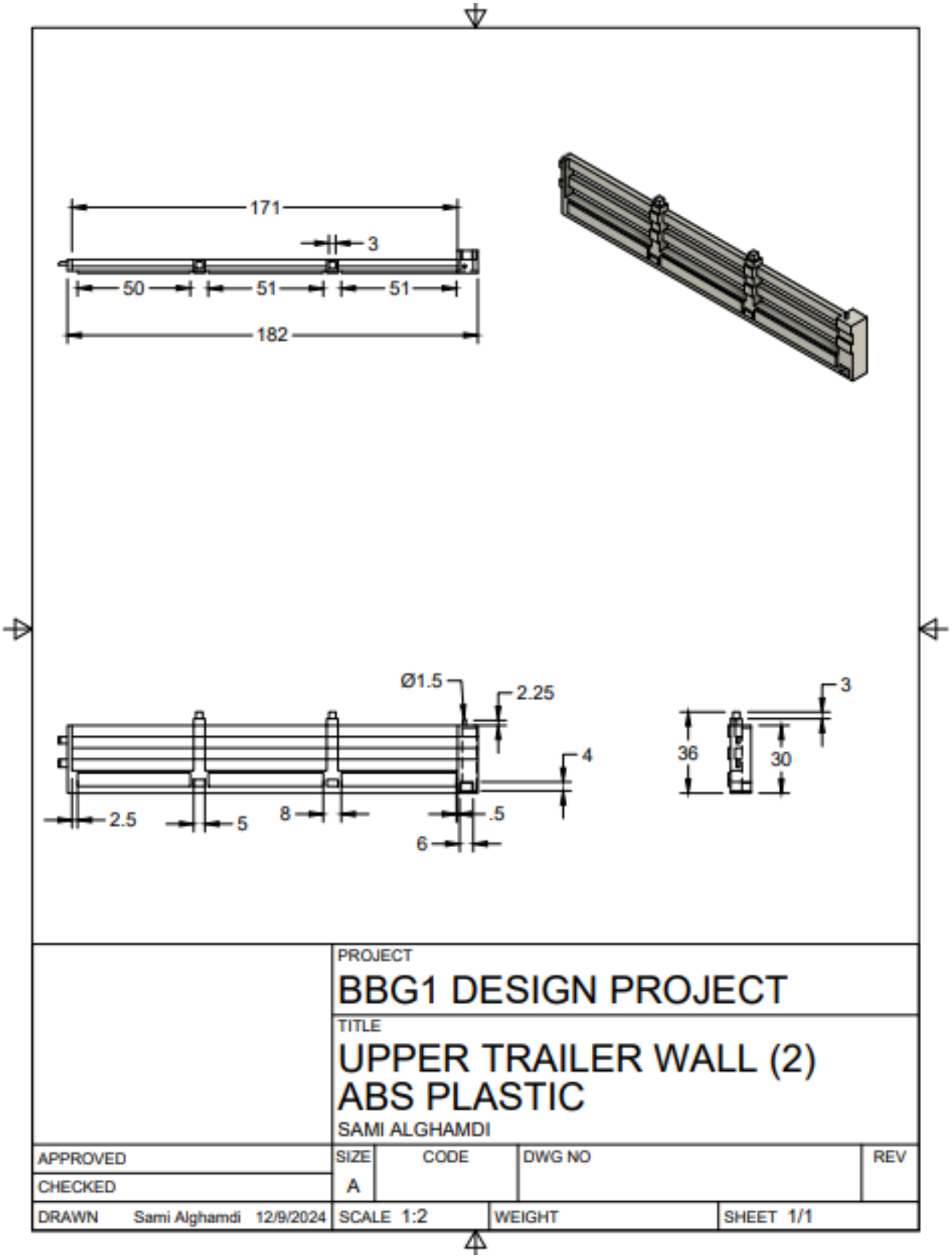




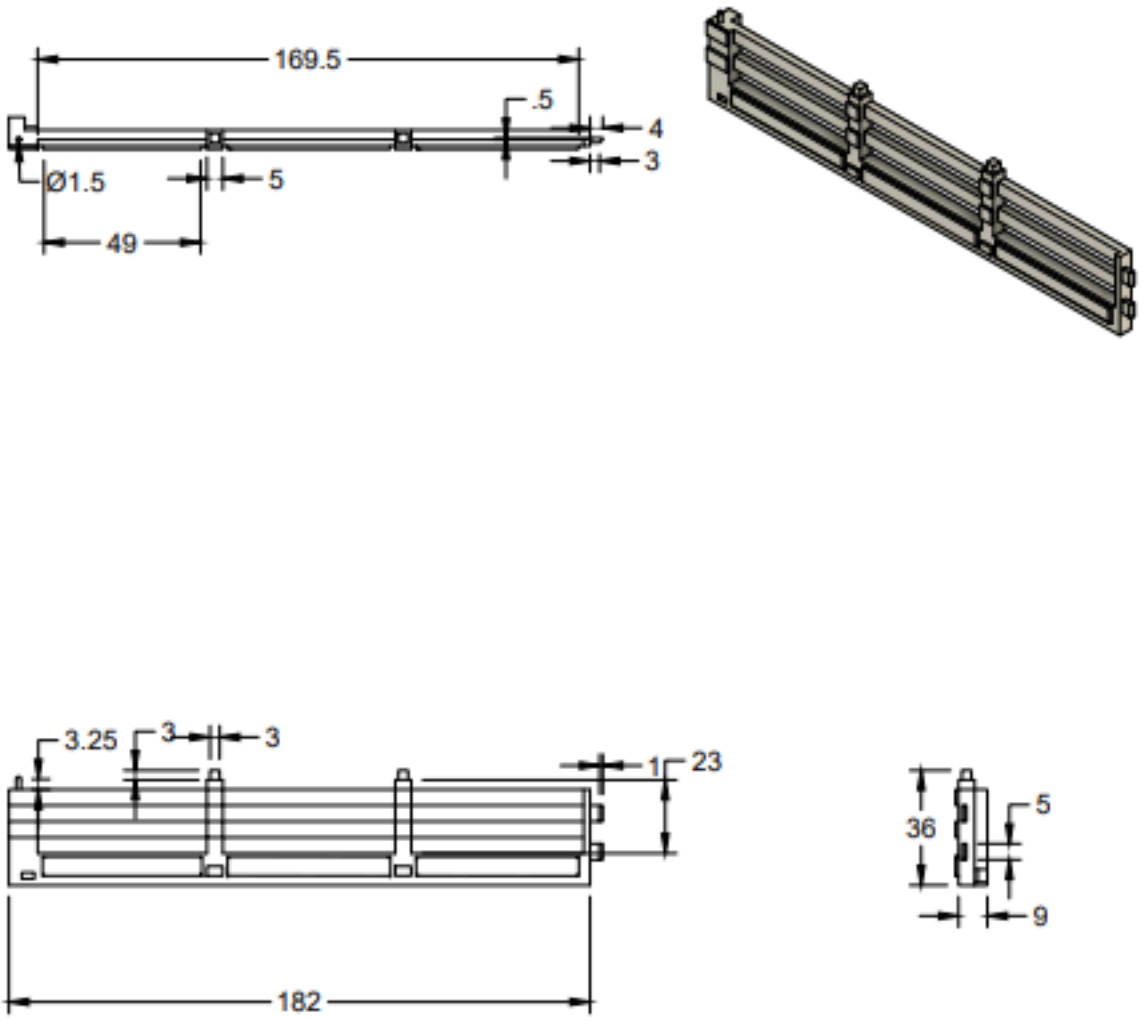




	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: TRAILER WALL (BACK ABS PLASTIC SAMI ALGHAMDI			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Sami Alghamdi 12/9/2024	SCALE 1:1	WEIGHT	SHEET 1/1	



	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: UPPER TRAILER WALL (2) ABS PLASTIC SAMI ALGHAMDI			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN Sami Alghamdi 12/9/2024	SCALE 1:2	WEIGHT	SHEET 1/1	



	PROJECT: BBG1 DESIGN PROJECT			
	TITLE: UPPER TRAILER WALL (1) ABS PLASTIC SAMI ALGHAMDI			
APPROVED	SIZE: A	CODE	DWG NO	REV
CHECKED				
DRAWN: Sami Alghamdi 12/9/2024	SCALE: 1:2	WEIGHT	SHEET: 1/1	

F Final Assembly