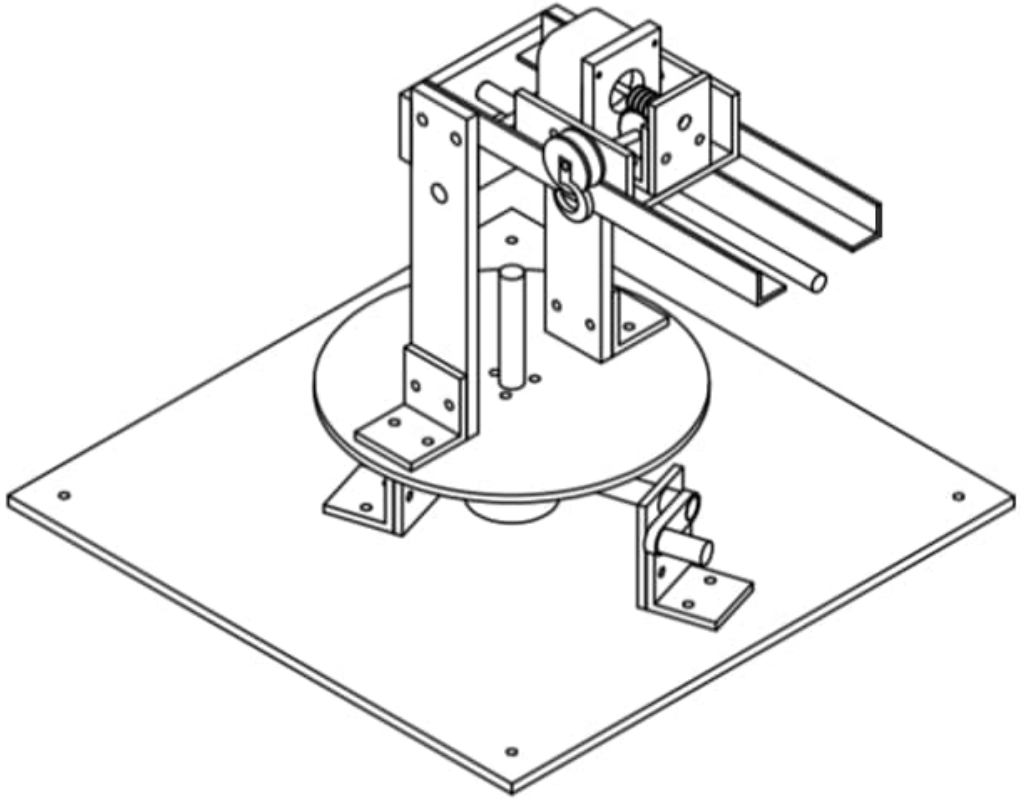


# ACKNOWLEDGEMENT

*"Every successful project has the complete effort of a number of people working continuously and effectively together."*

Keeping this in mind, we express our sincere gratitude towards our instructor, Dr. Mohit Law, for providing us with this opportunity to do this project and express our ideas more creatively and constructively.

We are also grateful to Mr. Kuldeep Vishwakarma, our project guide, whose guidance, encouragement, suggestions and constructive criticisms have contributed immensely in the shaping and completion of our project.

We would also like to extend our thanks to the Lab staff at the TA202 Lab for lending us a hand at various stages of the project. Their efforts are highly appreciated.

# MOTIVATION

As TA202 students, we are eager to get our hands on practical application of concepts and process we learn about in class in our group Project. The construction of this Tower Crane is an exciting opportunity for us to apply what we've learned because involves everything we were exposed to in first 5 labs.

We hope to gain hands-on experience in these processes through the project, which will help us understand the benefits and constraints of each method, as well as how they can be used in achieving specific goals. This hands on experience will be useful as we progress through our engineering studeis.

Furthermore, brainstorming the design for the tower crane will allow us to demonstrate our creativity as well as Knowledge of mechanics and gears while taking the constraints into account.

In a nutshell, this project will be a valuable leaning opportunity for us allowing us to gain practical experience in various process while also demonstrating our creativity and understanding of mechanical systems which will help us understand how these processes work in real life and how we can apply our knowledge to design.

# INTRODUCTION

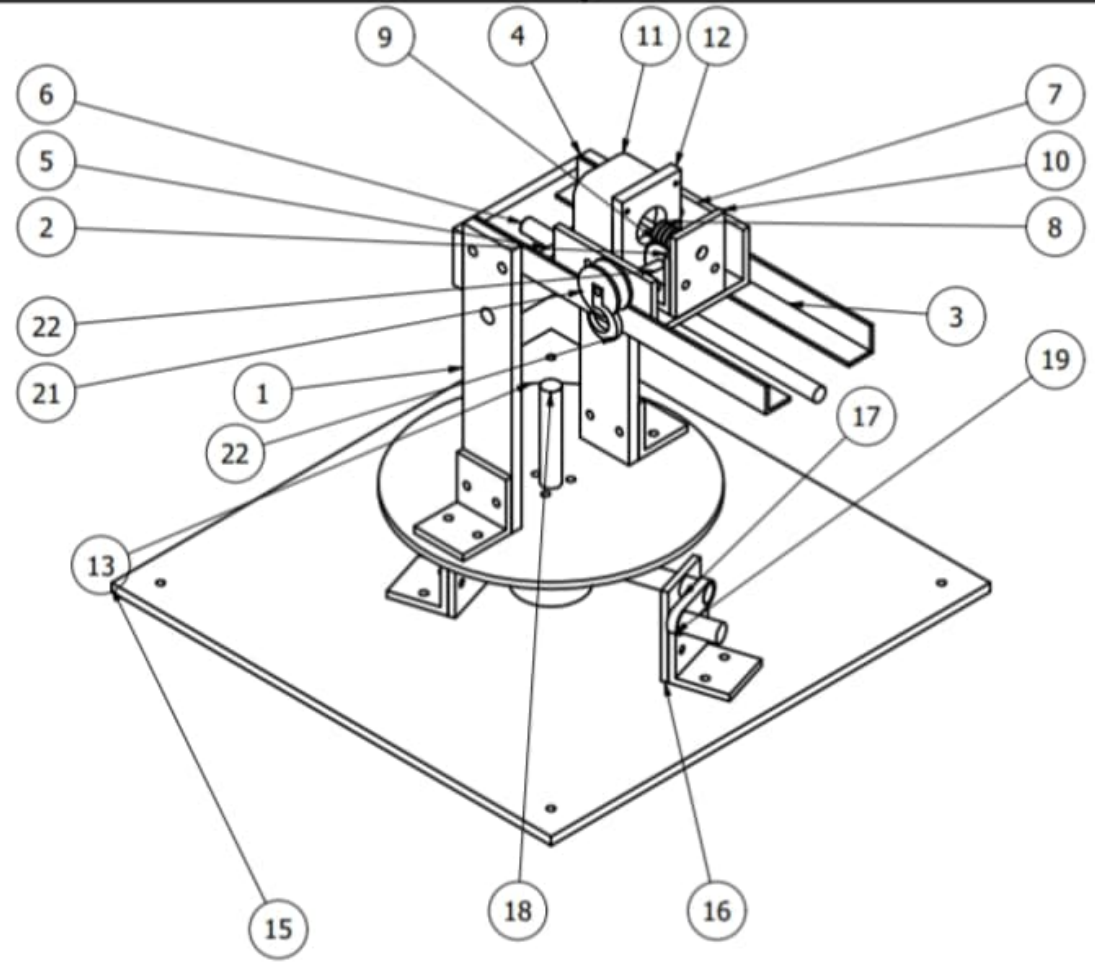
The Tower Crane is heavy equipment carefully designed to control and guide heavy equipment at heights. The word "Tower" is used in the name because it is tall and often installed on a tower-like structure, providing the crane with the necessary height to lift objects to great heights.

In this Project, we have made a working model of a Tower Crane and simplified some complex components to understand its working.

Our Project contains two vertical bars mounted on a circular disc which rotates using a worm and worm wheel mechanism allowing Tower Crane to whole circular movement.

The vertical bars are also connected to two support rods and a lead screw where a box slides in a radial direction allowing radial coverage to the crane.

The box contains a rope and a motor which can move up and down, allowing movement in the vertical direction. This component will help us to pick any load and move it in the vertical direction.




ISOMETRIC VIEW

| PARTS LIST | | | |
|---|---|---|---|
| ITEM NO. | QTY | PART NAME | DESCRIPTION |
| 1 | 2 | VerticalPlate | mild steel, Flat |
| 2 | 5 | L support | mild steel, Angle |
| 3 | 2 | Guide | mild steel, angle |
| 4 | 1 | Back Plate | mild steel, flat |
| 5 | 1 | Front Plate | mild steel, flat |
| 6 | 1 | Lead Screw | mild steel, threaded Mx16 |
| 7 | 1 | Flat Moving Base | mild steel, flat |
| 8 | 2 | Worm | mild steel |
| 9 | 2 | Worm Gear | mild steel |
| 10 | 1 | Worm Shaft Holder | mild steel, cylinder |
| 11 | 1 | Motor2 | provided |
| 12 | 1 | Motor Holder | 3D printed |
| 13 | 1 | Circular base | mild steel, flat circular |
| 14 | 1 | collor | mild steel, cylinder |
| 15 | 1 | base plate | mild steel, flat rectangle |
| 16 | 2 | vertical bar small | mild steel, flat |
| 17 | 1 | main shaft | mild steel,dylinderical rod |
| 18 | 1 | wormShaft | mild steel, cylindircal rod |
| 19 | 1 | handle | mild steel, flat |
| 20 | 1 | pulley shaft | mild steel, cylindrical rod |
| 21 | 1 | pulley | mild steel |
| 22 | 1 | hook | mild steel |

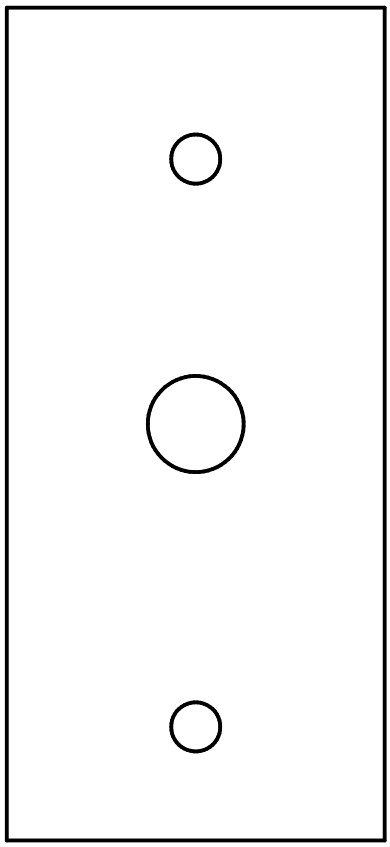
# Project Overview

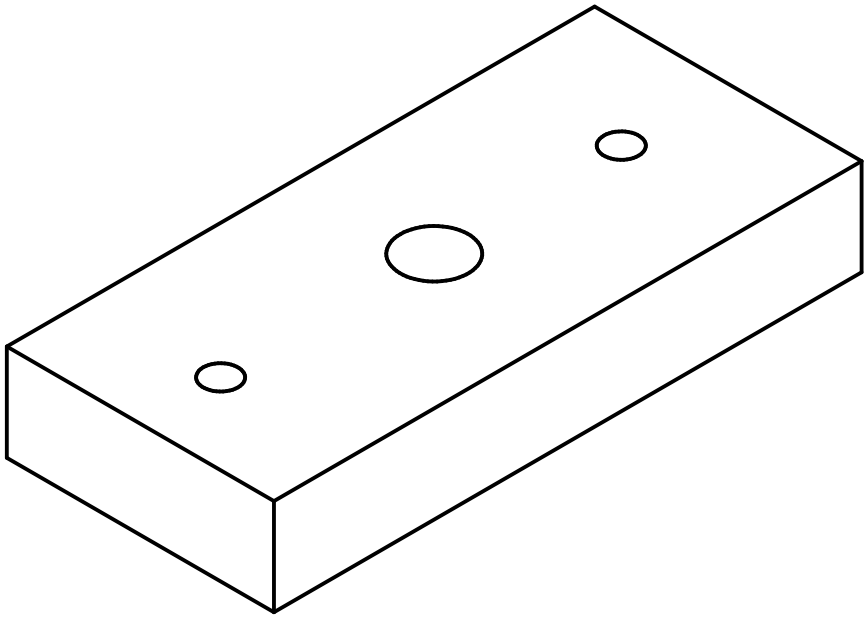
The objective of this college project is to create a working model of a Tower Crane by designing and assembling a mechanism that can control and guide heavy equipment at heights. The aim is to simplify some complex components of the Tower Crane to understand its working and demonstrate its ability to lift objects to great heights through a model that replicates its functions.

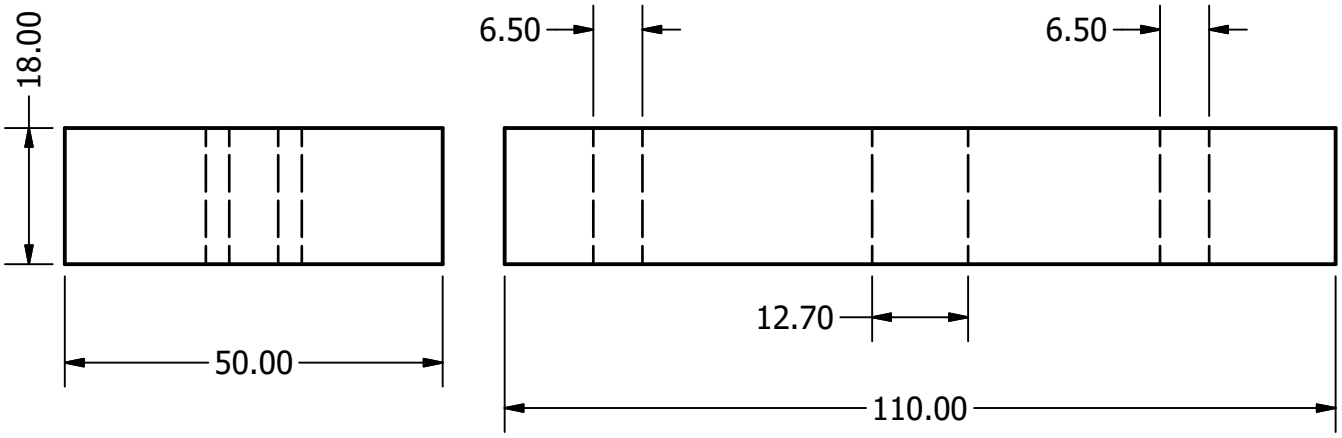
In this project we modified and manufactured around 30 parts.

On analyzing we found that total cost of our project is ₹ 23,495.87.

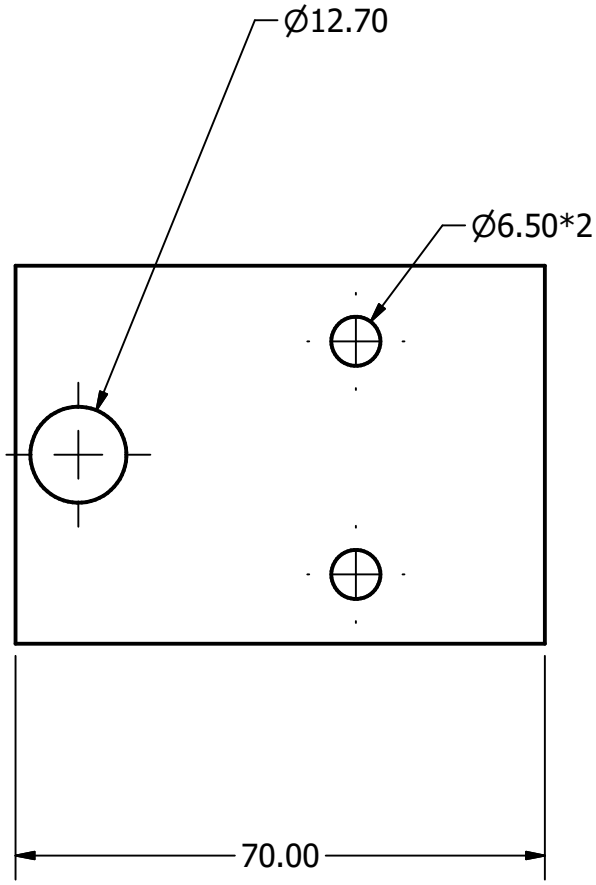
We could have used a motor instead of handle to drive the lower worm wheel and the two motors placed on the guide could be controlled by a remote control as an alternative to Arduino.

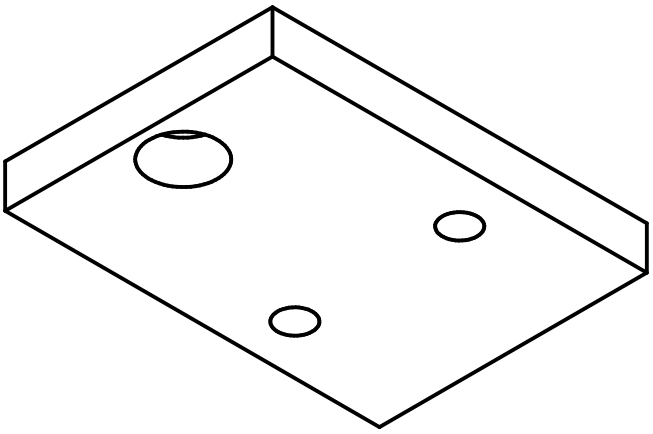


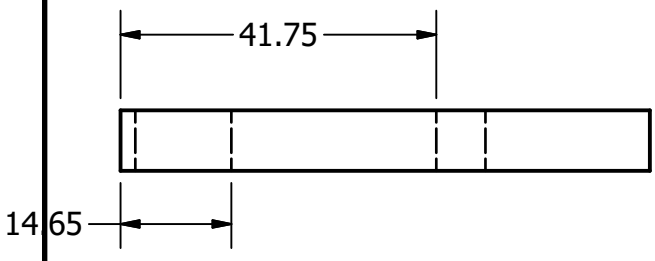


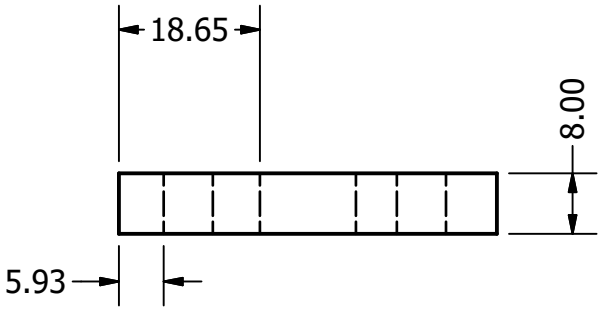



| | | |
|---|---|---|
| PART NO. 13 | QTY: 1 | SCALE.1:1 |
| PART NAME . WOOD | | UNITS : ALL DIMENSIONS ARE IN MM |
| DESCRIPTION. FLAT 110*58*18 mm | | TOLERANCE:±1mm |
| MATERIAL: WOOD | | MADE BY: ANANT KUMAR |

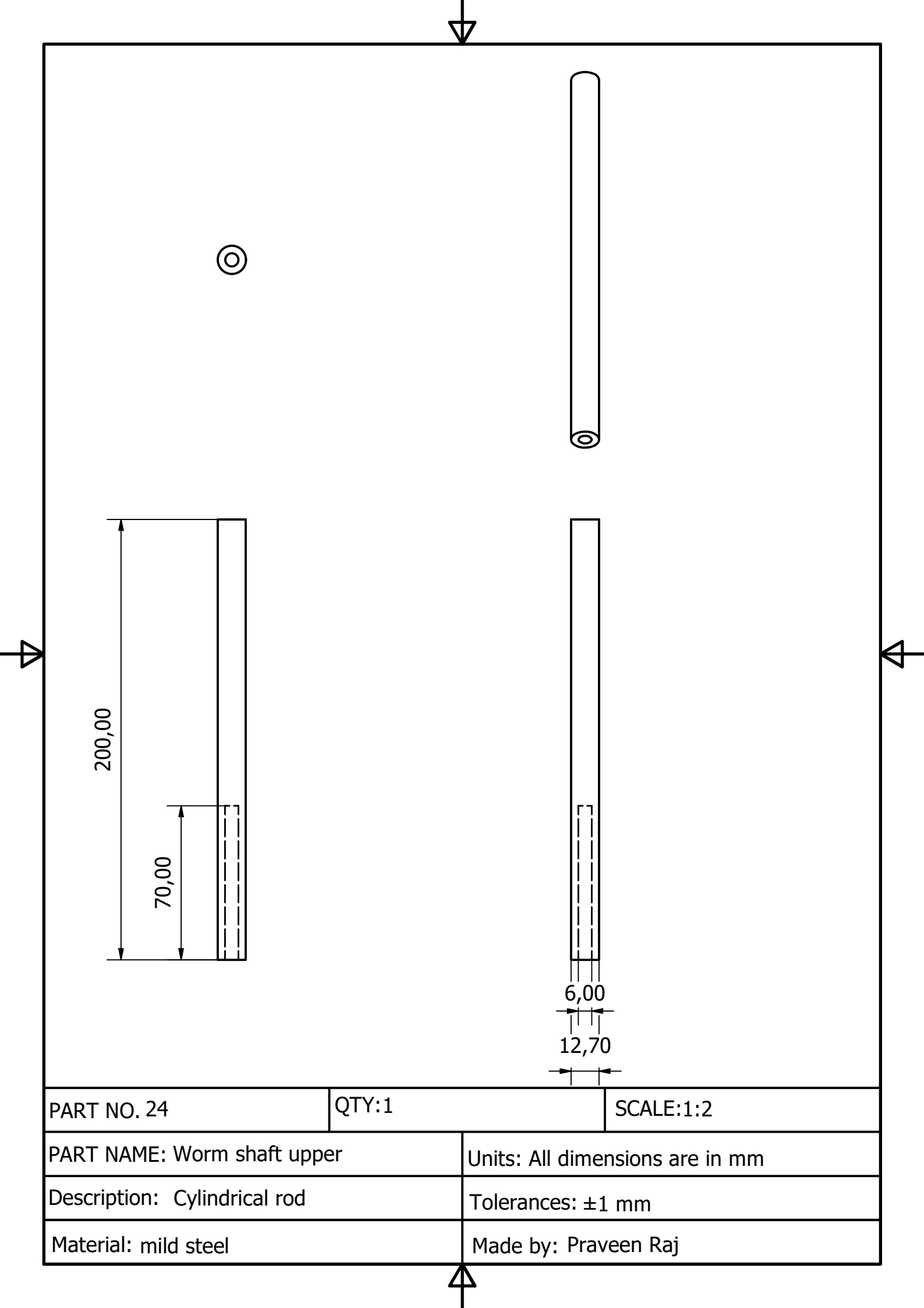


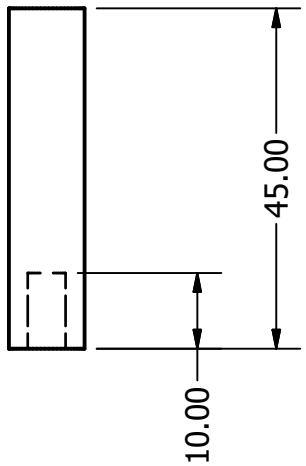


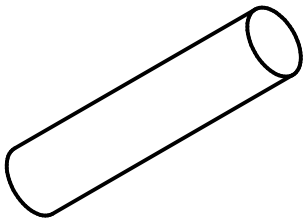



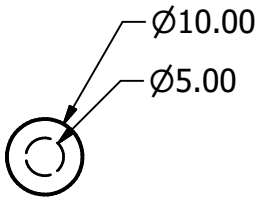

| | | |
|---|---|---|
| PART NO. 10 | QTY: 1 | SCALE: 1:1 |
| PART NAME: WORM SHAFT HOLDER | Units: All dimensions are in mm | |
| Description: CYLINDER | Tolerances: ±1MM | |
| Material: MILD STEEL | Made by: PUSHPENDRA | |




| | | |
|---|---|---|
| PART NO. 24 | QTY:1 | SCALE:1:2 |
| PART NAME: Worm shaft upper | | Units: All dimensions are in mm |
| Description: Cylindrical rod | | Tolerances: ±1 mm |
| Material: mild steel | | Made by: Praveen Raj |

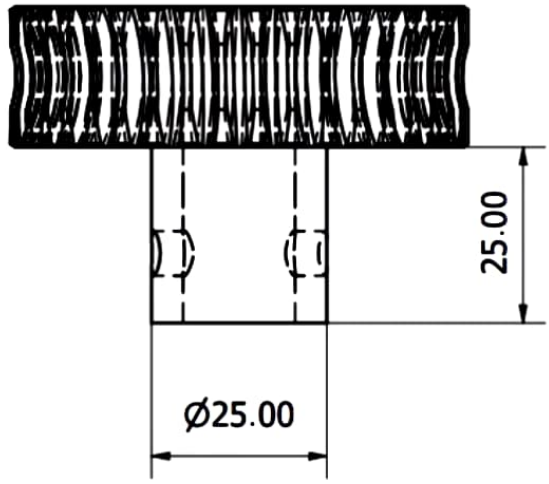


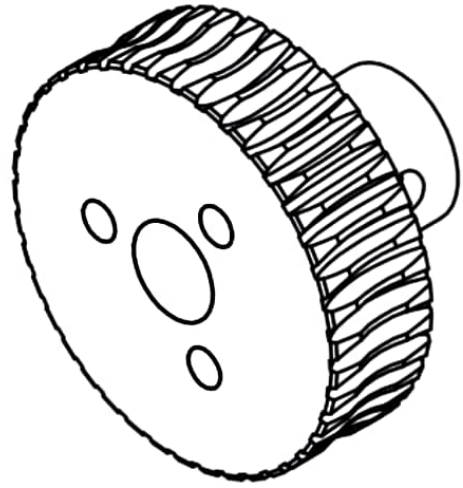



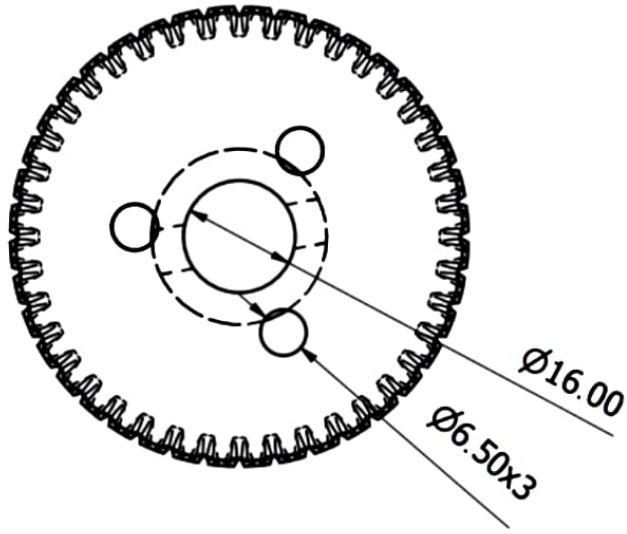


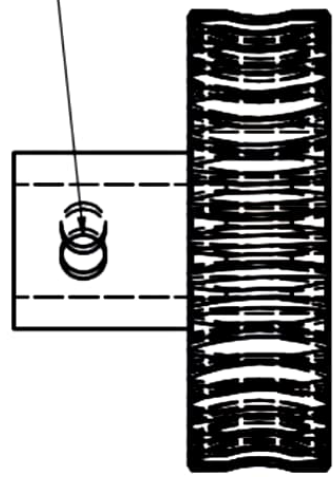

| | | | | | |
|---|---|---|---|---|---|
| PART NO. | 18 | QTY: | 1 | SCALE: | 1:1 |
| PART NAME: | WORM SHAFT | Units: All dimensions are in mm | | | |
| Description: | CYLINDRICAL ROD | Tolerances: | ±1MM | | |
| Material: | MILD STEEL | Made by: | LAVANSHU | | |

| PART NAME | QUANTITY | MATERIAL USED | MANUFACTURED/ BROUGHT | MACHINING PROCESS |
|---|---|---|---|---|
| Vertical Plate | 2 | Mild Steel | Manufactured | Cutting, Drilling, Filing |
| L Support | 4 | Mild Steel | Manufactured | Cutting, Drilling, Filing |
| Collar | 1 | Mild Steel | Manufactured | Boring, Extrusion |
| Back Plate | 2 | Mild Steel | Manufactured | Cutting, Filing, Drilling |
| Front Plate | 1 | Mild Steel | Manufactured | Drilling, Cutting, Filing |
| Lead Screw | 1 | Mild Steel | Manufactured | Turning, Drilling, Sandpapering |
| Flat Moving Box | 1 | Mild Steel | Manufactured | Cutting, Welding, Drilling |
| Worm and Worm Wheel (BIG) | 1 | Mild Steel | Manufactured | Cutting, Turning, Drilling, Milling, Filing |
| Worm and Worm Wheel (SMALL) | 1 | Mild Steel | Manufactured | Cutting, Turning, Drilling, Milling, Filing |
| Motor-1 | 1 | | Brought | |
| Motor-2 | 1 | | Brought | |
| Motor Holder-1 | 1 | Poly Lactic Acid (PLA) | Manufactured | 3D Printing |
| Motor Holder-2 | 1 | Poly Lactic Acid (PLA) | Manufactured | 3D Printing |
| Circular Base | 1 | Mild Steel | Manufactured | Drilling |
| Angular Guide | 1 | Mild Steel | Manufactured | Cutting, Drilling |
| Base Plate | 1 | Mild Steel | Manufactured | Drilling, Sandpapering |
| Vertical bar Small | 2 | Mild Steel | Manufactured | Cutting, Filing, Drilling |
| Main Shaft | 1 | Mild Steel | Manufactured | Cutting, Extrusion, Filing |
| Worm Shaft | 2 | Mild Steel | Manufactured | Cutting, Extrusion, Filing |
| Handle | 1 | Mild Steel | Manufactured | (Recycled) |
| Hook | 1 | Mild Steel | Manufactured | Cutting, Folding |
| Roller | 2 | Mild Steel | Manufactured | Drilling, Extrusion, Filing |
| Wooden Block | 1 | Mild Steel | Manufactured | Cutting |
| Base Screw | 4 | Mild Steel | Collected | (Recycled) |
| Nuts | 2 | Mild Steel | Collected | (Recylced) |





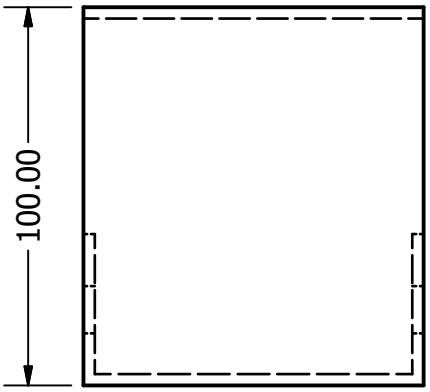



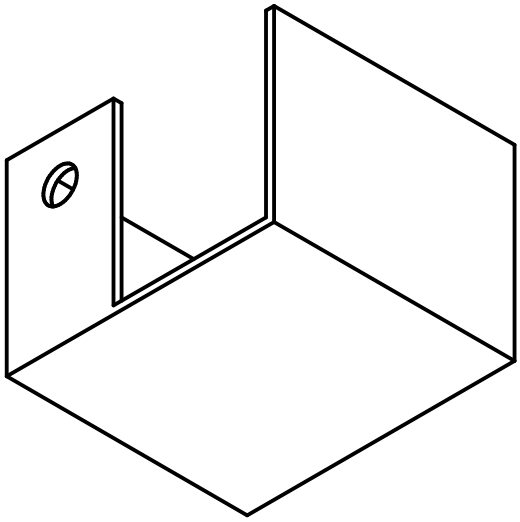

| | | |
|---|---|---|
| PART NO. | QTY: 1 | SCALE: |
| PART NAME: WORM AND WORM GEAR | Units: All dimensions are in mm | |
| Description: | Tolerances: +-1 mm | |
| Material: MILD STEEL | Made by: HIMANSHU YADAV | |

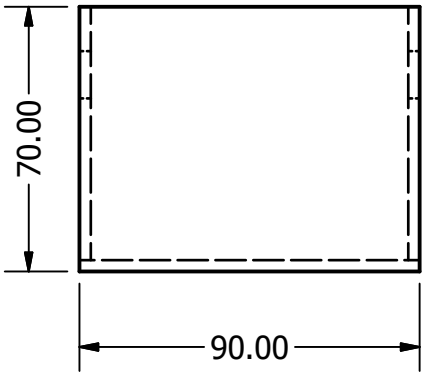
# GEAR CALCULATIONS

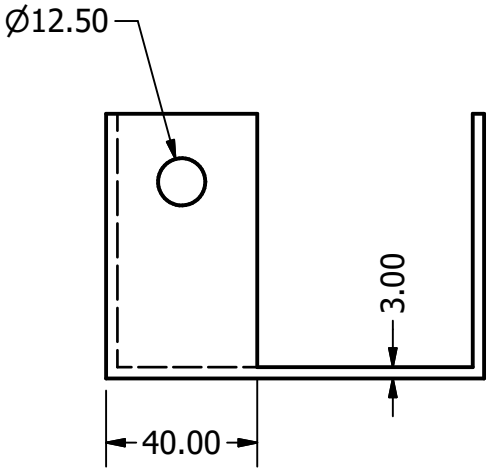
## (a) Worm and Worm Wheel - 01

| | | |
|---|---|---|
| Module | m | 1.5 |
| Number Of Teeth | N | 40 |
| Pitch of the Single Start Worm | $p_1$ | 4.7 mm |
| Outside Diameter of Worm | $d_1$ | 22 mm |
| Ratio Of Worm and Worm Wheel | | 40:1 |
| Face Ange | $\Theta$ | 60 ˚ |
| Lead Of Worm | $p_{1}$*No. of start | 4.7 |
| Appendum of Worm (a) | 0.3183*Pitch | 1.496 mm |
| Pitch Diameter of the Worm (d) | $d_o$-2a | 19.008 mm |
| Depth of Worm Tooth ($h_t$) | 0.6866*pitch | 3.227 mm |
| Root Diameter of Worm ($d_r$) | $d_o$-2 $h_t$ | 15.546 mm |
| Pitch Diameter of the Wheel (D) | (N+P)/π | 59.842 mm |
| Centre distance between Worm and Worm Wheel | (D+d)/2 | 39.451 mm |
| Throat Diameter of the Wheel ($D_o$) | D+2a | 62.834 mm |
| Throat radius of the Worm Wheel (r) | $d_o$/2-2a | 8.008 mm |
| Diameter of the Wheel over sharp Corners ($D_o$') | 2r(1-cos(Θ/2)) | 64.980 mm |
| Face Width of the Wheel | 2.38p + 6.35 | 17.536 mm |
| Helix Angle of the Worm ($\alpha_h$) | tan($\alpha_h$) = πd/lead | tan($\alpha_h$) =12.7054 $\alpha_h$ = 85.30˚ |
| Gashing Angle of Worm Wheel ($\alpha_g$) | $\alpha_g$ = 90- $\alpha_h$ | 4.30 ˚ |

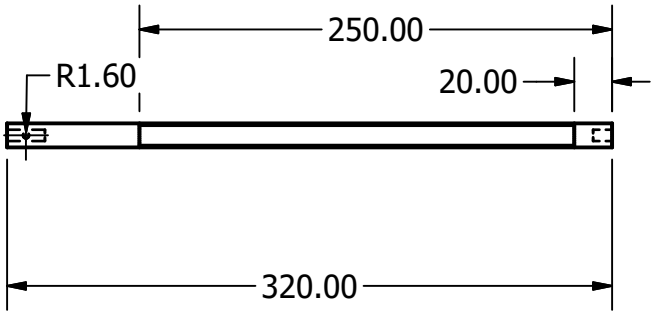


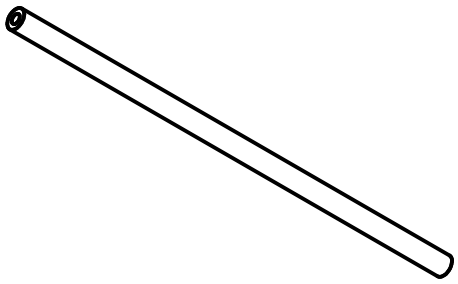



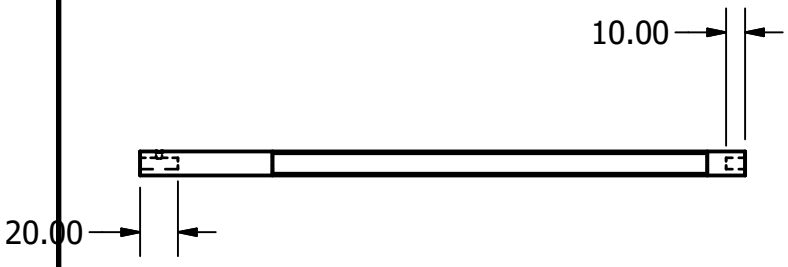


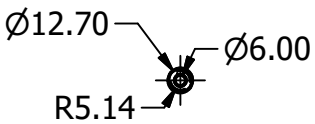




| | | |
|---|---|---|
| PART NO. 7 | QTY: 1 | SCALE: 1:2 |
| PART NAME: SLIDING BOX | Units: All dimensions are in mm | |
| Description: FLAT | Tolerances: +-1 mm | |
| Material: MILD STEEL | Made by: ANANT KUMAR | |

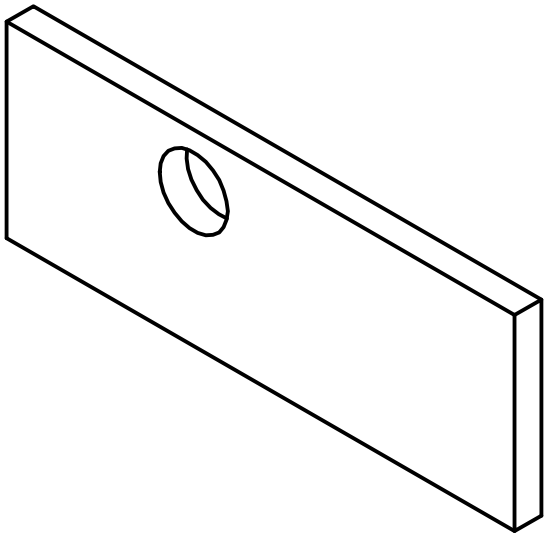


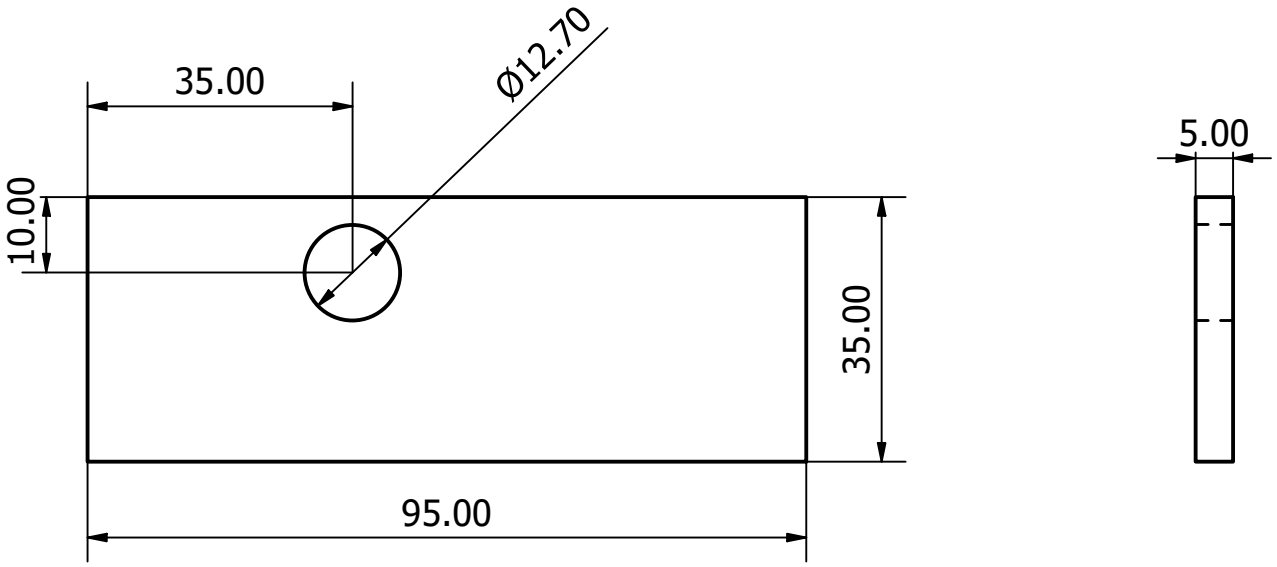





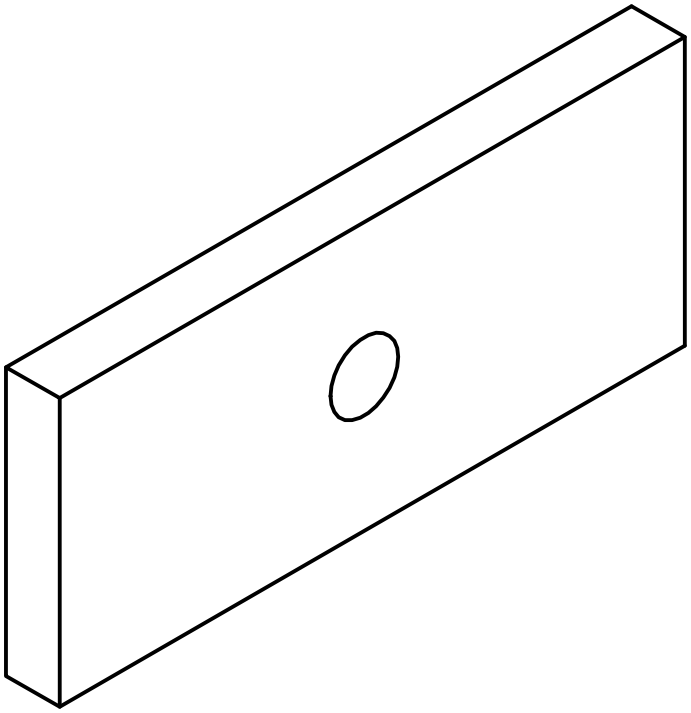



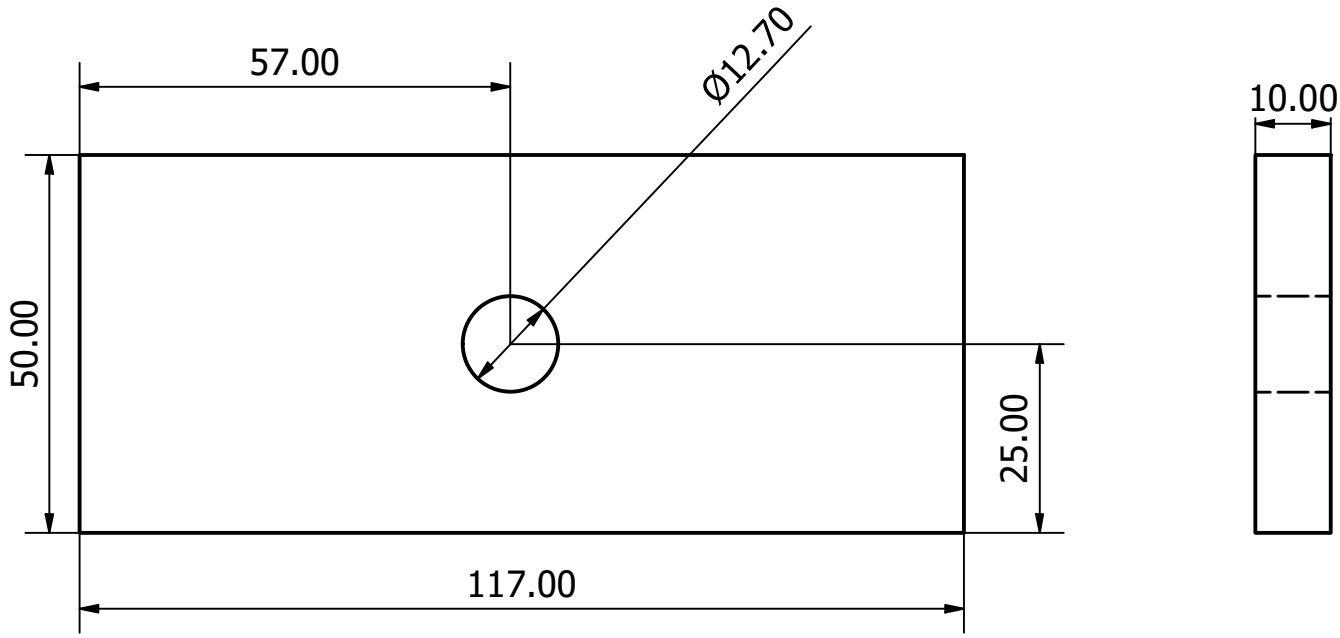

| | | |
|---|---|---|
| PART NO. 6 | QTY: 1 | SCALE: 1:4 |
| PART NAME: LEAD SCREW | | Units: All dimensions are in mm |
| Description: THREADED M16*2 | | Tolerances: ±1MM |
| Material: MILD STEEL | | Made by: HEMANT KUMAR |



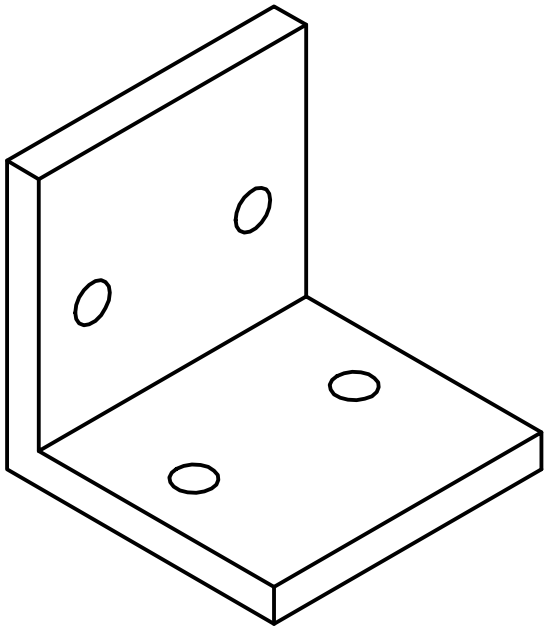


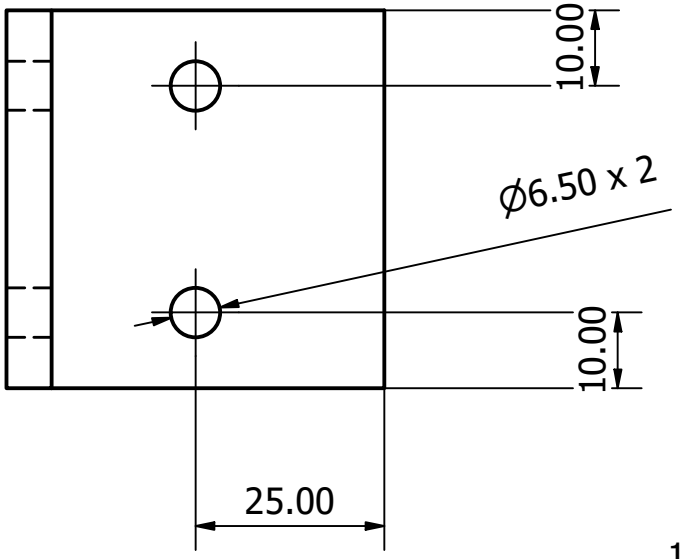

| | | |
|---|---|---|
| PART NO. 05 | QTY: 1 | SCALE: 1:1 |
| PART NAME: Front Plate | Units: All dimensions are in mm | |
| Description: Flat 95x35x5 mm | Tolerances: ±1 mm | |
| Material: Mild Steel | Made by: Mukesh Nath | |

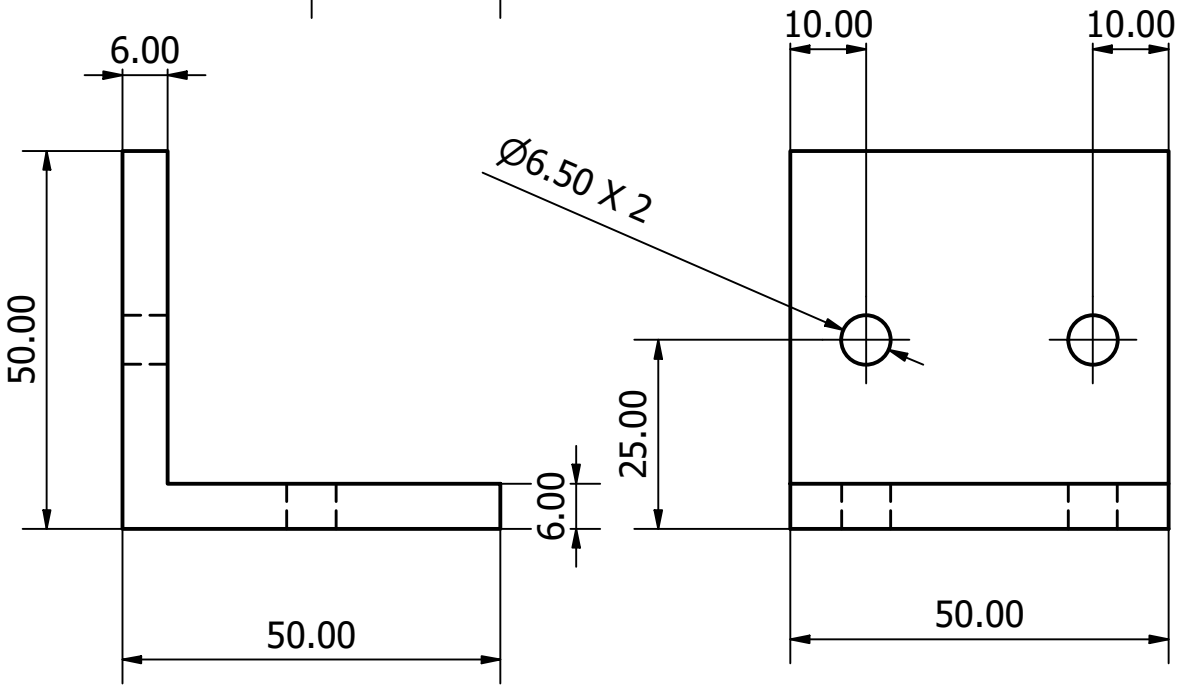




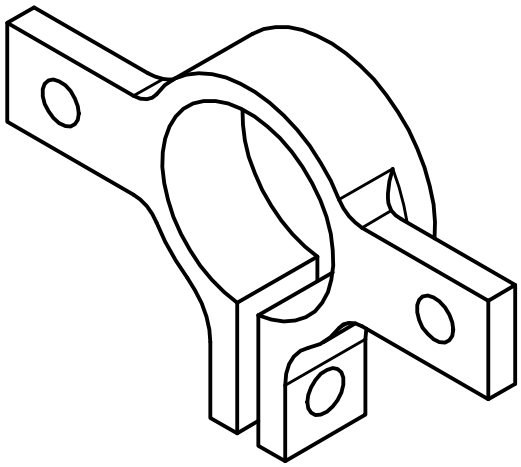

| | | |
|---|---|---|
| PART NO. 04 | QTY: 2 | SCALE: 1:1 |
| PART NAME: Back Plate | Units: All dimensions are in mm | |
| Description: Flat 117x50x10 mm | Tolerances: ±1 mm | |
| Material: Mild Steel | Made by: Mukesh Nath | |

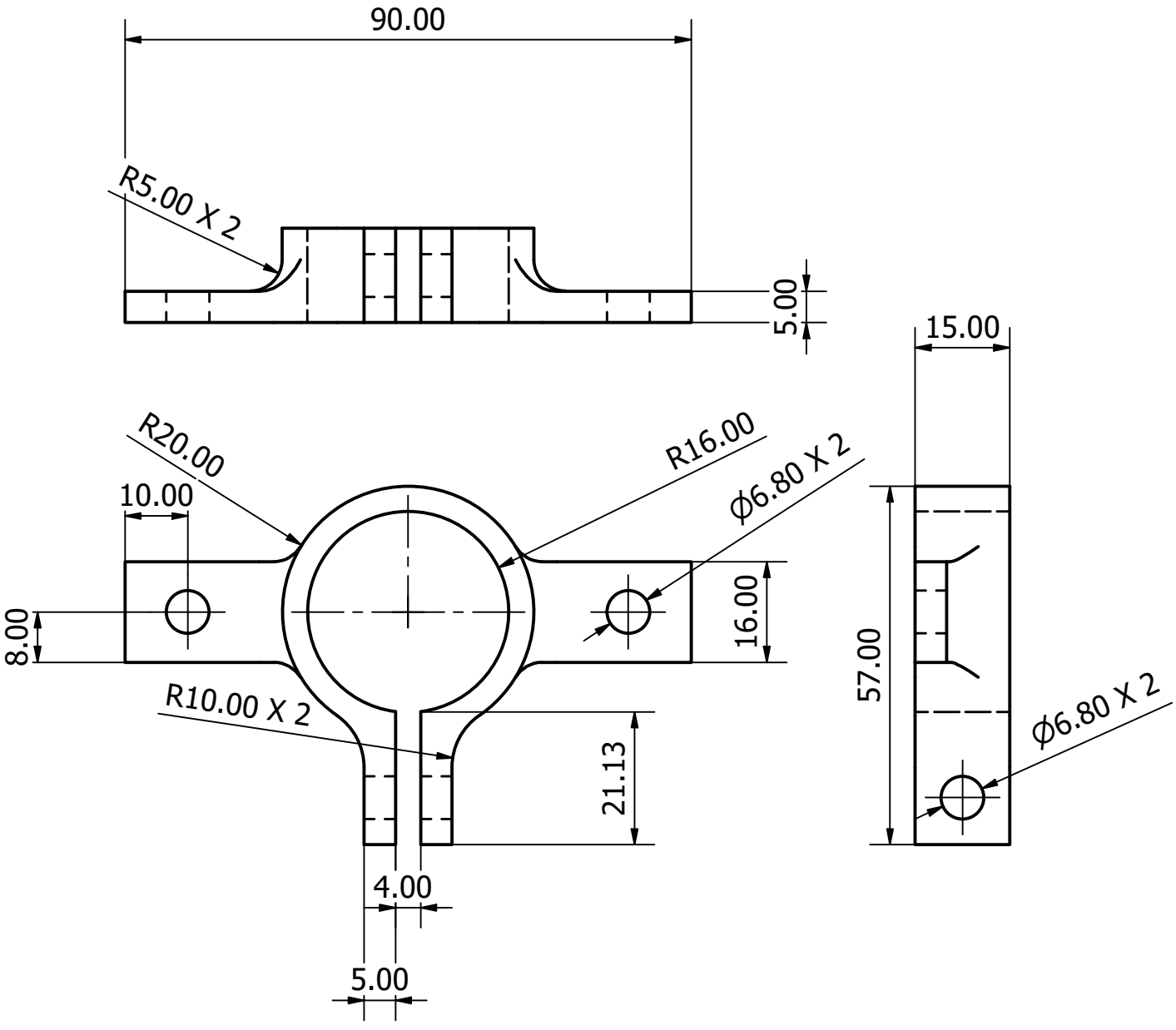




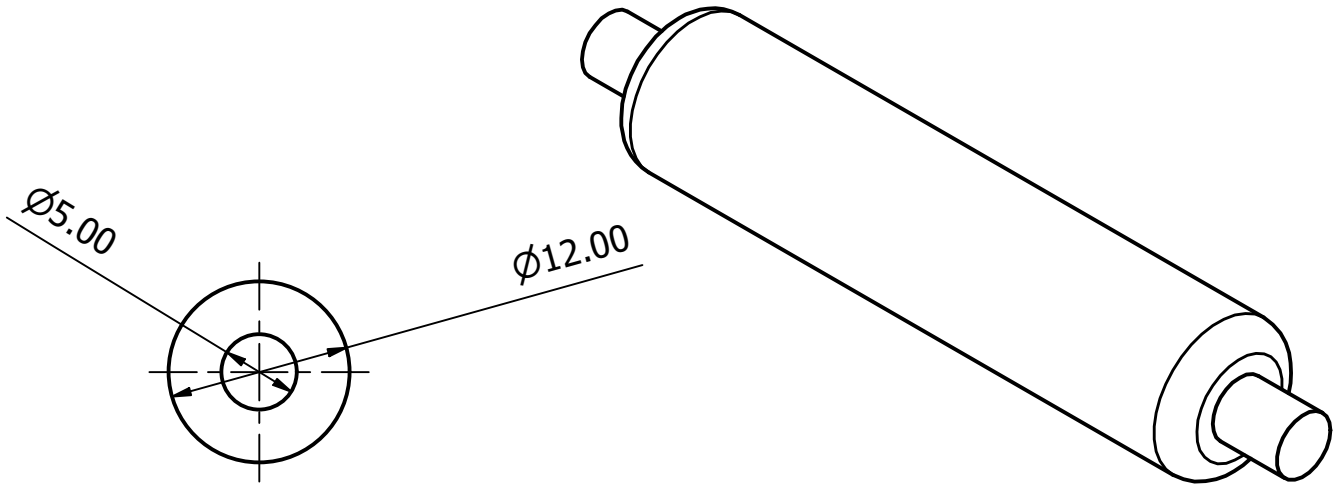



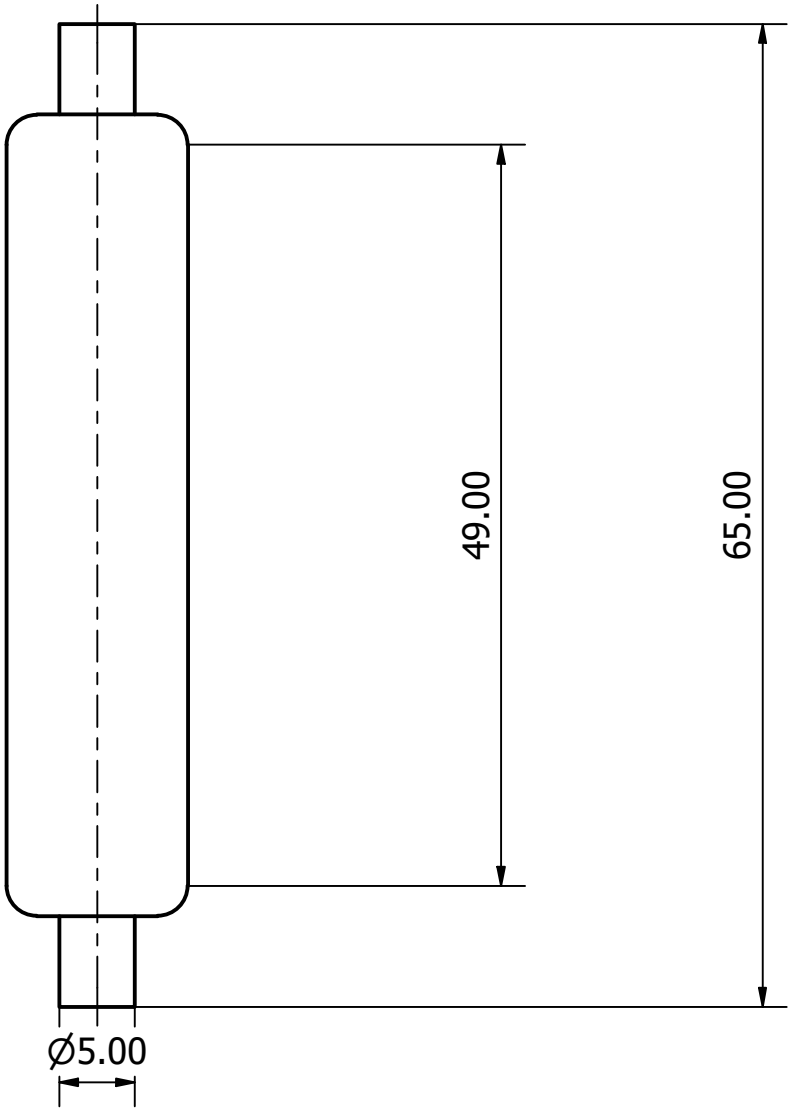

| | | |
|---|---|---|
| PART NO. 2 | QTY: 4 | SCALE: 1:1 |
| PART NAME: L-SUPPORT | Units: All dimensions are in mm | |
| Description: | Tolerances: | |
| Material: MILD STEEL | Made by: GAURAV KATARIA | |



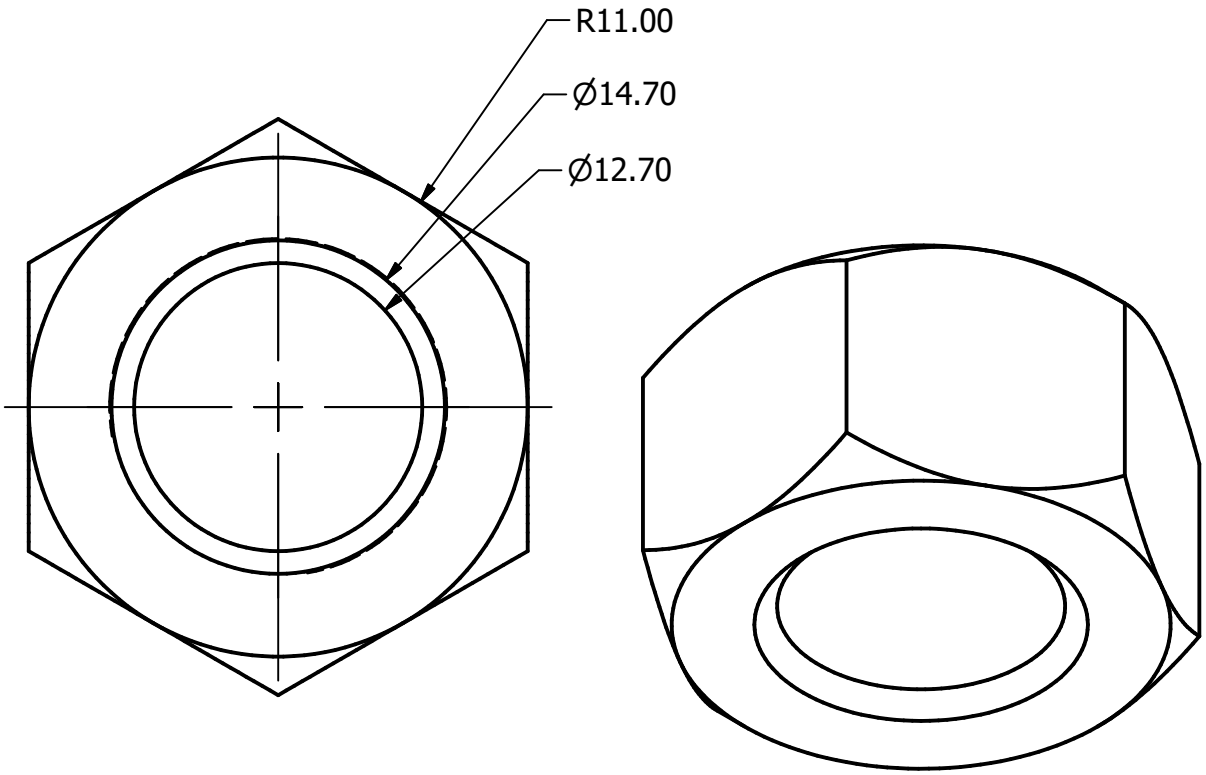


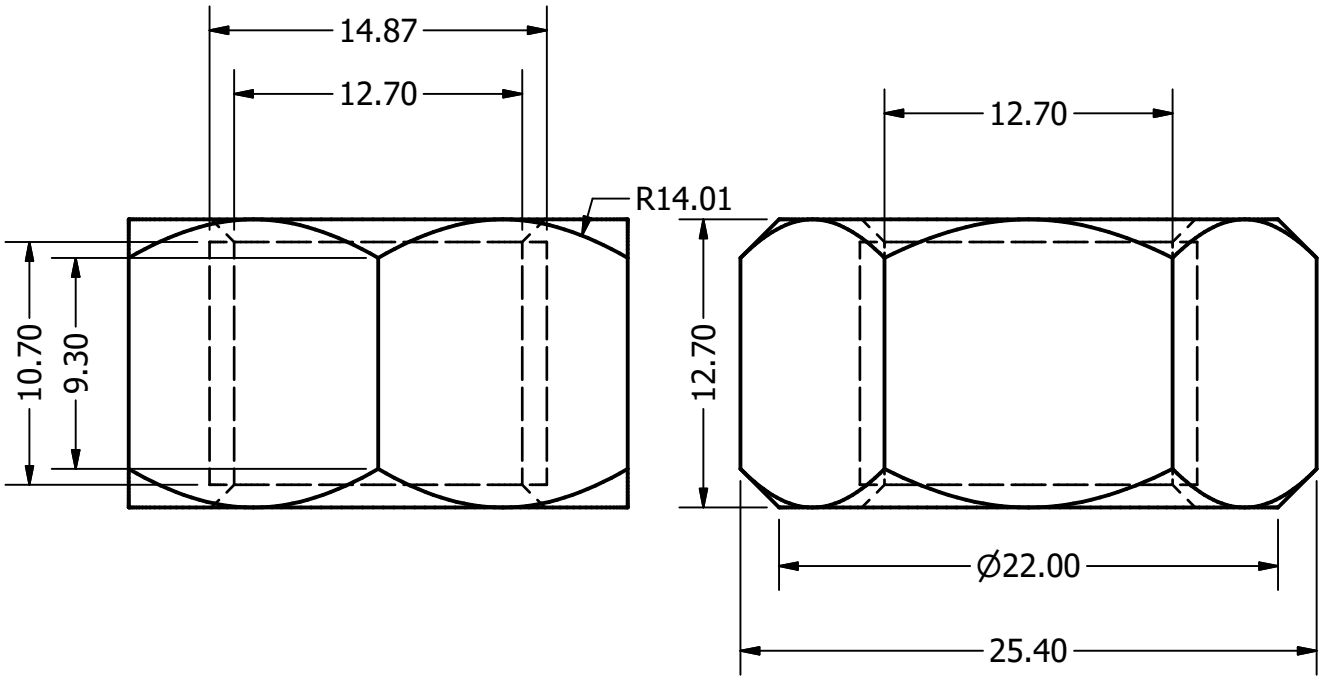

| | | |
|---|---|---|
| PART NO. 24 | QTY: 1 | SCALE: 1:1 |
| PART NAME: MOTOR CLAMP-SMALL | Units: All dimensions are in mm | |
| Description: | Tolerances: | |
| Material: 3D PRINTED-PS | Made by: GAURAV KATARIA | |



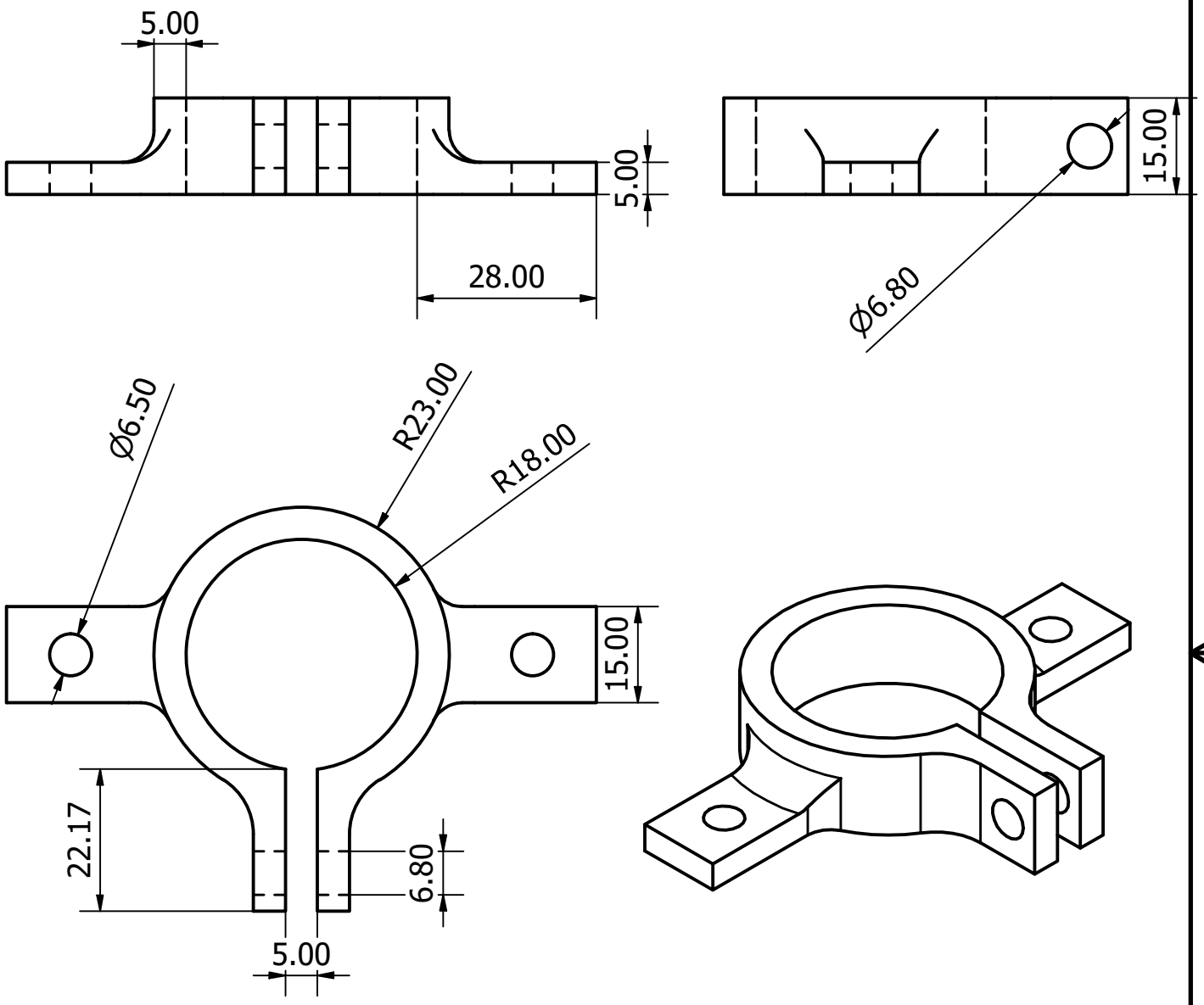




| | | |
|---|---|---|
| PART NO. 23 | QTY: 2 | SCALE: 2:1 |
| PART NAME: ROLLER | Units: All dimensions are in mm | |
| Description: | Tolerances: | |
| Material: MILD STEEL | Made by: MADHAV KUMAR | |

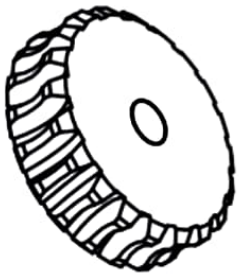


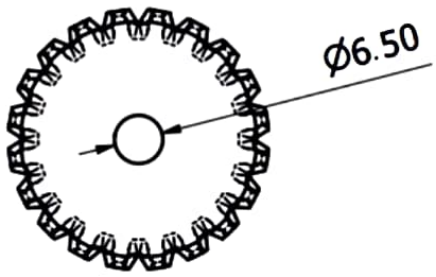




| | | |
|---|---|---|
| PART NO. 23 | QTY: 1 | SCALE: 1:3 |
| PART NAME: NUT | | Units: All dimensions are in mm |
| Description: NUT M16 | | Tolerances: ±1MM |
| Material: MILD STEEL | | Made by: HEMANT KUMAR |

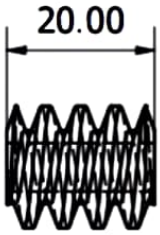


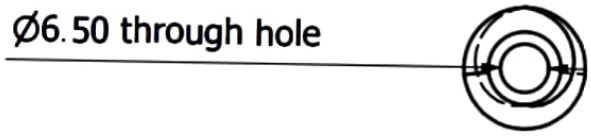

| | | |
|---|---|---|
| PART NO.:23 | QTY:1 | SCALE: 1:1 |
| PART NAME: MOTOR CLAMP | Units: All dimensions are in mm | |
| Description: Circular Ø36 | Tolerances: ± 1mm | |
| Material: 3D- PRINTED-PS | Made by: Shefali Murmu | |



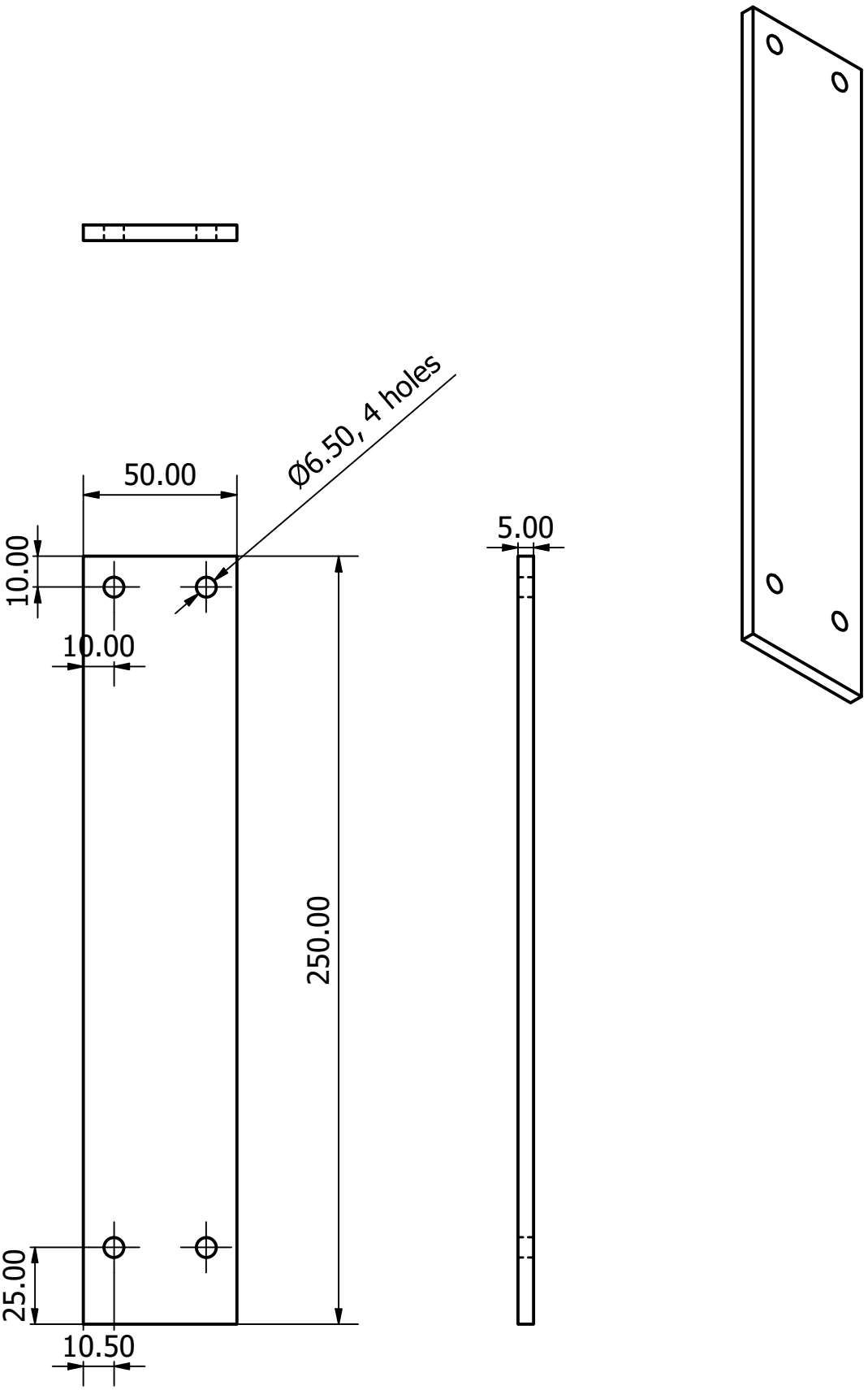




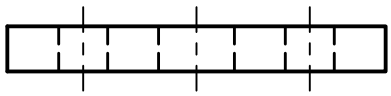


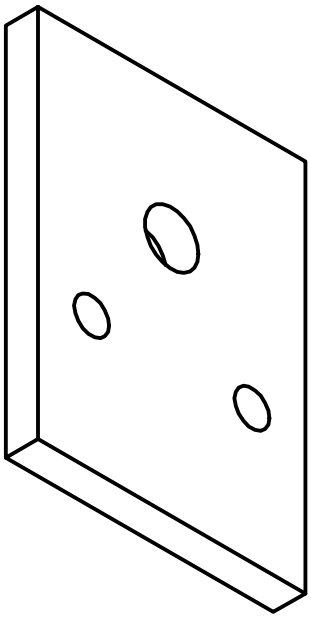



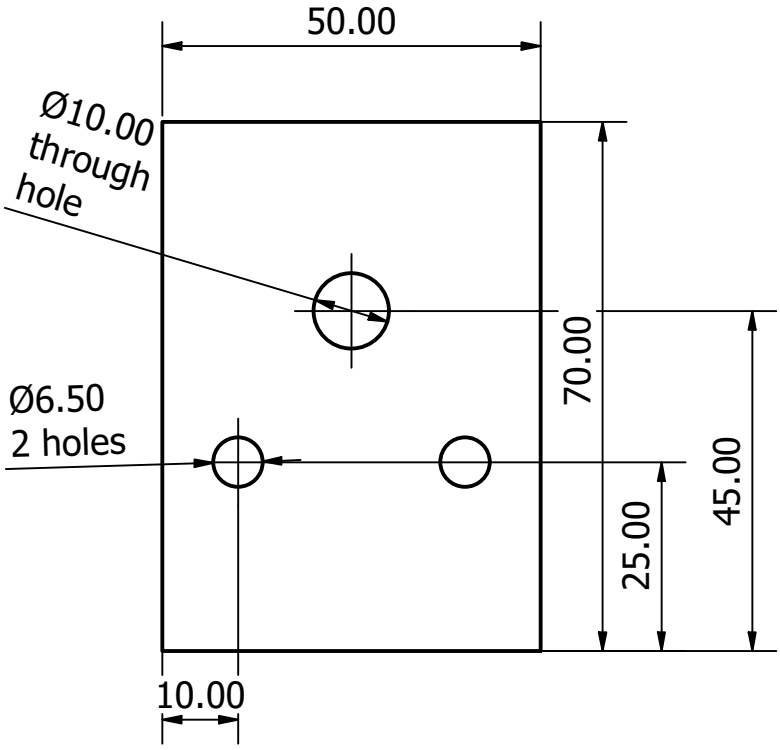

| | | |
|---|---|---|
| PART NO. | QTY: 1 | SCALE: |
| PART NAME: WORM AND WORM GEAR | Units: All dimensions are in mm | |
| Description: | Tolerances: ± 1mm | |
| Material: MILD STEEL | Made by: MADHAV KUMAR | |

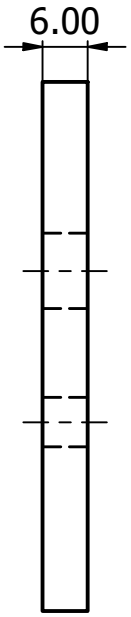



| | | |
|---|---|---|
| PART NO: 1 | QTY: 2 | SCALE: 1:2 |
| PART NAME: Vertical Plate | Units: All dimensions are in mm | |
| Description: Flat 50x250x5 | Tolerances: ±1mm | |
| Material: Mild Steel | Made by: Himanshu Yadav | |

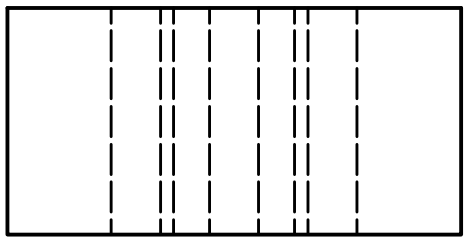


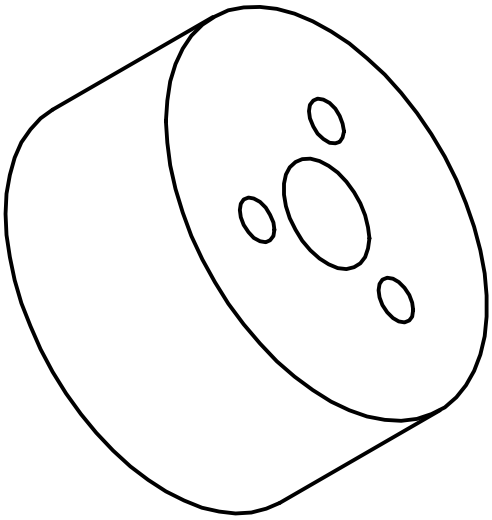


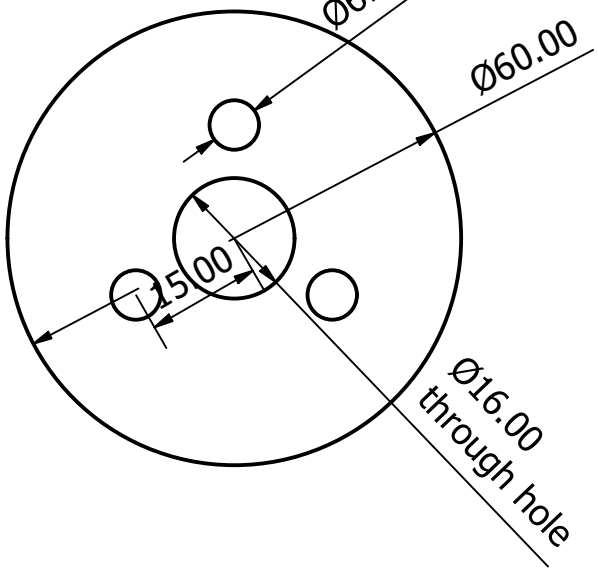


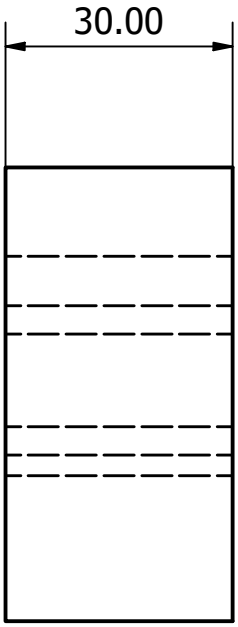




| | | |
|---|---|---|
| PART NO: 16 | QTY: 2 | SCALE: 1:1 |
| PART NAME: Lower Vertical Bar | Units: All dimensions are in mm | |
| Description: Flat | Tolerances: ±1mm | |
| Material: Mild Steel | Made by: Aniruddh Kushwah | |

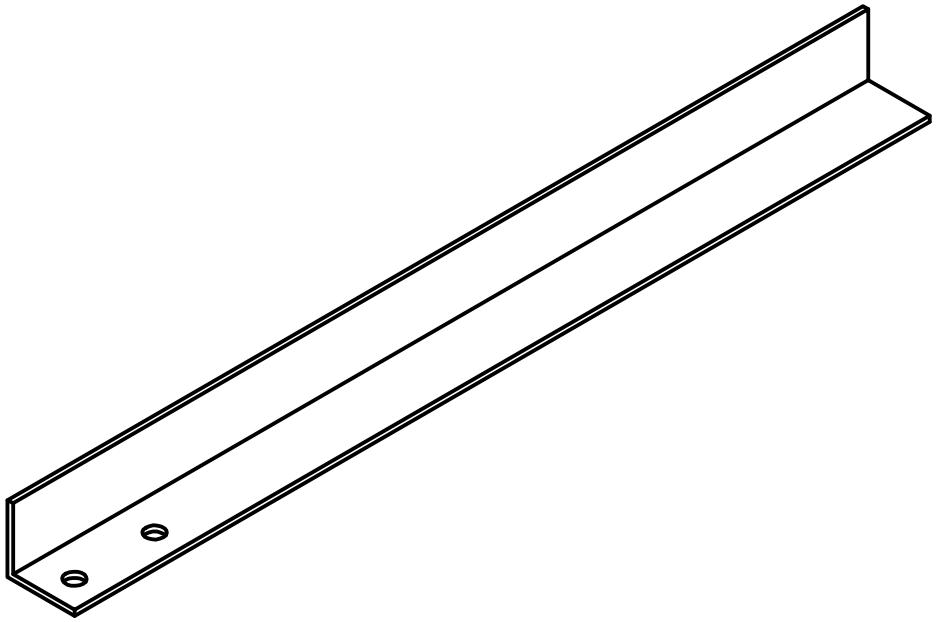






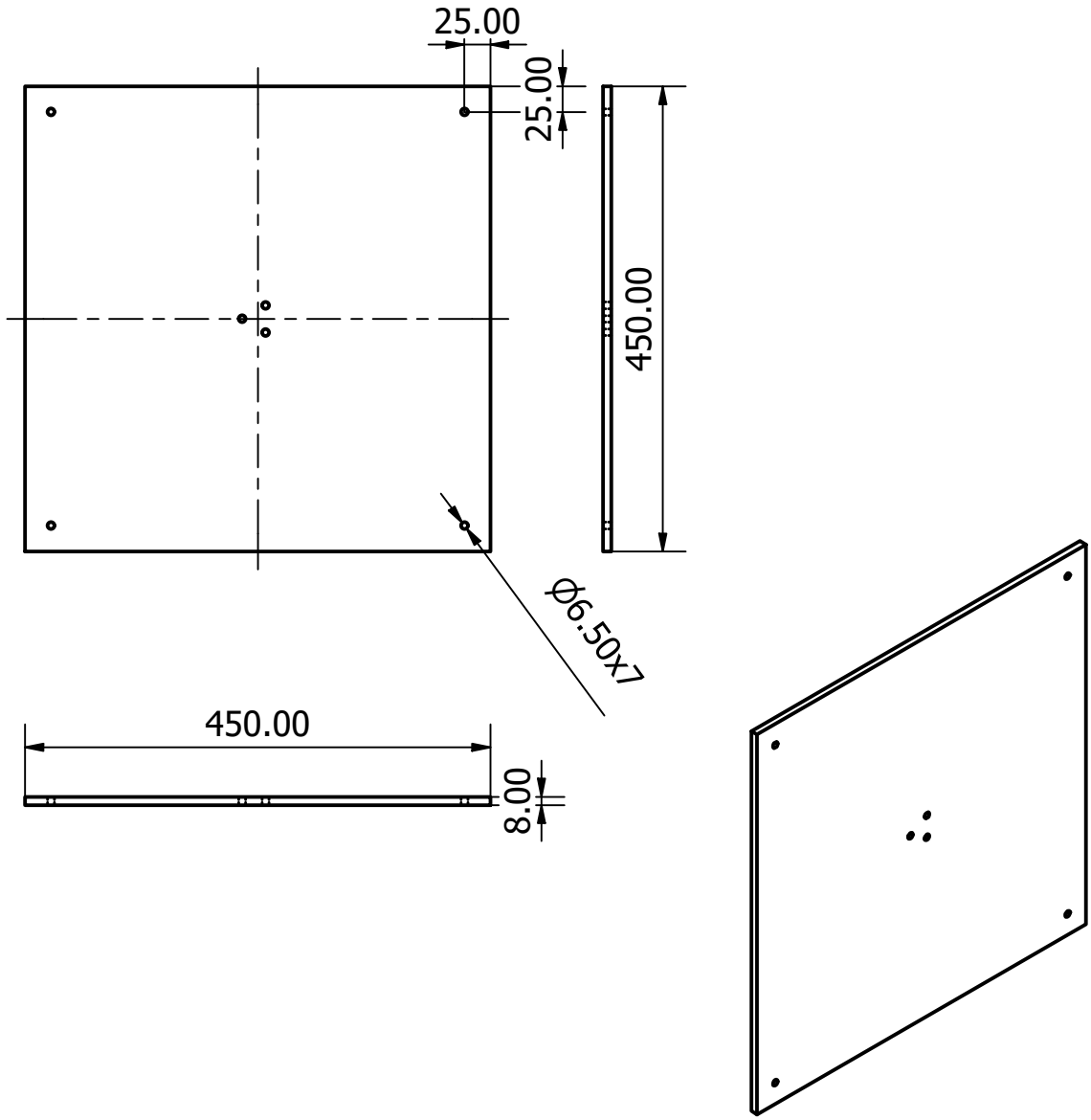




| | | |
|---|---|---|
| PART NO: 14 | QTY: 1 | SCALE: 1:1 |
| PART NAME: Collar | Units: All dimensions are in mm | |
| Description: Cylindrical | Tolerances: ± 1mm | |
| Material: Mild steel | Made by: Himanshu Yadav | |

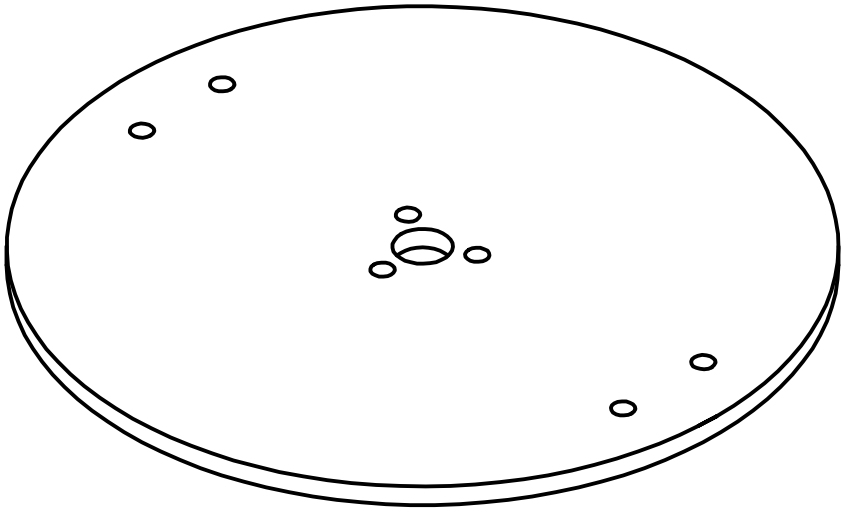


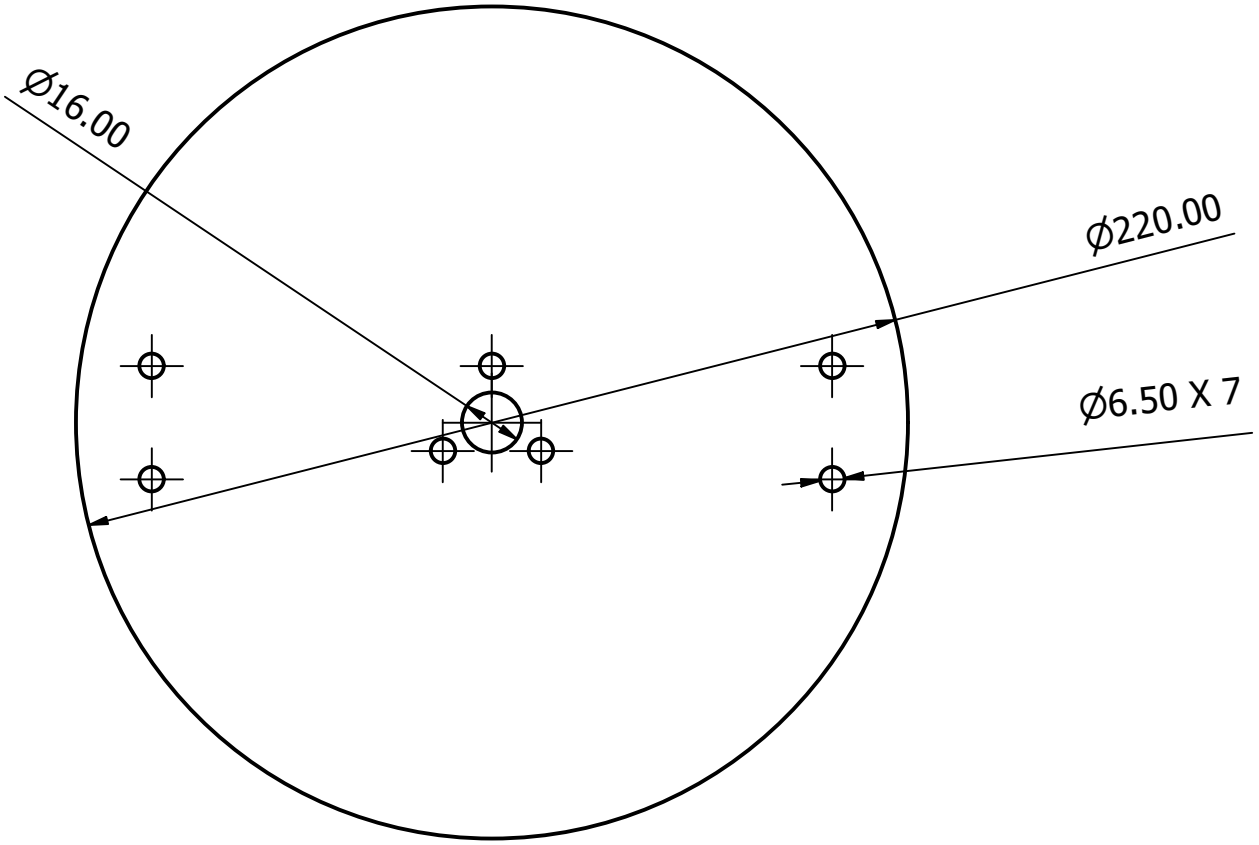


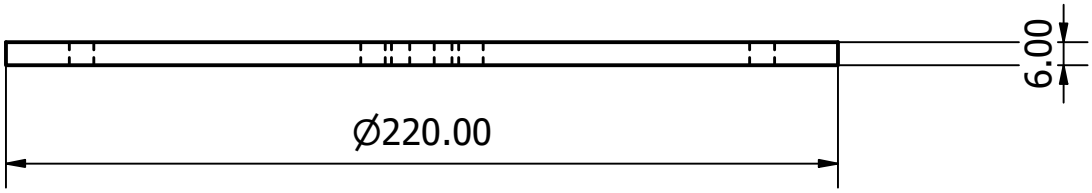

| | | |
|---|---|---|
| PART NO. 14 | QTY: 2 | SCALE: 1:2 |
| PART NAME: ANGULAR GUIDE | Units: All dimensions are in mm | |
| Description: | Tolerances: +-1 mm | |
| Material: MILD STEEL | Made by: MADHAV KUMAR | |



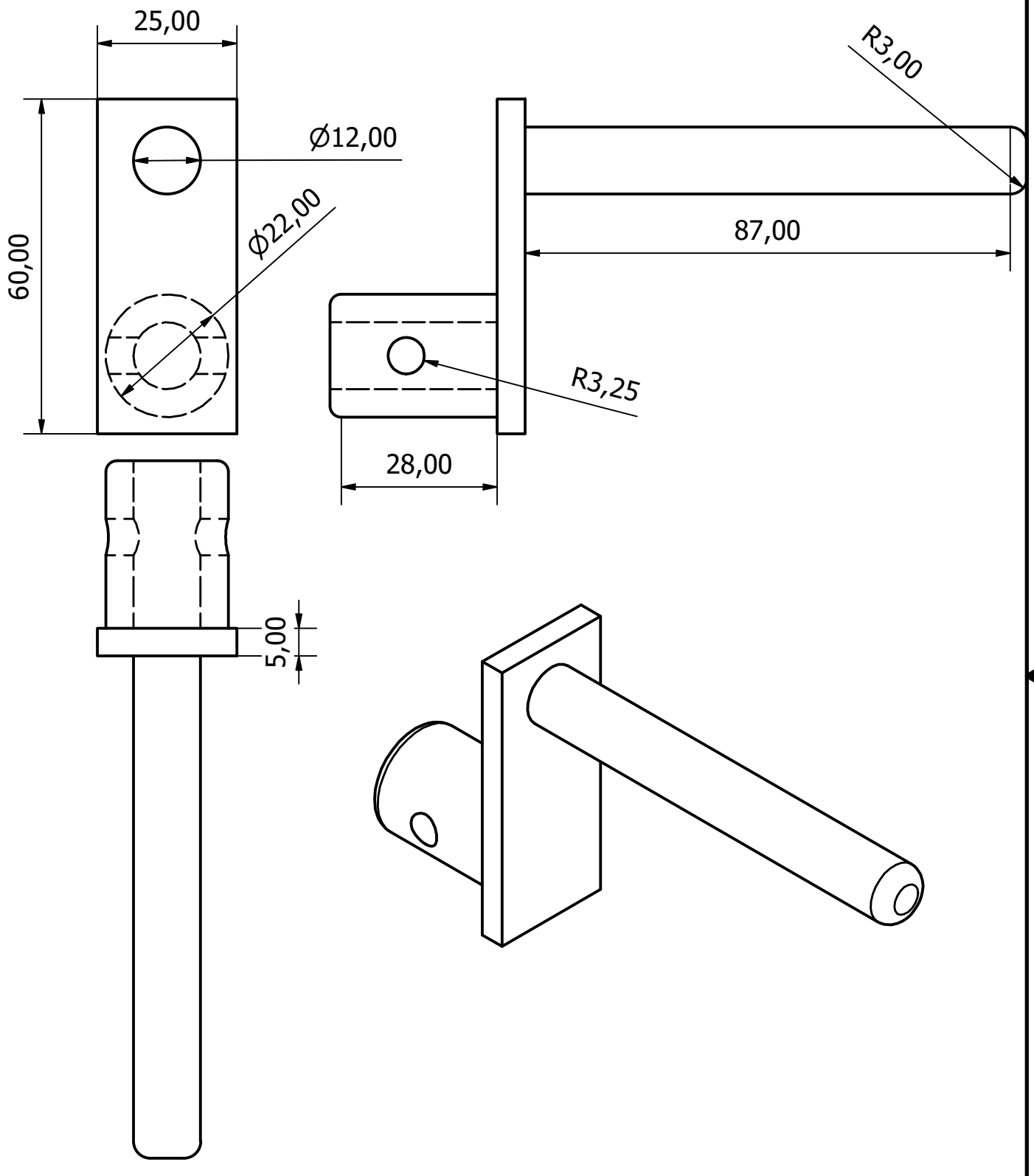

| | | |
|---|---|---|
| PART NO. 13 | QTY: 1 | SCALE: 1:7 |
| PART NAME: Base plate | Units: All dimensions are in mm | |
| Description:flat 450x450 | Tolerances: ±1mm | |
| Material:mild steel | Made by: Shefali Murmu | |






| | | |
|---|---|---|
| PART NO. 13 | QTY: 1 | SCALE: 1:2 |
| PART NAME: CIRCULAR BASE PLATE | Units: All dimensions are in mm | |
| Description: | Tolerances: | |
| Material: MILD STEEL | Made by: GAURAV KATARIA | |




| | | |
|---|---|---|
| PART NO. 10 | QTY: 1 | SCALE: 1:1 |
| PART NAME:handle | Units: All dimensions are in mm | |
| Description:flat,cylindrical | Tolerances: ±1mm | |
| Material: mild steel | Made by: Shefali Murmu | |

# COST ANALYSIS

Material: Steel

Cost = ₹ 100/kg

Total Weight of Steel used = 22kg 500 gm

Total cost of Steel used = ₹ 2250

Cost of Electric Kit = ₹ 1000

Cost of additional Motor used = ₹ 1300

| Process | Price (₹/hr) | Total Hours | Total Cost |
|---|---|---|---|
| Drilling | 75 | 1.5 | 112.5 |
| Milling | 250 | 3 | 750 |
| Turning | 150 | 8 | 1200 |
| 3D Printing | 100 | 2 | 200 |

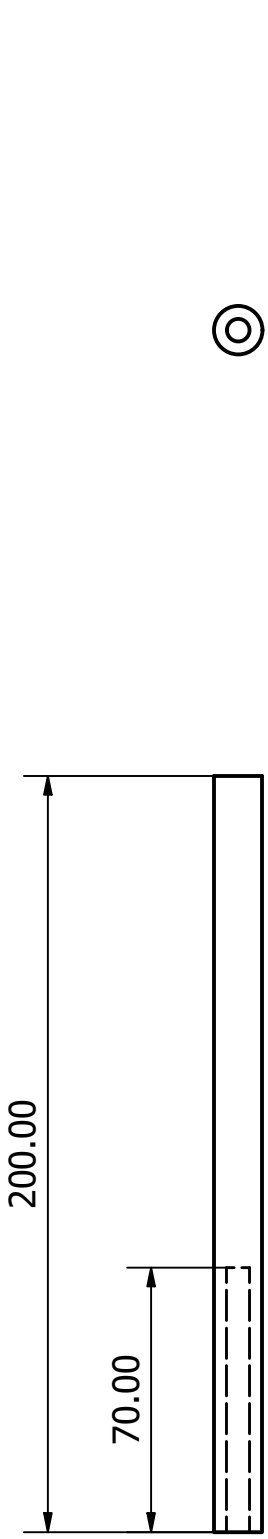
Labour Cost = ₹ 650/day (8 hours)

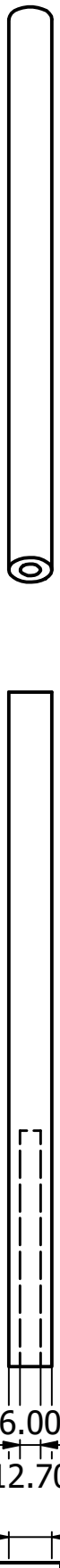
Total Working Time = 18 hours 40 minutes

Number of team members = 11

Total Labour Cost = ₹ 16683.37

***Total Cost = ₹ 23495.87***




| | | |
|---|---|---|
| PART NO. | QTY:1 | SCALE:1:2 |
| PART NAME: Worm shaft upper | | Units: All dimensions are in mm |
| Description: Cylindrical rod | | Tolerances: ±1 mm |
| Material: mild steel | | Made by: Praveen Raj |