Automated Portable Hammering Machine

TA202A: Manufacturing processes II

GROUP NUMBER 8:

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COURSE INSTRUCTOR:

DR. MOHIT LAW

GUIDE:

MR. GIREESH PRATAP

Project Overview

Objective: The aim of the project is to fabricate an automated hammering machine that facilitates fast and safe hammering without much human effort.

Manufacturing: In all, 23 parts were used to make the project, of which 9 were manufactured and the rest were recycled or bought for the complete making of the machine.

Cost: The project cost was estimated to be ₹ 14955/- including labor, machining and material costs.

Improvements: The time between two consecutive strokes of the hammer can be reduced so that time can be saved and other one is apart from the anvil, an elaborate elevation system for the machine can be devised. This will allow us to hammer a wide range of objects with varying sizes.

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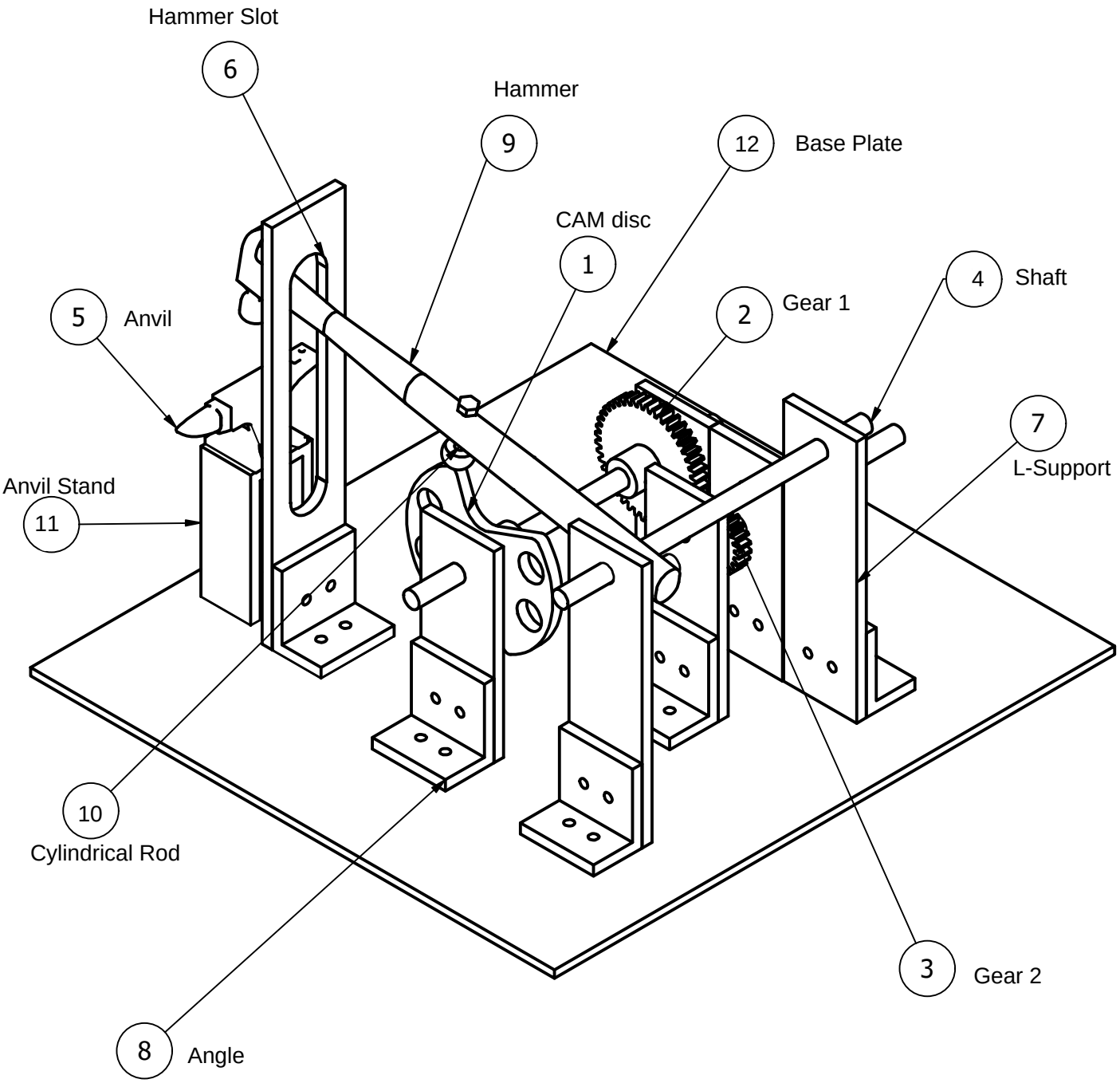


Isometric View
Automated Portable Hammering Machine

Sizing of Motor

Moment of Inertia of Shaft-1:

Dimensions:

- Diameter, D = $12.7\ mm$
- Length, L = $180\ mm$

Density of material of shaft (mild steel), ρ = $7860\ kg/m^3$

Mass of shaft, $M = \pi\rho\frac{D^2 X\ L}{4} = 0.1792\ kg$

Moment of inertia, I1 = $\frac{1}{8}\ X\ M\ X\ D^2 = 3.6129\ X\ 10^{-6} kg\ m^2$

Moment of Inertia of Shaft-2:

Same as Shaft - 1

Moment of Inertia of Spur Gear-1 (approximated as a disc):

Dimensions of gear:

- Diameter, D = $83\ mm$
- Width, W = $10\ mm$

Dimensions of extension:

- Outer Diameter, d = $25\ mm$
- Length, l = $25\ mm$
- Inner Diameter, d2 = $12.7\ mm$

Density of material of gear (mild steel), ρ = $7860\ kg/m^3$

Moment of Inertia, I2 = $\pi\rho\frac{(D^4-d2^4)X\ W}{32} + \pi\rho\frac{(d^4-d2^4)X\ l}{32} = 3.7305\ X10^{-4}\ kg\ m^2$

Moment of Inertia of Spur Gear-2 (approximated as a disc):

Dimensions of gear:

- Diameter, D = $43\ mm$
- Width, W = $10\ mm$

Dimensions of extension:

- Diameter, d = $25\ mm$
- Length, l = $10\ mm$
- Inner Diameter, d2 = $12.7\ mm$

Density of material of gear (mild steel), ρ = $7860\ kg/m^3$

Moment of Inertia, I3 = $\pi\rho\frac{(D^4-d2^4)X\,W}{32} + \pi\rho\frac{(d^4-d2^4)X\,l}{32} = 2.8994\ X\ 10^{-5}\ kg\ m^2$

Distances between shafts, d3 = 250mm

Total moment of inertia wrt motor axis (approx.), J = (I3+I1) + (I2+I1+(M+mass of gear 1)$Xd3^2$) = $3.2607\ X\ 10^{-5} + 1.8710\ X\ 10^{-2}\ kg\ m^2$
$= 1.8743\ X\ 10^{-2}\ kg\ m^2$

Speed of rotation, V = 75 RPM

Required Torque = $\frac{J X\ V}{9.55\ X\ ta} = \frac{1.8743\ X\ 10^{-2} X\ 75}{9.55\ X\ 2} = 0.0736\ Nm$

Final torque = Required Torque X FOS = $0.0736\ X\ 2 = 0.1472\ N\ m$

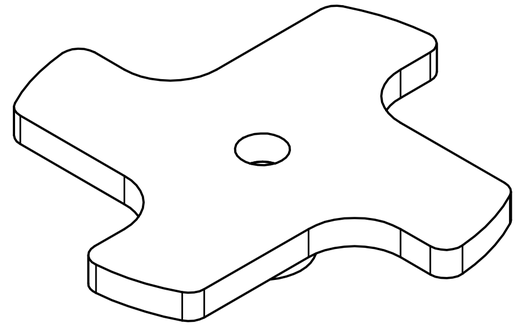
The motor provided has a maximum torque rating of 1 Nm and maximum angular velocity rating of 300 RPM. Both of the specifications are being met.

Parts List

Part Name	Quantity	Material	Manufactured / Bought	Machining Operations
Cam disc	1	Mild Steel	M	Drilling + Cutting
Spur gear	2	Mild Steel	M	Turning + Milling
Hammer head	1	Mild steel	M	Turning + Drilling
Hammer handle	1	wood	M	Drilling + Cutting
Anvil	1	Mild steel	M	Cutting
Hammer Slot	1	Mild Steel	M	Drilling + Cutting + Vertical Milling
L support	6	Mild Steel	M	Drilling + Cutting
Rolling Cylinder	1	Mild Steel	M	Drilling + Turning
Anvil Stand	1	Mild Steel	M	Drilling + Cutting
Base plate	1	Mild Steel	B	-
Motor Holder	1	Plastic	M	3-D printing
Shaft	3	Mild Steel	B	Cutting
Motor	1	-	B	-
Arduino	1	-	B	-
Infrared Sensor	1	-	B	-

NOTES:
1. PART TO BE POWDER COATED

ISO (1 : 1)



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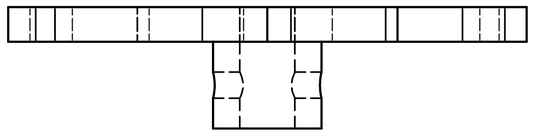

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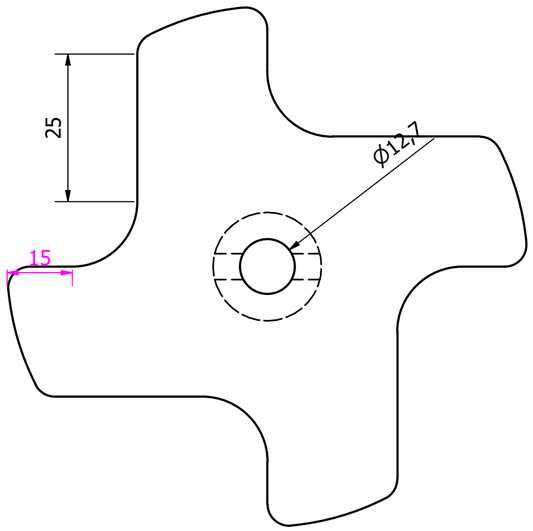

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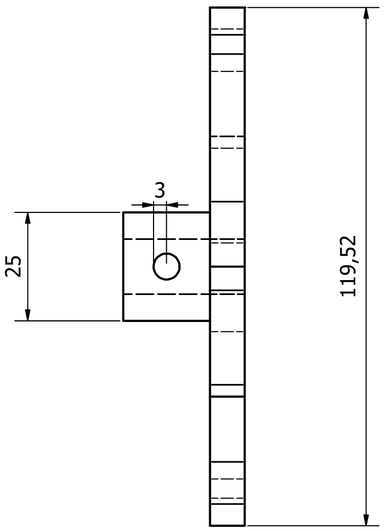

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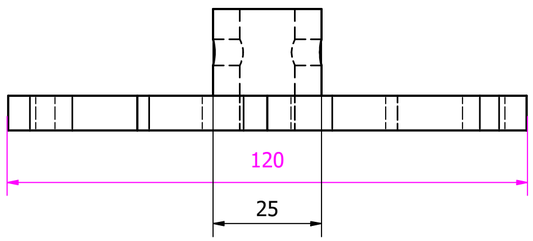
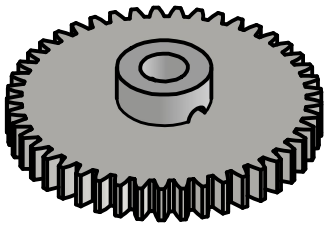


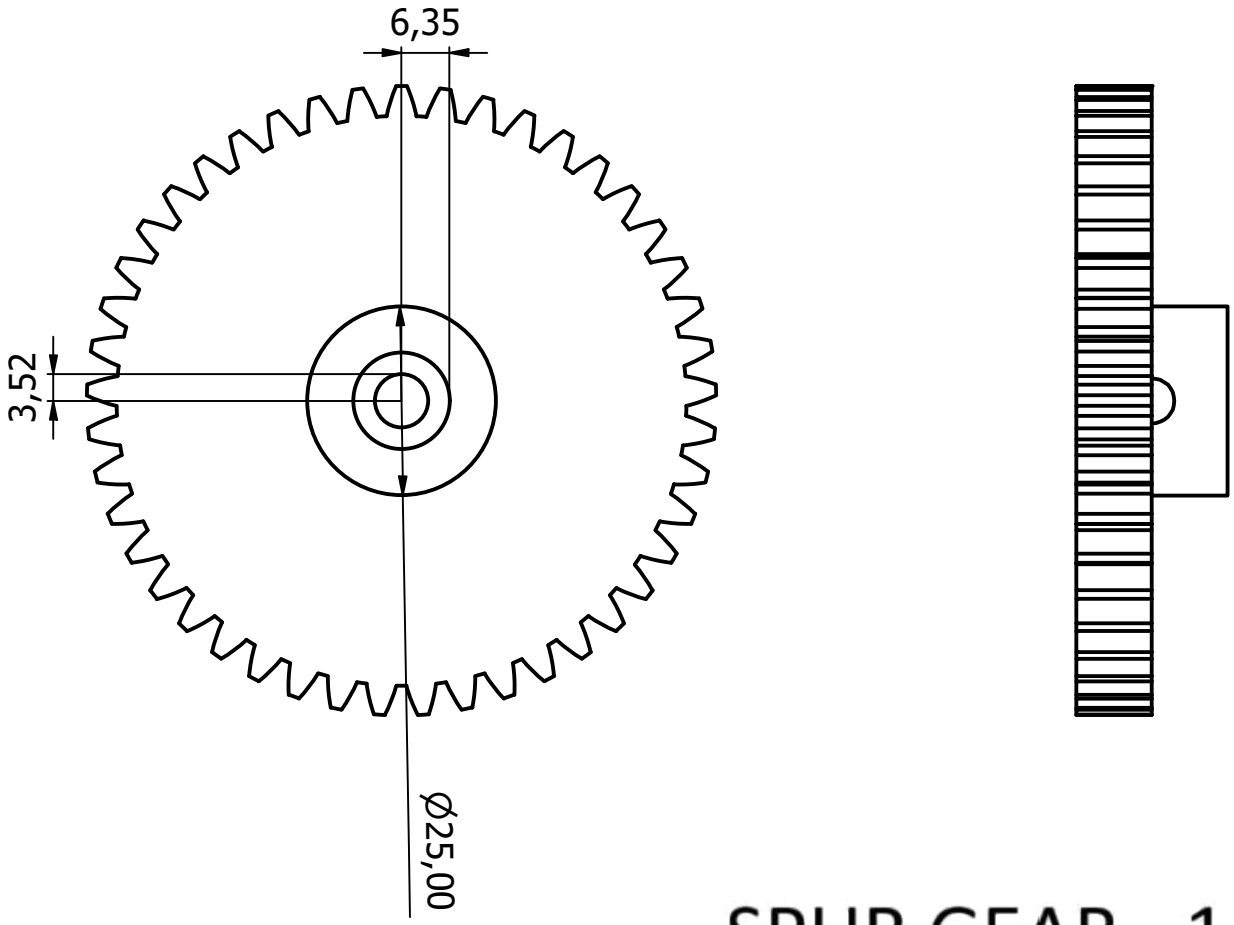
MATERIAL: Mild Steel
Manufactured traditionally
Tolerance: 0.1 mm

DESIGNED BY	CHECKED BY	APPROVED BY	DATE		DATE	
dwija					12-02-2023	

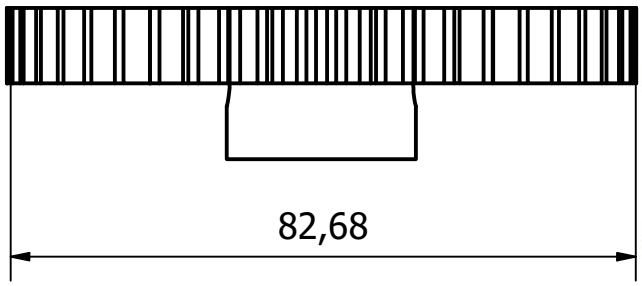
Part 1- CAM with collar	Material- Mild Steel		
	cam new draw	ISSUE	SHEET 1 / 1

PARTS LIST		
ITEM	QTY	PART NUMBER
1	1	collar by havi
2	1	Spur Gear2





SPUR GEAR - 1



SPECIFICATION QUANTITY = 1

NUMBER OF TEETH (N) = 40

MODULE (M) = 2

OUTER DIAMETER = M*(N+2) = 2*42 = 84

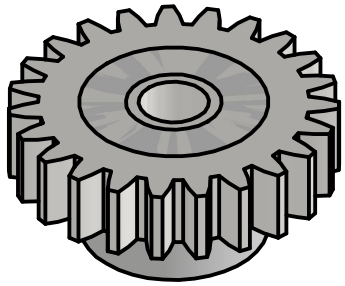
INDEX CALCULATION = 40/N = 40/40 = 1

MATERIAL: Mild Steel
Manufactured traditionally
Tolerance: 0.1 mm

Designed by	Checked by	Approved by	Date		Date	
Indresh					13-02-2023	

collar_gear_dimension	Edition	Sheet 1 / 1	

PARTS LIST		
ITEM	QTY	PART NUMBER
1	1	Spur Gear1
2	1	collar by havi



SPUR GEAR - 2

SPECIFICATION QUANTITY = 1

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MODULE (M) = 2

OUTER DIAMETER = M*(N+2) = 2*22 = 44

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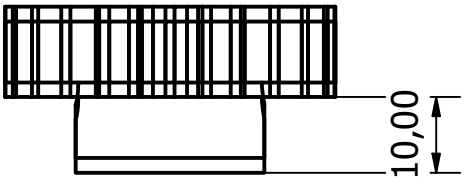

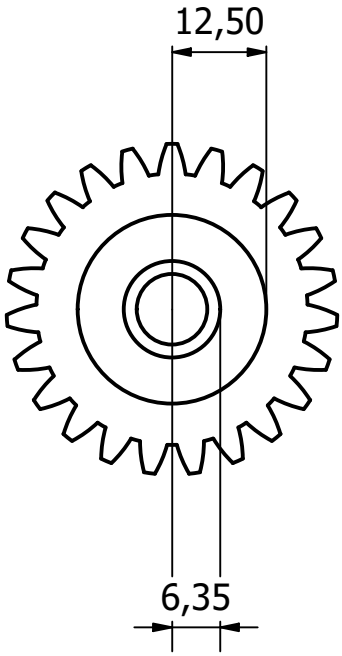

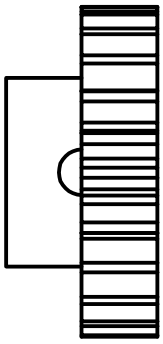

MATERIAL: Mild Steel
Manufactured traditionally
Tolerance: 0.1 mm

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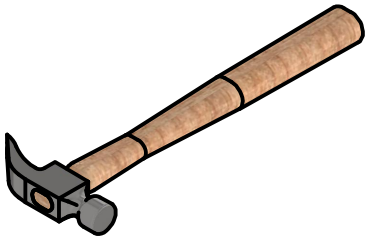
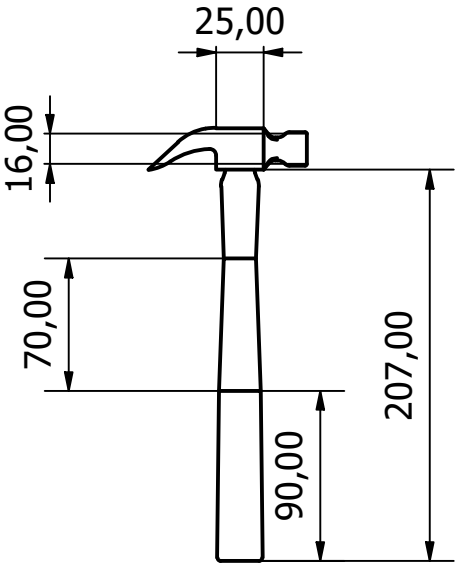
collar_gear_2		Edition	Sheet 1 / 1

PARTS LIST		
ITEM	QTY	PART NUMBER
1	1	Hammer_Head
2	1	Hammer_Shaft



MATERIAL: Mild Steel , wood
Manufactured traditionally
Tolerance: 0.1 mm



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Hammer_Assembly_Chacking_Balance_Assembly	Edition	Sheet	1/1

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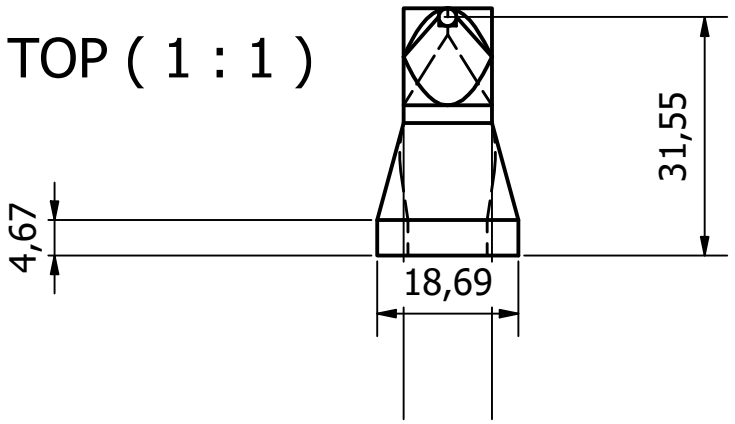

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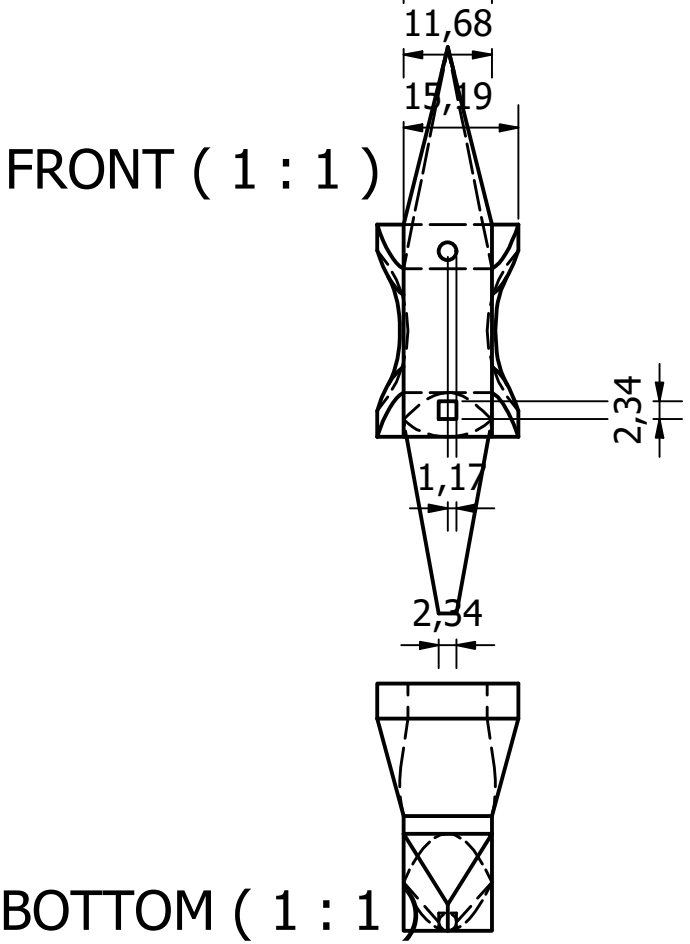

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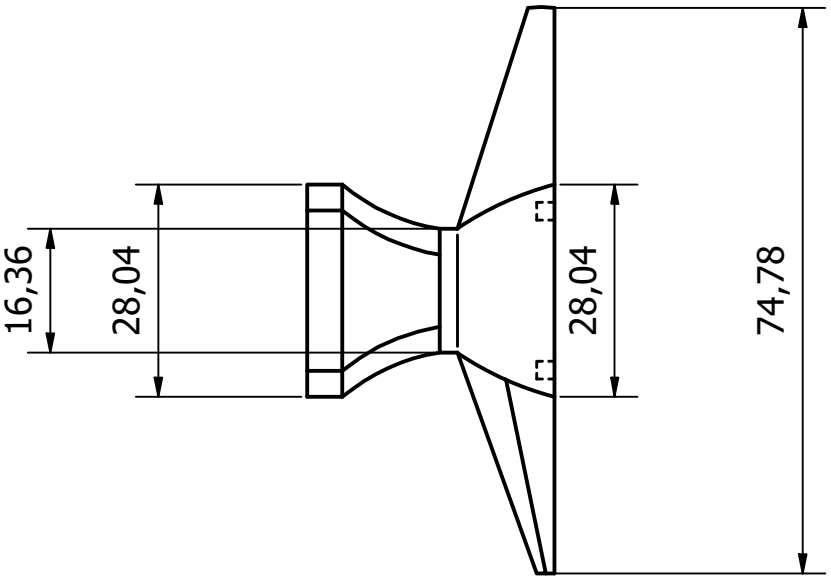

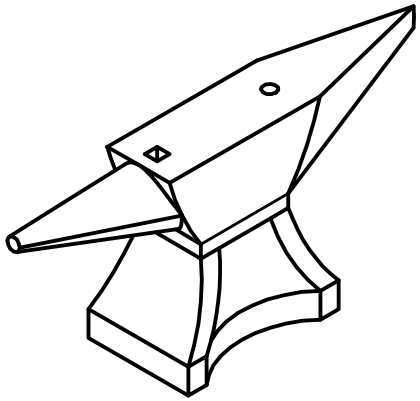

MATERIAL: Mild Steel
Manufactured traditionally
Tolerance: 0.1 mm

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Part5_Anvil	ISSUE	SHEET 1 / 1	

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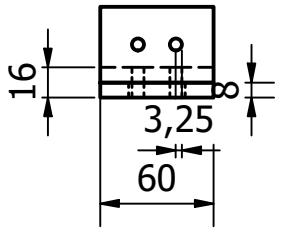

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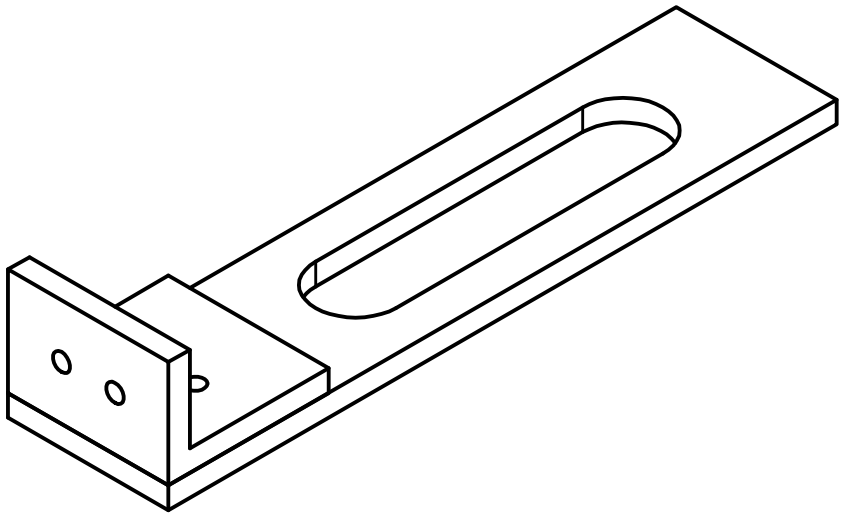

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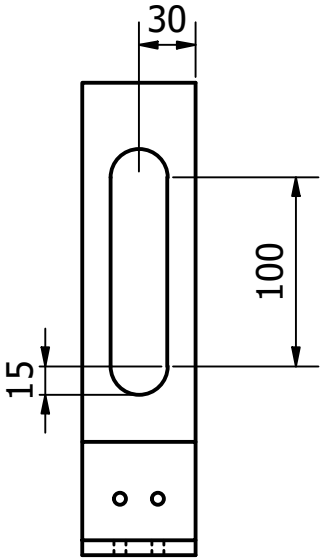

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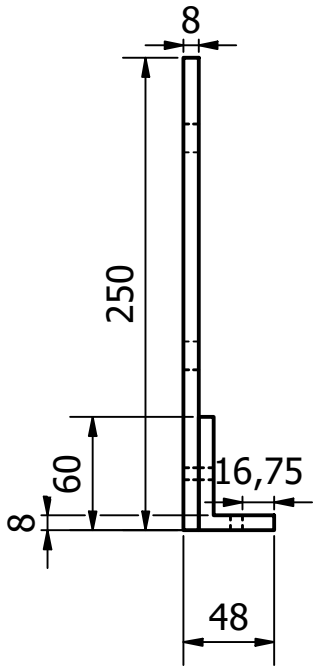

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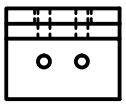

MATERIAL: Mild Steel
Manufactured traditionally
Tolerance: 0.1 mm

DESIGNED BY	CHECKED BY	APPROVED BY	DATE		DATE	
dwija					12-02-2023	

Part6_Hammer_slot	ISSUE	SHEET 1 / 1	

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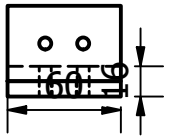

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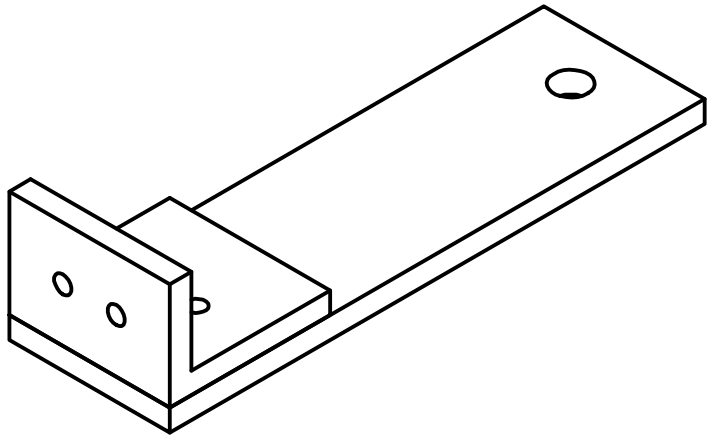

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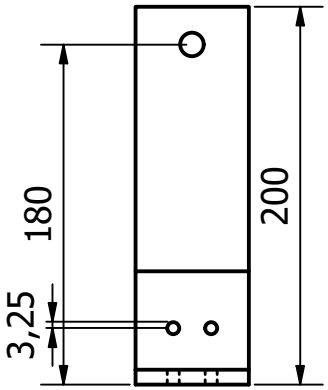

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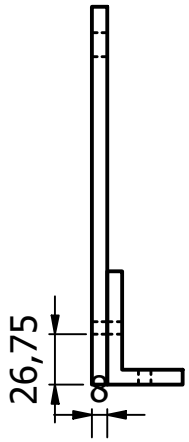

MATERIAL: Mild Steel
Manufactured traditionally
Tolerance: 0.1 mm

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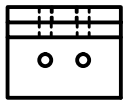

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Part7_L_support_hammer	ISSUE	SHEET 1 / 1	

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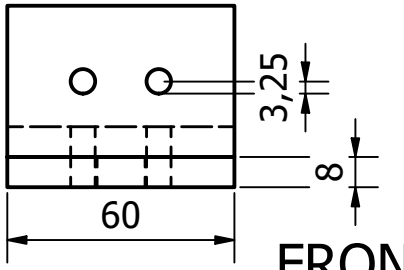

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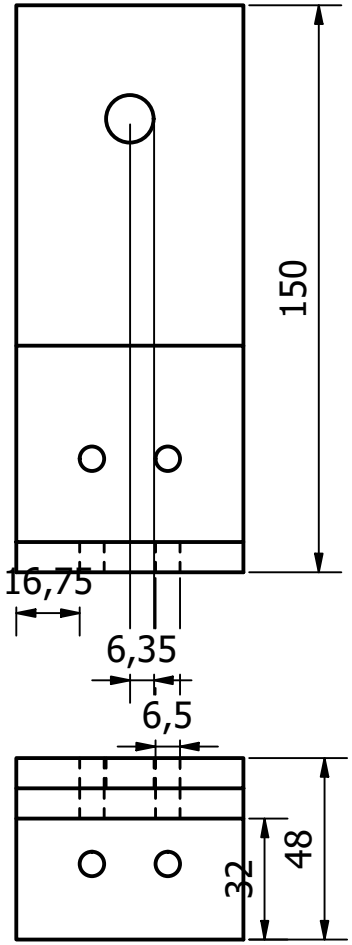

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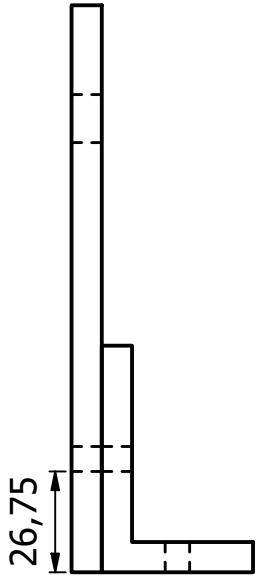

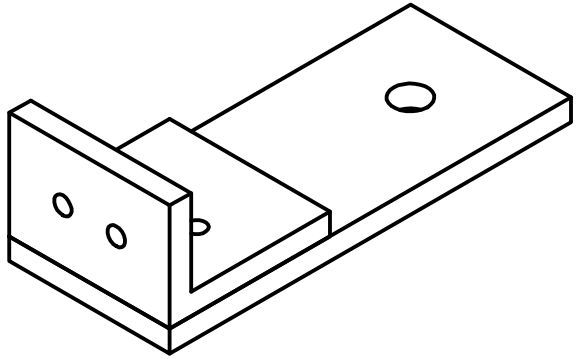

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MATERIAL: Mild Steel
Manufactured traditionally
Tolerance: 0.1 mm

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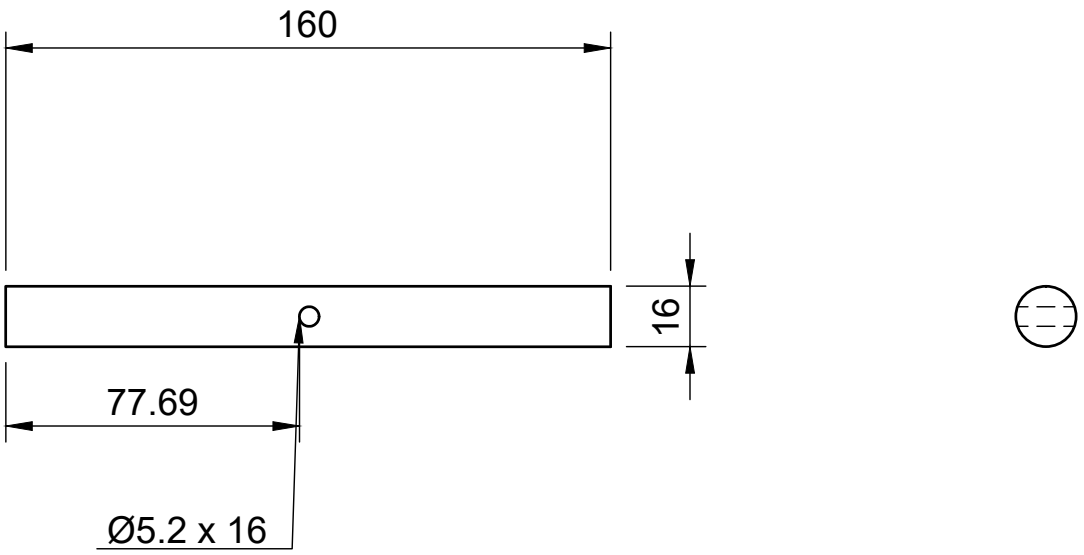
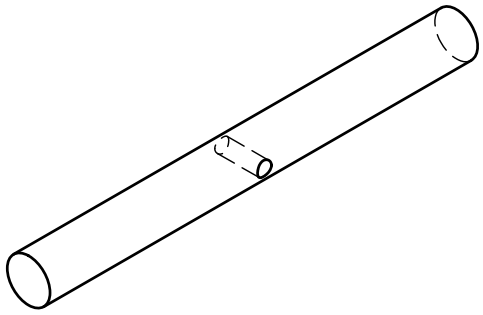
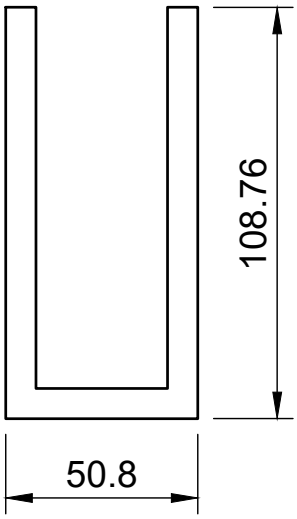
Part8_L_support_gears	ISSUE	SHEET 1 / 1	

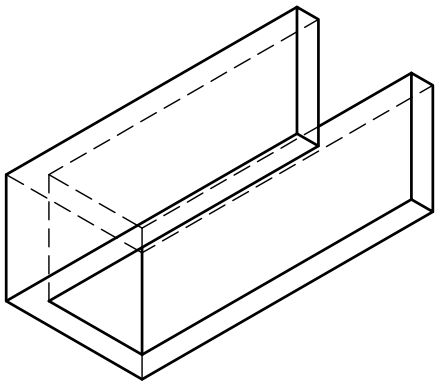


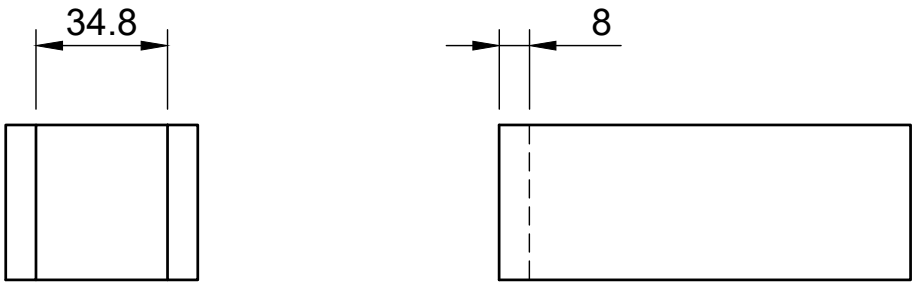


MATERIAL: Mild Steel
Manufactured traditionally
Tolerance: 0.1 mm

Dept.	Technical reference	Created by	Approved by
		Pooja Kumari 14-04-2023	
scale: 1:1		Document type	Document status
		Title: Chase rolling Cylinder	DWG No.
			Rev. / Date of issue / Sheet: 1/1

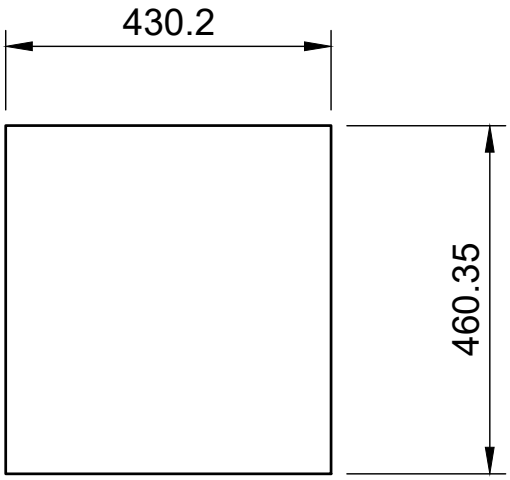






MATERIAL: Mild Steel
Manufactured traditionally
Tolerance: 0.1 mm

Dept.	Technical reference	Created by Dhruv Garg 12-02-2023	Approved by	
		Document type	Document status	
		Title: anvil dimensions	DWG No.	
			Rev. / Date of issue	Sheet: 1/1



MATERIAL: Mild Steel
Manufactured traditionally
Tolerance: 0.1 mm

Dept.	Technical reference	Created by Dhruv Garg 12-02-2023	Approved by		
		Document type	Document status		
		Title **Baseplate dimensions**	DWG No.		
			Rev.	Date of issue	Sheet 1/1

Cost Analysis

Total weight of project = 21.8kg
Weight of steel used = approx. total weight of project
= 21.8kg

1. Cost of Material

   Density of mild steel = 7850kg/m^3
   Cost of mild steel = 100Rs/kg
   Weight of mild steel used =21.8 kg
   Total cost of material =Rs. 2180

2. Cost of machining:
   1. Drilling: (6 X 1 hr) X Rs 75/hr = Rs 450
   2. Milling: 4 hrs X Rs 250/hr = Rs. 1000
   3. 3D printing: 3hrs X Rs. 100/hr = Rs. 300
   4. Turning: 6 hr X Rs 75/hr = Rs. 450

3. Cost of electric kit = Rs. 1000

4. Labour
   Unskilled Labour Rate = Rs. 650/Day = Rs. 81.25/Hr
   Hours of Unskilled labour = 6 x 7 x 2 = 84
   Unskilled Labour Charge = Rs. 6825
   Skilled Labour Rate = Rs. 850/Day = Rs. 106.25/Hr
   Hours of Skilled Labour = 6 x 4 x 1 = 24
   Skilled Labour Charge = Rs. 2550
   Total Labour Cost = Rs. 9375

5. Additional Cost:
   1. Cost of wood = Rs 100
   2. Cost of nut, bolt etc = Rs 50
   3. Cost of Sensor = Rs. 50

Total cost of project = Rs. 14955