Scissors Screw Jack

TA202A – Manufacturing Processes

Group Number: 30

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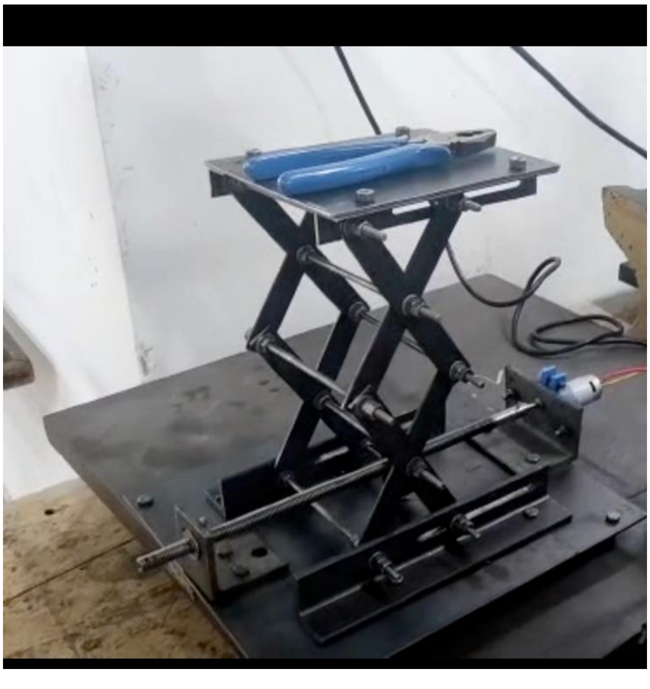
Instructor : Dr. Arvind Kumar



Introduction

A screw jack is a type of jack that is operated by turning a leadscrew. It is commonly used to lift weights or objects. The major components of our screw jack are plates, clamps and rods. The system generally made of L-clamp (motor holding), motor clamp, L-clamp, fixed clamp, base plate, top plate, rods, thread rod, bars.

The benefit of screw jack is that the load is generally self-locking. This mean that the motion can’t be back-driven by the weight of the load. This makes them a very safe option, and the load will maintain that position even when the motion force is removed, no matter what load the screw jack is supporting.

Motivation

For the things we have to learn before we can do them, we learn by doing them. While searching for ideas for our TA 202 project we came across this double screw jack. It caught our attention on the first glance as it looked fascinating and it is useful for laboratory purposes. To check its effectiveness and feasibility we decided to apply our knowledge gained from TA202 to it and create a working double screw jack.

It was a really invigorating journey while working on this project. We learned the real life applications of the processes. We were taught in class and different materials and their uses. This project also strengthened our teamwork and communication skills.

Acknowledgments

Throughout the preparation and implementation of this research, we are thankful to prof. Dr. Arvind Kumar for their insightful and constructive feedback.

During the execution of this project, we are also appreciative of the staff for giving us their valuable suggestions and constant supervision during the completion of this project.

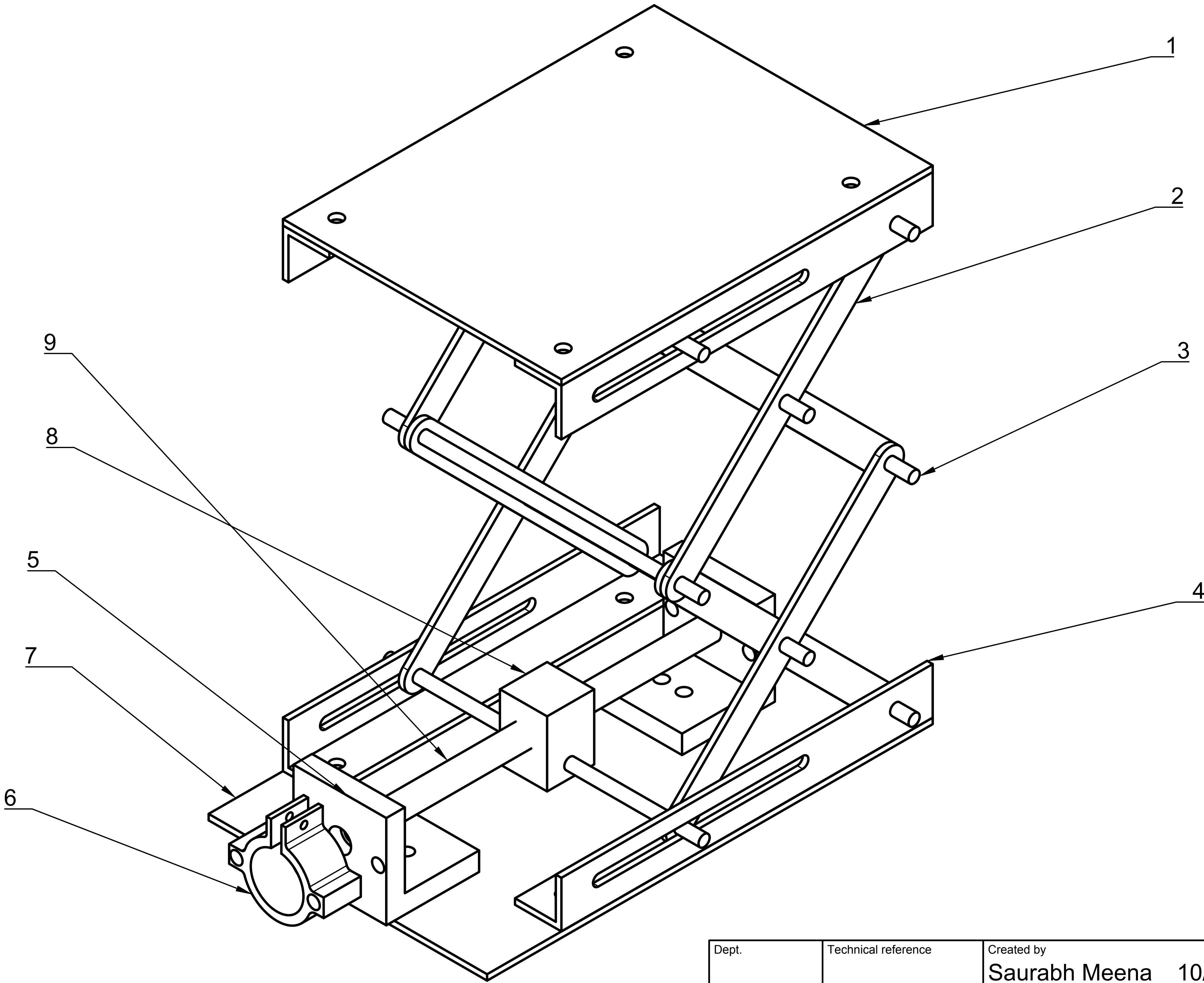
Special thanks to our TA Mr. Dheeraj Kumar Soni for their valuable time and suggestions.

Table of Content

Part List

Part No.	Part Name	QTY	Type of Material Required	Dimension	Material	Page No.
1.	Top Plate	1	Sheet	200mm*150mm*3mm	Steel,Mild	7
2.	Bar	8	Sheet	175mm * 15mm * 3mm	Steel, Mild	8
3.	Rod	8	Rod	6mm dia * 170mm	Steel, Mild	9
4.	L-Clamp	4	Angle	200mm * 25mm * 3mm	Steel, Mild	10
5.	Fixed Clamp	2	Angle	50mm *50mm * 10mm	Steel, Mild	11
6.	Motor Clamp	1	Circular	51mm * 20mm * 28.36mm dia	Steel, Mild	12
7.	Base Plate	1	Sheet	240mm* 150mm * 3mm	Steel, Mild	13
8.	Square Nut	1	Cubic	25.4mm * 25.4mm * 35mm	Steel, Mild	14
9.	Thread Rod	1	Rod	210mm*11.85mm dia	Steel, Mild	15

ISOMETRIC VIEW



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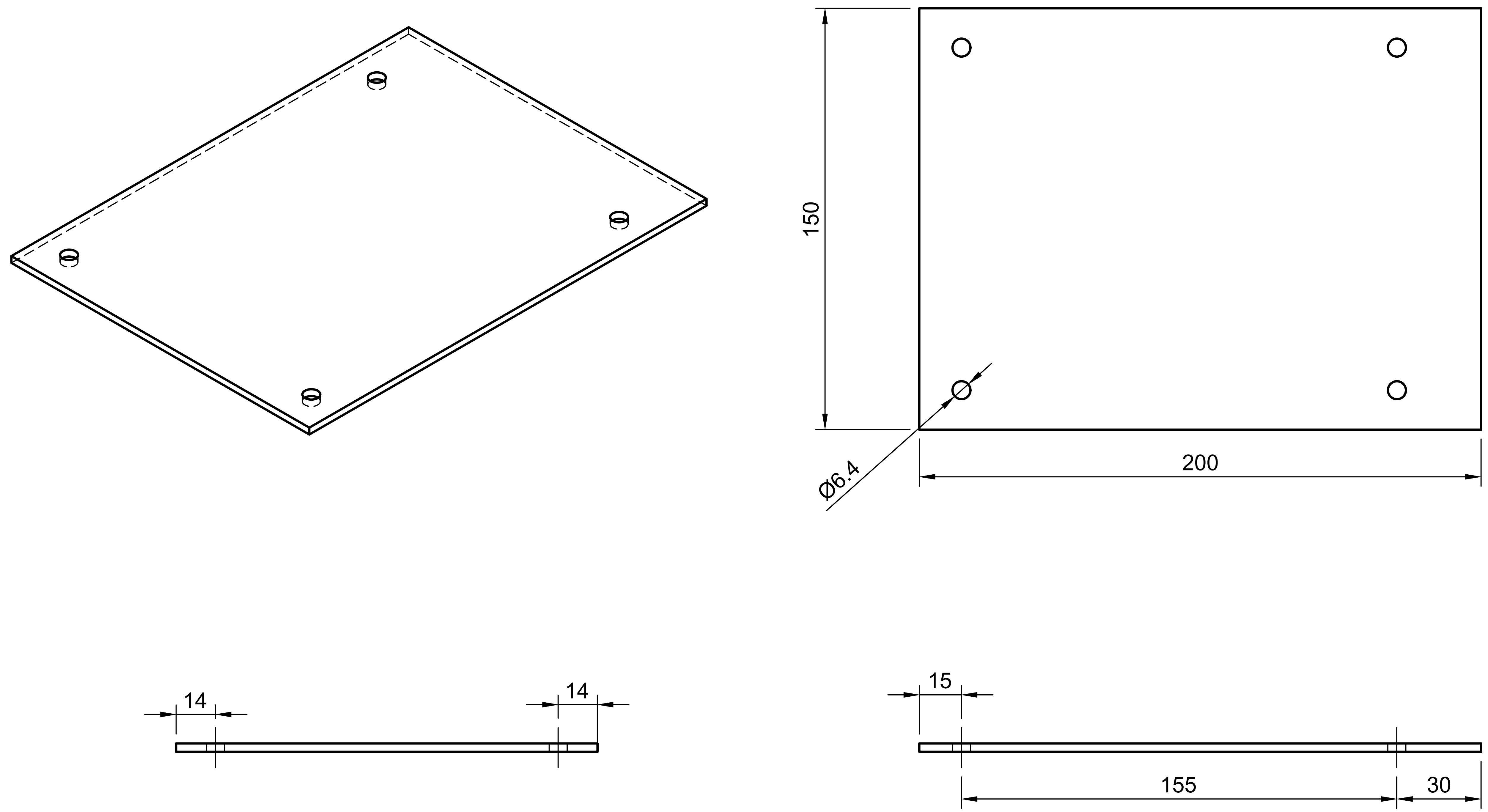
PART - 1

TOP PLATE



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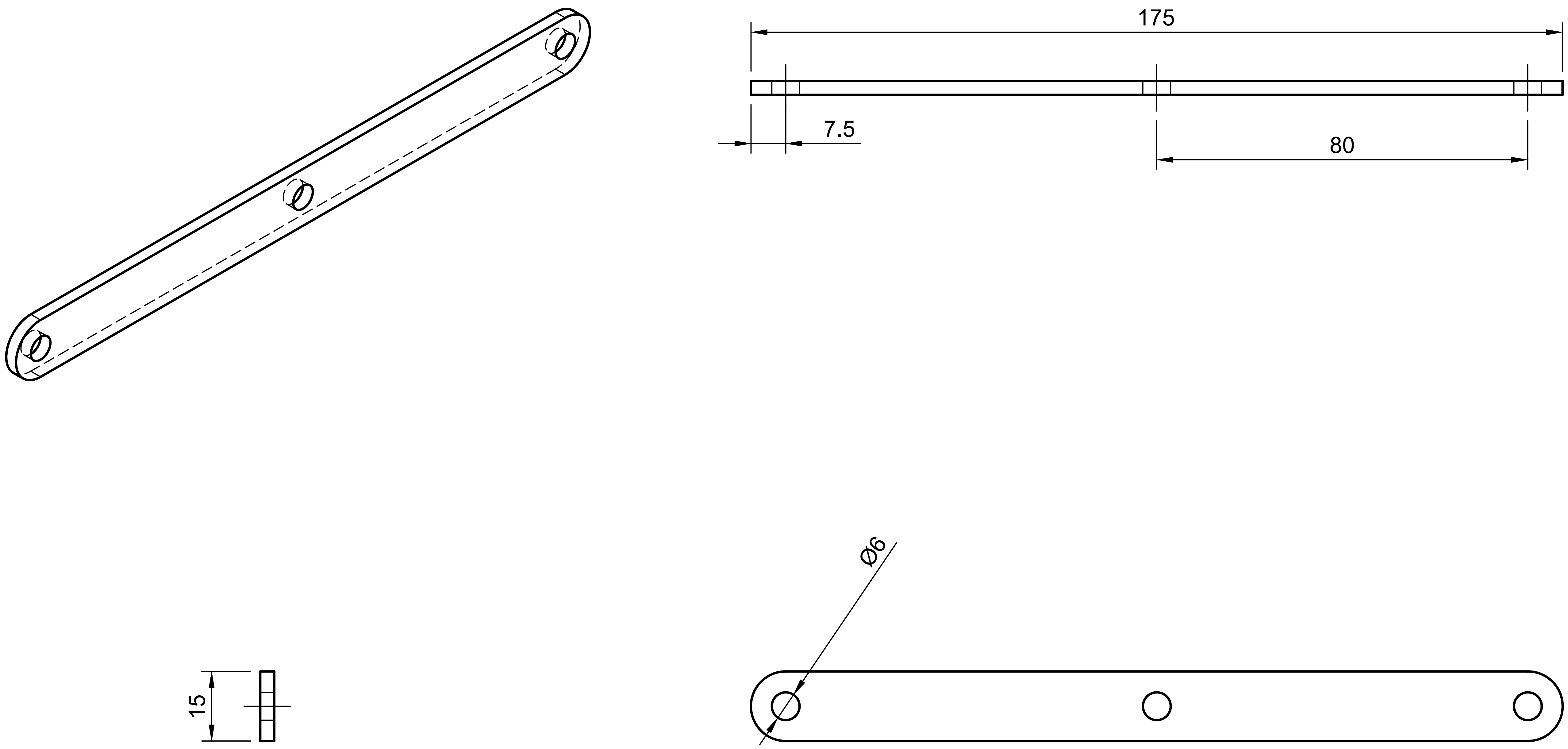
PART - 2

BAR



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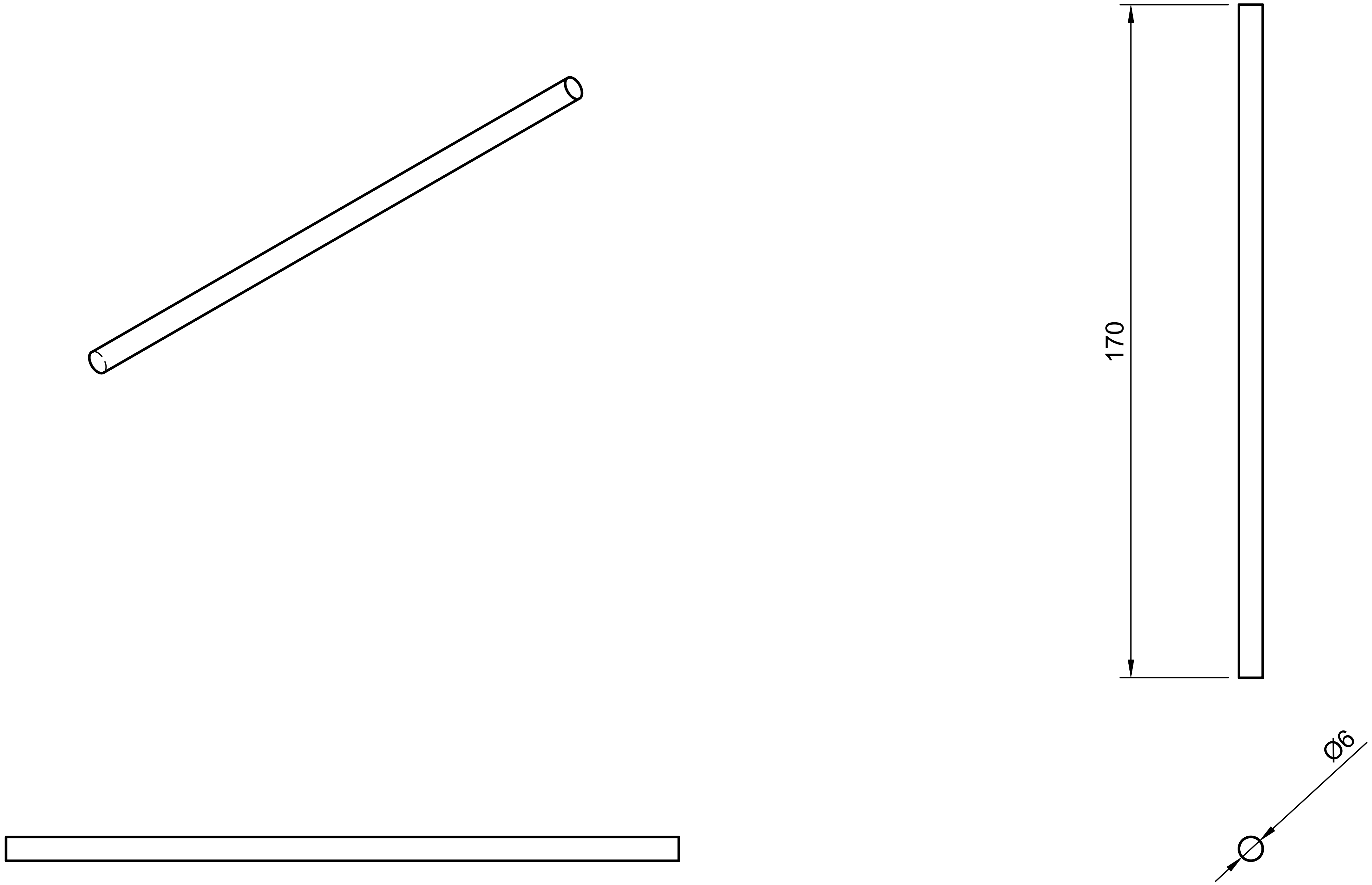
PART - 3

ROD



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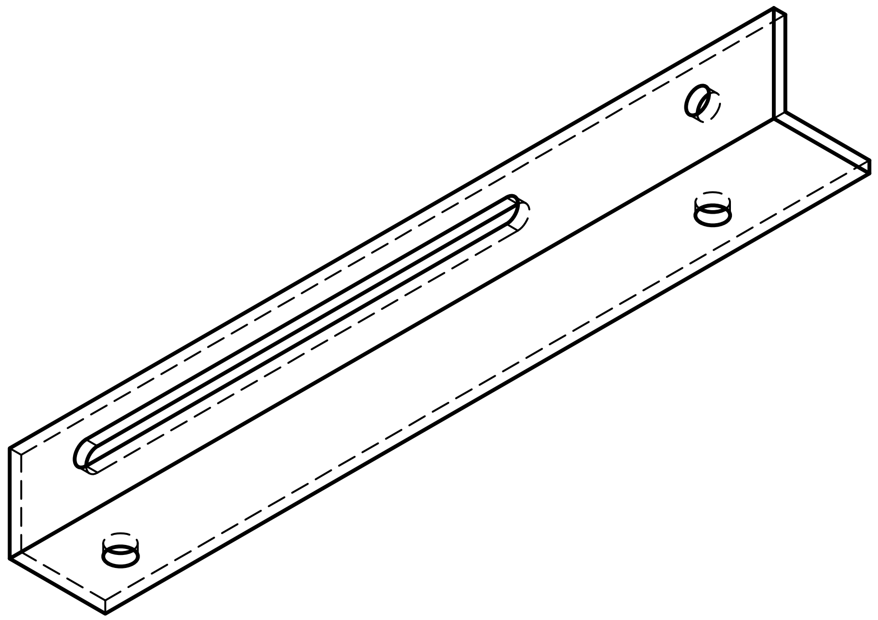
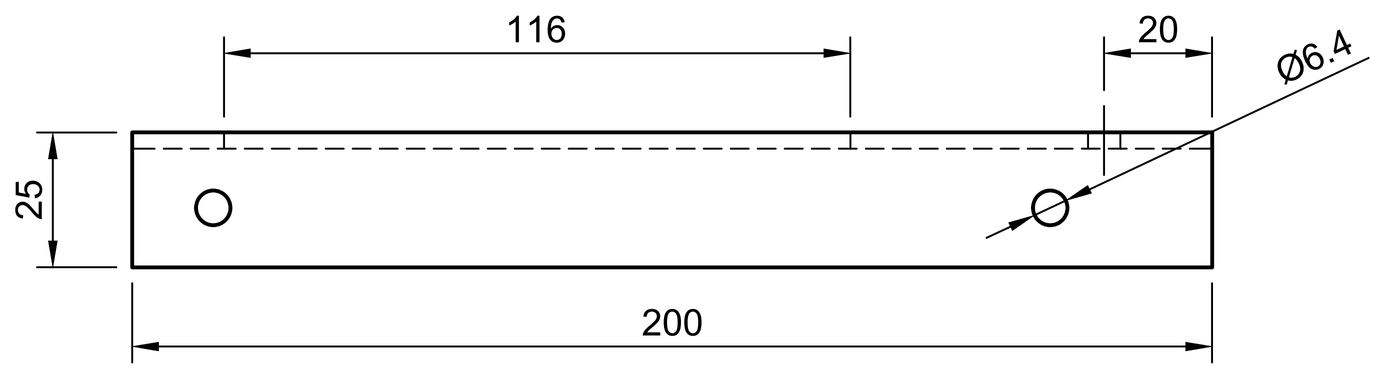
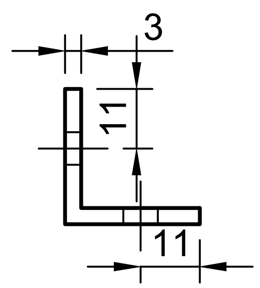
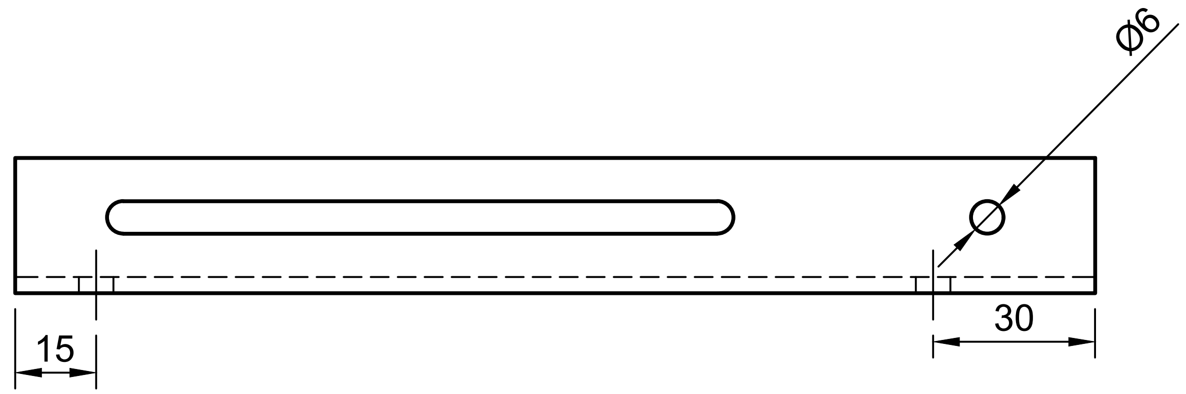
PART - 4

L - CLAMP









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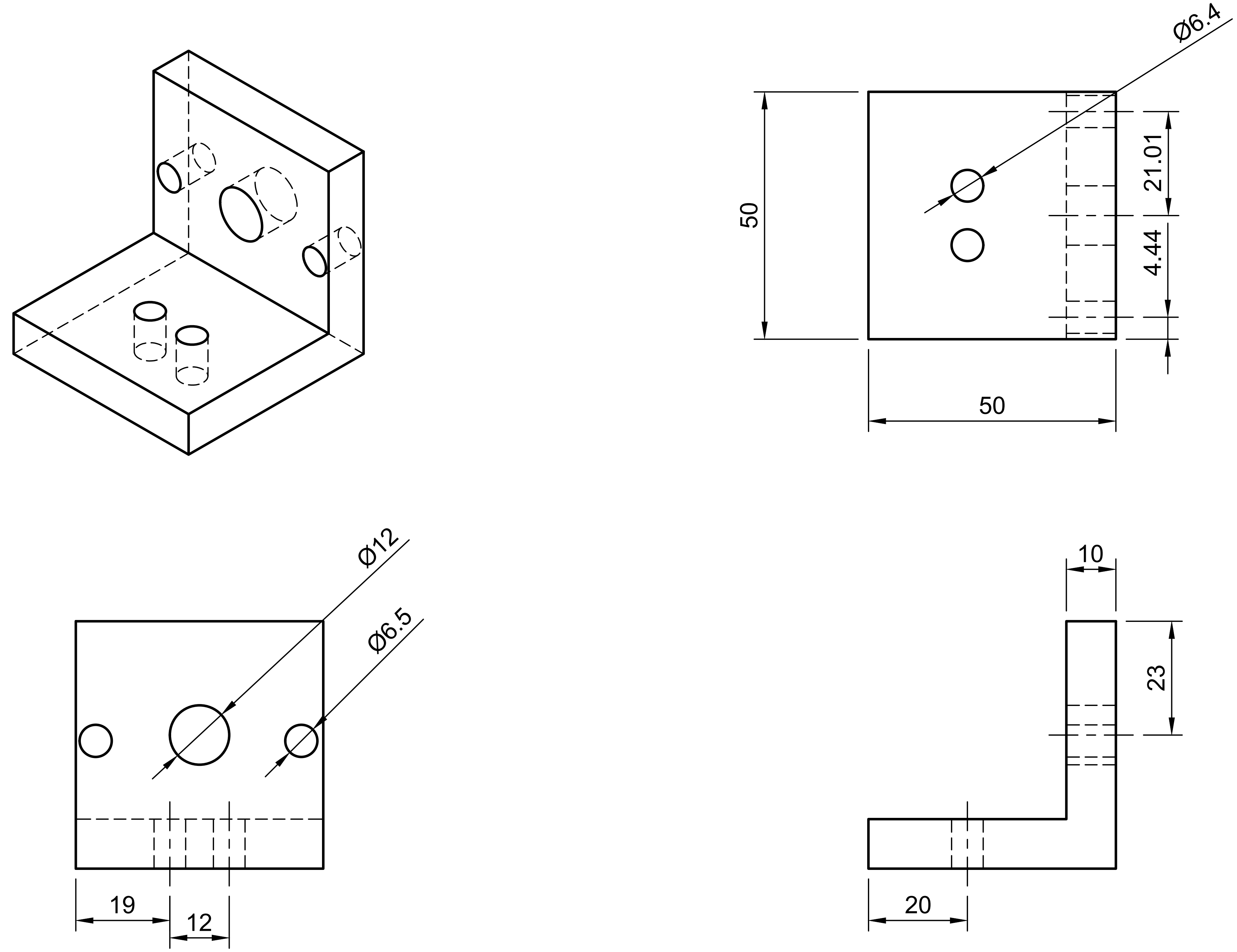
PART - 5

FIXED CLAMP



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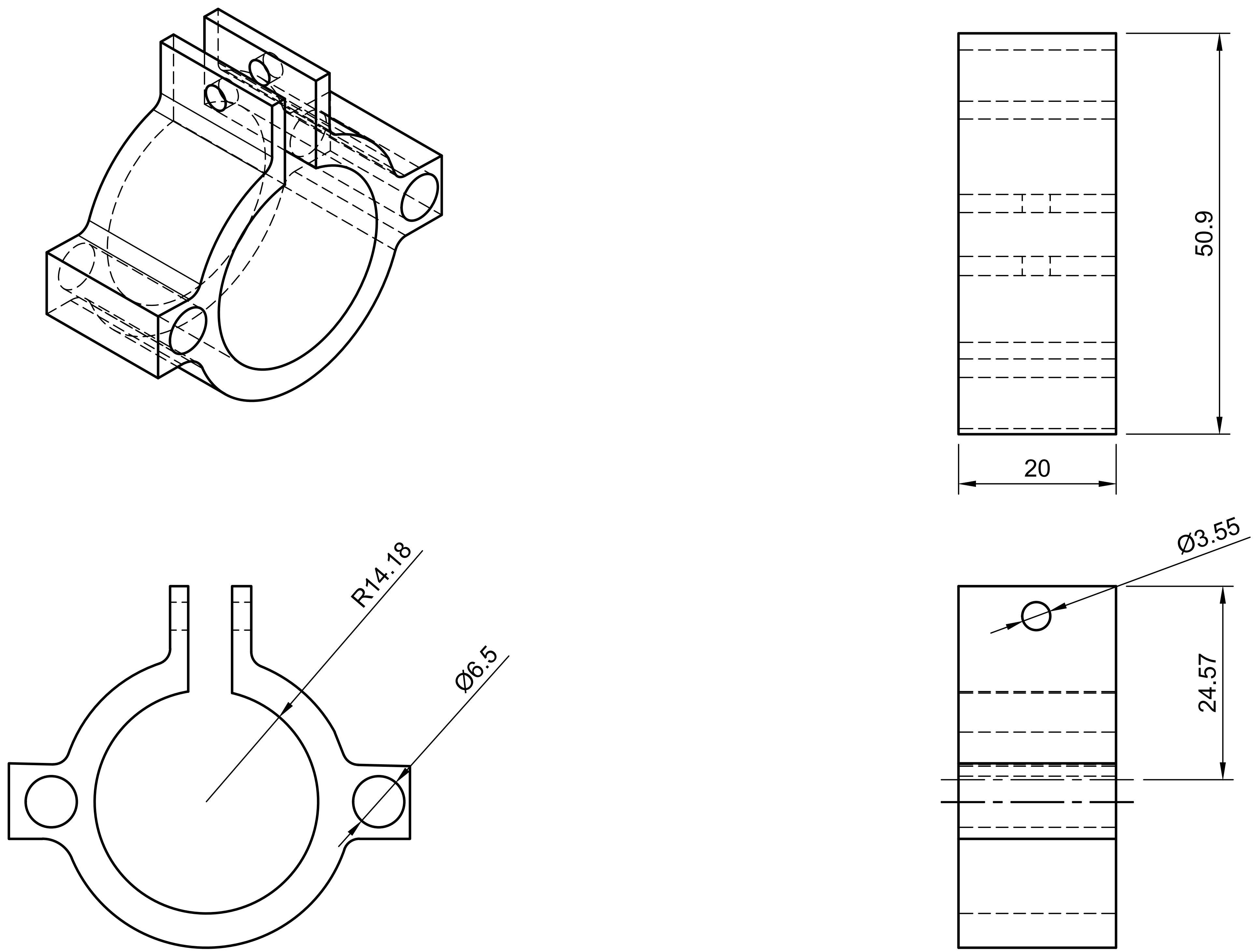
PART - 6

MOTOR CLAMP



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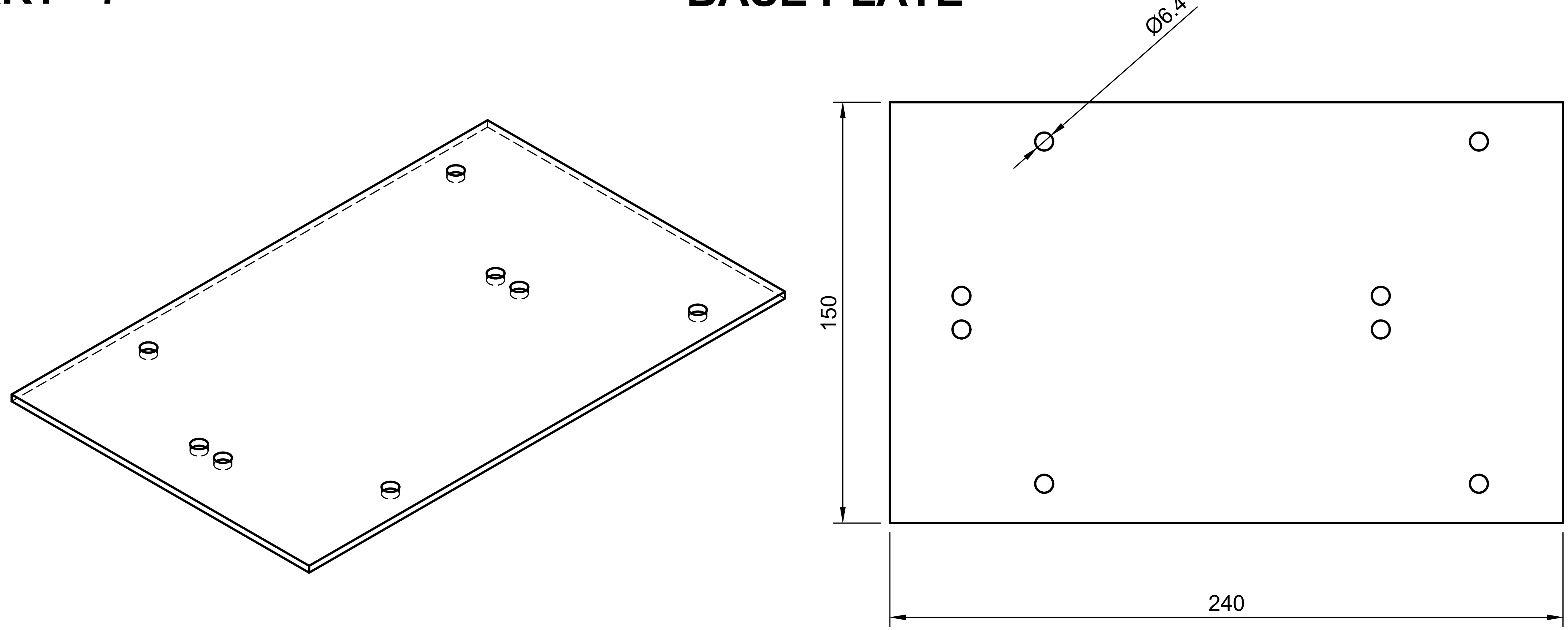
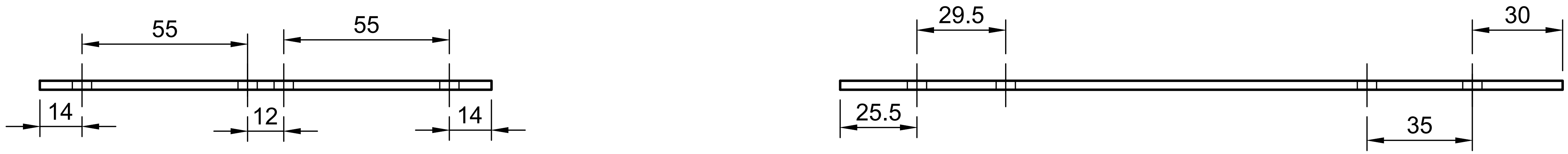
PART - 7

BASE PLATE





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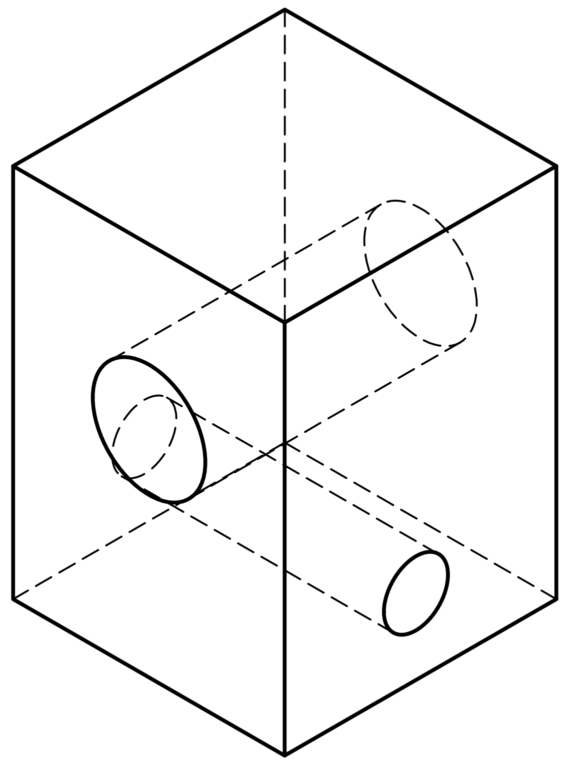
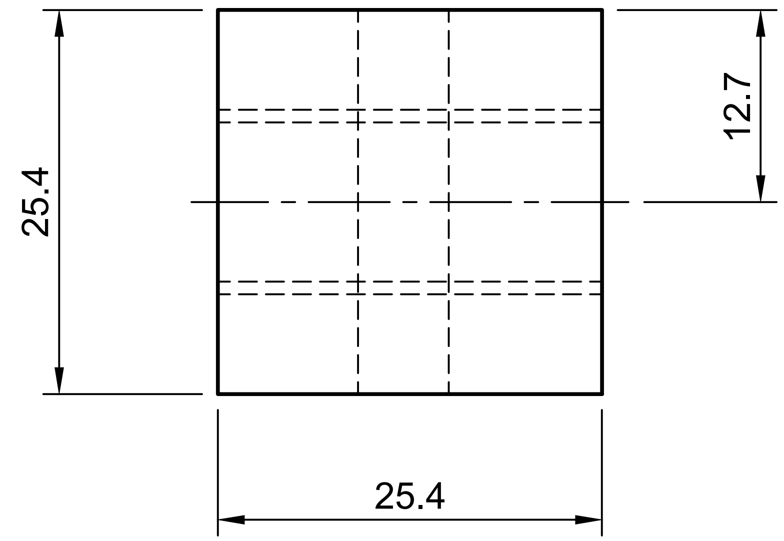
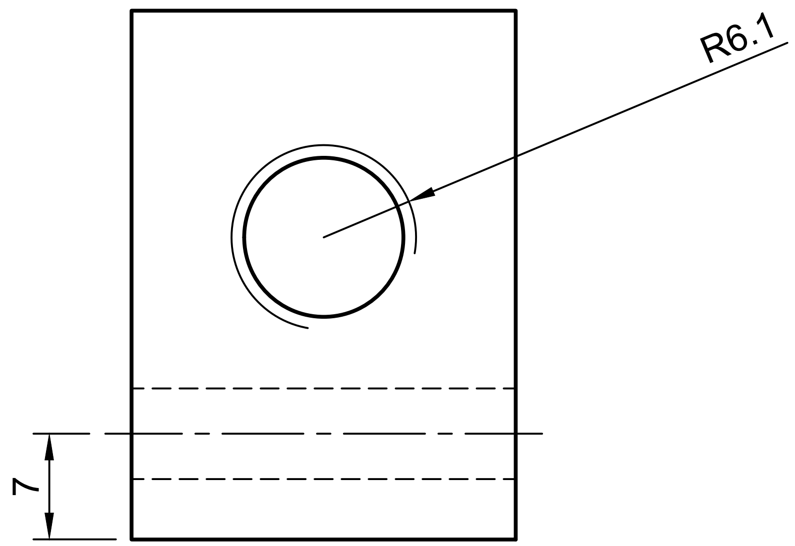
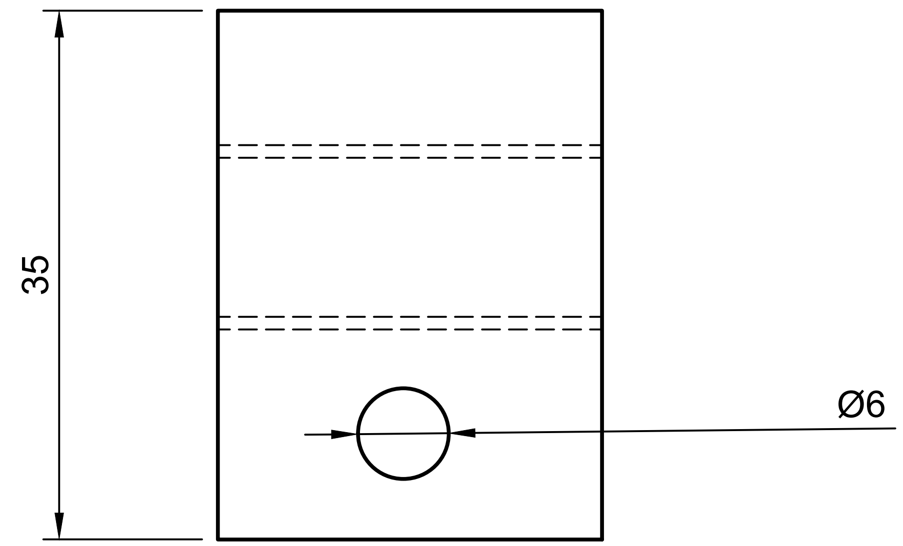
PART - 8

SQUARE NUT









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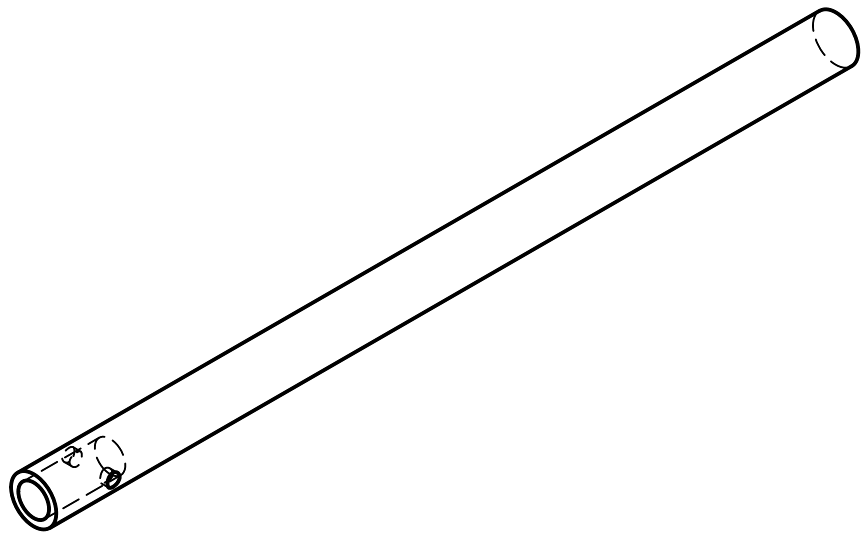
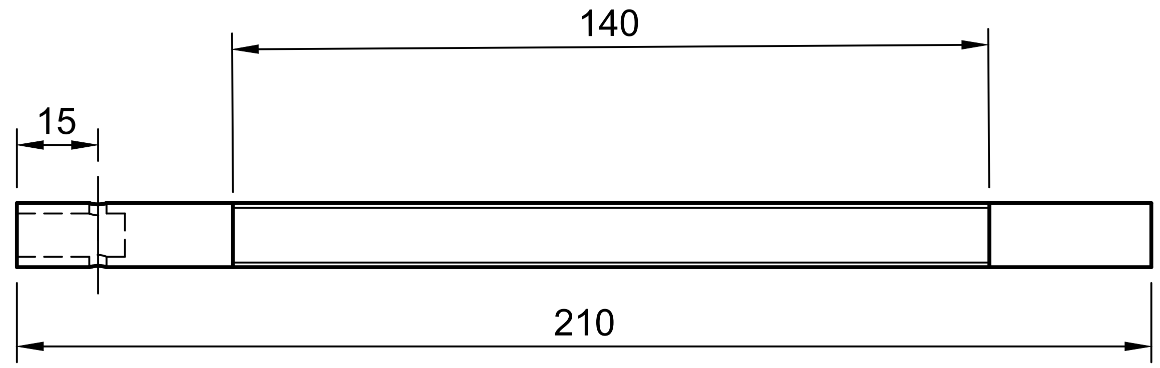
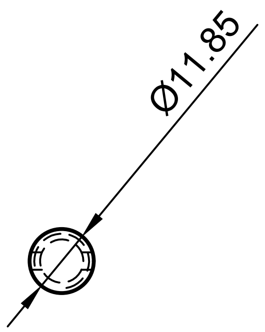
PART - 9

THREAD ROD





Pitch - 12tpi



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Cost Analysis

Material Coal-

1. Mild Steel – 18(KG) * 75(Rs./Kg) = 1350Rs
2. Nut and Bolts – 2.5(Kg) * 85(Rs./Kg) = 212.50Rs
3. Split Screw – 45 pieces * .75(Rs/piece) = 33.75RSs
4. Chain and Sprocket system = 150Rs

   Total Mechanical Cost - 1746.25 Rs

Machining Cost

1. Lathe – 0(hrs) * 250(Rs/hrs) = 000Rs
2. Milling - 3(hrs) * 350 (Rs/hrs) = 1050Rs
3. Drilling – 10(hrs) * 75(Rs/hrs) = 750Rs
4. Cutting – 1(hrs) * 60(Rs/hrs) = 60Rs

   Total Machining Cost = 1860 Rs

Labour Cost-

1. Skilled – 23(hrs) * (550/8)(Rs/hrs) = 1581.25 Rs
2. Unskilled – 88(hrs) * (450/8)(Rs/hrs) = 4950 Rs

   Total Labour Cost=6531.25 Rs

Total cost = Material Cost + Machining Cost + Machining Cost + Labour Cost
= 10137.75 Rs

COST ESTIMATION

MATERIAL	COST/KG.
M.S	Rs.90/KG
Nuts Bolts	Rs.130/KG
Clips & Folds	Rs.120/KG

MACHINING COST

Lathe	Rs.350/Hrs.
Milling	Rs.450/Hrs.
Drilling	Rs.100/Hrs
Cutting	Rs.60/Hrs

Labour Cost

Un Skilled	Rs.650/Day(8Hrs.)
Skilled	Rs.850/Day(8Hrs.)

Calculations and Observations

Maximum Load

J_t = Inertia of the table = $m\,(p_b/2\pi)^2$

J_s = Inertia of the screw = $\rho l_b d_b^4\,\pi/32$

Load Inertia, $J_L = J_t + J_s$

where, p_b = pitch of screw (mm/rev) = 4.8 mm/rev

d_b = diameter of lead screw (mm) = 12.7 mm

l_b = length (mm) = 360 mm

ρ = density of iron = 7800 kg/m^3

t_a = acceleration/deceleration time = 1 s

v = velocity in rpm = 30 rpm

$T_a = J_L v/9.55\ t_a$ = 1 N-m (given)

=> $J_L = 9.55\ t_a / v = 9.55 \times 1 \times 6/30 = 1.9$ kg-m^2

And, $J_t = J_L - J_s = 1.9 - \rho l_b d_b^4\,\pi/32$

$= 1.9 - 7800 \times 0.36 \times (0.0127)^4 \times \pi/32$

$= 1.9 - 7.17 \times 10^{-6}$

$= 1.9$ kg-m^2

$m\,(p_b/2\pi)^2 = 1.9$

=> $m\,(4.8/2\pi)^2 = 1.9$

=> $m = 1.9/0.63$

=> $m = 3$ kg

Maximum Height

p_b = pitch of screw (mm/rev) = 4.8 mm/rev

p_y = distance moved in vertical direction per rev = 7.5 mm/rev

l_x = length of slot = 116 mm

l_y = total displacement in vertical direction (final height of top plate)

n = no. of rev to be performed for slot distance

y_0 = initial height of top plate = 16.4 cm

Thus,

$p_b = l_x/n \quad => \quad n = l_x/p_b = 116/4.8 = 24.167$ rev

$p_y = l_y/n \quad => \quad l_y = np_y$

$l_y = 24.167 \times 7.5$

$l_y = 181.25$ mm or 18 cm

Hence,

$Y_{max} = y_0 + l_y = 16.4 + 18.1 = 34.5$ cm

WEAKNESSES OF THE SCISSORS SCREW JACK-

1. The jack can only lift upto 3 kg and the round-shaped object would roll-off the top plate.
2. The speed of jack cannot be increased much because of the zig-zag structure of bars.

FUTURE MODIFICATIONS-

1. We can change the top plate and use different top plate according to our requirement.
2. We can make the structure more strong so that its speed can also be increased.
3. Using lighter rods and bars using less material.
4. Can be modified to work with high power motor.

USES-

Can be used to lift a certain weight upto certain height using the rotational energy given by motor to thread rod and converting it to potential energy using the rods and bars aligned in the zig-zag manner.