



DESIGN OF A TANK LIFTING EQUIPMENT



ISO 9001:2000
Certified

A PROJECT REPORT

Submitted by

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*in partial fulfilment for the award of the degree
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DEPARTMENT OF MECHANICAL ENGINEERING

PROJECT WORK

This is to certify that the project entitled

DESIGN OF A TANK LIFTING EQUIPMENT

is the bonafide record of project work done by

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of B.E. Mechanical Engineering during the year 2011-2012



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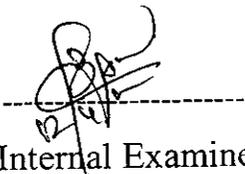
Project Guide



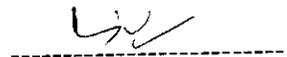
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Submitted for the End semester examination held on 12/04/2012 .



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ABOUT THE COMPANY

ELGI Equipments limited, founded in the year 1960 as a part of large ELGI group of companies Coimbatore, has today emerged as one of the largest manufacturers of compressors in the world. The collective contribution of Elgi is correspondingly very significant.

ELGI has been conceived and developed over the years as an industrial expertise for providing high quality service in the field of compressors. They give utmost importance in enforcing quality and in following the principles of TQM.

A versatile base for taking up complex manufacturing processes coupled with the skilled manpower available at ELGI has enabled the company to master in the field of compressor manufacturing. ELGI is today, the market leader and Asia's largest manufacturer of air compressors and automobile service station equipment.

ELGI's products are used in a wide range of applications in areas ranging from mining, transport, pharmaceuticals, power, oil, railways, chemicals, textiles, printing to ship building, paper, electronics, telecommunications, medical, food & beverages and plastics.

The project work on Design Of Tank Lifting Equipment has been performed at ELGI Equipments Ltd, Coimbatore. This project is dedicated to the **Manufacturing Division** of ELGI Equipments Ltd, Coimbatore

ELGI

March 31, 2012

TO WHOMSOEVER IT MAY CONCERN

This is to certify that the following students have done a combined project work on the topic “**Design of a Tank Lifting Equipment**” in our organization between **19th December 2011 and 20th March 2012**.

During this period, their performance, conduct and character were found to be good.

1. Mr. Dinesh. R, Kumaraguru College of Technology, Coimbatore
2. Mr. Kirubha Karan, Kumaraguru College of Technology, Coimbatore

We wish all success in their career

for ELGI Equipments Ltd



Sundararajan V
DGM – Learning & Development

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I also thank all the staff members and the lab technicians in the organization and Mechanical Engineering Department for their excellent cooperation throughout the project work.

ABSTRACT:

At present, in ELGI Equipments Ltd., the compressor tanks of the Small Electric Powered Screw Air Compressor(SEPSAC) assembly(S1)line are assembled with the canopy structure using Electric Overhead Travelling(EOT) crane of 5 ton capacity(7.5kW motor). But the maximum weight of the tanks assembled in the S1 line is limited to 150 kgs. Moreover the vertical space is not properly utilized due to the presence of EOT crane. The main objective of our project is to eliminate the EOT crane and to design a tank lifting equipment, which could use pneumatic power source and occupy minimum floor space. The equipment model that we have proposed is mobile with wheels fitted to its base. Clamping can be performed quickly, compared to the present system that uses a EOT crane. Two separate grippers of varying thickness can be used by toggling between them in the same equipment. Labor fatigue can be considerably reduced ensuring safety to the workers. The model consists of a vertical structure called rails, which guides the beam structure. The beam is separately attached to the pneumatic cylinder by means of a flexible link. This reduces the moment acting on the cylinder. Taking in to consideration the maximum cylinder range specified, this mode has been proposed.

TABLE OF CONTENTS

CHAPTER NO	TITLE	PAGE No
	ABOUT THE COMPANY	iii
	ABSTRACT	v
	LIST OF TABLES	ix
	LIST OF FIGURES	x
	LIST OF ABBREVIATIONS	xi
1	INTRODUCTION	1
	1.1 OBJECTIVE OF THE PROJECT	1
	1.2 Present practice	1
2	DESCRIPTION OF TANK AND PROPOSED MODEL	3
	2.1 About the tank	3
	2.1.1 Split type tank	3
	2.1.2 Vertical tank	4
	2.2 Proposed system	5
3	PART DESCRIPTION	6
	3.1 Major components	6
	3.2 Base	6
	3.3 Pneumatic cylinder	8
	3.3.1 Technical details	9
	3.4 Rail	9
	3.5 Beam	10

	3.6 Gripper	11
	3.7 Toggle Clamp	15
4	OPERATING PROCEDURE	16
	4.1 Process description	16
	4.2 Steps Involved	16
	4.2.1 Initial setup	16
	4.2.2 Clamping	16
	4.2.3 Tank lifting	17
	4.2.4 Assembly in canopy	17
	4.3 Global series tank	18
5	DESIGN CALCULATION	19
	5.1 Beam design	19
	5.2 Pivot bolt calculation for horizon series	20
	5.3 Swinging arm bolt calculation for	
	Global series	19
	5.4 Pneumatic cylinder selection	23
	5.5 Bolts on the rail base	24
	5.6 Hook design	25
6	ANALYSIS OF COMPONENTS	26
	6.1 Gripper analysis for	
	Horizon series	26
	6.2 Gripper analysis for	
	Global series	28
	6.3 Analysis of rail	29

7	BILL OF MATERIALS	30
8	CONCLUSION AND FUTURE DEVELOPMENT	33
	REFERENCES	34
	LIST OF DRAWINGS	

LIST OF TABLES

S.NO	TABLES	PAGE NO.
01	Material properties	26
02	Bill of materials	30

LIST OF FIGURES

S.NO	FIGURES	PAGE NO.
01	Assembly of tank in canopy structure	2
02	Split type tank model	4
03	Vertical type tank model	4
04	Equipment model	5
05	Base plate	7
06	Base castor wheel	7
07	Pneumatic cylinder	8
08	Rails& sliders	10
09	Beam	11
10	Gripper model	11
11	Horizon series gripper	12
12	Global series gripper	12

13	C-clamp	13
14	Beam support	13
15	Flange support	14
16	Base cylinder housing	14
17	Toggle clamp	15
18	Initial setup & clamping	16
19	Tank lifting & assembly	17
20	Equipment & Global series tank	18
21	Analysis of Horizon series gripper	27
22	Analysis of Global series gripper	28
23	Analysis of rails	29

LIST OF ABBREVIATIONS

- M-** Bending Moment(N-mm)
- F-** Stress(N/mm²)
- I-** Moment of inertia(mm⁴)
- FOS-** Factor of safety
- P-** load applied(N)
- l-** length(mm)
- d-** diameter of the bolt(mm)
- A-** area(mm²)
- y-** distance from outer surface to neutral axis
- h-** height(mm)
- s-** stroke length(mm)

CHAPTER 1

INTRODUCTION

1.1 OBJECTIVE OF THE PROJECT:

- To eliminate Electrical Overhead Travelling (EOT) crane in SEPSAC(S1) assembly line for lifting tanks
- To design a tank lifting equipment
- Use of pneumatics is preferred
- Quick clamping should be done
- Same equipment should be used for gripping tanks of various sizes

1.2 PRESENT PRACTICE:

At present in SEPSAC (S1) assembly line of ELGI Equipments Ltd., assembly of two types of compressors is done. They are **HORIZON & GLOBAL** SERIES namely. For lifting the compressor tanks in this assembly line, an EOT crane of 5 ton capacity is used.

The tanks are assembled separately in sub-assembly line and are brought to the main assembly line by using trolleys. Once the trolley is brought in to position, a belt is used to hold the tank in position and the tank is lifted using an EOT crane. (The tank is initially at a height of 100mm from the ground. It is lifted to a height of 420mm above the ground level using the EOT crane). Then the tank is assembled with the canopy, which houses the other major components like motor, airend, cooler, etc...

The assembly of tanks with a the canopy structure in the present setup is depicted in the figure.1



figure.1: assembly of tank in canopy structure

CHAPTER 2

DESCRIPTION OF TANK AND THE PROPOSED MODEL

2.1 ABOUT THE TANK:

Two types of tanks are used in the SEPSAC assembly line (S1), they are

- Split type tanks(10series,12series)
- Vertical tanks(F2 series)

The tanks are of different sizes. Assembly of accessories for the tanks is done separately in the sub-assembly line. Holding position for the tanks also vary while lifting them.

2.1.1. SPLIT TYPE TANK:

There are two series of split type tanks namely

- 10 series tanks
- 12 series tanks

They are hollow structures of 4mm thickness and can be divided in to three major parts namely, the upper part, neck region and the lower part. The lower part houses the oil filter, the neck region joins the upper and the lower parts.

The basic difference in these types of tanks is the overall height of the tanks and their mounting points. The 10 series tanks are 598mm high with their mounting point at a height of 320 mm from the base. These tanks are fitted with oil filter, air filter and other accessories in the sub-assembly line. Typical model of 10 series and 12 series split type tank is shown in the figure.2

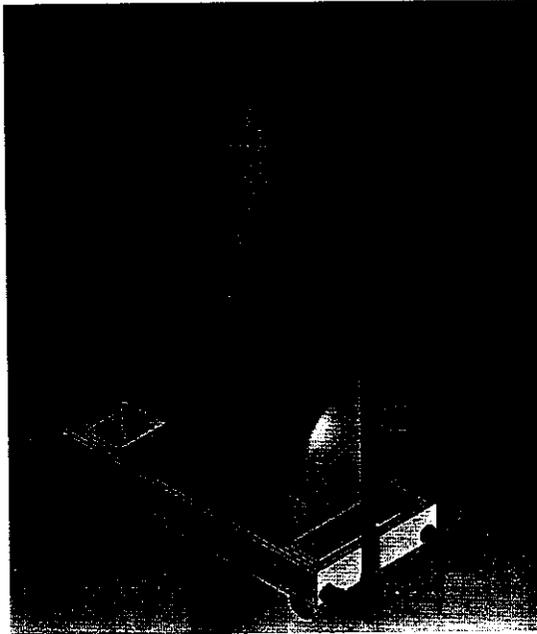


figure.2: split type tank model

2.1.2. VERTICAL TANK:

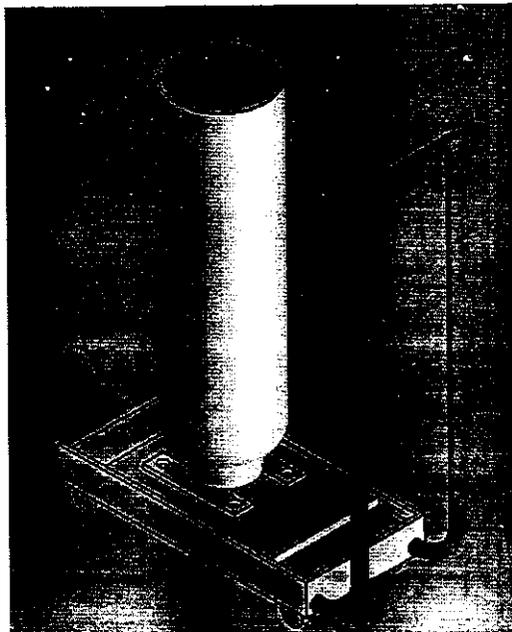


figure.2.1: vertical type tank model

Typical model of vertical tank is as shown in the figure2.1. They are also called F2 series tanks. These types of tanks are used in the latest version of the compressors called, GLOBAL SERIES. Total height of the tank is 837mm and the mounting point is half the distance from its base (i.e. center of gravity of the tank)

2.2. PROPOSED SYSTEM:

The main objective of our project is to design a lifting equipment, which uses pneumatic power source for lifting the tanks. The basic concept involved in our project is that, when the tank is brought in to the position with reference to the equipment (in sub-assembly line), it is gripped by the equipment using the suitable gripper and then it is clamped to ensure the tank from slipping.

The clamping is achieved by manual toggle (pull action) clamp. By using pneumatic power source, the tanks are lifted to the required level from the ground. Since the equipment is mobile, it is brought in reference with the main trolley and the tank is lowered. Finally the tank is assembled with the canopy structure.

Typical equipment model is shown in the figure.



figure.2.2: equipment model

CHAPTER 3

PART DESCRIPTION

3.1 MAJOR COMPONENTS:

Following are the major parts/components of the equipment

- Base
- Pneumatics cylinder and accessories
- Rails
- Beam
- Gripper
- Toggle clamp

3.2 BASE:

It is a rigid structure made up of steel. It is fitted with the rollers, and supports the entire equipment. Clearance from the ground level is about 164mm. Thickness of the base plate is about 10mm. overall dimension of base is 600x400 mm.

Drills can be made at required portions of the base plate and the vertical structures are attached to the base by means of fasteners. Material used is mild steel. It is mounted with four caster wheels, rails, beam supports and flanges supporting pneumatics cylinder. It also carries the cylinder housing arrangement.

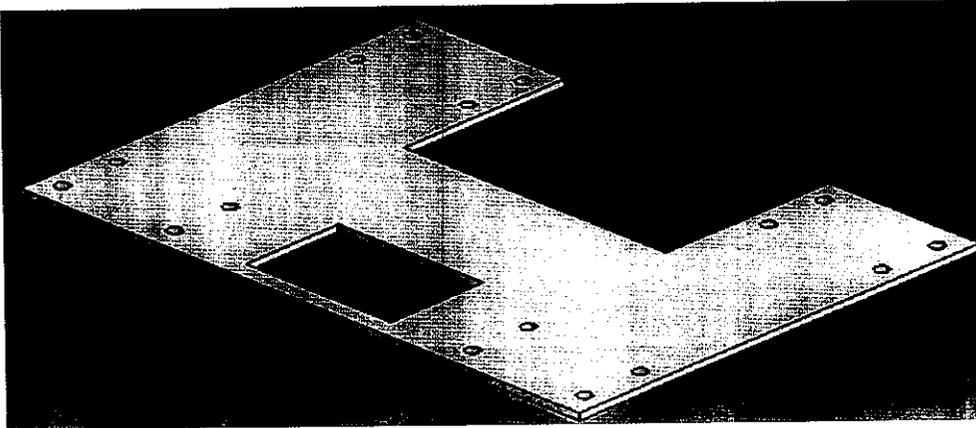


Figure 3.1: base plate

Base roller:

There are two types of rollers fixed and swivel type rollers namely. The swivel type rollers are used for steering the direction of the equipment. In this equipment, fixed rollers are located at the front end and the swivel rollers at the rear end, to control the equipment effectively. The rollers are 100mm diameter and the height of the rollers is 164mm. The roller material is nylon and the weight carrying capacity is 750kgs. Width of the rollers is 50mm.

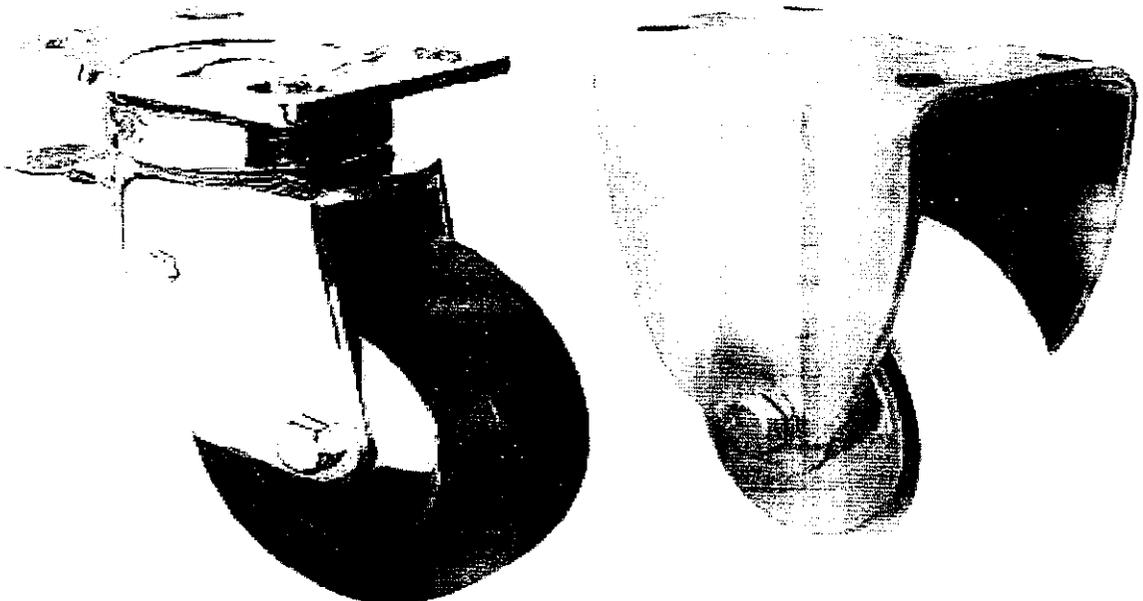


Figure 3.2: base castors wheel (swivel and fixed type)

3.3 PNEUMATIC CYLINDER (DOUBLE ACTING CYLINDER-SQUARE TYPE):

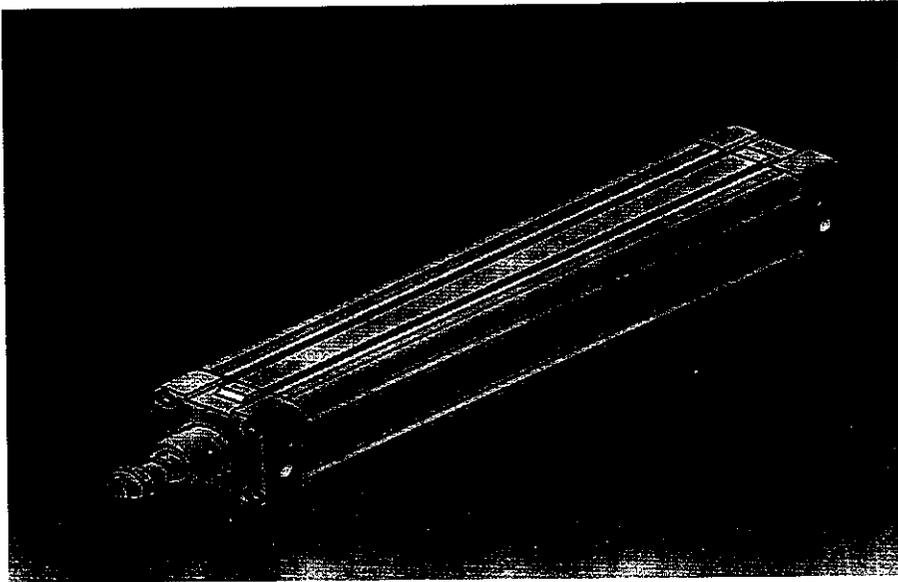


Figure 3.3: Pneumatic Cylinder

Pneumatic cylinders (known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion.

Like hydraulic cylinders, pneumatic cylinders use the stored potential energy of a fluid, in this case compressed air, and convert it into kinetic energy as the air expands in an attempt to reach atmospheric pressure. This air expansion forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved.

Engineers prefer to use pneumatics sometime because they are quieter, cleaner, and do not require large amounts or space for fluid storage.

Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement.

3.3.1 Technical details:

- Diameter = 80mm
- Available pressure = 4 bar
- Stroke length = 400mm
- Extend force =1809N
- Retract force =1633N
- Cushioning of 25mm at both end
- Supported by rear and front flange

Pneumatics Accessories:

5/3 Block type solenoid valve is used. It blocks the pneumatics circuit when there is power failure (pneumatics supply).Flow control valve is used to vary stroke speeds. Filter regulator unit is used to prevent entry of foreign particles and regulate air supply. Silencer is used at both inlet to avoid noise generated while working. The diameter of the hose used is 8mm. rear and front flanges are used for mounting the cylinder in rigid position.

3.4 RAILS:

They are the structure which helps the rollers to slide in the vertical direction. The length of the rails is 1m. It is composed of two different structures, an L-frame and a plate welded together. The L-frame has basic dimension of (3.5 inch * 2.5 inch) and 0.5 inch thick. The plate is 2.5inch wide and 0.5 inch thick. The sliding casters are attached to the H-beam (cantilever structure). The model of rails used in the equipment is shown in the figure. Top plate of rail is made of 10mm plate fastened at top of rails by bolt.

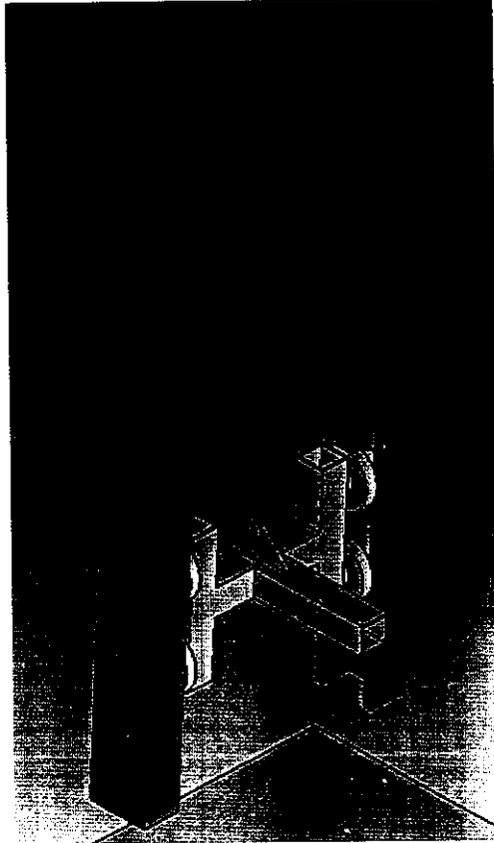


figure.3.4: rail and sliders

Gussets are provided along with bolts to support the rail column. They are made up of mild steel plate of 10mm thickness. Sliding flanged casters are used to guide the beam smoothly over the rails. The diameter of the sliders is 3 inch and length is 2.5 inches.

3.5 BEAM:

The beam is of canti-lever type. It is supported by means of T-frame at the bottom. Length of the beam is 405mm, one end of the beam is welded and the free end carries a gripper. Cross-sectional area of the beam is hollow square and the thickness is 3mm. Material used is mild steel. It is to be noted that the beam is not directly lifted by the cylinder, whereas rope is attached to the L-beam (attached at the top of the cylinder) which raises/lowers the cantilever beam according to the action of the cylinder.

The beam is guided by the rollers on either side for the vertical motion in the rails. Typical model of the beam is depicted in the figure

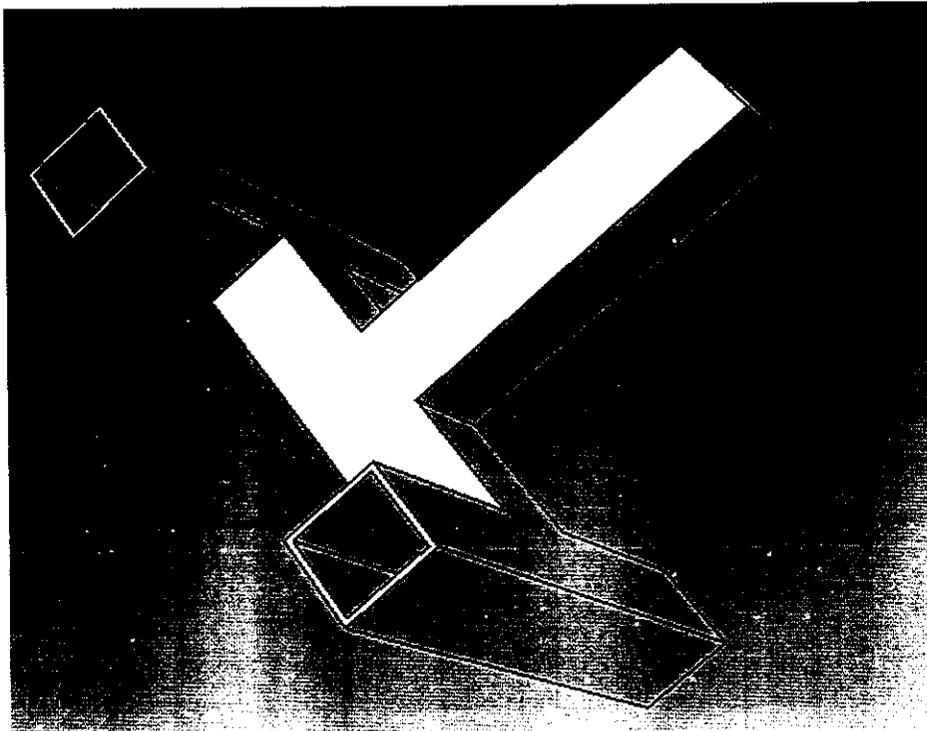


figure.3.5: model of beam

3.6 GRIPPER:

Two grippers are accommodated in the same equipment, the gripper in the figure3.6 is used for split type tanks, while the gripper in the figure3.7 is used for vertical tanks. Both the grippers can be made out from mild steel. The grippers are pivoted at one end as shown in the figures.

The gripper used for vertical tank uses a magnet for locking, when it is in idle state. Soft material is pasted over the surface of contact of the gripper with that of the tank to prevent any damage to the tank. The thickness of the grippers is 8mm & 10mm respectively.

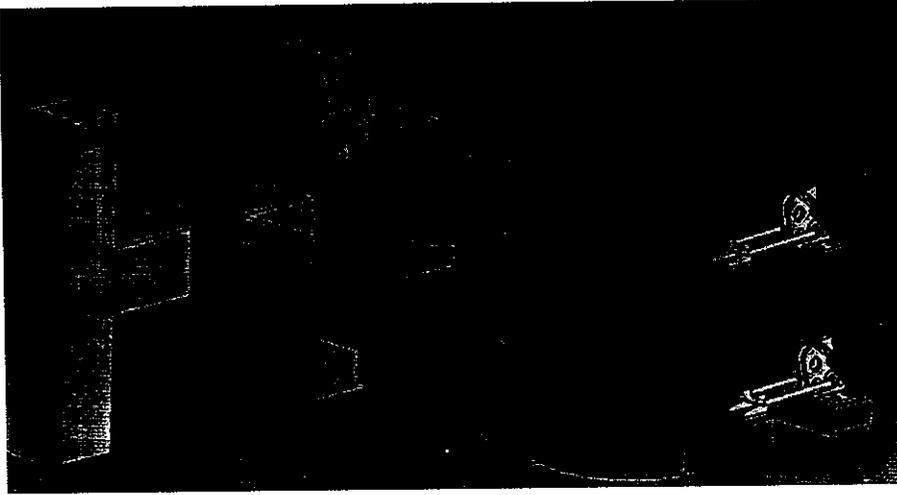


Figure3.6: gripper model

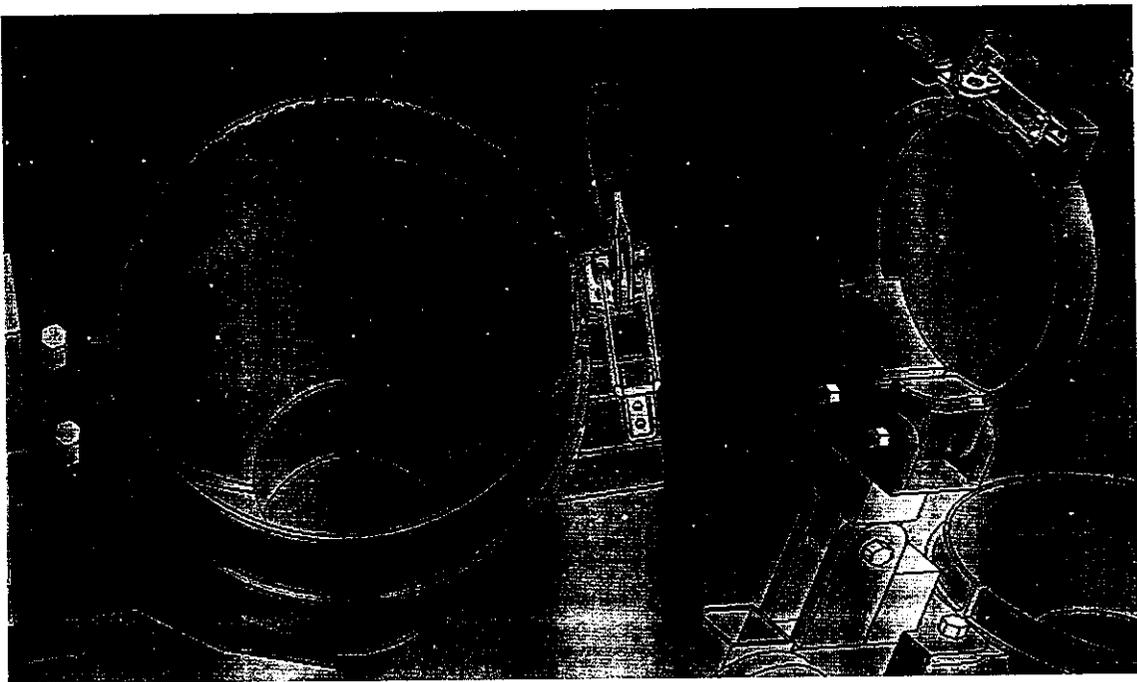


Figure3.7: horizon series gripper

Figure3.8: global gripper

C-CLAMP:

It provides swinging action to the grippers pivoted on it. Pivot is made by fastened with bolt. The edge of plate is filleted or chamfered to enhance a gripper movement of about 100 degrees from the locking axis. The centre structure is stop for travel of gripper when clamped.

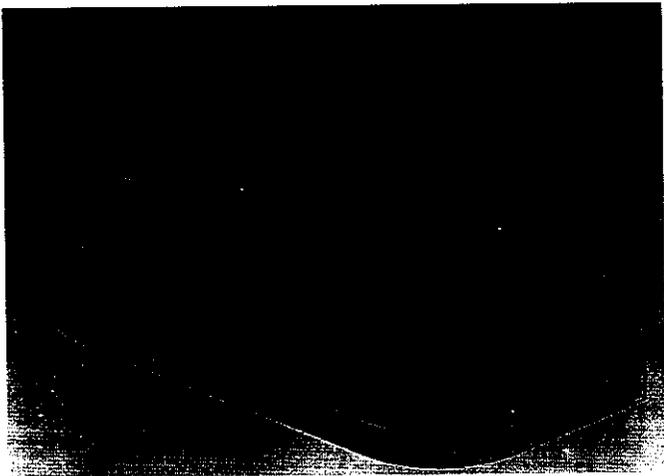


Figure3.9: C-clamp

Beam support:

When beam retracts it rests on the support from base. The cylinder is not carrying any load when there the equipment is not working. Full load will be balanced by rails and beam support at rest condition.



Figure3.10: beam support

Flange support:

The cylinder is mounted rigidly by means of top and lower flanges. The top flange is supported by means of top flange support whereas lower flange is supported by means of cylinder base housing. Flanges are fastened to plates (supports) by means of bolts. One face of cylinder base housing is opened to have connections for pneumatic house.

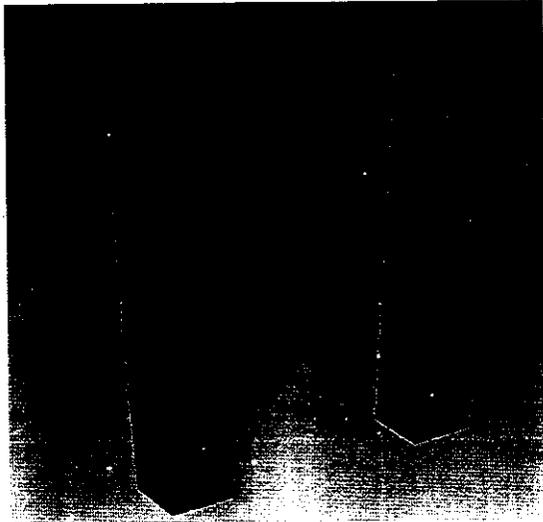


Figure3.11: top flange support

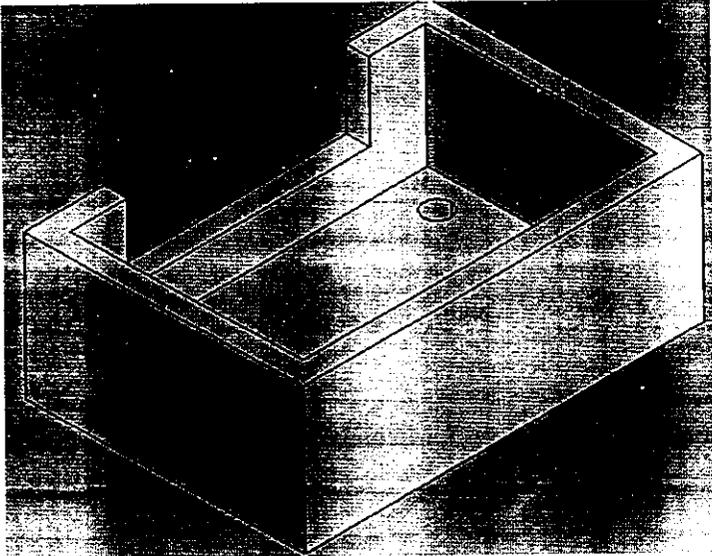


Figure3.12: Base cylinder housing

3.7 TOGGLE CLAMP:

It is attached to the gripper and consists of two parts namely, male and female part. The toggle clamp used is manual pull-type clamp (manual clamp). It is to be noted that the gripping force required is thrice the force required for holding.

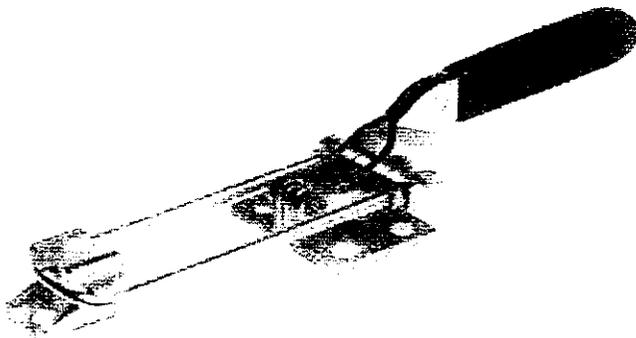


Figure.3.13: toggle clamp

Technical specifications:

- Holding capacity= 350kgs
- Weight = 350gms
- Overall length= 190mm
- Overall width =45mm
- Drawing movement= 50mm

CHAPTER 4

OPERATING PROCEDURE

4.1 PROCESS DESCRIPTION:

- Sub-assembly of tanks are done separately.
- Then the tanks are brought to the main assembly line using trolleys.
- The equipment (proposed) is aligned with reference to the trolley.
- Clamping of the tanks is done
- Using the pneumatic power source, the tanks are lifted to the required position and assembled with the canopy structure.

4.2 STEPS INVOLVED:

4.2.1 STEP1: INITIAL SETUP



4.2.2 STEP2: CLAMPING

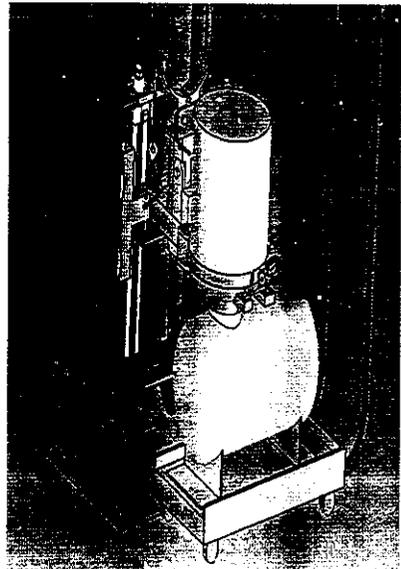


Figure.4: initial setup & clamping

The figures depict the initial setup of the equipment and clamping of the tanks respectively. Initially tanks are at height of 100mm from the base. They are clamped at a height of 437mm from the ground. The grippers can be rotated freely through an angle of 100 degrees. Clamping is achieved manually using the toggle clamp.

4.2.3 STEP3: TANK LIFTING

4.2.4. STEP4: ASSEMBLY IN CANOPY

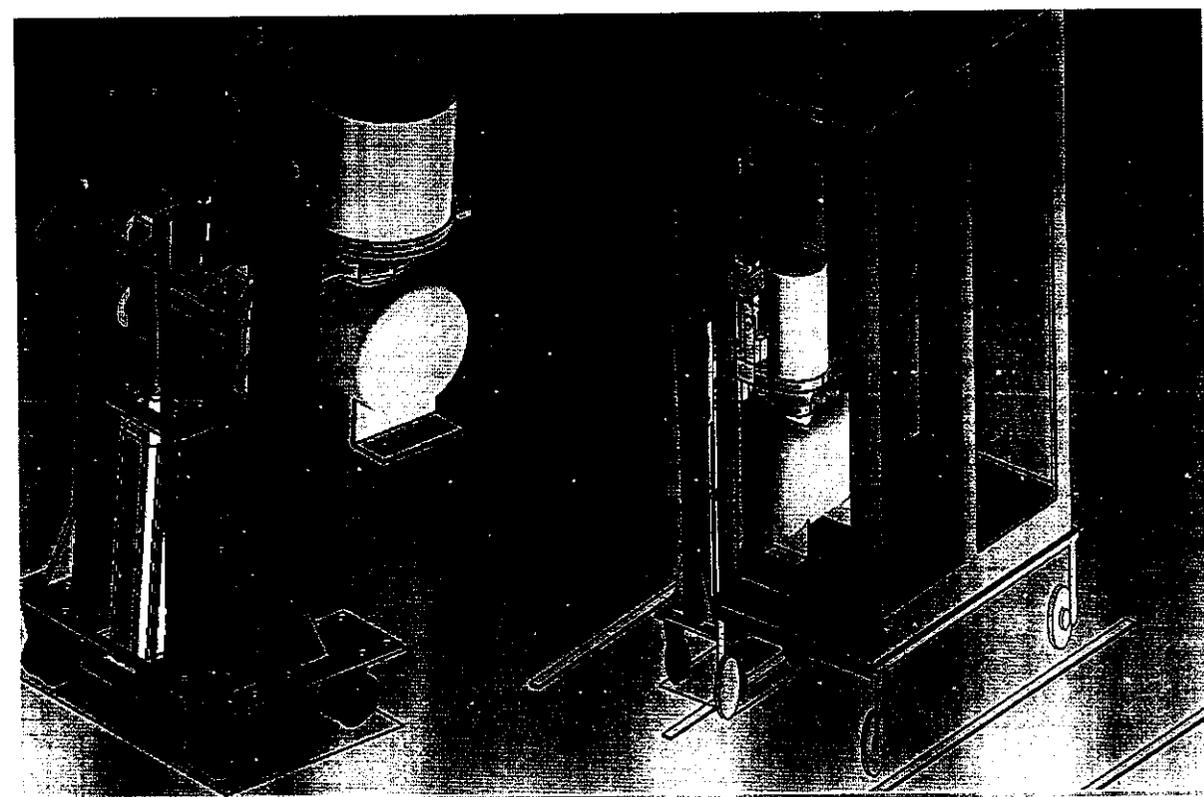


Figure.4.1: tank lifting & assembly

The tanks are lifted to a height of 400mm from its clamping stage using pneumatic power source. They are then located inside the canopy and assembled.

4.3 GLOBAL SERIES TANK:

Same procedure is to be followed for lifting F2 series tanks. While doing so, the 8mm grippers are brought to the initial condition and clamping is achieved by using 10mm grippers. A model depicting the equipment and the F2 tank is shown in the figure

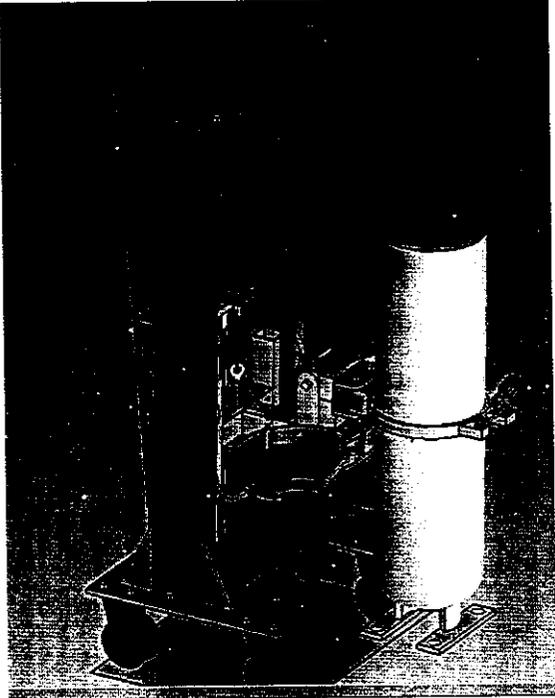
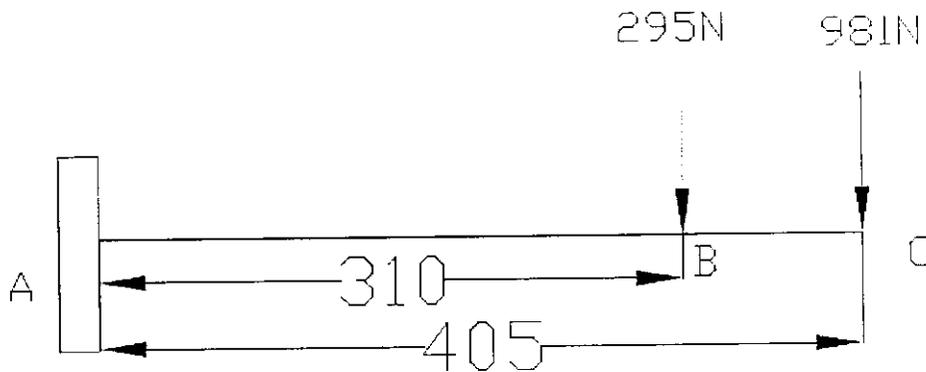


Figure.4.2: equipment & global series tank

CHAPTER5

DESIGN CALCULATION:

5.1 Beam dimensions:



Length of the canti-lever beam =405mm

Load at free end =981N

Load at 310 mm from fixed end =295N

Taking moment about the fixed end,

$$M_a = (981 \cdot 405) + (295 \cdot 310)$$

$$M_a = 488755 \text{ Nmm}$$

We know that,

$$(M/I) = (f/y)$$

$$F = (240/4) = 60 \text{ N/mm}^2$$

$$Y = D/2 = 25 \text{ mm}$$

Taking standard values (since $D=50\text{mm}$)

$$I = (D^4 - d^4)/12$$

$$(60/25) = (488755/I)$$

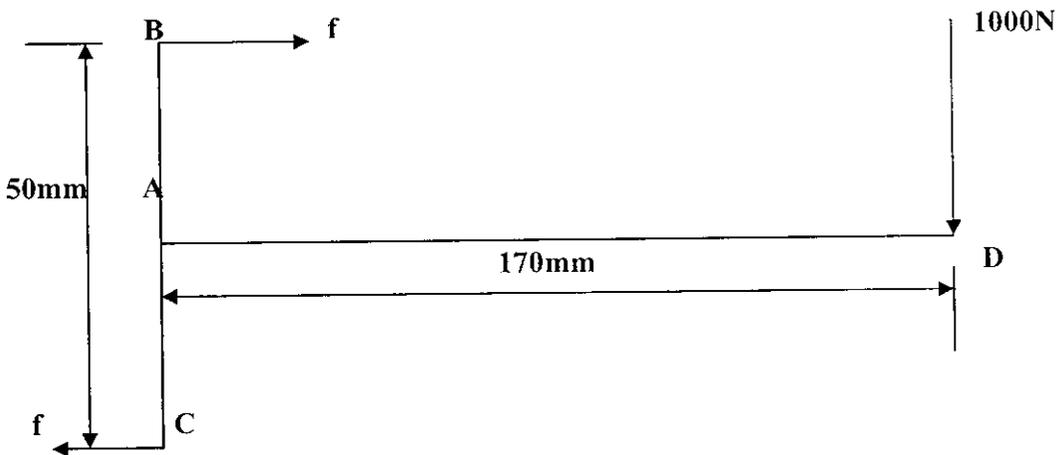
$$I = 2036479\text{mm}^4$$

Hence equating I, we get $d=44.169\text{mm}$

Therefore, $D=50\text{mm}$, $d=44\text{mm}$

Thickness of the beam= 3mm

5.2 Pivot bolt calculation for horizon series:



Distance of gripper load point and pivot= 170mm

Load at gripper load point (self and tank weight) = 1000N

Bending moment about pivot= $1000 \times 170 \text{ Nmm}$

Maximum bending moment= $1,70,000\text{Nmm}$

There will be double shear in the bolt.

Shear force on the bolt, $F = (\text{Max. bending moment} / \text{dist between bolt})$

$$F = (1,70,000 / 50) \\ = 3400 \text{ Nmm}$$

Allowable shear stress = (allowable tensile stress / 2)

$$= (60 / 2) \\ = 30 \text{ Nmm}$$

We know that, shear stress = (shear force / shear area)

$$30 = (3400 / \text{area}) \\ \text{Area} = (3.141 * d^2) / 4 = 113.33 \\ \text{Dia of bolt, } d = 12 \text{ mm}$$

Designation of bolt = M12*1.25

5.3 Swinging arm bolt calculation for Global series:

Distance between gripper centre point and support point = 183 mm

Load at gripper centre point = 1000 N (self weight and tank weight)

Distance between support point (D) and the bolt (A) = 75 mm

Taking moment about D,

$$M_D = (183 \times 1000) - (F_A \times 75)$$

At equilibrium position, $M_D = 0$,

$$F_A = (183 \times 1000) / 75$$

$$= 2440 \text{ N}$$

Shear stress = (shear force) / (shear area)

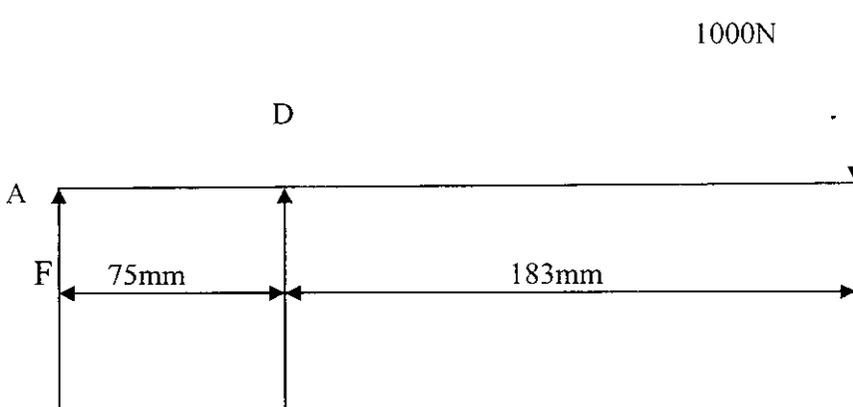
$$\text{Allowable shear stress} = 30 \text{ N/mm}^2$$

$$30 = (2440) / (\text{shear area})$$

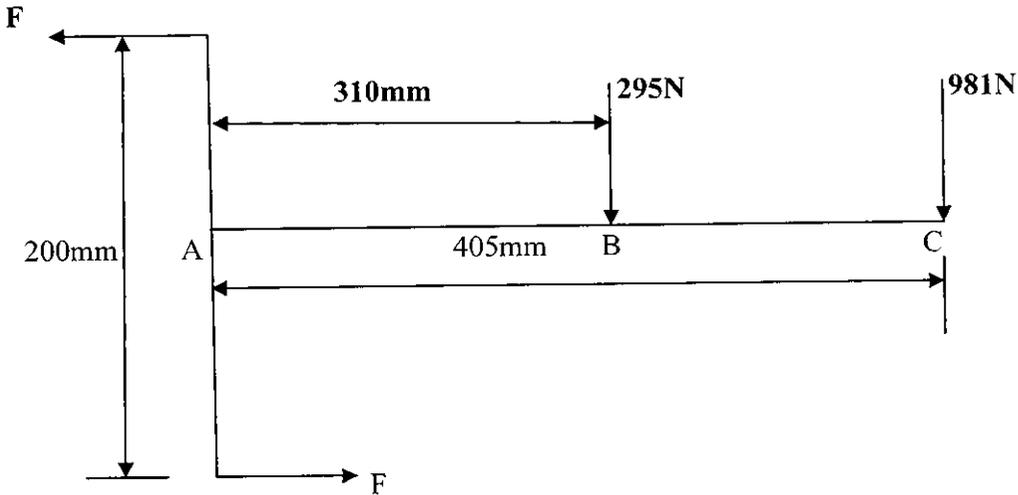
$$\text{Shear area} = 81.33 \text{ mm}^2$$

$$\text{Hence, } d = 10.176 \text{ mm}$$

From the data, the designation of the bolt is M12*1.25



5.4 Pneumatic cylinder selection:



Bending moment about A,

$$(981 \times 405) + (295 \times 310) = 488755 \text{ N-mm}$$

Normal reaction due to friction = (bending moment) / (dist. between sliders)

$$F = 488755 / 200 = 2.44 \text{ kN}$$

Resisting force = (co-efficient of friction * normal reaction)

$$= (0.1 \times 2.44 \times 1000) = 244 \text{ N}$$

Above result is the resisting force for the upper sliders (two no's)

Total resisting force for all the four sliders = $2 \times 244 = 488 \text{ N}$

Self weight of the beam = 295N

Weight of the tank = 981N

Required lifting force = $(488 + 295 + 981) = 1764 \text{ N}$

Taking standards, diameter of the cylinder = 80mm

Stroke length of the cylinder= 400mm

Available pressure= 4bar

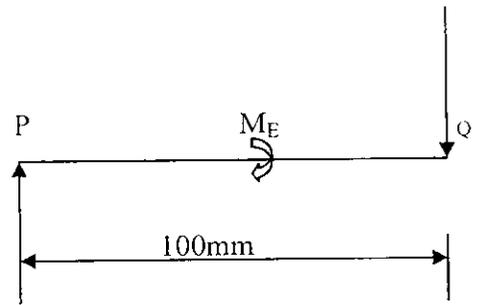
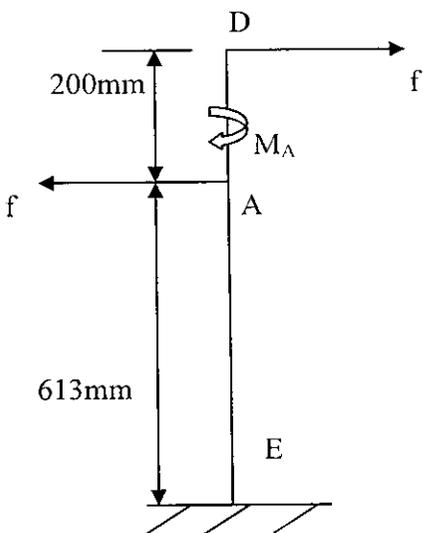
Extend force= 1809N

5.5 Bolts on the rail base:

The beam tends to produce a bending in the rails.

Bending moment about the axis of intersection of the beam and the rail,

$$(M_A) = (813 * 2.44 * 1000) - (613 * 2.44 * 1000) = 488000 \text{ Nmm}$$



Bending moment at the rail base,

$$M_E = 488000 \text{ Nmm}$$

P and Q represents the bolts located at the base.

$$F = (488000) / (100) = 4880 \text{ N}$$

Shear force=(4880)/(2)= 2440N

Stress = (force/area)

Area = (2440/30)=81.33mm²

d=10.176mm

Taking standard from isometric screw threads,

Designation-M12*1(fine series)

Nominal diameter =12mm

Pitch =1mm

5.6 Hooks:

Weight of the H-beam & gripper=130kg

Allowable tensile stress of the bolt = (yield stress/factor of safety)

= (240/4)=60N/mm²

Area = (1275.3/60)

Area = 21.255mm²

Taking standard values from chart (basic dimensions for isometric screw threads)

Designation-M8*1.25

Nominal diameter =8mm

Pitch=1.25mm

Tensile stress area =36.6mm

CHAPTER 6

ANALYSIS OF COMPONENTS

The below are the properties of mild steel which are used for analysis of following components.

Table.1: Material properties

Material	Steel
Young Modulus	2e+011N_m2
Poisson Ratio	0.266
Density	7860kg_m3
Thermal Expansion	1.17e-005_Kdeg

6.1 ANALYSIS OF GRIPPER (HORIZON SERIES):

The gripper is applied with a pressure of 28,550.79N (including self weight). The pivot point of the gripper is fixed

$$\text{Applied pressure} = (\text{load of tank} / \text{contact base area of gripper})$$

$$= (1000 / (3.141 * (120^2 - 57^2)))$$

$$= 28,550.79 \text{N/m}^2$$

6.2. ANALYSIS OF GLOBAL SERIES GRIPPER:

The gripper is of 10mm thickness and a pressure of 80,437 N/m² over top surface of gripper by fixing the pivot end.

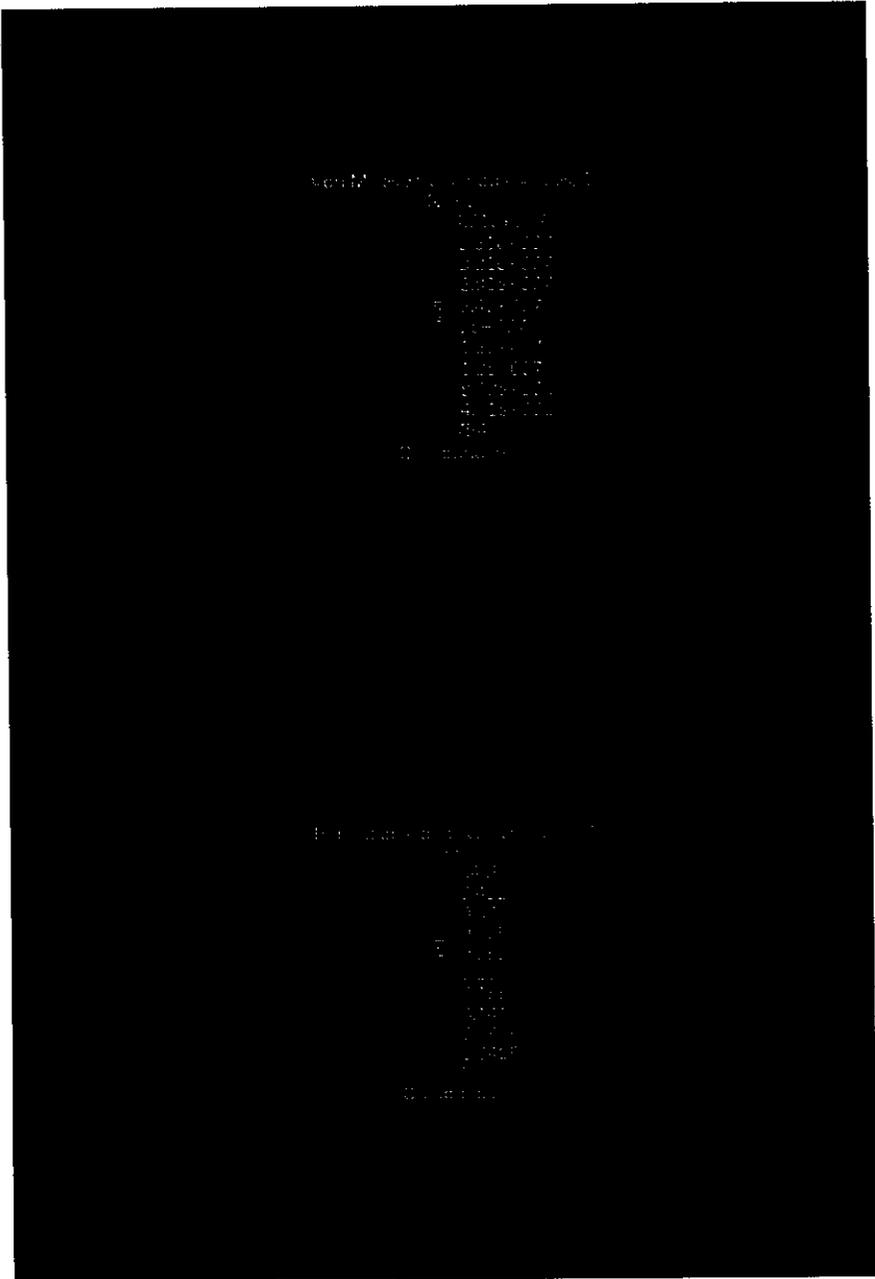


Figure.6.2: Analysis of F2 gripper

6.3 ANALYSIS OF RAILS:

Rails are 1m length and guide the canti-lever beam attached to sliding casters. Bending moment about 488755N-mm will be developed at 713mm from the base. This form a couple with a force of 3.3KN separated by a distance of 200 mm. Analysis is made fixing the lower end.

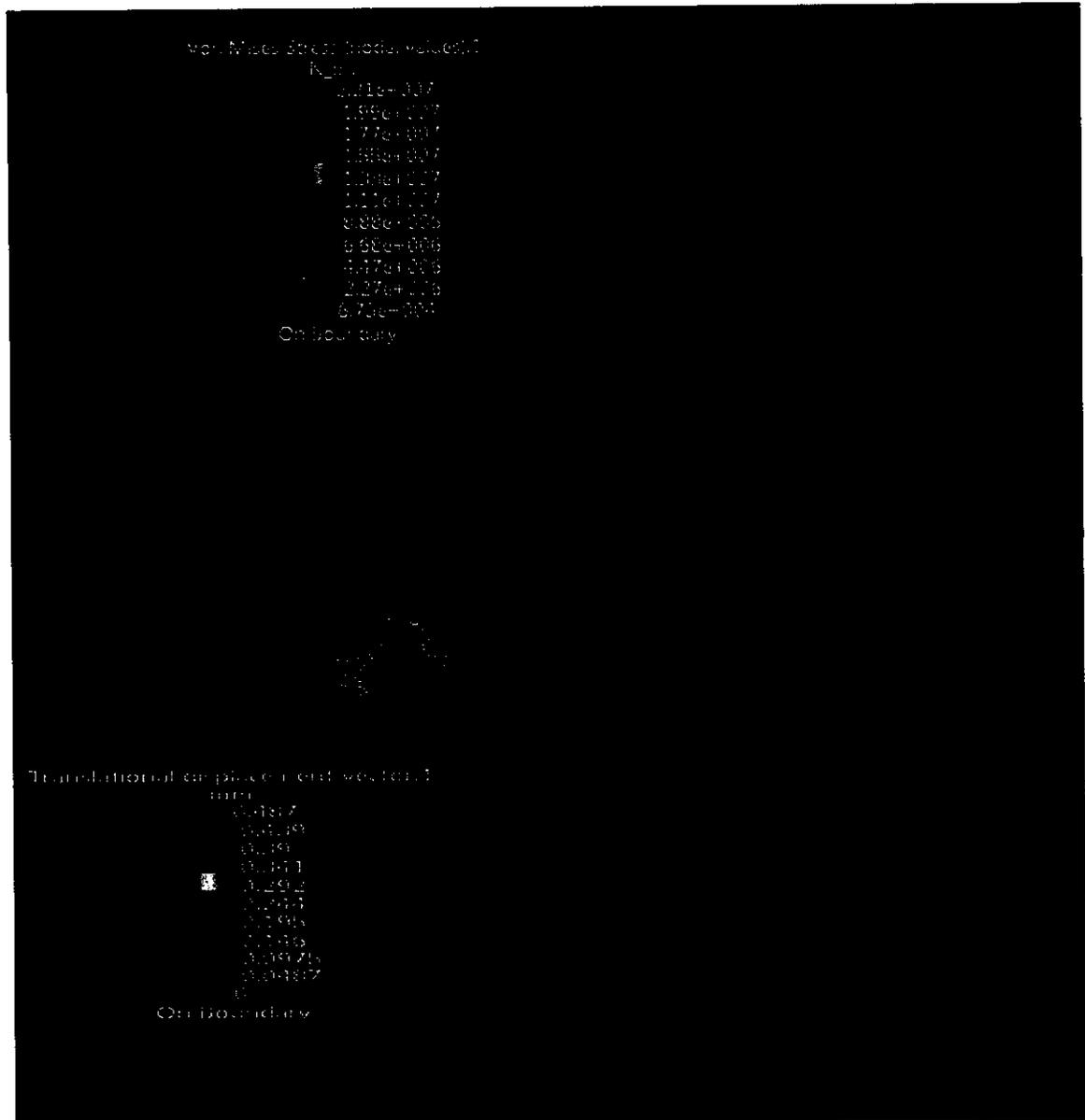


Figure.6.3: Analysis of F2 gripper

CHAPTER 7
BILL OF MATERIALS

COMPONENTS	MATERIAL/ SPECIFICATION	DIMENSION	MASS (kg/each)	QUANTITY
Base roller(swivel)	DXMBH-PT DIA 100	Width=50, Height=164	1	2
Base roller(fixed)	DXMBH-FX DIA 100	Width=50, Height=164	1	2
Base plate structure	Mild steel (plate)	(600x430x10)	14.94	1
Rail	Mild steel	C-section (4x2.5x2.5)inch Thick=0.5 inch	20.28	2
Rail top plate	Mild steel	550x100	4.39	1
sliding caster	Flanged	Dia 3.5 inch, Length=3.5 inch, Flange=1inch	1	4
H-beam	Mild steel	B=(50x50x3) Length=1000	3.99	1
Beam support	Mild steel	(150x75x10), B=(50x50x3) Length=263	2.05	1
Front flange support	Mild steel	(266x125x10), Beam(50x50x3) Length=500.	6.07	1
Handle	Mild steel	Dia=30,thick=1mm, Length=2500	3.12	1

Cylinder housing plate	Mild steel	175x120x10 100x80x10 175x80x10	3.34	1
Upper hook mountings	Mild steel	175x50x30	1.98	1
Lower hook mountings	Mild steel	50x25x25, 50x50x10	0.39	1
c-clamp	Mild steel	115x90x10, 115x70x10	1.38	2
Horizon gripper holder(right)	Mild steel	175x75x62	1.68	1
Horizon gripper holder(left)	Mild steel	175x75x62	1.68	1
Horizon gripper	Mild steel	(500x500x8)	2.61	2
Pivot(swing)	Mild steel	116x50x12.5	0.52	2
Connector(swing)	Mild steel	100x50x50	1.41	1
Solid block(swing)	Mild steel	65.5x50x38	0.933	1
Global toggle mountings	Mild steel	75x40x40	0.52	2
Global gripper	Mild steel	500x200x10 175x50x40	1.40	2
Toggle clamp	PAH-1725 (steel smith)	-	0.350	2
Gripper lock	OHNC	-	2	1
Front flange	MF1063 (janatics)	-	-	1
Pneumatics cylinder with rear flange	A24080400R (janatics)	-	25	1
Flow control valve	GR5105208	-	-	1

	(janatics)			
5/3 valve(blocked)	DS265SC61 220V (janatics)	-	-	1
Valve mountings	WP2110851 (janatics)	-	-	3
FRC unit	FRCLM146234/W (janatics)	-	-	1
FRC mountings	WP2210852 (janatics)	-	-	2
silincer	ASO/60 (janatics)	-	-	2
Tube(dia 8 mm)	WH00B08 (janatics)	-	-	3meters

CHAPTER 8

CONCLUSION & FUTURE WORK

The present system, using EOT crane involves huge investment and maintenance cost. Other drawbacks of using EOT crane is that it occupies vertical space in the shop floor, this prohibits the usage of display boards and other construction works.

Capacity of the EOT crane used in the SEPSAC(S1) Assembly line is 5 ton and uses 7.5kW motor. But the maximum weight of the tanks assembled in the S1 line is limited to 150 kgs. Hence, the power is being wasted for lifting purpose.

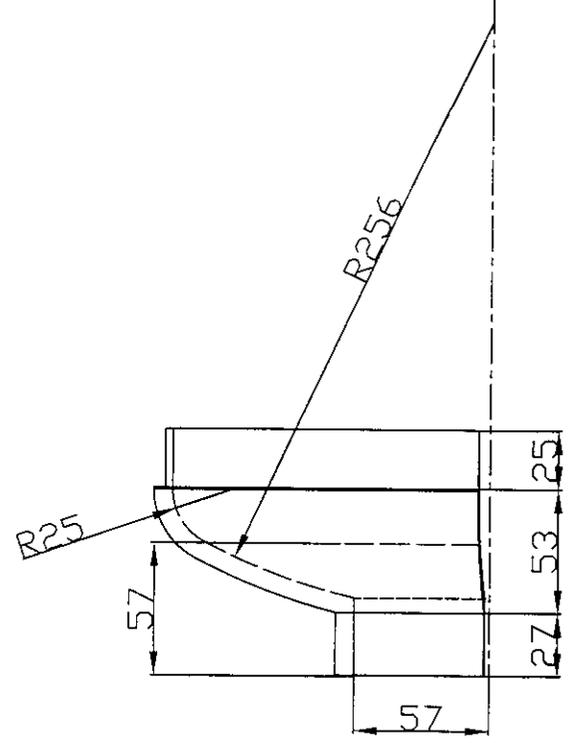
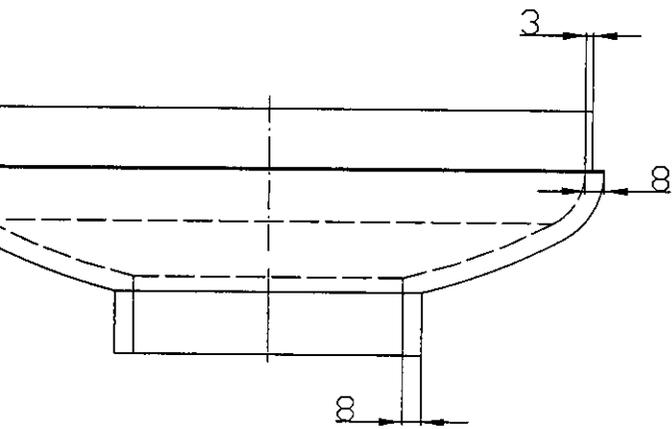
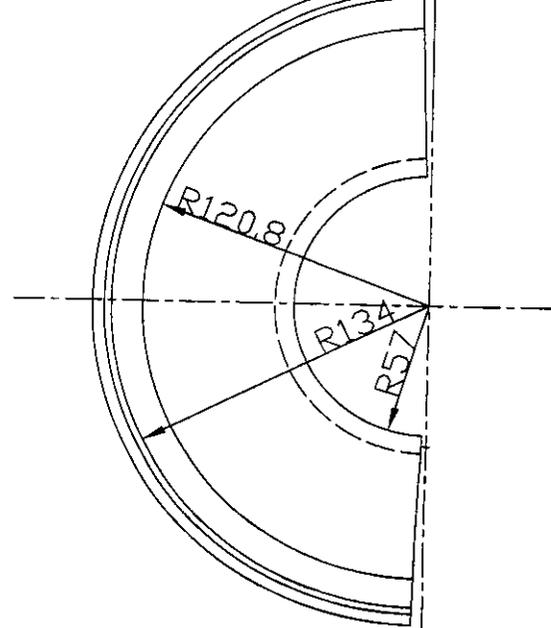
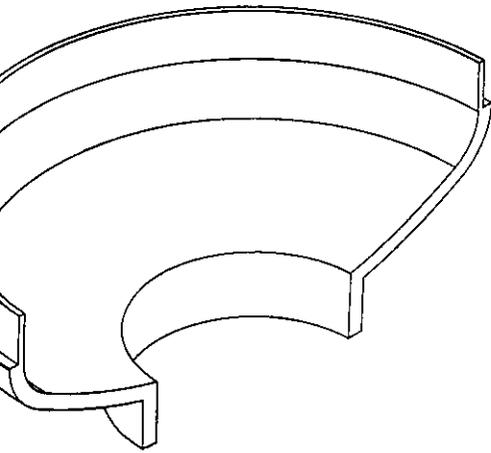
A manual equipment for lifting panel boards has already been designed and manufactured successfully as a preliminary step, to eliminate EOT crane. Since the lifting capacity of that equipment is less(20kgs) and it involves more fatigue, it can be used only for lifting panel boards. Hence for lifting tanks as a second stage of this crane elimination project, equipment using pneumatic power source has been designed.

Considering the power consumption and the maintenance, the proposed equipment holds good in all the aspects. Pneumatic power source can be obtained from the test rig, which is considered economical for this equipment.

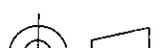
By using electronics(PLC, microprocessors) along with the above design the process can be automated, which reduces fatigue. The next stage in the crane elimination project is to design an automated equipment for lifting coolers of 200kgs .

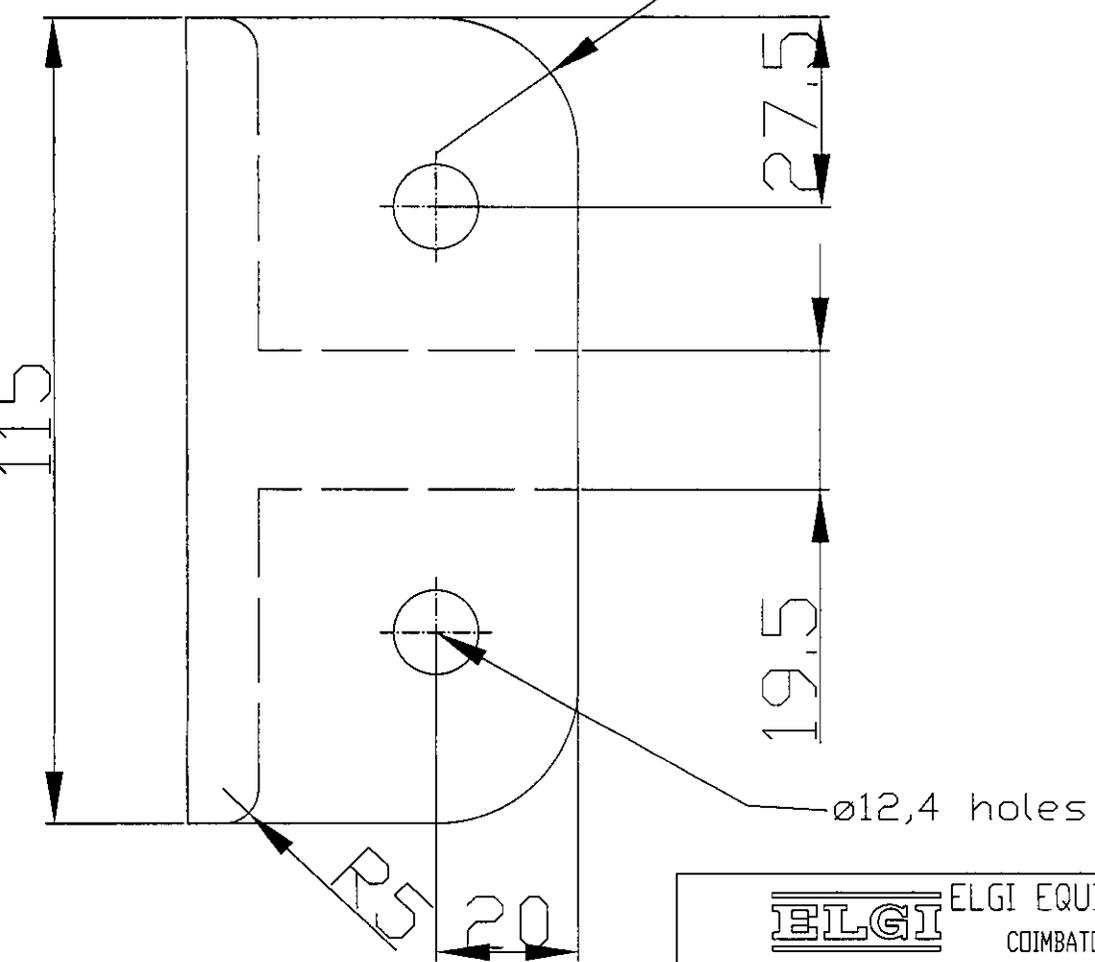
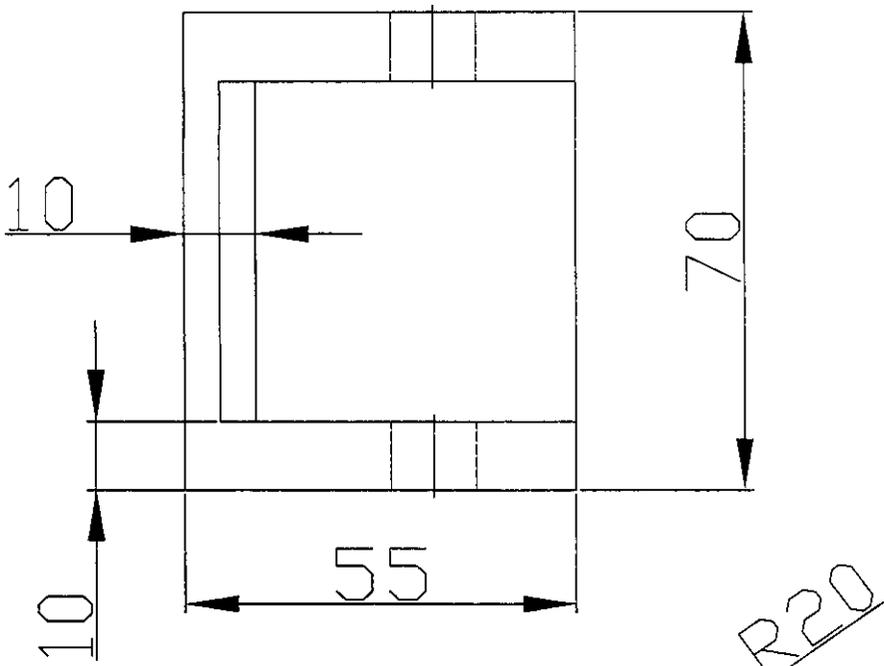
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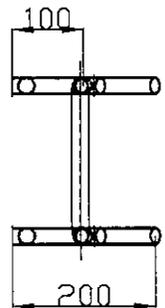
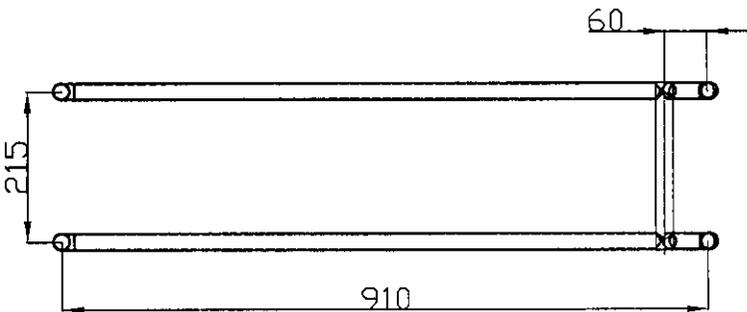
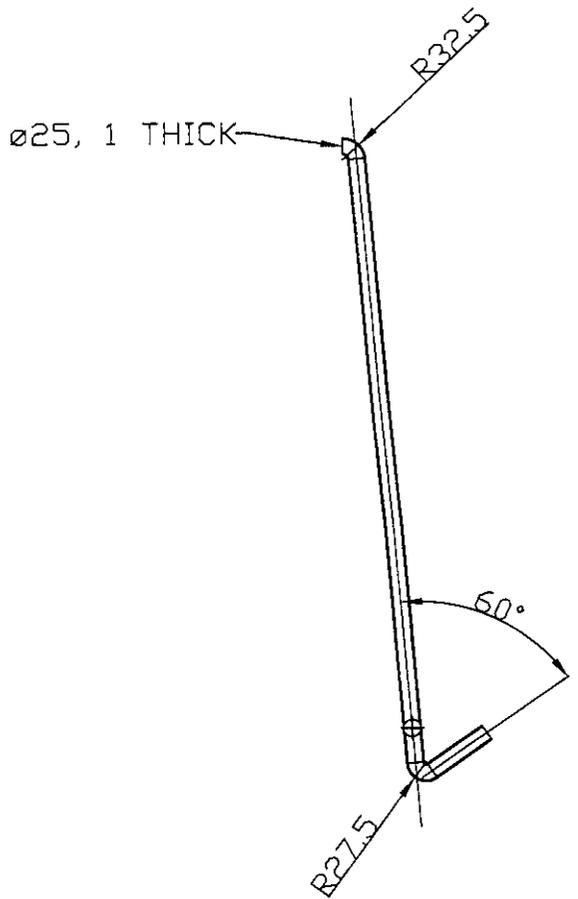
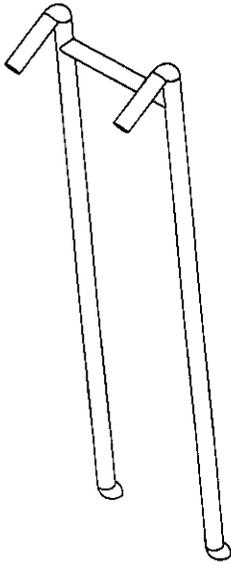
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ALL DIMENSIONS ARE IN MM
SCALE 1:1

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MATERIAL: MILD STEEL	PART NAME: HORIZON GRIPPER
QUANTITY:	 PART NO:



 ELGI EQUIPMENTS LTD., COIMBATORE - INDIA.	
MATERIAL: MILD STEEL	PART NAME: C-CLAMP

NOTE: ALL DIMENSIONS ARE IN MM

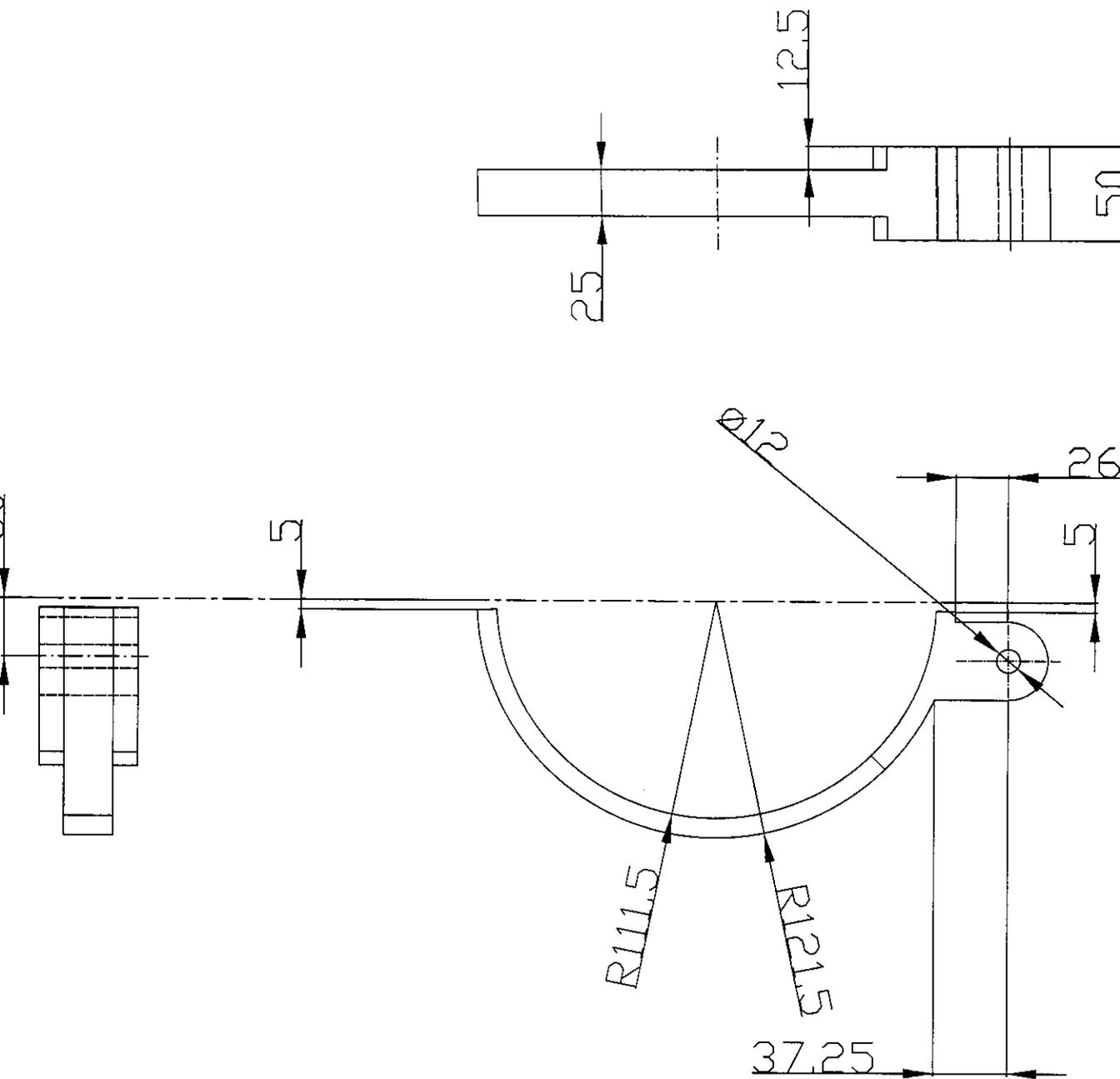


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COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
HANDLE

NOTE:
ALL DIMENSIONS ARE IN MM



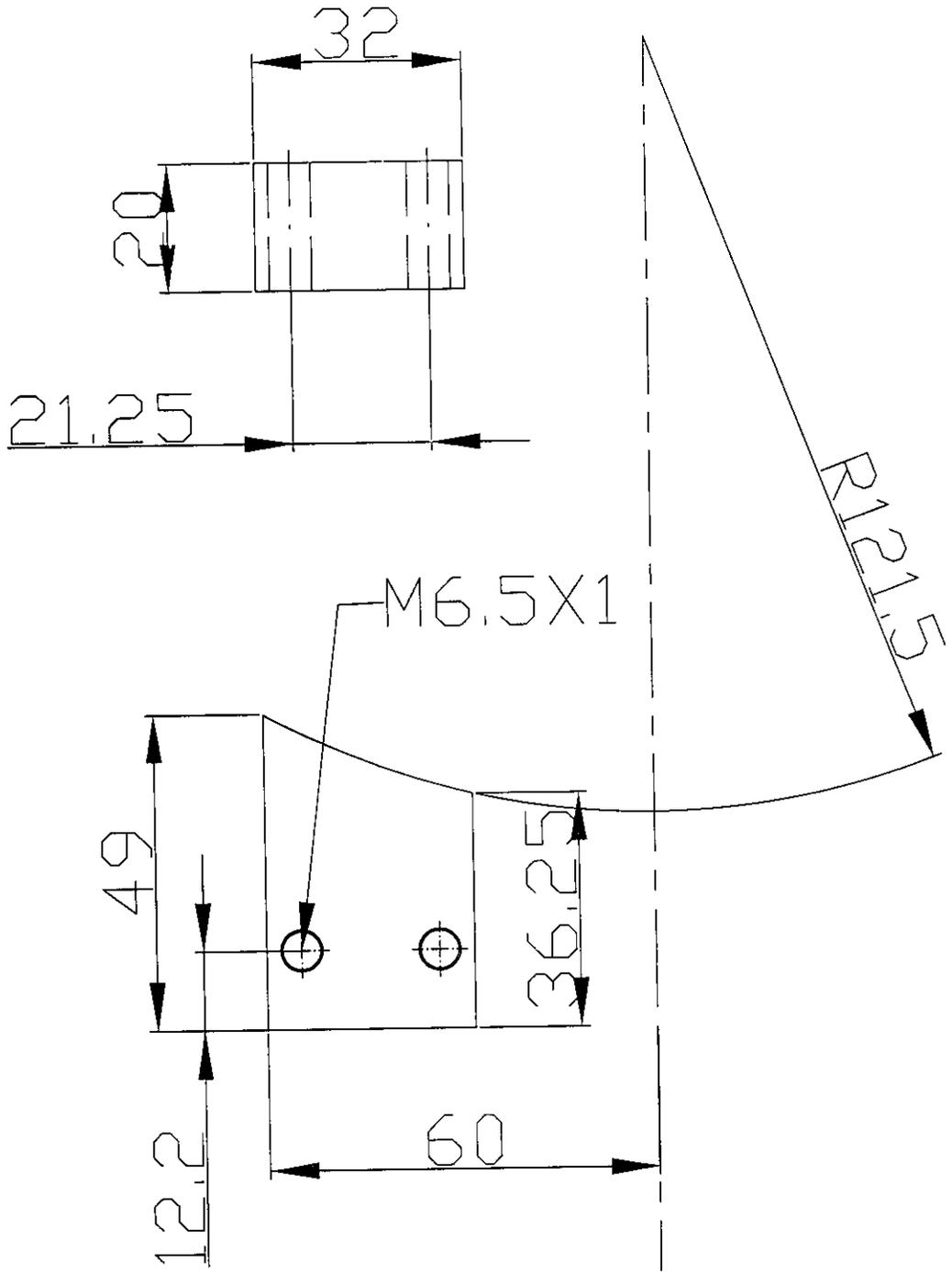
ELGI

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MATERIAL:
MILD STEEL

PART NAME:
GLOBAL GRIPPER

NOTE:
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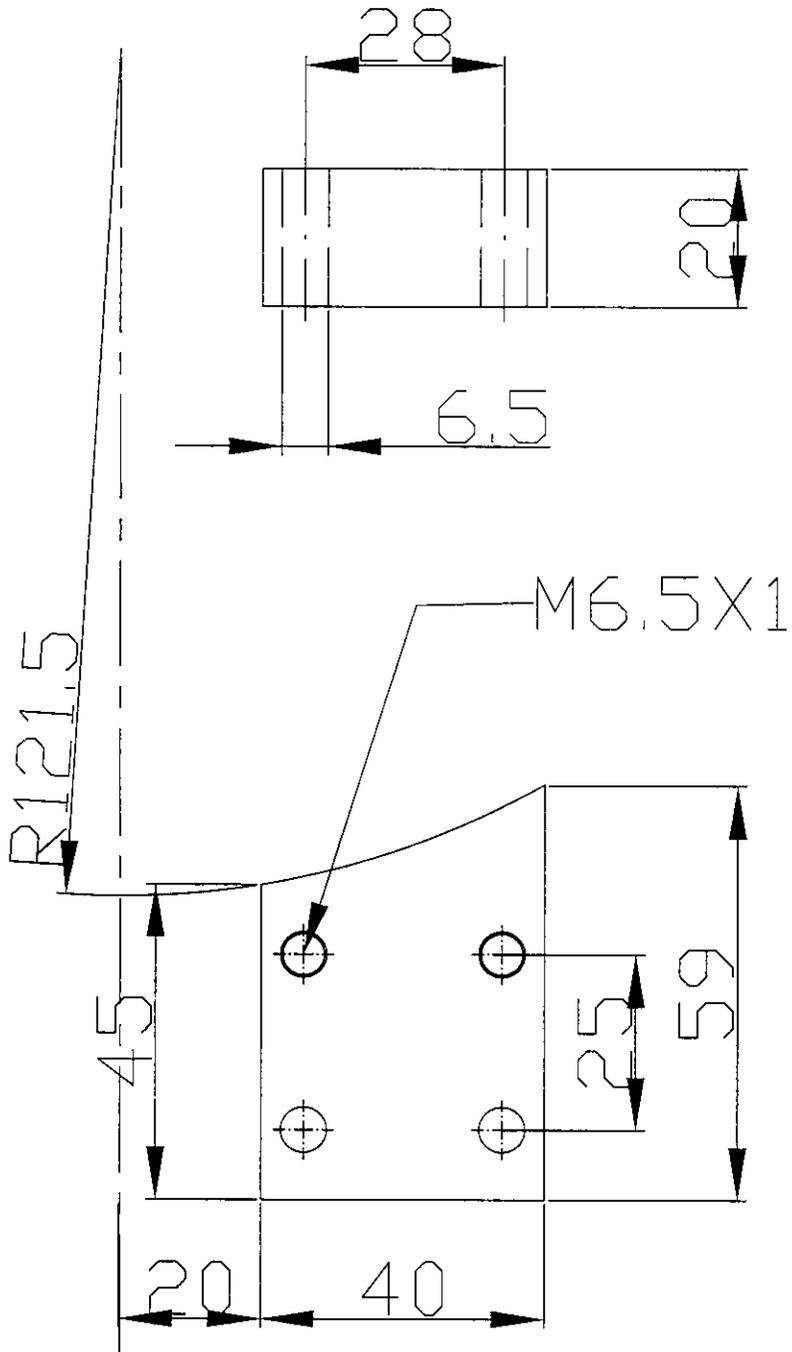


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MATERIAL:
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PART NAME: GLOBAL
TOGGLE HOLDER<RIGHT>

NOTE:



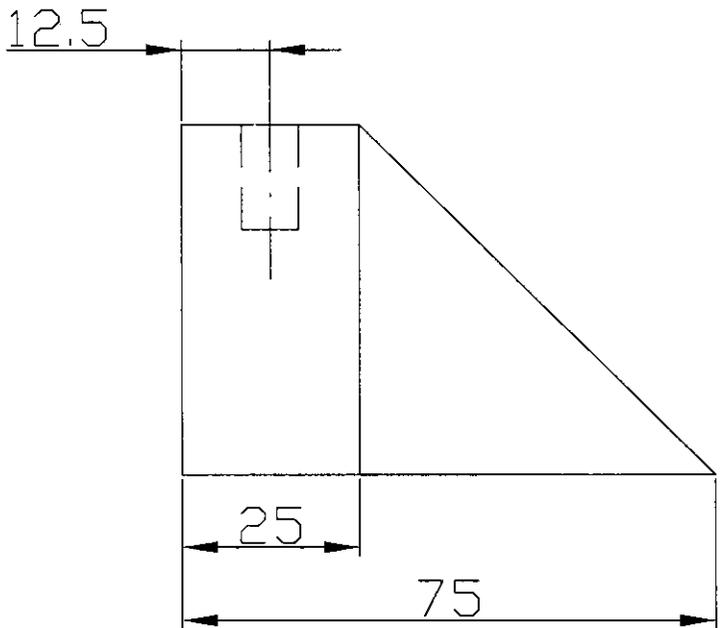
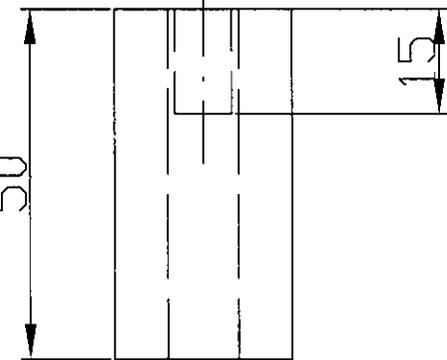
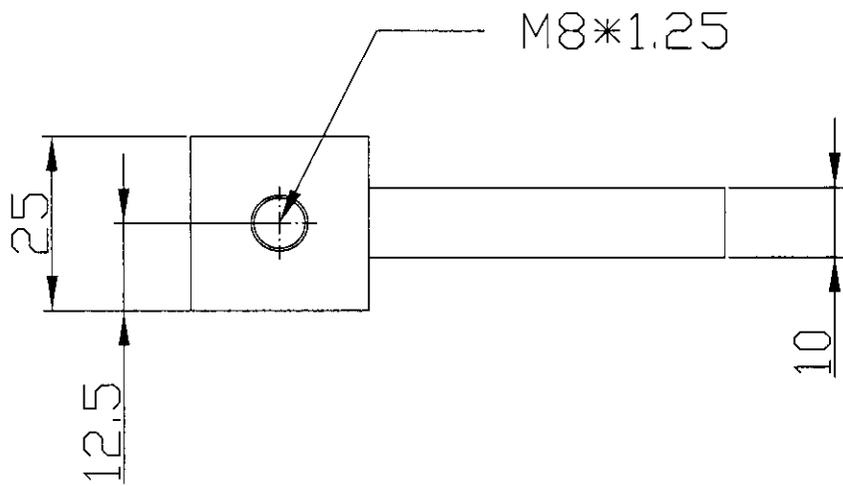
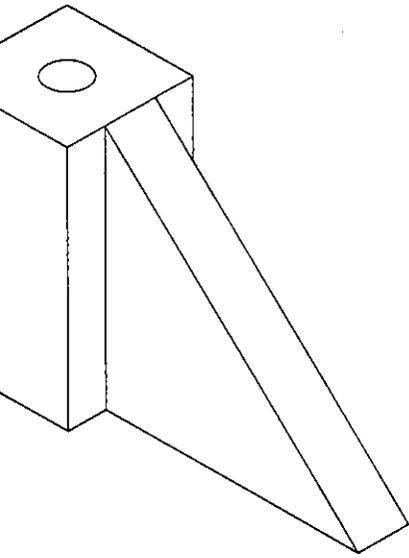
ELGI

ELGI EQUIPMENTS LTD.,
COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
GLOBAL TOGGLE
HOLDER (LEFT)

NOTE:
ALL DIMENSIONS ARE IN MM



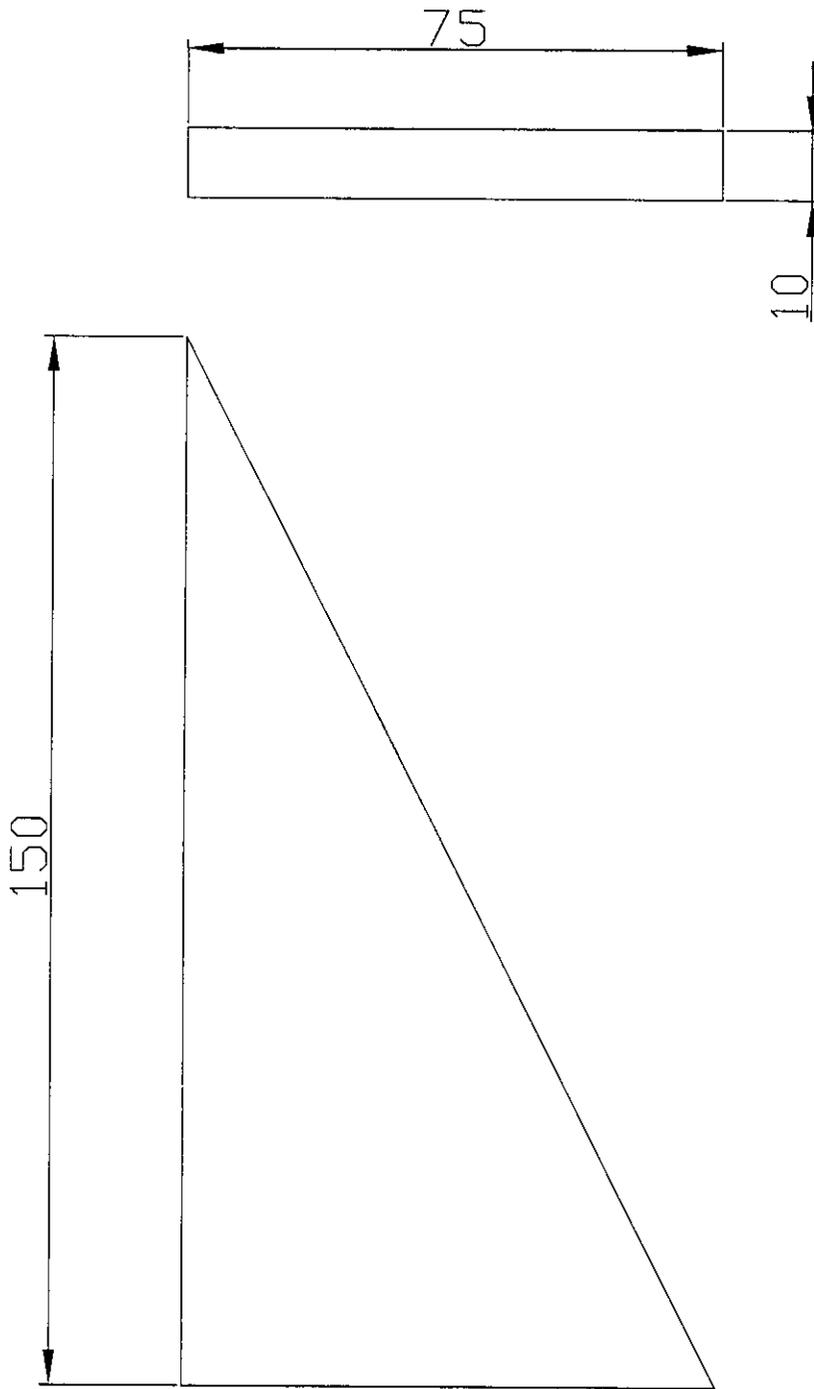
ELGI

ELGI EQUIPMENTS LTD.,
COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
7.LOWER HOOK

TE:



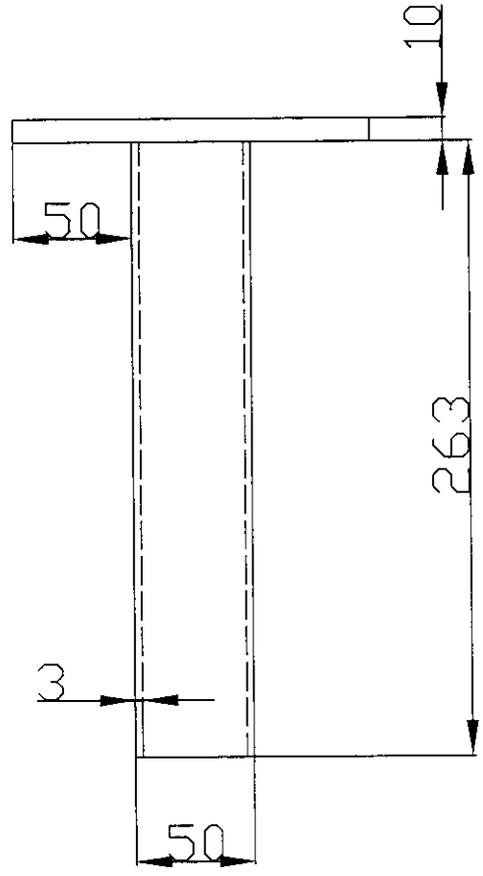
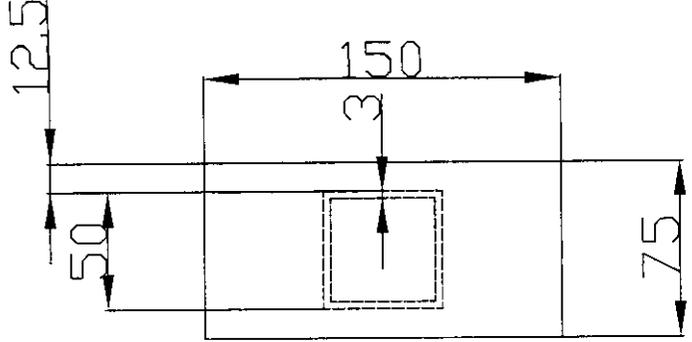
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MATERIAL:
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PART NAME:
RAIL GUSSET

NOTE:
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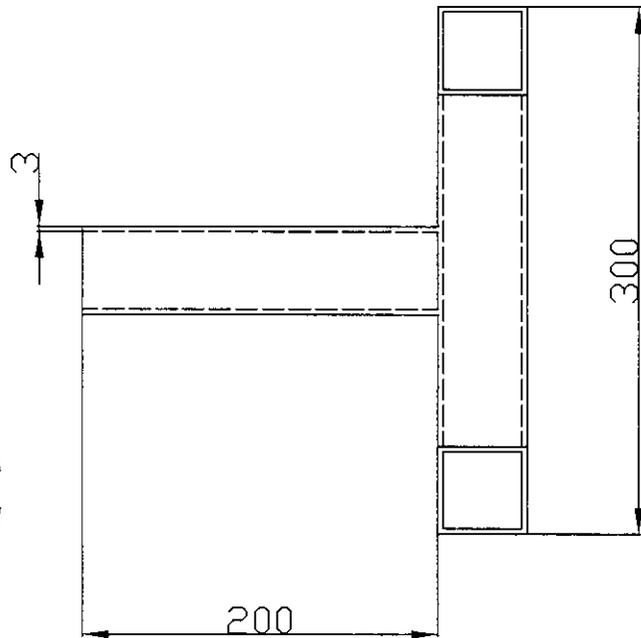
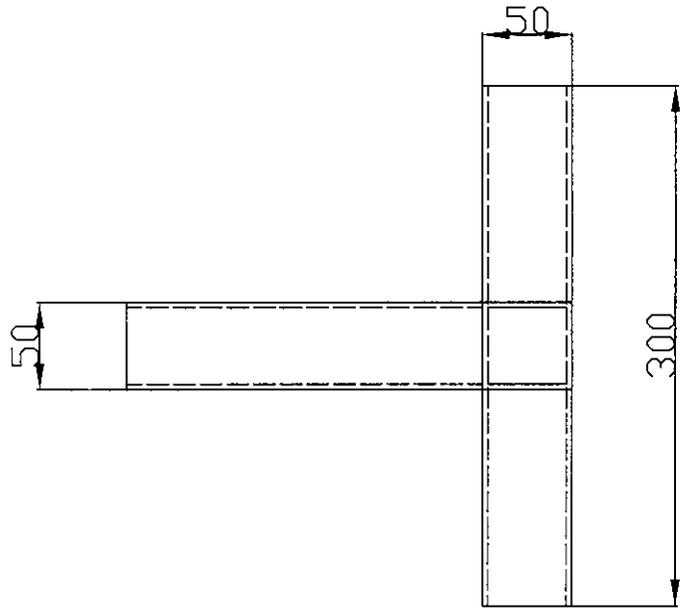
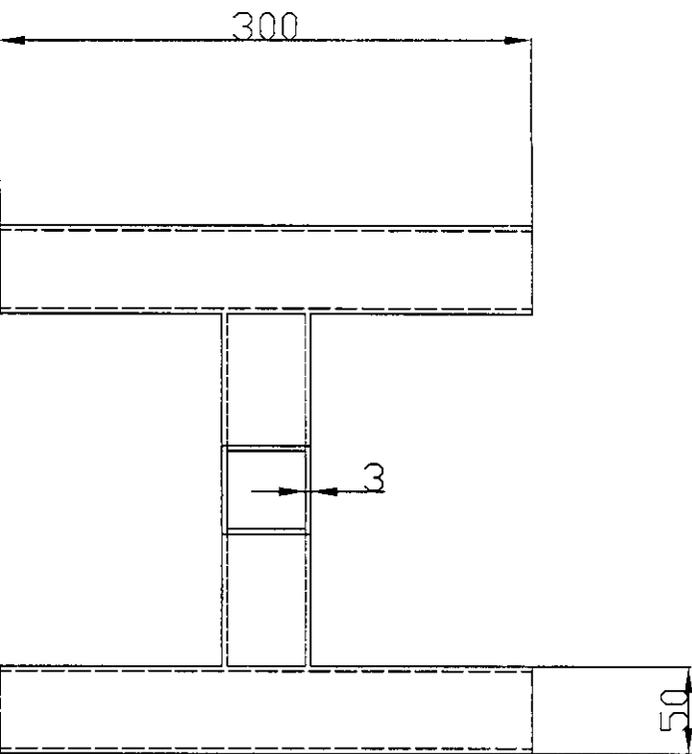


ELGI EQUIPMENTS LTD.,
COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
H-BEAM SUPPORT

TE:
DIMENSIONS ARE IN MM



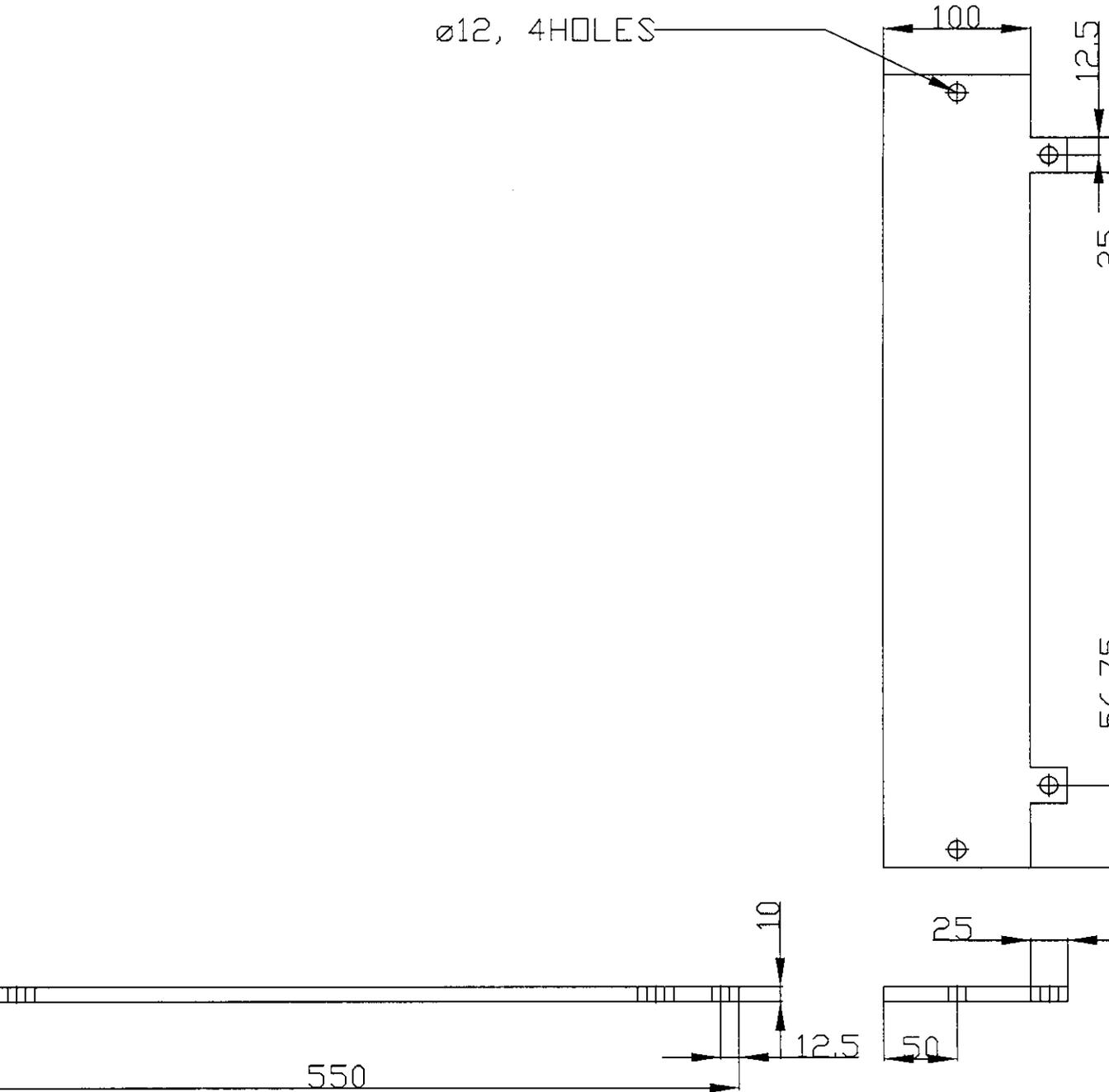
ELGI

ELGI EQUIPMENTS LTD.,
COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
H BEAM

NOTE:
ALL DIMENSIONS ARE IN MM



$\phi 12$, 4HOLES

100

12.5

25

75

10

25

12.5

50

550

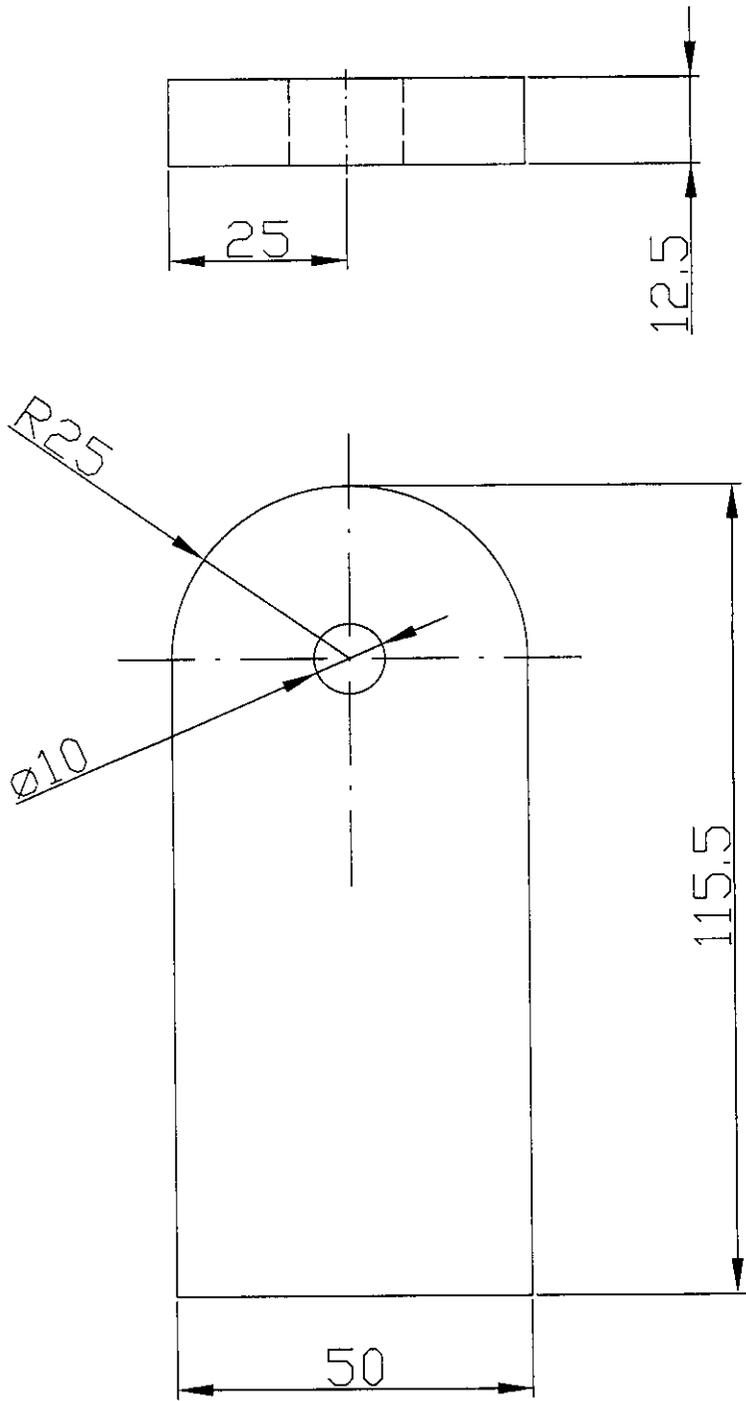
ELGI

ELGI EQUIPMENTS LTD.,
COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
RAIL TOP PLAT
MOUNTINGS

NOTE: ALL DIMENSIONS ARE IN MM



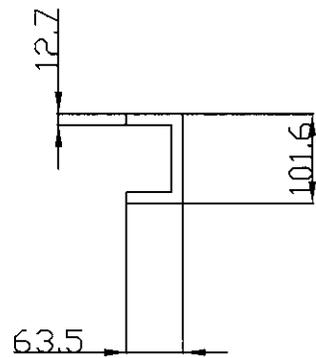
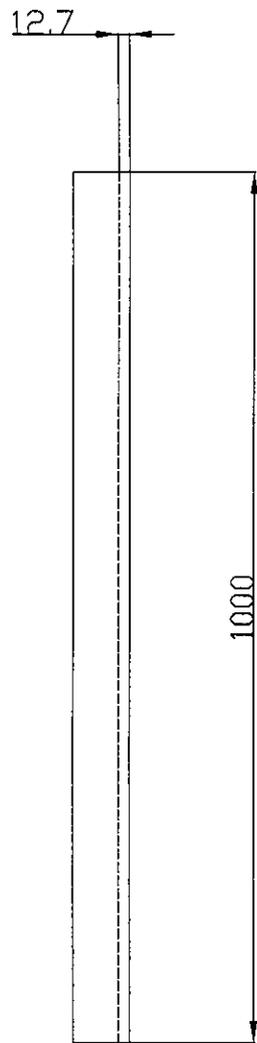
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MATERIAL:
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PART NAME:
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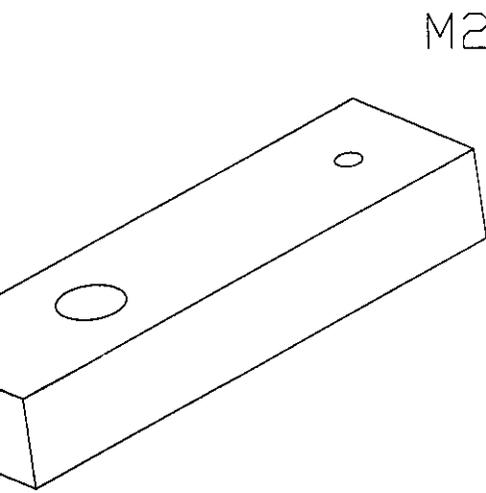


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MATERIAL:
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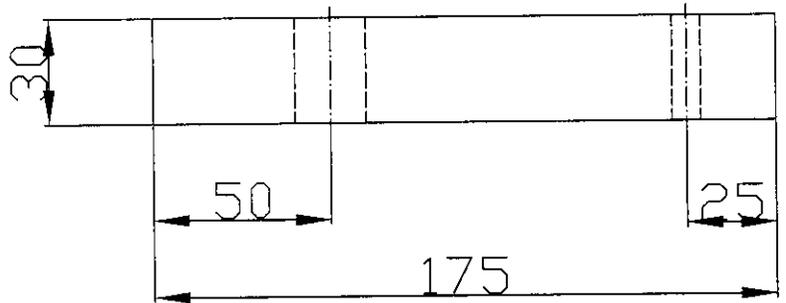
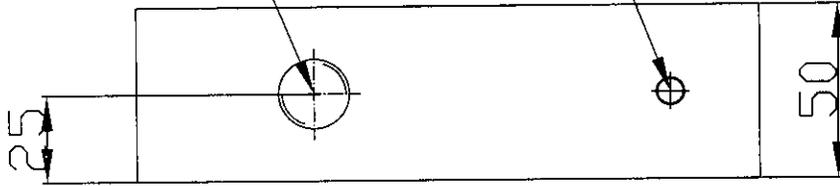
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NOTE:
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M20*1.5

M8*1.2



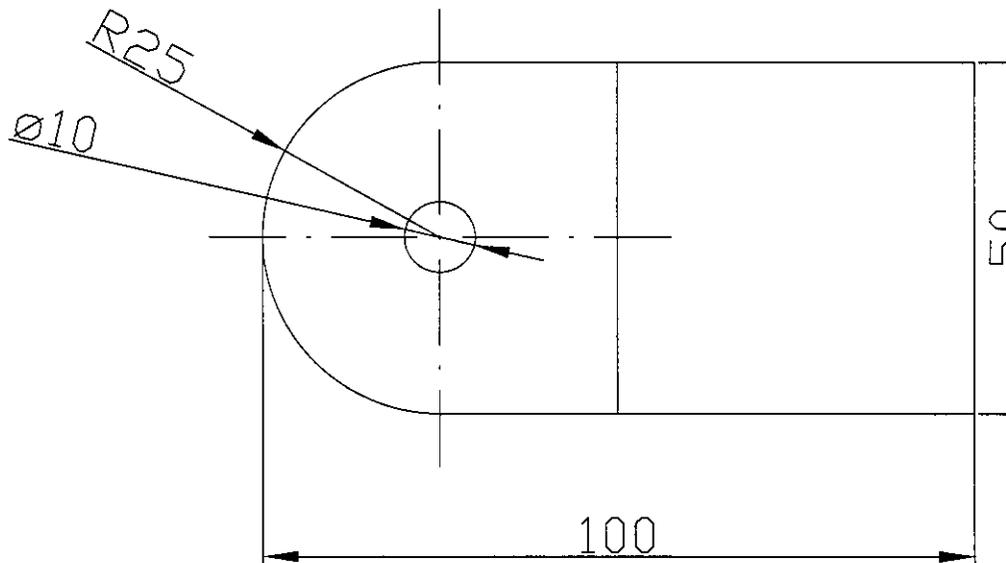
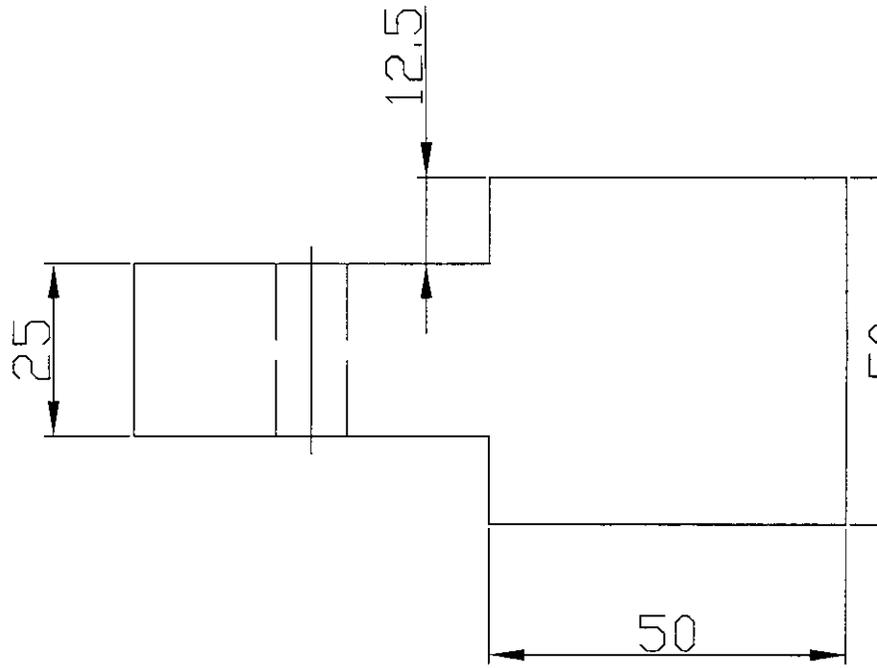
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ELGI EQUIPMENTS LTD.,
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MATERIAL:
MILD STEEL

PART NAME:
UPPER HOOK MOUNTING

TE:



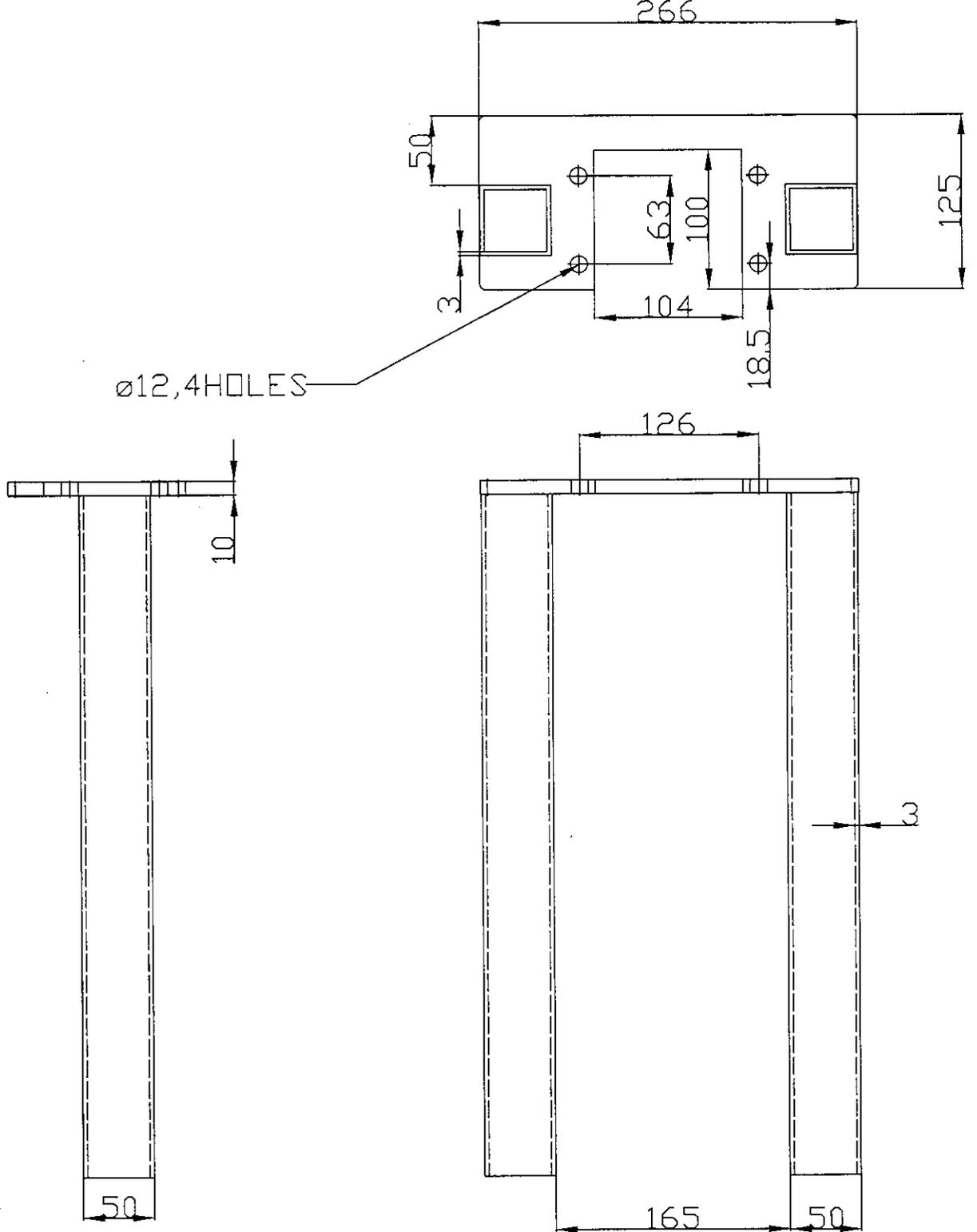
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MATERIAL:
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PART NAME:
GLOBAL ARM CONNECT

TE:

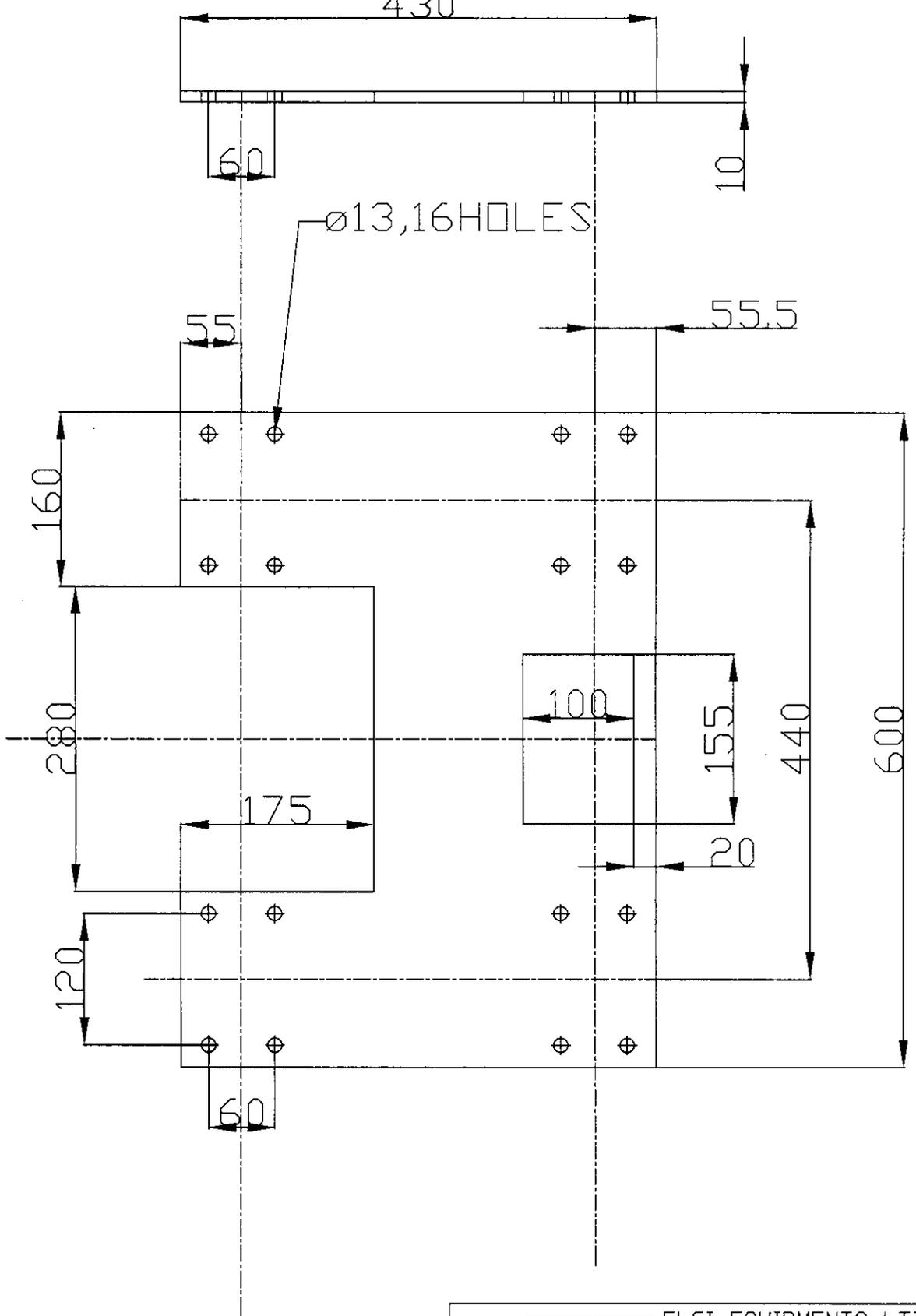


ELGI EQUIPMENTS LTD.,
COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
FRONT FLANGE
SUPPORT

NOTE: ALL DIMENSIONS ARE IN MM



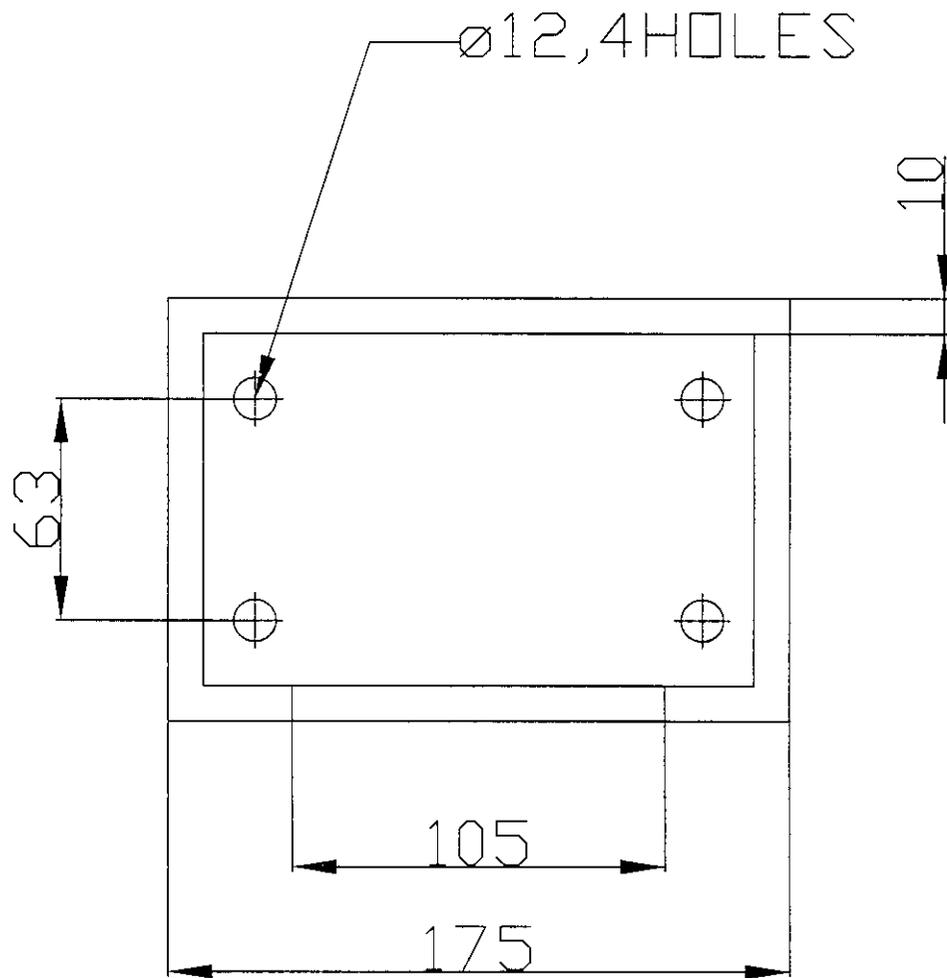
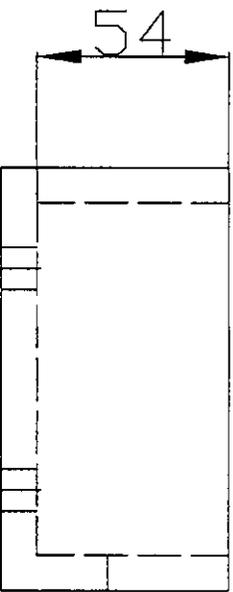
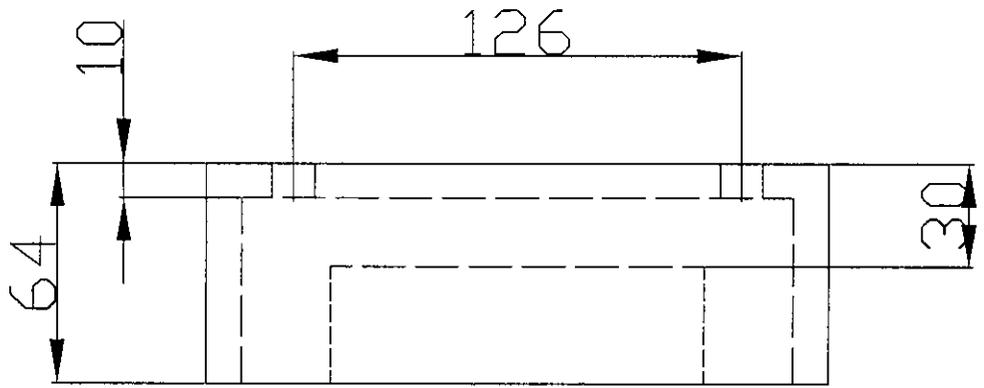
ELGI

ELGI EQUIPMENTS LTD.,
COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
BASE PLATE

NOTE: ALL DIMENSIONS ARE IN MM

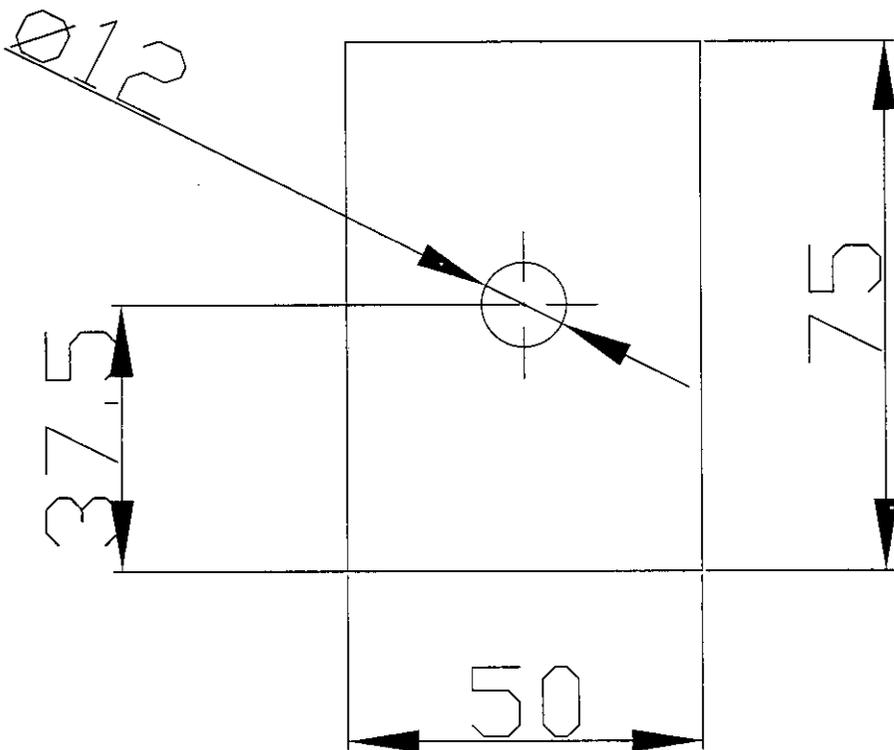
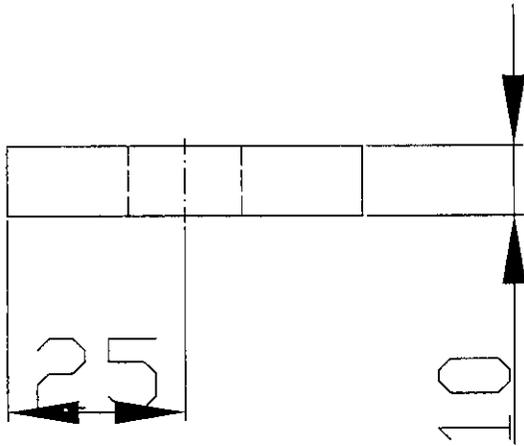


ELGI EQUIPMENTS LTD.,
COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
BASE CYLINDER HOUSING

NOTE:
ALL DIMENSIONS ARE IN MM



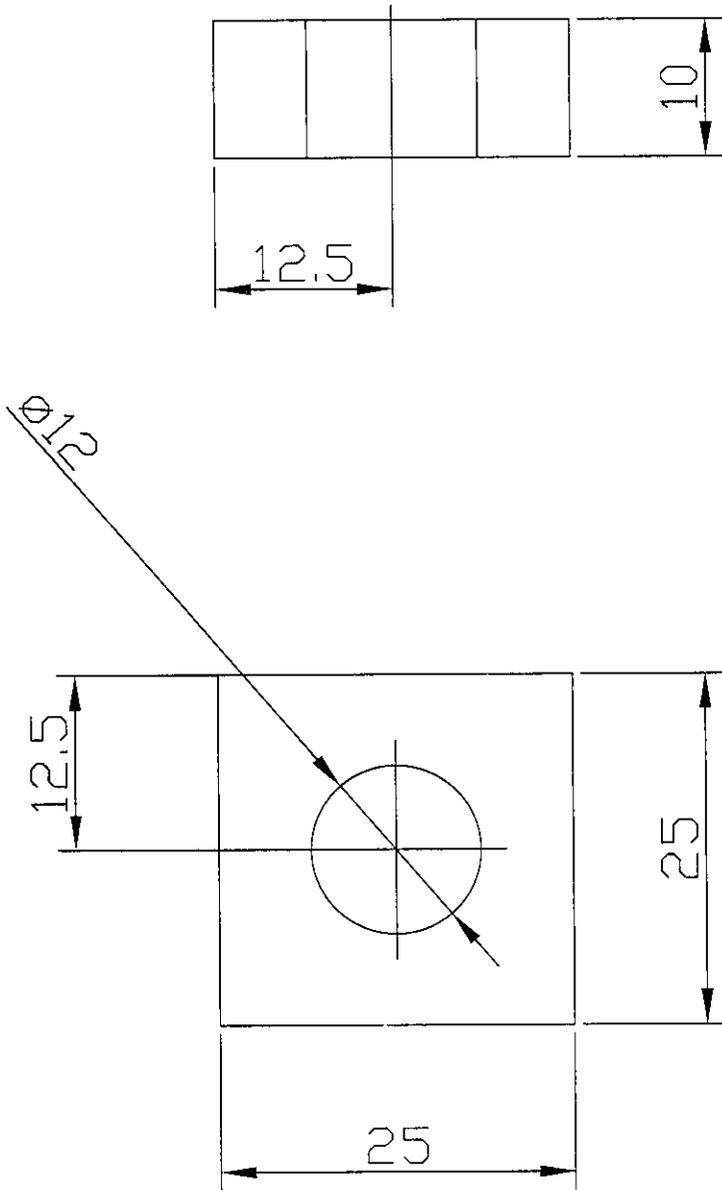
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MATERIAL:
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PART NAME:
RAIL BASE BOLT
MOUNTING

TE:



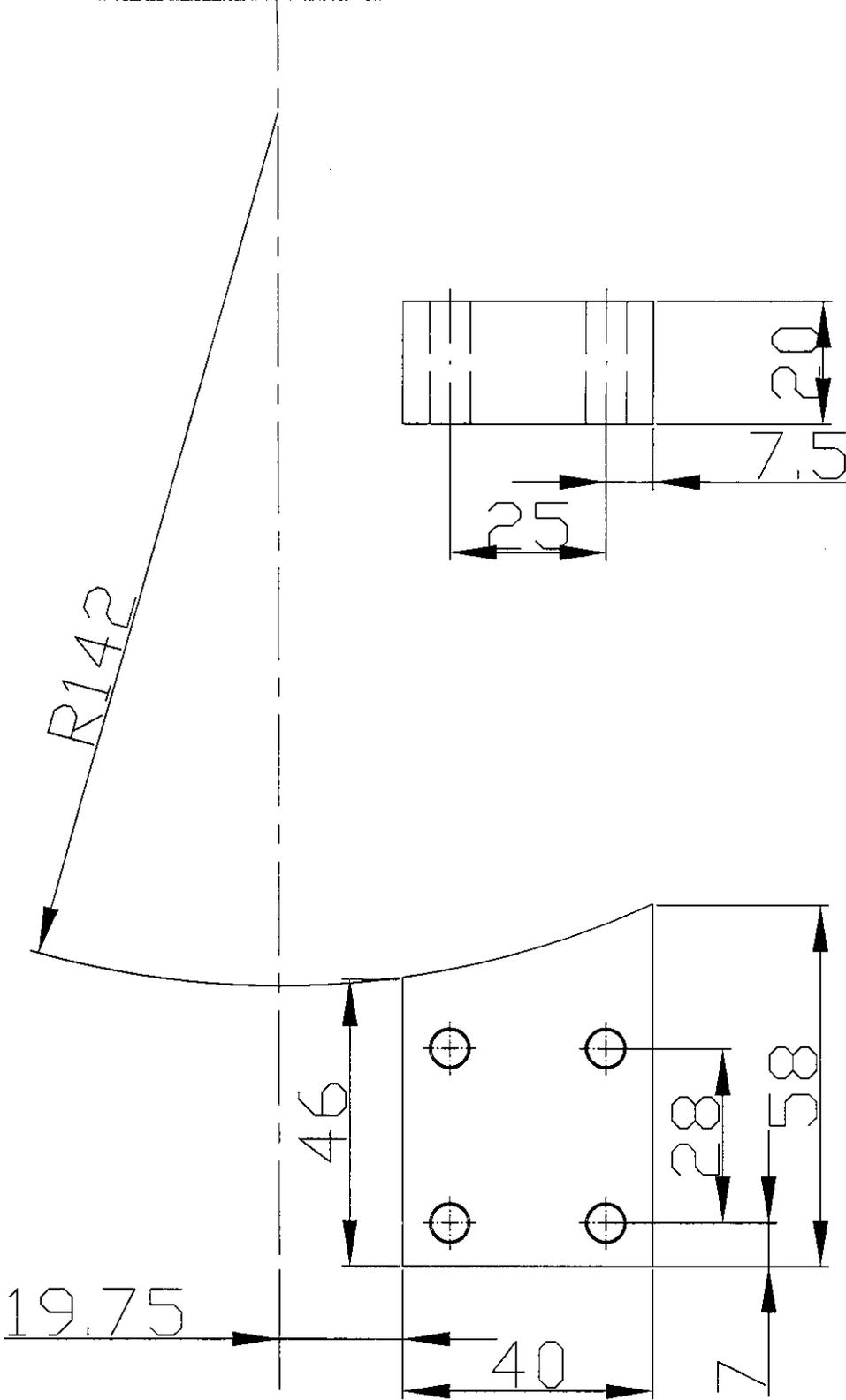
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MATERIAL:
MILD STEEL

PART NAME:
RAIL TOP BOLT
MOUNTING PLATE

TE:

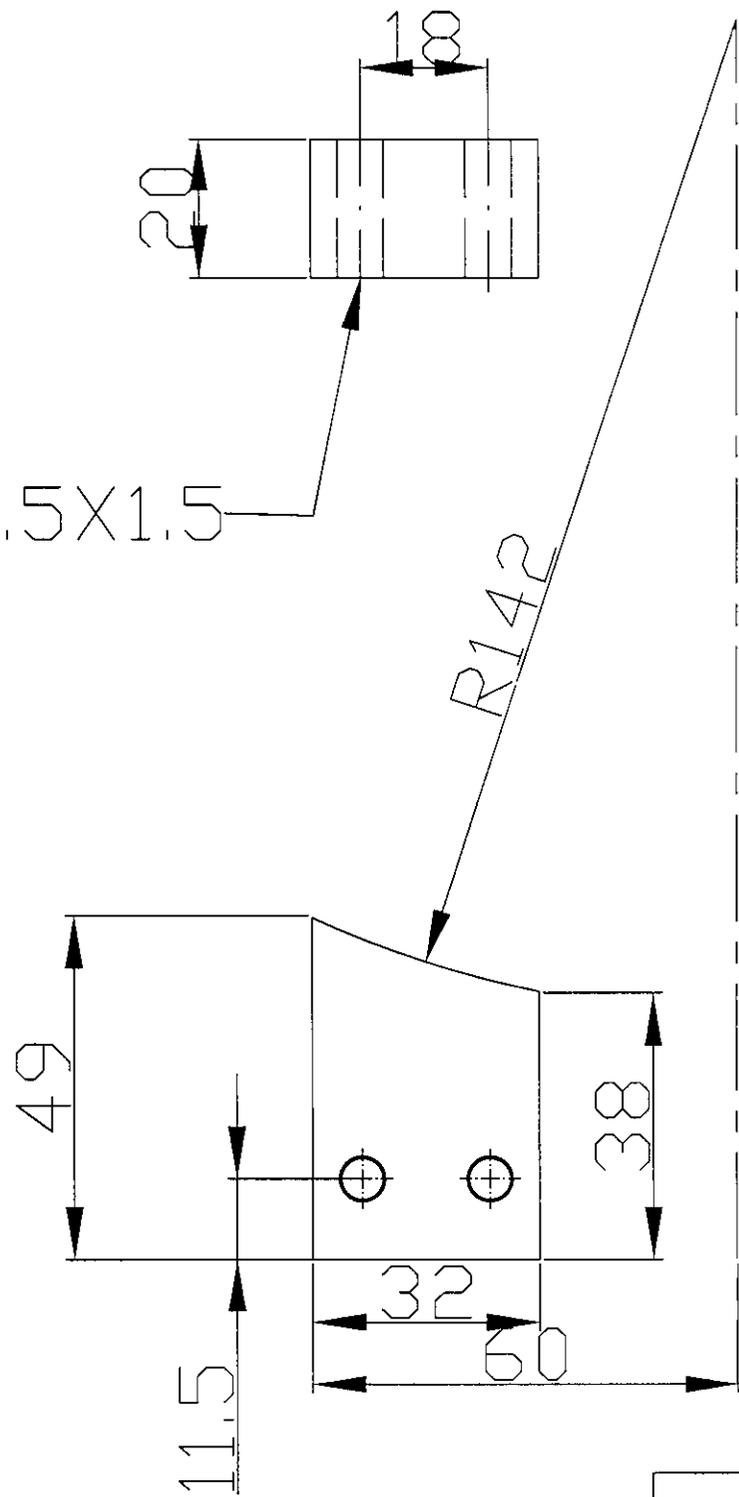


ELGI

ELGI EQUIPMENTS LTD.,
COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
HORIZON TOGGLE
HOLDER(LEFT)



ELGI

ELGI EQUIPMENTS LTD.,
COIMBATORE - INDIA.

MATERIAL:
MILD STEEL

PART NAME:
HORIZON TOGGLE
HOLDER(right)