

DIPLOMA IN MECHANICAL ENGINEERING



SUBJECT: PROJECT-I (Course code: 3351908)
PROJECT TITLE **HYDRAULIC FORK LIFT**

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CERTIFICATE

This is to certify that following students as below has satisfactorily completed their term work for subject PROJECT-1 (3351908) and submitted the report on HYDRAULIC FORKLIFT for year 2016-17

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ACKNOWLEDGEMENT

The completion of this project would not have been possible without the expert guidance and support of our respected project guide and the Head of our department for his continuous support and also valuable suggestions when required by our respected Professors at the college.

We would be leaving a great dent in the work if we don't thank the following persons. We are very much thankful to,

Shri S.H. Sundarani for his valuable guidance and support for work and also the encouragement.

Shri C. M. Patel for his support and suggestion when required.

At last but not the least I am also thankful to my team members for their effort, participation, enthusiasm, helping to build and bring out great team work to bring success of the project.

AIM OF PROJECT

We as students of Diploma in Mechanical Engineering have studied in detail about fundamentals of engineering, manufacturing processes, machine design, strength of material, metallurgy, maintenance, costing, management, etc. In this semester we have been given opportunity to exhibit our learning abilities through project work.

During the project work most aspects of engineering fields are covered. In Diploma in Mechanical Engineering the purpose of introduction of project is to develop

- Attitude of Inquiry.
- Ability of exploring Ideas
- Ability of selection
- Market Surveying Skill
- Ability of process/product planning
- Decision making ability
- Team Work and etc

In short PROJECT summarizes the course of Diploma in Mechanical Engineering.

SELECTION OF PROJECT

Selection of project is an important aspect of this course. Project must be appealing in learning aspects and should provide a scope of developing the qualities – technical and managerial both. The group had a thorough discussion and analysis of various ideas.

This discussion included talks on new trends in the fields, learning aspects provided by them, cost consideration, SWOT analysis of them, weightage of work provided to have inclusive participation and many other factors.

After the discussion and literature study the team had come down to a shortlist of few ideas that would serve the purpose to its whole content. The projects considered were

- Solar Operated Bicycle
- Wind Operated Bicycle
- Hydraulic Forklift
- Electricity Generation by Speed Beaker
- Multi Hacksaw Cutter
- Mechanical Segway

The team after discussion on certain factors came to the selection of **Hydraulic forklift**. This decision was an inclusive one where all the team members brought in their views of advantages and drawbacks. The discussion helped to develop the quality of considering factor, evaluation, and also to bring out ideas and also how to conduct them.

The team selected The Project of Hydraulic Forklift because of these aspects:

- The Forklift Project includes a well enough use of manufacturing processes and thus will develop a practical knowledge of carrying them out and apparatus used.
- The project has good scope of testing the skill and knowledge of estimating and costing.
- The project has a various parts that would be required to purchase thus exposing us to market survey and develop skill of compare and purchase.
- There is a wide scope of Hydraulic forklift in every Industry where Material Handling is required.
- Without the forklifts no warehouse industry will work efficiently.
- Hydraulic Forklifts uses hydraulic principle for lifting Heavy loads so there is no fuel required hence no environment pollution will occur.
- Forklifts are very compact in size and can be used in very small passages so material handling can be carried out success fully for indoor uses.

PROJECT PLANNING

Before starting any project its planning is to be done. Planning of project is a very important task and should be taken up with great care as the effective implementation of the whole project largely depends upon unit planning.

Project planning consisted of following steps:

- Selection of project
- Production Capacity
- Investment Decision
- Design and Drawings
- Selection of Material
- Selection of Machine tools and equipment required.
- Resource labor, transportation and loss in manufacturing.
- Inventory planning
- Process planning
- Preparation of F.P.C and O.P.C
- Costing and Estimating
- Testing of project
- Market response of project

Project planning is thus helpful to totally prepare an action plan that would lead to success of the project. As it is said “A work well begun is half done.” The same sense is applied here “A project well planned is half done.”

INTRODUCTION OF FORKLIFT



In general the forklift can be defined as a tool capable of lifting hundreds of kilograms. A forklift is a vehicle similar to a small truck that has two metal forks on the front used to lift the load. The forklift operator drives the forklift forward until the forks push under the cargo, and can then lift the cargo several feet in the air by operating the forks. The forks, also known as blades or tines, are usually made out of steel and can lift up to a few tons.

Forklifts are either powered by gasoline, or electricity. Electric forklifts rely on batteries to operate. Gasoline or propane forklifts are sometimes stronger or faster than electric forklifts, but they are more difficult to maintain, and fuel can be costly.

Electric forklifts are great for warehouse use because they do not give off noxious fumes like gas powered machines do. Forklifts are most often used in warehouses, but some are meant to be used outdoors. The vast majority of rough terrain forklifts operate on gasoline, but some use diesel or natural gas. Rough terrain forklifts have the highest lifting capacity of all forklifts and heavy duty tires (like those found on trucks), making it possible to drive them on uneven surfaces.

Forklifts have revolutionized warehouse work. They made it possible for one person to move thousands of pounds at once. Well-maintained and safely operated forklifts make lifting and transporting cargo infinitely easier. This is the general description of a normal forklift.

HISTORY OF FORKLIFT

Just like many other inventions, the forklift was born out of necessity. The two-wheel hand operated forklift first appeared over one hundred years ago. These original units were wrought-iron axle and cast iron wheels which enabled loads to be lifted and transported without manual labor. In the early 1900s the evolution to combine horizontal and vertical motion resulted in the first hand operated forklift capable of lifting a few inches of the ground. And with this the development of the forklift are on fastrack till today.

In 1917 the Clark Company, manufacturers of axles, created a truck called the Tructractor to move materials around their factory. As people visited the factory and saw the Tructractor at work they placed orders from Clark to build Tructractors for their companies. A few years later the first hydraulic powered lift was added to some trucks to give them lifting power. In 1923, Yale was the first company to use forks that lifted loads off the ground and an elevated mast that could extend beyond the height of the truck. The Yale truck is considered to be the first forklift.

A few developments helped the forklift to increase in production including the introduction of the standardized pallet in 1930 and World War II. Both of these developments increased production of forklifts and allowed distributors the means to efficiently move heavy loads.

TYPES OF FORKLIFT

1. 3 or 4 wheel forklift truck



- Three wheel forklift trucks are used for indoor and warehouses where space requirement is very important.
- While four-wheel forklift trucks are used for lifting heavy loads in outdoor uses and transportation at long distances.
- Used for loading trucks and moving pallets and other loads.
- It may be electric, diesel or gasoline operated.
- Diesel and gasoline powered forklifts will generate more power than electric lifts and move faster over long distances.
- Capacity ranging from 3 ton- 40 ton.

2. Reach trucks/ Narrow-Aisle forklift



- Perfect for optimizing storage space use.
- Use to rack pallets on smooth surfaces.
- Are generally electric powered.
- Very much useful at small passages in warehouses and small industries.
- Can lift heights upto 10 meters.
- Ranging from 1-3 tons load lifting capacity.

3. Order-pickers/ Stock-pickers



- Use for rider to stand on an elevating platform along with forks so rider may rise to select the materials.
- Very much useful for packaging industries and warehouses where they are constantly required to pick and put heavy packages at certain level.
- Used in very narrow paths.
- Generally electric powered.
- Capacity ranging from 1-3 ton.

4. Turret trucks type forklift



- In this type of forklift, Forks are mounted on a mast and carriage that operates on a turret able to rotate at 90 degrees in either direction for picking the loads without turning the base of the forklift.
- Use in very narrow aisles and employ a rotating mast.
- Generally electric powered.
- Capacity of lifting load is from 1.5- 4 ton.

5. Rough Terrain Forklifts



- Rough terrain forklifts are used for outdoor works where uneven surface conditions need to be faced.
- It is an one type of heavy capacity forklift widely used for engineering and construction purposes.
- It is generally gasoline, diesel or CNG operated.
- Load capacity is 15 ton or more according to size and operations.
- Ideal for lumberyards, construction projects, landscaping and other outdoor uses.

6. Hydraulic Fork Lift or Pallet truck



- Hydraulic forklift is the most compact design from the overall forklift family.
- It is widely use in all types of industry where indoor material transportation are essential.
- It is the most economical solution for small scale industry as well as big ones for transporting loads at short distances.
- It is generally hydraulic operated which utilizes the pascal's principle for lifting heavy loads at negligible efforts applied.
- According to the type of hydraulic cylinder use the forklift can lift the load from 1- 3 ton.

7. Side Loader Forklift



- In this type of forklifts the load lifting pallets are fitted by the side of the truck, so that while traveling at long distances operator doesn't get any kind of trouble.
- Use for narrow aisle work where space between racks are limited.
- This type of forklifts may be electric or gasoline powered.
- Loading or unloading can be done by the sides.
- Lifting capacity are high for this type of forklifts.

HYDRAULIC FORKLIFT

Hydraulic forklift also know as hydraulic hand pallets is a tool used to lift and transport heavy load for sort distances with the help of pallets.

Pallet jacks are the most compact and modern form of forklifts and are intended to move heavy and light weight materials within a warehouses.

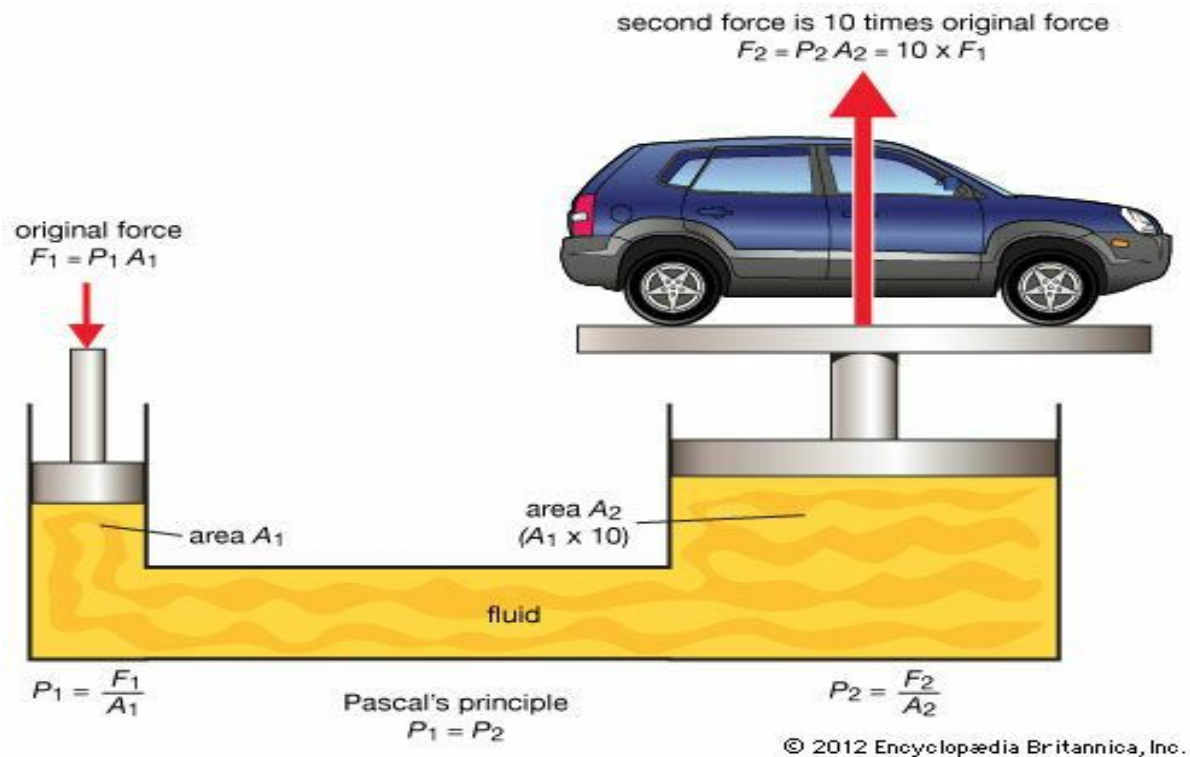
Like other forms of fork lift hydraulic forklift doesn't require any kind of electric power source or diesel and gasoline. Because hydraulic forklifts works on the principle of hydraulic force transmission.

Lifting of heavy loads are accomplished with the help of hydraulic cylinder in the forklift. Cylinder are generally fitted at upperparts of the pallet.

Working principle of hydraulic forklift

The hydraulic forklift works on the principle of hydro static force transmission which utilizes a non-compressible fluid for transmission of pressure from fluid to lifting heavy loads. The principle of hydraulic forklift can be easily understand by the **Pascal's law**.

Pascal's law



Pascal's law is very popular in every equipment where heavy loads need to be lifted by applying negligible amount of forces.

“ Pascal's law simply states that when there is an increase in pressure at any point in confined fluid, there is an equal increase in pressure at every other point in the container.”

Pressure is equal to the force divided by the area on which it acts. According to Pascal's law, in a hydraulic system a pressure exerted on a piston produces an equal increase in another piston in the system. If the second piston has an area 10 times that of the first piston, the force produced on second piston will be 10 times more than the force applied on the first piston.

OPERATION OF HYDRAULIC FORKLIFT



The jack is steered by a ‘tiller’ like lever that also acts as the handle for raising the forklift pallets on which load are resting. A small lever provided on handle will releases the hydraulic fluid, causing the forks to lower.

The front wheel inside the end of the forks are mounted on levers attached to the hydraulic cylinder. As the hydraulic jack at the ‘tiller’ end is raised, the links forces the wheel down, raising the forks vertically above the front wheels, raising the load upward until it clears the floor space. The pallet is only lifted enough to clear the floor for subsequent travel.

Often, hydraulic pallet jacks are used to move and organize pallets inside a trailer, especially when there is no forklift truck available.

OPERATING MECHANISM



Pallet jack in lowered position, allowing it to be inserted under a load on a pallet.

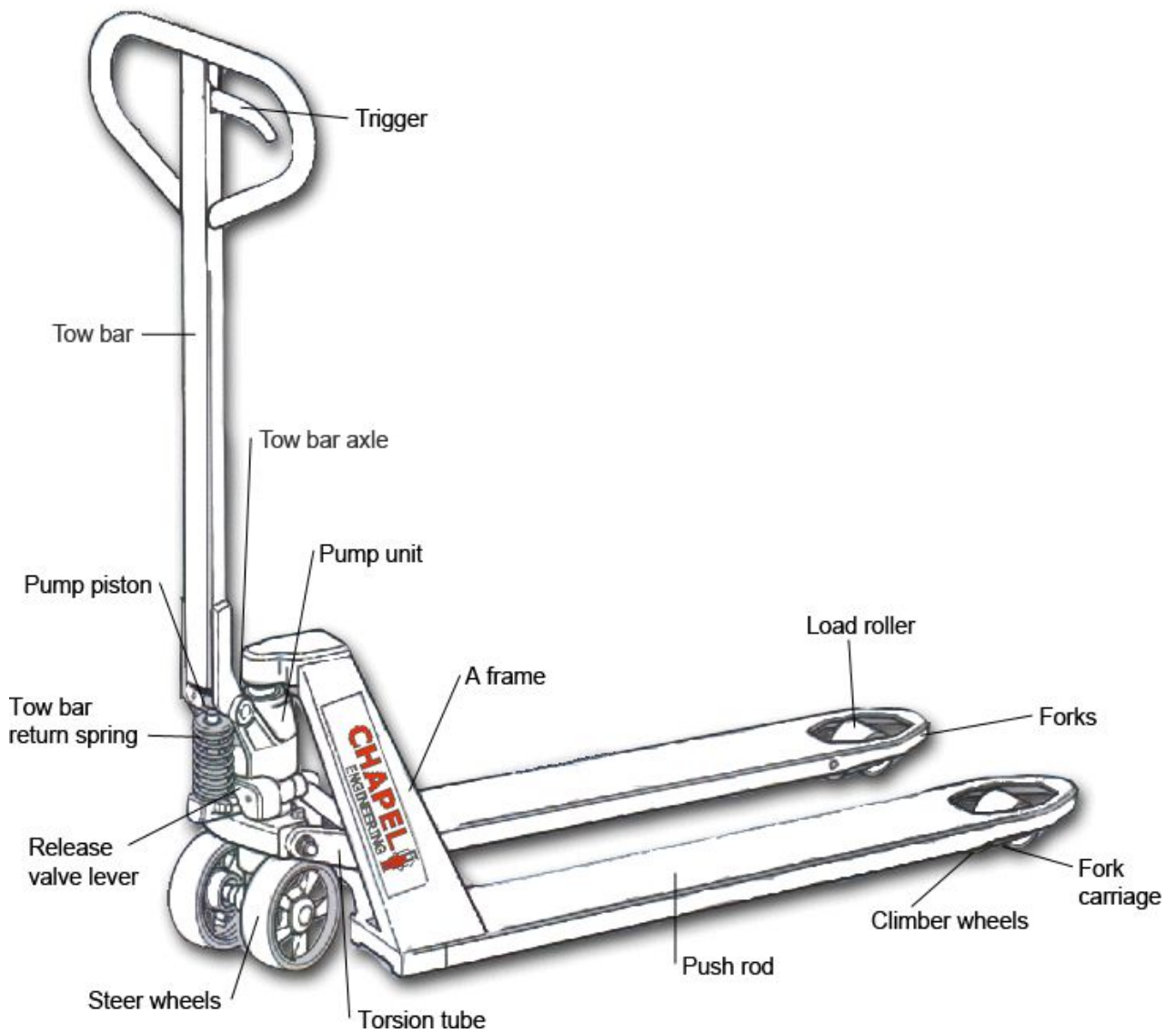


Forklift showing how wheels drop, lifting forks and load. The steering tiller and raised hydraulic cylinder are clearly visible on the right side.



Under side of forklift showing Push rod under the forks.

CONSTRUCTION OF HYDRAULIC FORKLIFT



MAIN PART

1. Body or frame
2. Hydraulic pump unit
3. Steer wheels
4. Push rod
5. Load Roller
6. Handle
7. Handle Trigger

1. Body or Main frame:

Body is the most important part of forklift. It supports all other parts of the forklift. The main frame of the forklift is made from Mild steel plates.

2. Hydraulic pump unit:

Pump is the main element of the hydraulic forklift and mainly responsible for lifting heavy load at minimum efforts.

It utilizes an non-compressible liquid mainly oil for transferring pressure of piston and lifting the load resting on the pallet.

Hydraulic pump unit comprises of so many parts like Piston and Cylinder, Fluid release valve, push springs and other welding joints for connecting all the parts rigidly.

3. Steer wheels:

Steer wheel are the primary wheels of the forklift for the rotation of forklift from one direction to another.

The steering wheels are generally made from Nylon, rubber, or from any other metal or non metal material. The only must have requirement is that wheel should work efficiently on rough surfaces and must sustain the load lifted by the pallets.

4. Push rod:

The push rod is a round long rod which connects the load roller and hydraulic cylinder for transmitting the pressure to lift the load wheels above the surface. The push rod is mounted below the two forks of the forklift. And are generally made from mild steel bars.

5. Load roller:

Load rollers are the front wheels of the forklifts. And Is intended for the lifting of load and traveling of forklift at short distances.

The front wheels are generally made from nylon, high grade plastic or from any other metal or non metal. The main requirement for the material is that it must work on rough surfaces and lift the load according to its capacity without bending and cracks.

6. Handle:

Handle is also very important part of the fork lift. It is used for mainly three purposes.

1. For creating pressure in the cylinder by tilting or pushing the handle frequently.
2. For the proper direction alignment of the forklift by hand.
3. For the traveling of forklift by pushing the handle in forward direction.

The fork lift handle works as a lever for lifting the load. And is generally made from a round bar of mild steel. Proper gripping is to be given at the handle for efficient traveling.

7. Handle trigger:

Handle trigger is lever or clutch type small element provided at upper part of the forklift handle. The main function of the Trigger is to release the fluid pressure and lower the forks and front wheel for loading the pallets on the fork.

ADVANTAGES AND DISADVANTAGES

Advantages

- 1) Hydraulic forklift utilizes the non-compressible fluid like oil for lifting the heavy loads with the help of hydraulic cylinder arrangement, so there is no fuel required like other power operated forklifts.
- 2) No environment pollution and health hazards occurs while using hydraulic forklifts.
- 3) Hydraulic forklifts are the most economical solution for indoor and warehouse uses because it requires very small space to operate.
- 4) The best thing is that you can choose a forklift with the right configuration and capacity depending on your need.
- 5) One advantage of forklifts is that they can reach at higher altitude for loading and unloading of the materials.
- 6) Without these machines, the warehouses would not be able to operate efficiently and with easiness.
- 7) They perform eco-friendly operation and have very long working life span.

Disadvantages

- 1) According to the capacity and size of the forklift limited weight is lifted.
- 2) The capacity of the hydraulic hand operated forklift is limited to some 1.5- 3 ton.
- 3) Manually operated so long distance can not be traveled.
- 4) One person is required for the operation.
- 5) More time consuming than the other types of powered forklifts.

APPLICATION OF FORKLIFT

1) There is hardly any industry where material handling is not required. The Hydraulics and other type of forklifts are the most economical solution for all the industries and warehouses where material handling as well as transportation of it at short distances is required.

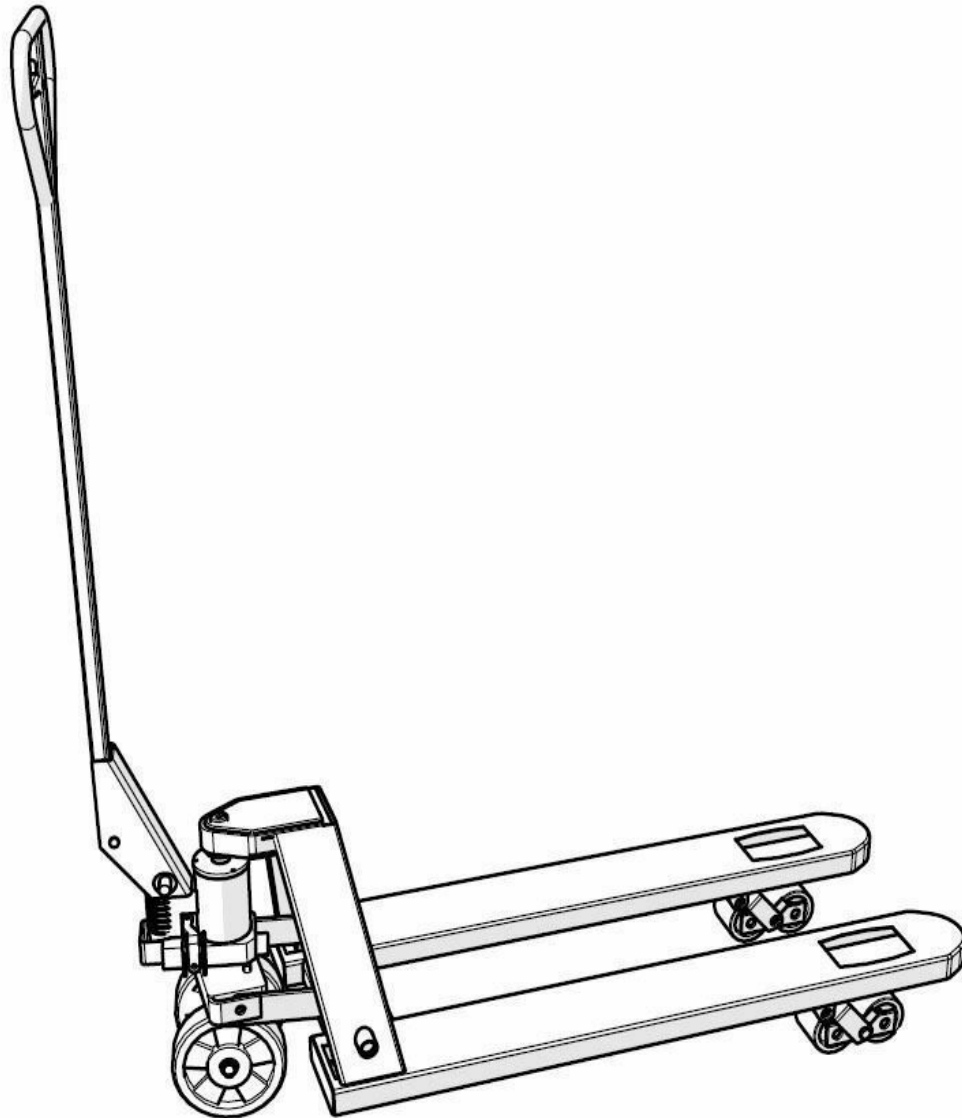
2) Fork lifts are used for lifting and transporting all kind of materials like packaged products, raw material and other equipment.

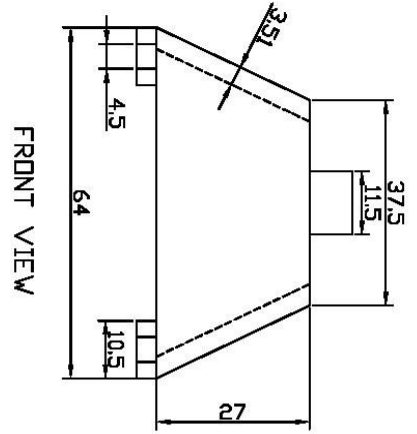
3) Warehousing is the most popular area where forklifts have proven their worth. In a warehouse, materials are constantly being move around. Most of the activity is focused around the loading and unloading of trucks. The warehousing operation can sometimes take on the appearance of a hive as forklifts of every size and description scurry about, ferrying boxes and crates from one place to another. A forklift's design also makes them excellent machines for stacking and unstacking boxes and crates. Forklifts extreme maneuverability means that they also fit into small spaces to retrieve cargo. It is hard to imagine such an operation getting along without forklifts.

4) Another popular place where forklifts are used is transportation industry. It may be ship ports, railways or an air line transportation. Everywhere forklifts are used. The principle and application are same MATERIAL HANDLING, the only thing differs is the the size and power source of the forklift according to the application for which it is used.

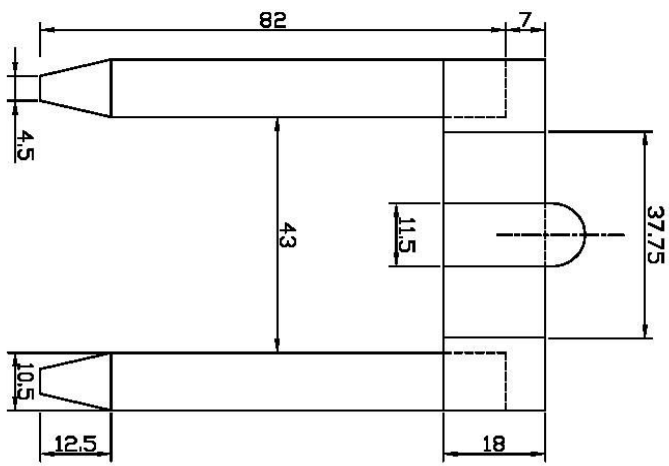
5) Forklifts are also proven very useful for ship crushing, metal scraps etc. Industry where heavy materials are required to be lifted and transported.

DETAIL AND ASSEMBLY DRAWING

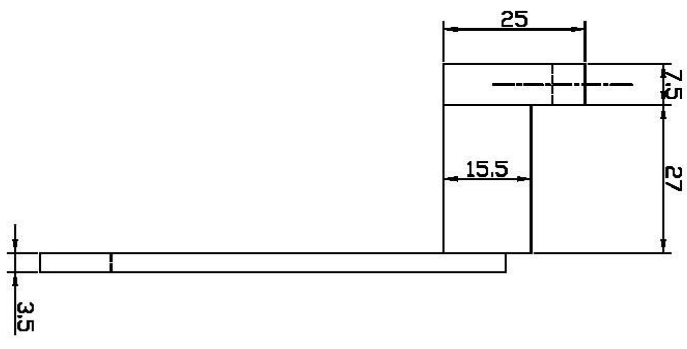




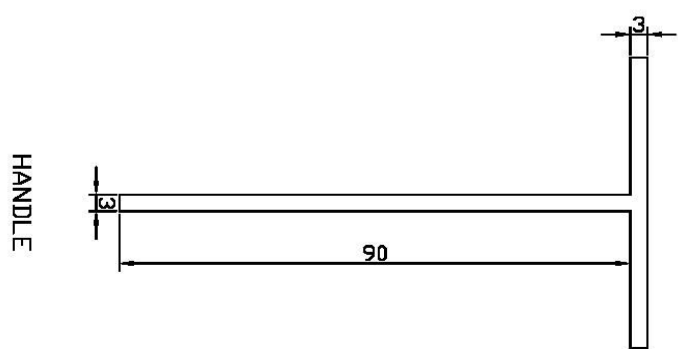
FRONT VIEW



TOP VIEW



SIDE VIEW



HANDLE

SPECIFICATION OF HYDRAULIC FORKLIFT

Load lifting capacity	1500-2000 kg
Fork length	82 cm
Distance between two forks	43 cm
Fork width	10.5 cm
Max. Lift height	10 cm
Handle length	90 cm
Gripping handle width	25 cm

MATERIALS AND EQUIPMENTS REQUIRED

❖ Equipment Required:

1. Hacksaw Cutter or Machine
2. Welding Machine
3. Hand Drilling Machine
4. Color sprayer

❖ Tools Required:

1. Cutting tools (for above stated machines)
2. Hacksaw
3. Hammers
4. Measure tape
5. Spanner set
6. Screwdriver

❖ Materials Required:

1. M.S. Plate(7 mm thick)
2. M.S. Hollow round bars
3. Arc welding electrodes
4. Spraying color
5. Coolants and oil
6. Fasteners
7. Safety wears

MAKE OR BUY DECISION CHART

SR.NO	NAME OF COMPONENT	QUANTITY	MAKE /BUY
1	Base Frame	1	Make
2	Hydraulic cylinder	1	Buy
3	Double Steering wheels	1	Buy
4	Forklift handle	1	Make
5	Load wheels	2	Buy
6	Push lever	1	Make
7	Nut-bolts	As required	Buy

COST ESTIMATION

Cost estimating is an art of finding the cost which is likely to be incurred on manufacturing of an article before it is actually manufactured. This calculates material cost. It prepares the estimate for labor cost based on production time and wages of worker. Based on these estimated cost data decides the cost of production, selling price and profit estimates.

Estimating prepares the records showing all the above details, which can be used in material and product. It requires a highly technical knowledge hence an estimator is basically an engineer.

Elements of Cost:

1. Material Cost
2. Labor Cost
3. Other expenses or overhead

Material Cost

Object	Weight	Price(per kg)	Cost
M.S. plate (7mm thick)	36 kg(body)	Rs 45/kg	Rs 1620
M.S. hollow pipe (7 mm thick, 30 mm dia.)	2 kg (handle)	Rs 40/kg	Rs 80
Cylinder and other joining links	1 kg	Rs 40/kg	Rs 40

Standard calculation (all dimension in cm)

1)volume

$$\begin{aligned}\text{A) 2 Forks} &= 2 (l \times b \times t) \\ &= 2 (82 \times 10.5 \times 0.7) \\ &= 2 (602.5) \\ &= 1205 \text{ cm}^3\end{aligned}$$

Fork also have a side plates at its base. volume of which will be 1200 cm^3 . So total volume of base will be **2400 cm³**.

B) Upper body

The upper body of the forklift have total 4 plates welded together.

$$\begin{aligned}\text{i. Front plate} &= (L \times H \times t) \\ &= (64 \times 27 \times 0.7) \\ &= 1200 \text{ cm}^3\end{aligned}$$

$$\begin{aligned}\text{ii. Upper plate} &= (35 \times 18 \times 0.7) \\ &= 440 \text{ cm}^3\end{aligned}$$

$$\begin{aligned}\text{iii. 2 side plates} &= 2 (27 \times 18 \times 0.7) \\ &= 340 \text{ cm}^3\end{aligned}$$

$$\begin{aligned}\text{Total volume of body above the fork} &= 1200 + 440 + 340 \\ &= 1980 \text{ cm}^3.\end{aligned}$$

C) Fork lift handle:

$$\begin{aligned}\text{I. Long hollow handle} &= P \div 4 (D_o^2 - D_i^2) \times L \\ &= p/4 (3^2 - 2.3^2) \times 90 \\ &= 260 \text{ cm}^3\end{aligned}$$

$$\text{II. Gripping handle} = 70 \text{ cm}^3.$$

$$\begin{aligned}\text{Total volume of Whole body and handle} &= A+B+C \\ &= 2400+2000+250 \\ &= 4650 \text{ cm}^3.\end{aligned}$$

2) Weight of body

$$\text{Mass} = \text{Volume} \times \text{Density}$$

$$\text{Density of mild steel} = 7.8 \text{ gm/cm}^3$$

$$\text{Mass} = 4650 \times 7.8$$

$$= 36270 \text{ gm}$$

$$= 36.2 \text{ kg}$$

3) Material cost:

Material cost = Mass × Price/ kg

According to our survey market price of the mild steel is 45/kg.

$$\begin{aligned}\text{Material cost} &= 36 \times 45 \\ &= \text{Rs. 1620}\end{aligned}$$

Welding Cost

The total length of plates which needs to be joined by welding is around 600 cm. Or around 20 feet.

Considering market cost of welding Rs 40 per feet. The estimated welding length will be around 20 feet. Hence

$$\begin{aligned}\text{Welding cost} &= 20 \times 40 \\ &= \text{Rs. 800}\end{aligned}$$

Total Cost of Manufacturing Components

Material cost+ Welding Cost+ Overheads

$$1600+800+500 = \text{Rs.2900}$$

Cost chart of Bought Elements

Sr. No	Product	Quantity	Cost
1.	Hydraulic cylinder unit	1	1200
2.	Fasteners	As required	300
3.	Steering wheel	1	250
4.	Load wheel	2	150
5.	Paint Color Spray	2	300
		Total	2200

Total Cost of Project

Total Cost = Manufacturing cost + Cost of Bought Element + other overheads

$$= 2900 + 2200 + 1000$$

$$= 6100$$

Total project cost = 6100

PLANNING FOR THE NEXT SEMESTER

In our next semester we are going to do a Retrofitting of our Hydraulic Forklift in which we are Determine to do the Following Practical work.

- 1) Cleaning work of the Hydraulic forklift.
- 2) Dis mental all the parts of Hydraulic forklift.
- 3) Identify which parts are working properly and which needs to manufactured and replacement.
- 4) Retrofitting of the Hydraulic Cylinder.
- 5) Welding of the supporting link of Hydraulic cylinder.
- 6) Changing the steering wheels.
- 7) Changing the Load wheels.
- 8) Adding some innovative and creative Elements in the forklift which are absent in the Traditional hydraulic forklift.
- 9) Painting of whole Forklift by spray paint.
- 10) Testing the successful operation of Forklift.

REFERENCE

To complete our project HYDRAULIC FORKLIFT, help is taken from various resources. In which Internet has been the most essential tool for any kind of information we needed for our project. If we don't mention the resources from which we have gathered all the information about our project, our project will be incomplete. So here we would like to thank all of the websites and books which have been proven the most essential tool for the successful completion of our project.

- 1) www.Atlantaforklift.com
- 2) www.Wikipedia.com
- 3) www.academia.edu
- 4) www.mechengg.net
- 5) www.Toyotaforklift.com
- 6) www.Grabcad.com

Work Log Book

Date	Details of work carried out	Sign.
2-7-16	Searching for the project ideas	
16-7-16	Study of selected project	
30-7-16	Gathering all the information required for the project	
6-8-16	Preparing the Drawings	
6-8-16	Make or Buy Decisions	
20-8-16	Market survey	
3-9-16	Identifying the required resources, materials, machine tools and workshop tools required.	
17-9-16	Cost Estimation	
17-9-16	Preparation of notes individually on: 1. Extent to which he has achieved learning outcomes 2. Own experience in executing project. 3. Technical problem faced and solutions found	
1-10-16	Preparation of list of references Preparation of project report	
15-10-16	Presentation	