IJARSCT

ISSN (Online) 2581-9429

IJARSCT International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Volume 2, Issue 8, June 2022

Impact Factor: 6.252

Design and Analysis of Two Wheel Drive Forklift for Industrial Warehouses

Prof. G. V. Pise[1], Mr. Mayur Shitole[2], Mr. Suhas Marade[3], Mr. Rushikesh Dhamal[4], Aditya Choure[5]

Assistant Professor, Mechanical Engineering, NBNSSOE, Pune, India[1]

UG Student, Mechanical Engineering, NBNSSOE, Pune, India[2,3.4,5]

Abstract: *Gears are a critical element in a variety of industrial applications such as machine tools and gearboxes. An unexpected failure of the gear may cause significant economic losses. For that reason, fault diagnosis in gears has been the subject of intensive research. Vibration analysis has been used as a predictive maintenance procedure and as a support for machinery maintenance decisions. As a general rule, machines do not break down or fail without some form of warning, which is indicated by an increased vibration level. By measuring and analyzing the machine's vibration, it is possible to determine both the nature and severity of the defect, and hence predict the machine's failure. The vibration signal of a gearbox carries the signature of the fault in the gears, and early fault detection of the gearbox is possible by analyzing the vibration signal using different signal processing techniques. This paper presents analysis of vibration in gears using modal analysis and FFT analysis. It also presents analysis of gears with crack and gear with missing teeth. It also presents the analysis of Natural frequency in steady as well as running condition.*

Keywords: Gears, Fault Diagnosis, Vibration, etc.

I. INTRODUCTION

On floor, lifting heavy components or materials is a hectic job and also a risky job. Fork lift are always play an important role for heavy duty works, if cargos are being organized properly for the use of forklifts with right attachment would be a best way to load and unload which would make the whole process less time consuming, the less labours intensive in addition forklifts optimize the use of storage space by eliminating the need for many people to handle the loading and unloading operation. The value of use of internal transport square measures a typical part of the company's accounting, whereas the environmental consequences associated with it square measure usually unmarked.

In many cases, significantly in very little and medium organization, there is Associate in Nursing absence of awareness of the requirement to pay the environment fees incurred by the exploitation of internal transport suggests that that apply to off road vehicle, like wheeled vehicle, excavators or loaders usually, the wheeled vehicle is made public as a tool capable of lifting several kilograms of weight. A wheeled vehicle can be a vehicle form of somewhat truck that hastwo metal forks on the front accustomed carry merchandise

II. OBJECTIVES:

1. To reduce the human efforts.
2. This machine can be used in warehouses as well as various cargo plants, airports, railway junctions.
3. There is a large scope of transportation of goods from one place to another place easily.

III. METHODOLOGY

Step 1: - We started the work of this project with literature survey. We gathered many research papers which are relevant to this topic. After going through these papers, we learnt about car towing machine.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, June 2022
Impact Factor: 6.252

Step2: - After that the components which are required for my project are decided.
Step 3: - After deciding the components, the 3 D Model and drafting will be done with the help of CATIA software.
Step 4: - The components will be manufactured and then assembled together.

The testing will be carried out and then the result and conclusion will be drawn.
In this two-wheel drive fork lifting machine, we have used Arduino circuit to control the fork translation and drive train. This Arduino circuit is used to control servo motor which controls the motion of lead screw attached to guide the fork for upward and downward motion. Another servo motor is used to drive the unit to its required position. Basically, the main components of this project are Fork, Lead screw which guides the fork for lifting and lowering motion, Arduino circuit to control the drive of respective servo motors, and the base unit for the mounting of servo motors and Arduino circuit.

III. LITERATURE REVIEW:

1) "DESIGN OF TWO WHEEL AUTOMATIC ELECTRIC FORKLIFT FOR INDUSTRY WAREHOUSES& DOMESTIC PURPOSE", Lakshya Garg, Nitish Chauhan, Nikhil Tyagi UG (B. Tech) Students, Asst. Prof Department of Mechanical Engineering, Sunder Deep Engineering College, Ghaziabad.
In this research paper they have researched about two Wheel Automatic Electric forklifts, it's a small electrical vehicle designed to build a cheap forklift for industry warehouses& domestic purpose. A goods transportation device which can drive by anyone. Safe movement during
picking, stacking and traveling with loads. The dynamics of the vehicle is simple to the control the vehicle which means that it is stable. This is prevented by two small supporting wheels for balance the vehicle and its time derivative, controlling the motors to keep the vehicle balancing.

2) "Two Wheel Aisle Forklift", Ravi G. Kaithwas, Aniket A. Pattiwar, Rahul R. Ulmale, Ashish D. Wabhitkar UG Student,Department of Mechanical Engineering Jawaharlal Darda Institute of Engineering &Technology, Yavatmal, India.
In this paper they have stated that, Forklifts are designed to handle and transport both raw materials and goods carefully and efficiently. From time to time these machines must be transported from one work site to another. A normal sit-down forklift with the ability to lift 5,000 pounds will itself weigh as much as 9,000 pounds. The average automobile weighs approximately 4,000 pounds. Weighing in at more than two times the weight of the average family automobile. This paper presents research related to the choice of the criteria that can be used to fill the gap between the forklift's minimum capacity and works maximum capacity to lift the objects from a place to another place in warehouse operation. The analysis had been done with the aim of exploring the requirements of warehouses and construction sites. With some changes to forklift we designed a two-wheeler forklift, this research paper gives an exact idea about how should be a two-wheel forklift is useful, safer and efficient in narrow passages working sites and how to design and contrast the two-wheel aisle forklift for such working places.

3) "Design, Development and Modelling of Forklift", Ugale Sachin , Salvi Tushar , Lanjekar Sachin , Kshirsagar Prashant Mechanical Engineering Department, Final Year Students RMCET, Ambav, Ratnagiri,India. Assistant Professor, Mechanical Engineering Department, RMCET, Ambav, Ratnagiri, India.
They describe the development of robotic forklift intended to operate alongside human personnel, handling palletized materials within existing, busy, semi-structured outdoor storage facilities. The main objective of this project is to fabricate a Mechanical forklift for material handling in industries. In this paper a robotic vehicle is fabricated which runs to carry material from one place to another by using Radio Frequency Technology. Nowadays in industries, forklift used with hydraulic system. To use forklift, it requires one spot guide to guide a

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, June 2022
Impact Factor: 6.252

forklift driver because of less visibility. This paper discusses how to integrate Radio frequency identification (RFID) technology into a forklift truck to make it wireless to increase visibility and human safety.

4) "3 WHEEL DRIVE FORKLIFT FOR INDUSTRIAL WAREHOUSE" RAJAT.RAJENDRA. WADE, DIGVIJAY. K. TAKE, MAHESH. S. DESHMUKH, PRANAW. A. RAUT Student, Department of Mechanical Engineering Jawaharlal Darda Institute of Engineering & Technology, Yavatmal, Maharashtra, India
In today's life, there's a good type of forklifts, from the big significant loading truck to the one that works among slim aisles. Forklifts have become one in all the fundamental transportation tools we tend to use in our lives. With all the forklifts in existence, we discover that their square measure some enhancements that can be created to bring the self-propelled vehicle to a much better performance. Mechanical fork raise is associate improved and advance technology that helps caused revolution at intervals the mechanical industries these days all important engineering company uses it. Widespread use of the wheeled vehicle truck had revolutionized deposition practiced before the center of the 20th century. a mix of cloth handling system is at intervals the employment, actual from that entirely physical to people who unit of measurement semi-automatic but manually controlled. self-propelled vehicle has revolutionized warehouse work. They created to achievable for one person to maneuver thousands of pounds promptly. Well maintained and safely operated forklifts build lifting and transporting freight infinitely easier. this may be the ultimate description of a conventional wheeled vehicle truck. To enhances the technology any, this image module is created with remote technology, there by the operator can walk at the facet of the wheeled vehicle for higher visibility & the instrumentality area unit usually placed accurately (precision position). this may increase the protection of the operator

5) "Innovative design of the lifting mechanisms for forklift trucks", Jian-Yi Wang, Jing-Shan Zhao, Fu-Lei Chu, Zhi-Jing Feng Department of Precision Instruments and Mechanology, Tsinghua University, Beijing 100084, PR China.
They say Forklift truck is one of the most important tools in logistics. However, the general mast system of a forklift truck not only restrains the driver's vision, but also increases the whole weight of a truck and decreases the fuel economy. Therefore, this paper focuses on the innovative design of a new lifting mechanism for forklift truck. Firstly, a spatial multi-link lift-guidance mechanism is proposed. And then, under the constraints of this mechanism, the mobility of the fork and fork frame is investigated in theory. Lastly, a new lifting mechanism based on it is presented and computer simulation is used to demonstrate the feasibility of motion. This multi-link lifting mechanism takes advantage of flexible cable drive and rigid body guidance, which not only provides the operator with a wider field of vision but also reduces the equilibrate weight of a vehicle and therefore improves the fuel economy.
Forklift trucks are usually used at railway stations, warehouses, ports and factories for loading, unloading and conveying. A general weight-balanced forklift truck consists of a chassis and a work device which can be tilted and lifted vertically. However, the general forklifts have the following major disadvantages. First, the mast system composed of several large components will badly affect the driver's field of vision because it locates in front of the driver. Many accidents involving collisions between pedestrians and trucks are due to inherently bad visibilities of the forklift trucks.

6) "Design and Fabrication of Battery-Operated Forklift", Anil A. Sequeira, Saif Mohammed, Avinash A. Kumar, Muhammed Sameer, Krishnamurthy H. Sachidananda School of Engineering and IT, Manipal Academy of Higher Education, Dubai 345050, UAE Manipal Academy of Higher Education, Dubai 345050, UAE.
Forklift is defined as an industrial truck which is capable of lifting hundreds of kilograms. Forklift is commonly used in warehousing and manufacturing and it consists of two metal forks at the front of the vehicle in order to lift and transfer the load. The way the load is lifted in case of forklift is in such a way that the operator is going to move forward the vehicle until the two forks push under the cargo and then it is lifted by operating the forks.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, June 2022
Impact Factor: 6.252

Sometimes forks are also known as blades and made of steel and is capable to lift a few tons. The power to operate the forklift are either given using gasoline or electricity. Electric forklift depends on batteries to operate as compared to Gasoline or propane forklifts.

These gasoline or propane forklifts are much stronger or faster as compared to electric forklifts, but considered to be difficult to maintain, and it is also fuel efficient.

IV. CAD DESIGN

Computer-aided design (CAD) is the use of computers to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations.

COMPONENTS USED:

Lead Screw:

A lead screw (or lead screw), sometimes called a power screw or translation screw, is used to translate turning motion into linear motion. Lead screws can be manufactured by rolling, cutting, or grinding the threads.

Figure: Lead Screw

Sprocket:

Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc.

Figure: Sprocket

Chain:

A bicycle chain is a roller chain that transfers power from the pedals to the drive-wheel of a bicycle, thus propelling it. Most bicycle chains are made from plain carbon or alloy steel, but some are nickel-plated to prevent rust, or simply for aesthetics.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, June 2022
Impact Factor: 6.252

Figure: Chain

DC Motor:

DC motors are suitable for many applications – including conveyors, turntables and others for which adjustable speed and constant or low-speed torque are required. They also work well in dynamic braking and reversing applications, which are common in many industrial machines.

Figure: Motor

Arduino UNO:

Arduino of type -328P, 8-bit controller, with 4 ports, 4 analogue & 13 digital pins With Bluetooth mode HC-05.

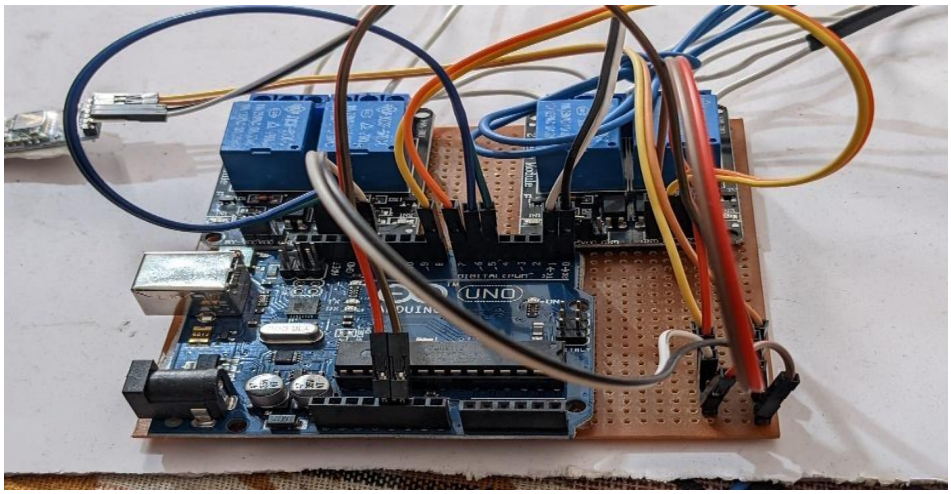


Figure: Arduino uno

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, June 2022
Impact Factor: 6.252

Lead Screw:

Data:

Diameter of lead screw, D=20 mm

Diameter of internal diameter of wheel=d=25 Efficiency of lead screw=42%

Calculation

Lead =pitch*starts =5*1 =5mm

Therefore,

Weight to be lifted is = 10kg

So, the maximum load will be 10 kg

Torque produce on lead screw is, $\text{Torque} = \mathbf{load \times lead \times efficiency / 2\pi}$

$= \mathbf{10 \times 9.81 \times 5 \times 0.42 / 2\pi}$

=32.79 N-mm

Chain Design:

Selecting standard chain used in cycle as Chain - 06 B From V.B. Bhandari page no. 14.3

Pitch -9.525mm

Roller diameter, d1=6.35 mm Width' b1=5.72 mm

Transverse pitch pt.=10.24 mm Teeth (z1) = 18

z2= 44

Approximate centre distance, a = 40*P nominal

a = 40*9.525

a = 381 mm

No of links

Ln=2(a/p) + (z1+z2/2) + (z2- z1/2* π)2 *(p/a)

= 2(381/9.525) + (18+44/2) + (44-18/2* π)2* (9.525/381)

= 111.43 = 111mm

Length of the chain

L= Ln*p = 111*9.525 = 1057.28 mm

Design of Sprocket:

Used chain no.06B For teeth (Z)=18 Pitch, P = 9.525 mm

Width between inner plates, b1= 5.72 mm Roller diameter, d1= 6.35 mm

Transverse pitch pt =10.24 mm

1) Pitch circle diameter

$D1 = p / \sin(180/z1)$ $D2 = p \sin(180/z2)$

$= 9.525 / \sin(180/18)$ $= 9.525 / \sin(180/44)$

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, June 2022
Impact Factor: 6.252

D_1 = 54.85 mm D_2 = 133.59mm

2) Roller seating radius (r_i)
$r_{imax} = 0.505d_1 + 0.069*(d_1)^{1/3}$ r_{imax} = 3.33mm
$r_{imin} = 0.505\ d_1$ = 3.2mm
3) Tooth Flank Radius (r_e)
$r_{emax} = 0.008(z^2+180)$ =16.928mm
$r_{emin} = 0.12*d_1(z+2)$ = 15.24mm

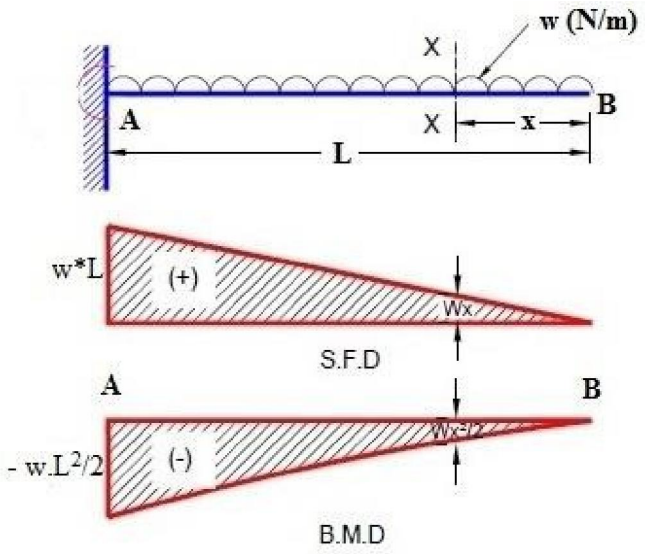
4) Root Diameter (D_f)
$D_f = D - 2*r_i$ = 88.47mm

5) Tooth height above pitch polygon (h_a)
$h_{amax} = 0.625*p - 0.5*d_1 + 0.8*p/z$ = 2.9513mm h_{amin} = 0.5(p-d_1) = 1.5875mm

6) Tooth Width (b_f)
$b_f = 0.93*b_1$ = 5.3196mm

7) Tooth Side Relief (b_a) b_a = 0.1p to 0.15p = 1.1907mm

For Calculation:
Fork lift:
Considering Uniformly distributed load over cantilever beam



For calculating the S.F.D and B.M.D for the fork,
we are going assume the load as 10kg which is = 10x9.81= 98.1N of load is distributed over the span of the fork after this conceptual calculation we are going to do the actual calculation while developing the project according to requirement.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, June 2022
Impact Factor: 6.252

Motor:

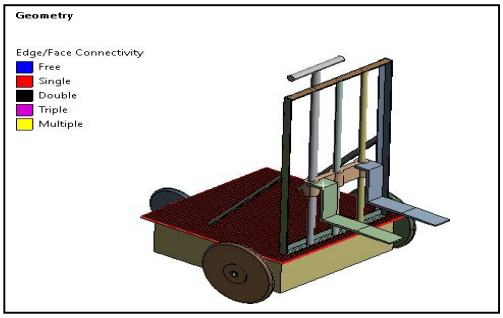
We have to lift 10kg of load and we know torque required for lead screw is 32.79 N-mm And for the drive we have assumed that the force carried by the motor is 20kg

So, therefore force = (20*9.81) =196.2 N

The distance between the driven sprocket and the prime mover is 350mm Torque = 196.2 x 350

= 68670 N-mm= 68.70 N-m

GEOMETRY:



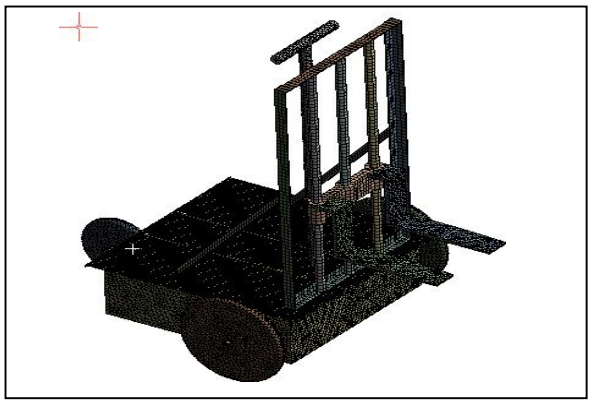
MATERIAL PROPERTIES:

Properties of Outline Row 3: Structural Steel

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	7850	kg m^-3
4	Isotropic Secant Coefficient of Thermal Expansion		
5	Coefficient of Thermal Expansion	1.2E-05	C^-1
6	Isotropic Elasticity		
7	Derive from	Young's Modulus an...	
8	Young's Modulus	2E+11	Pa
9	Poisson's Ratio	0.3	
10	Bulk Modulus	1.6667E+11	Pa
11	Shear Modulus	7.6923E+10	Pa

MESH:

ANSYS Meshing is a general-purpose, intelligent, automated high-performance product. It produces the most appropriate mesh for accurate, efficient multi physics solutions. A mesh well suited for a specific analysis can be generated with a single mouse click for all parts in a model. Full controls over the options used to generate the mesh are available for the expert user who wants to fine-tune it. The power of parallel processing is automatically used to reduce the time you have to wait for mesh generation.



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, June 2022
Impact Factor: 6.252

Nodes and Elements:

Statistics	
Nodes	153389
Elements	75601

V. STATIC STRUCTURAL ANALYSIS

Boundary Conditions:

A boundary condition for the model is the setting of a known value for a displacement or an associated load. For a particular node you can set either the load or the displacement but not both. The main types of loading available in FEA include force, pressure and temperature. These can be applied to points, surfaces, edges, nodes and elements or remotely offset from a feature. The way that the model is constrained can significantly affect the results and requires special consideration. Over or under constrained models can give stress that is so inaccurate that it is worthless to the engineer. In an ideal world we could have massive assemblies of components all connected to each other with contact elements but this is beyond the budget and resource of most people. We can however, use the computing hardware we have available to its full potential and this means understanding how to apply realistic boundary conditions.

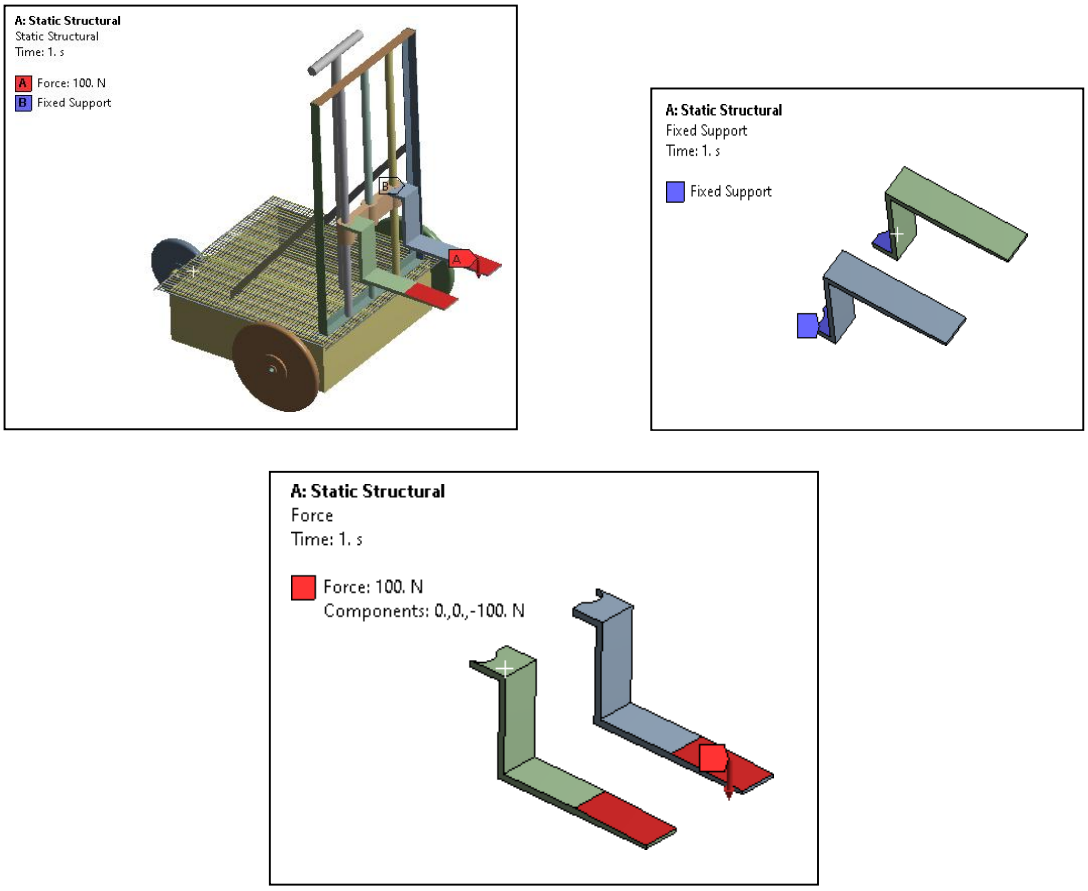
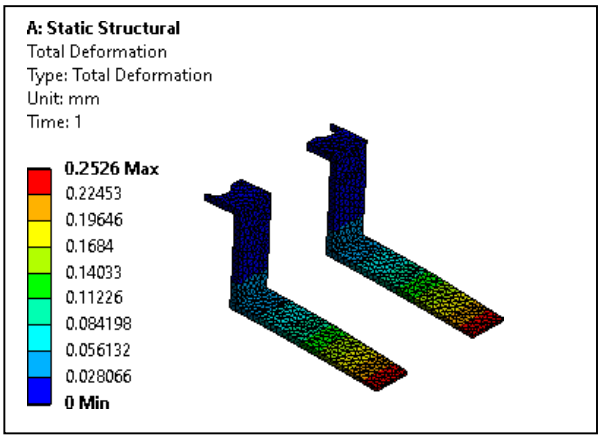


Figure 8.1: Boundary Conditions

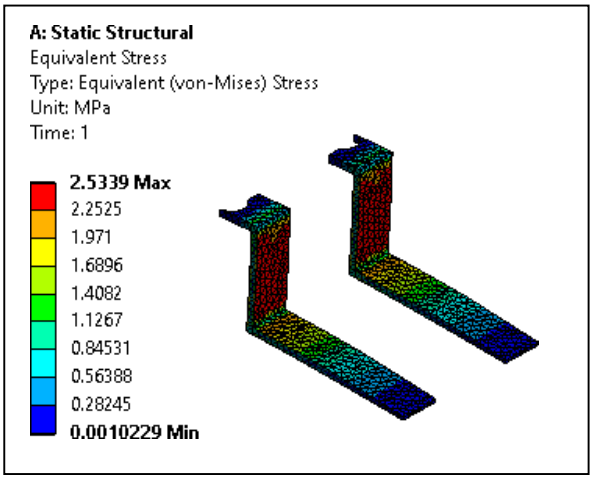
IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, June 2022
Impact Factor: 6.252

VI. RESULTS AND PLOTS: TOTAL DEFORMATION

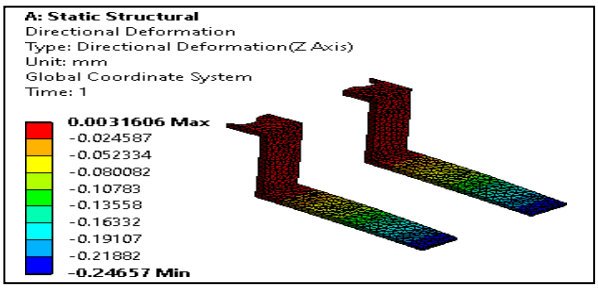


The total deformation is observed to be 0.2526mm

EQUIVALENT STRESS:



The equivalent stress is observed to be 2.5339 MPa which is less than the yield strength of the material which is 250 MPa so the fork design is safe.



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, June 2022
Impact Factor: 6.252

REFERENCES

[1] "DESIGN OF TWO WHEEL AUTOMATIC ELECTRIC FORKLIFT FOR INDUSTRY WAREHOUSES& DOMESTIC PURPOSE", Lakshya Garg, Nitish Chauhan, Nikhil Tyagi UG (B. Tech) Students, Asst. Prof Department of Mechanical Engineering, Sunder Deep Engineering College, Ghaziabad.

[2] "Two Wheel Aisle Forklift", Ravi G. Kaithwas, Aniket A. Pattiwar, Rahul R. Ulmale, Ashish D. Wabhitkar UG Student,Department of Mechanical Engineering Jawaharlal Darda Institute of Engineering &Technology, Yavatmal, India.

[3] "Design, Development and Modelling of Forklift", Ugale Sachin , Salvi Tushar , Lanjekar Sachin , Kshirsagar Prashant Mechanical Engineering Department, Final Year Students RMCET, Ambav, Ratnagiri,India. Assistant Professor, Mechanical Engineering Department, RMCET, Ambav, Ratnagiri, India.

[4] "3 WHEEL DRIVE FORKLIFT FOR INDUSTRIAL WAREHOUSE", RAJAT.RAJENDRA. WADE, DIGVIJAY. K. TAKE, MAHESH. S. DESHMUKH, PRANAW. A. RAUT Student, Department of Mechanical Engineering Jawaharlal Darda Institute of Engineering & Technology, Yavatmal, Maharashtra, India

[5] "Innovative design of the lifting mechanisms for forklift trucks", Jian-Yi Wang, Jing-Shan Zhao, Fu-Lei Chu, Zhi-Jing Feng Department of Instruments and Mechanology, Tsinghua University, Beijing 100084, PR China.

[6] "Design and Fabrication of Battery-Operated Forklift", Anil A. Sequeira, Saif Mohammed, Avinash A. Kumar, Muhammed Sameer, A. Kareem, Krishnamurthy H. Sachidananda School of Engineering and IT, Manipal