International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Design And Analysis of Two Wheel Drive Industrial Fork Lift for Light and Medium Duty Load

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ABSTRACT:

In today life there is wide of fork lifts variety of forklifts from the large heavy loadings trucks to the one that works among narrow aisles forklifts have becomes one of basics transportation tools we use in our lives with all the forklifts in existence we find that there are some improvements that can be to bring forklifts to the better performance.
Segway is a self-balancing transportation device with two wheels can operate in any level pedestrian environment. Existing forklifts design has its limitation in rotation and structures has potential safety risk our new design as 90 degrees rotating forks attached to truck body on both ends. also, it has a scissor lift under the operator cabin which improves the stability fork; there is a total of 8 parts in the new design.

Once the design is conceived, we calculate the mass properties of parts and subassemblies to ensure the stability of the fork lift results show that truck is safe to use its center of gravity remains in the safety triangle and we use this to get the maximum loading capacity then we run stress analysis important parts and subassemblies using finite elements Method (FEM) and their results show that the new design safe to working under these condition

1. INTRODUCTION:

A forklift (also called lift truck, fork truck, fork hoist, and forklift truck) is a powered industrial truck used to lift and move materials over short distances. The forklift was developed in the early 20th century by various companies, including Clark, which made transmissions; the use and development of the forklift truck have greatly expanded worldwide. Forklifts have become an indispensable piece of equipment in manufacturing and warehousing, remarked as raise truck, fork truck hoist, and vehicle truck is also a high-powered industrial truck want to spice up and move material over short distance. The wheeled vehicle was developed inside the first twentieth century by varied firms like Clark, that created transmission, and Yale & Towne manufacturing, that created hoist. The implementation of warehouse transportation technique could be an important house of business for many companies, blind of their size and profile. The value of use of internal transport square measures a typical a part of the company's accounting, whereas the environmental consequences associated with it square measure usually unmarked. A fork carry

one passes on the road may seem as if an up-to-date invention, but these machines square measure used for a minimum of the past 2000 years, if not longer. The Romans used forklifts to create Brobdingnagian monuments. Medieval churches were created with them. Also, the Egyptians may have used them to create pyramids. "The fashionable version is either easy or troublesome, and forklifts vary supported their application". To make the project, work lots of realistic, lots of importance is given for smart orientation, therefore a epitome module is formed for the demonstration purpose. This module simulates the required computer code this technology with slight changes at intervals the structure & motor ratings, the system may even be born-again for real applications. The maneuver of adjusting rotary to linear motion is implemented inside the mechanism.

1.1 OBJECTIVES

To made fork lifter automatic driven with help of controllers.

- To improve load carrying capacity.
- To make material handling easy.
- Reduces fuel consumption.

To reduces accidental losses,

The device was to move using motorized wheels and would be able to turn using swivel caster wheels. The batteries were to be mounted on the device underneath the device next to the wheels and off the ground, or otherwise concealed from the audience. The device was to be controlled via either remote control by another person or via switches by the user.

2. LITERATURE REVIEW

1. Forklift related accidents contribute a significant proportion of workplace fatalities all over the world. No more severe is this problem than in the USA, the location where the majority of forklifts are manufactured. "OHSA estimates forklifts cause about 85 fatal accidents per year,34,000 accidents result in serious injury and 61,800 are classified as non-serious".(Hall, 1996)
2. Furthermore, forklift accidents occur indiscriminately across all industry sectors; however, a significant fatality 'black spot' exists for plant and machine operators within the Manufacturing industry (NOHSC, 1998).
3. A high density of pedestrian workers exists within this environment, which in addition to vehicle roll-overs comprise the main accident mechanisms. Conditions like narrowed aisle ways and carrying loads were found to increase the likelihood of such accidents nearly two-fold. (Collins et al (a), 1999)

4. High-Capacity Forklift Trucks H8.00-12.00XM-6, H13.00XM16.00XM-6, HYSTER, 2013.
5. Top 20 Lift truck suppliers, Josh Bond, Modern Materials Handling, 2013
6. Toyota Material Handling Range, TP-Technical Publications, Sweden, 749803-040, 1304
7. Design and Control of Mobile Robot with Mecanum Wheel, Kyung-Lyong Han, Oh- Kyu Choi, Jinwook Kim, Hyosin Kim and Jin S. Lee, Dept. of Electr. Eng., Pohang University of Science & Technology, Pohang, South Korea, ICCAS-SICE, 2009

3. CONVENTIONAL FORFLIFT DESIGN

The seven different types of forklifts are,

1-Counterbalance forklift

2-Reach forklift

3-Electric forklift

4-Rough terrain forklift

5-Pallet truck

6-Order picker

7-Side loader

Fig3.1 Different types of forklifts

3.1 CHALLENGES IN CONVENTIONAL FORKLIFT DESIGN

Limited Maneuverability

Visibility Issues

Operator Fatigue

Load Stability

4 COMPONENETS

- Wheel hub
- Wheel axle
- Handle
- Frame
- Tires
- D.C motor
- Lifter motor
- Gears

4.1 WHEEL HUB

A hub is the central part of a wheel that connects the axle to the wheel itself. Many expressions use the term for a literal or figurative central structure connecting to a periphery. A wheel hub assembly (WHA), also referred to as hub assembly, wheel hub unit, wheel hub bearing, etc., is an automotive part used in most cars, passenger vehicles and light and heavy trucks. It is located between the brake drums or discs and the drive axle.

Fig 5.1-wheel hub

4.2 WHEEL AXLE

The wheel and axle can be viewed as a version of the lever, with a drive force applied tangentially to the perimeter of the wheel and a load force applied to the axle, respectively, that are balanced around the hinge which is the fulcrum. The mechanical advantage of the wheel and axle is the ratio of the distances from the fulcrum to the applied loads, or what is the same thing the ratio of the diameter of the wheel and axle.

Fig 5.2 Wheel axle

4.3 HANDLE

A handle is a part of, or attachment to, an object that can be moved or used by hand. The design of each type of handle involves substantial ergonomic issues, even where these are dealt with intuitively or by following tradition.

4.4 FRAME

A vehicle frame, also known as its chassis, is the main supporting structure of a motor vehicle, to which all other components are attached, comparable to the skeleton of an organism

4.5 TYERS

A tire (American English) or tire (British English; see spelling differences) is a ring-shaped component that surrounds a wheel's rim to transfer a vehicle's load from the axle through the wheel to the ground and to provide traction on the surface traveled over. Most tires, such as those for automobiles and bicycles, are pneumatically inflated structures, which also provide a flexible cushion that absorbs shock as the tire rolls over rough features on the surface. Tires provide a footprint that is designed to match the weight of the vehicle with the bearing strength of the surface that it rolls over by providing a bearing pressure that will not deform the surface excessively.

Fig 5.3 Tyre side view

4.6 ASSOCIATED COMPONENTS

- Wheel
- Rim
- Inner tube
- Valve stem

5 DESIGN OF EQUIPMENT AND DRAWING COMPONENTS

Step 1: Define Requirements

Gather Information

Step 2: Sketching

Create Sketches

Step 3: Part Design

Extrude and Revolve

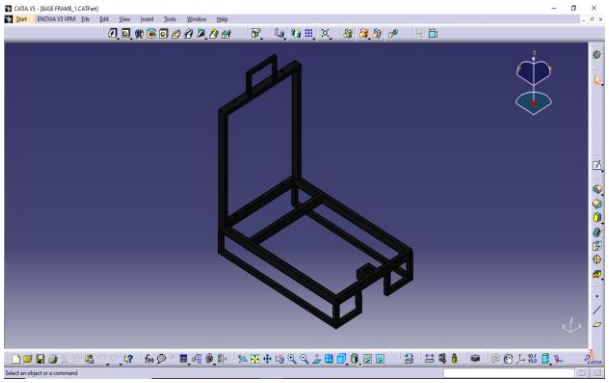


Fig 7.1 Base frame

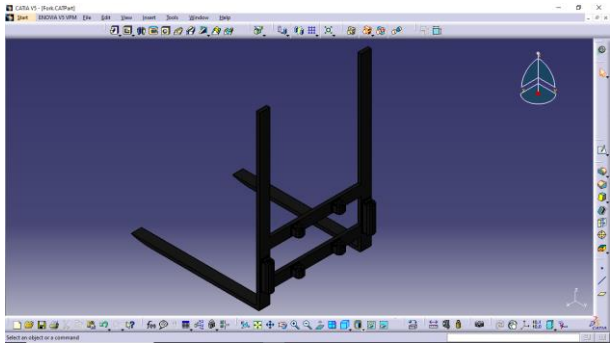


Fig 7.2 Fork

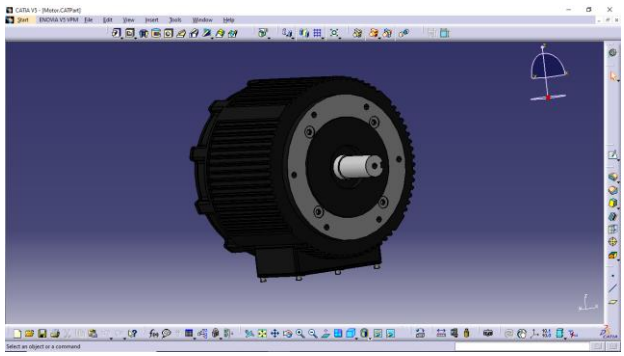


Fig 7.3 Electric Motor

Step 4: Assembly Design

Assemble Components:

- Use the Assembly Design workbench to assemble the individual parts. Place parts in their correct positions relative to each other.

Define Constraints:

- Apply constraints to ensure realistic movement and interaction between parts. For example, constrain the movement of the forks and the mast.

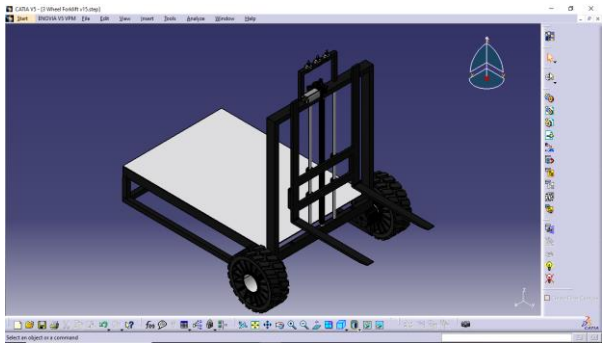


Fig 7.4 Assembly view

Step 6: Analysis

Step 7: Kinematics

Step 8: Drafting

Step 9: Rendering and Visualization

Step 10: Documentation

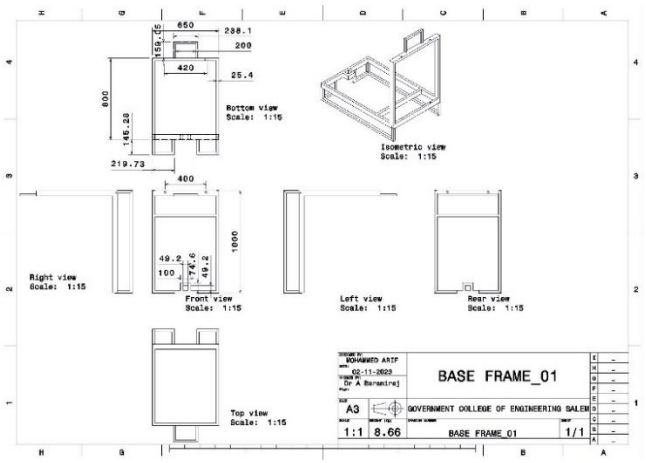


Fig 7.5 Base frame drawing

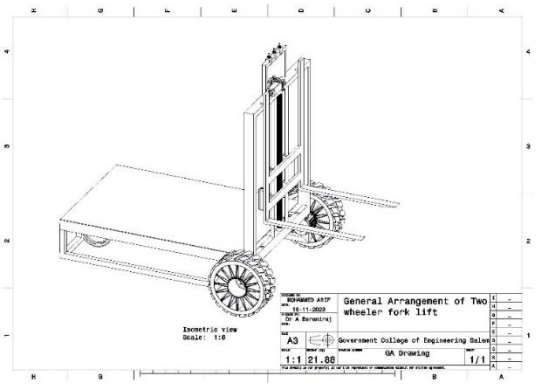


Fig 7.6 Final Assembly drawing of Forklift

Step 11: Review and Iterate

Review Design:

- Review the design for accuracy, functionality, and compliance with specifications. Make necessary iterations based on feedback.

Step 12: Finalize and Export

Finalize Design:

- Make any final adjustments, and then export the model in the desired format

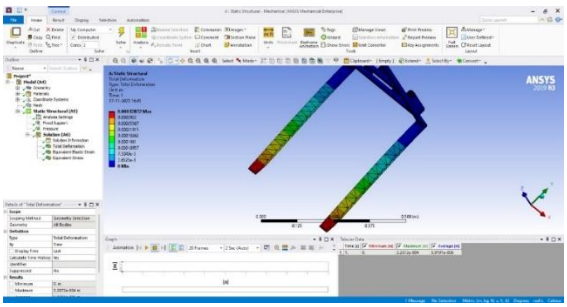
for manufacturing or further analysis.

Remember, this is a high-level overview, and the actual process may vary based on specific design requirements and the version of CATIA you are using. Always refer to CATIA documentation for detailed instructions and guidance.

6 FEM/FEA Analysis

Performing an ANSYS analysis of a fork in a forklift design involves using the ANSYS software to simulate and analyse the structural behaviour of the fork under various loading conditions. Here is a general outline of the steps you might follow:

1. **Geometry Import:** Import the 3D geometry of the forklift fork into ANSYS. This can typically be done by importing a CAD model of the fork.
2. **Mesh Generation:** Create a mesh for the fork geometry. A fine mesh is important to accurately capture the stress distribution. ANSYS provides different meshing tools and techniques.
3. **Material Properties:** Define the material properties of the fork material, such as Young's Modulus, Poisson's Ratio, and density. This information is crucial for the analysis as it determines how the material will deform under loading.
4. **Boundary Conditions:** Apply boundary conditions to simulate the real-world scenario. This might include fixing certain degrees of freedom at specific locations, simulating contact with other parts, or applying loads and constraints.
5. **Loads and Constraints:** Apply the loads and constraints that represent the operating conditions of the forklift. For example, simulate the weight of a load on the fork, forces during lifting, and any other relevant loads.
6. **Solver Setup:** Set up the solver settings, specifying the type of analysis you are performing (static, dynamic, etc.), the solution method, and convergence criteria.
7. **Solution:** Run the simulation and let ANSYS calculate the results. The software will provide information on stress distribution, displacement, and other relevant data.
8. **Results Post-Processing:** Analyse the results using ANSYS post-processing tools. Examine stress contours, deformation plots, and other visualizations to identify areas of high stress or potential failure.



9. **Evaluation:** Evaluate the results to ensure that the fork design meets safety and performance requirements. If necessary, make design modifications and iterate through the analysis process.

10. **Documentation:** Document the analysis, including the assumptions made, the boundary conditions applied, the results obtained, and any design changes implemented based on the analysis.

Keep in mind that this is a simplified overview, and the specifics of the analysis will depend on the details of the forklift fork design and the requirements of the analysis. It's always a good idea to refer to the ANSYS documentation and possibly consult with experts in structural analysis to ensure the accuracy and reliability of your simulations.

7. Conclusion

This project is mainly about a new design of a forklift. In Chapter 1 to chapter 9, we did some research on the products that already exist in the market for use. Then we studied in more details about how forklifts work and the primary structure and some new design ideas were proposed. After comparing their advantage / disadvantage, we finally have our new design proposal settled and finished the 2D design schematic.

Future Scope

This project although fulfilling our requirement has further scope for improvements. Some of the improvements that could be made in this fork lifter and it can be replaced with steering in place handle, in case of robotic switches can use controllers and sensors for directions, by increasing the motor capacity more weight can be lifted and human weight also can handle.