

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"DESIGN AND ANALYSIS OF STACKER FORK ARMS USING ANSYS SOFTWARE"

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ABSTRACT

In this paper, we studied the manufacturing process and functional activities of electric operated Stacker machine and came across with the various problems and handling in the current system. After thorough studies, careful static analysis and reviews of the various manufacturing systems and technologies. In this work an attempt is made to design of semi automatic Stacker. Semi automatic stacker is robust in construction and is smooth in operations. Semi automatic stacker is able to work efficiently for pallets on high rack, smooth control of precise lifting and lowering. By this project man power effort and time can reduce. And optimization weight of machinery. We design and analyze of carriage fork. Our aim is design and develops a model of semi automatic stacker. This system has a significant importance in the equipment and material handling system.

KEYWORDS : Stacker, manufacturing, lifting, static analysis, Semi automated, fork lifter, Optimization

I. INTRODUCTION

Material handling (MH) involves "short-distance movement that usually takes place within the confines of a building such as a plant or a warehouse and between a building and a transportation agency."¹It can be used to create "time and place utility" through the handling, storage, and control of material, as distinct from manufacturing (i.e., fabrication and assembly operations), which creates "form utility" by changing the shape, form, and makeup of material.

It is often said that MH only adds to the cost of a product, it does not add to the value of a product. Although MH does not provide a product with form utility, the time and place utility provided by MH can add real value to a product, i.e., the value of a product can increase after MH has taken place; for example:

The value (to the customer) added by the overnight delivery of a package (e.g., Federal Express) is greater than or equal to the additional cost of the service as compared to regular mail service—otherwise regular mail would have been used.

The value added by having parts stored next to a bottleneck machine is the savings associated with the increase in machine utilization minus the cost of storing the parts at the machine. Electric Pallet Stacker is a thin, highly-versatile lift that compliments nearly any primarily indoor application. Balanced similar to a traditional forklift and without base legs, the

Counter-Balanced Electric Stacker can fit into tight spaces. Extremely durable and budget friendly, the Toyota Counter-Balanced Stacker can help increase both your uptime and your bottom line.



Fig. 1

II. COMPONENTS OF STACKER

2.1 Pulley

A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable, supporting shell is referred to as a block.



Fig. 2

2.2 Hook

A hook is a tool consisting of a length of material that contains a portion that is curved or indented, so that this portion can be used to hold another object.



Fig 3

2.3 Wire rope

Wire rope is rope made from wire. It consists of several strands of metal wire laid (twisted) into a helix.



2.4 DC Motor

A **DC motor** is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.



| | | - |
|------------------------|------|--------|
| Dim ensions | Unit | Remark |
| Capacity | Kg | 100 |
| Max fork height | mm | 1500 |
| Lowered fork height | mm | 85 |
| Fork fixed width | mm | 550 |
| Fork width | mm | 85 |
| Fork length | mm | 1100 |
| Overall length | mm | 1050 |
| Overall height | mm | 1980 |
| Overall width | mm | 650 |
| Weight of unit | Kg | 110 |

III. STACKER SPECIFICATIONS Table.1

IV. MOTOR POWER CALCULATION FOR LIFTING

Power = Force = mass x acceleration.

= 100 x 9.81

= 981 N

Work done = Force x Lifting Height

= 981 x0.300

= 294.3 Nm

Power = Work done / Time Taken

=294.3/1

= 294.3 W

Safety Factor = 1.2

Total Power Required = 294.3×1.2

=353 W

=0.47 hp (1 HP = 746 Watt)

4.1 Structural Steel Mechanical properties

| Table 2 | | | |
|----------------------------------|------------|-------------------|--|
| Material Field Variable | Value | Units | |
| Density | 7850 | Kg/m ³ | |
| Young's modulus | 2E+05 | Мра | |
| Poisson Ratio | 0.30 | | |
| Shear modulus | 76923 | Мра | |
| Bulk Modulus | 1.6667E+05 | Mpa | |
| Tensile Yield Strength | 250 | Mpa | |
| Compressive Yield Strength | 250 | Mpa | |
| Tensile Ultimate Strength | 460 | Mpa | |
| Compressive Ultimate Strength | 0 | Mpa | |

V. COMPONANT STUDY



Fig.6 Stacker 3D Model



Fig.7 Fork lifter arm 3D model

VI. SIMULATION & ANALYSIS

6.1 Structural steel materials



Fig.8 Geometry



Fig.9 Meshing



Fig. 10 Force applied



Fig. 11 Von-misses stress



Fig.12 Deformation

6.2Stainless steel materials



Fig.13 Von-misses stress



Fig.14 Deformation

6.3 Aluminum Alloy



Fig. 15 Von-misses stress



Fig.16 Deformation



Fig.17 Von-misses stress

6.4 Magnesium Materials



Fig.18 Deformation

VII. RESULT & DISCUSSION

Fully automatic Stackers are robust in construction and are smooth in operations. Fully automatic stackers are able to work efficiently for pallets on high rack. Smooth control of precise lifting and lowering. By this project man power effort can be reduce and time of work can reduce. And we designed and analyzed of carriage fork and power pack box with different load. This system has a significant importance on the equipment and material handling system. Considered the aspects of noise and vibration. The objective of this work is to present an improved methodology, based on numerical and experimental analysis; to evaluate the life of the semiautomatic stacker system. It can be improving the industrial work, and also improve the material handling equipment system. In the last several years' material handling has become a new, complex, and rapidly evolving science. For moving material in and out of warehouse many types of equipment and system are in use, depending on the type of products and volume to be handled. The equipment issued, in loading and unloading operations, for movement of goods over short distances. The handling of material in warehouse is restricted to unitized forms, which require smaller size equipment. However, for bulk handling of material at logistics nodes such as fully automatic stacker can be used for the appropriate need of improved industry.

Materials comparisons Table.3

| S. No. | Materials | Von – Misses Stress (Mpa) | Deformation (mm) |
|--------|------------------|------------------------------|---------------------|
| 01 | Structural Steel | 160.9 | 5.33 |
| 02 | Stainless Steel | 160.85 | 5.52 |
| 03 | Aluminum Alloy | 160.75 | 14.99 |
| 04 | Magnesium Alloy | 160.2 | 23.6 |



Fig.19 Comparison of Von -misses stress for different materials



Fig. 20 Comparison of Deformation for different materials

7.1 Comparison between our model and exiting model

Table.4

Midland Manual Stacker Truck (Exiting Model)

- 1.6m lift height 500kg capacity Pallet Stacker Manual stacker
- 500kg capacity with a 1.6m lift height
- Robust steel profile construction
- Lifting function operated by foot and hand controls
- Precision engineered for smooth operation and performance
- An economical lifting solution for lifting pallets, skids and dies
- Ideal for operating in small areas
- This model will only lift open bottom pallets, for lifting closed bottom pallets
- Unit Weight : 146 kg

Our Modal

- 1.5m lift height 500kg capacity Pallet Stacker Manual stacker
- 500kg capacity with a 1.5m lift height
- Robust steel profile construction
- · Lifting function operated by
- Precision engineered for smooth operation and performance
- An economical lifting solution for lifting pallets, skids and dies
- Ideal for operating in small areas
- This model will only lift open bottom pallets, for lifting closed bottom pallet
- Unit weight : 110 Kg

7.2 Advantages

- 1. Simple in construction.
- 2. Simple and convenient lifting operating system.
- 3. Light and easy manual steering system, equipped with a parking brake.
- 4. Smooth control of precise lifting and lowering.
- 5. Special design is available according to customers' requirements.

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