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Design & Fabrication of Smart Trolley Combined Lifter

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ABSTRACT: There have been some concerns related to manual handling of large items in industry. Manual handling operations of large material or workpieces may expose workers to risks related to efficiency as well as occupational safety and health. Heavy materials are difficult to move and burdensome to lift/transfer, and handling the sharp edges of workpiece may result in contact stress and/or cut injuries on the workers. A smart trolley combined-lifter was then designed and fabricated to address these issues.

A study on the use of the trolley-lifter for handling heavy materials at small industries and workshops was conducted to compare between the new and traditional handling methods. The smart trolley combined lifter offers an alternative solution to automation and a mechanized assistive device by providing a simple mechanism to assist the handling of work and materials effectively and safely.

KEYWORDS: Manual handling, Lever Principle, Smart Trolley, Small Industries, Simple Mechanism.

I. INTRODUCTION

Small industries have major problem related to cost of material handling systems. Material handling systems or lifting machines existing currently function on hydraulics, electrically, fossil fuels etc. which are not that affordable for small scale industries and workshops. Rather use of fuel for such operations is so environment friendly.

So, we decided to make a project 'Design and fabrication of smart trolley combined lifter which is a complete solution to above mentioned problems. The operation of our lifting machine is completely manual without any actuators or complex parts. Our machine is easy to use compact in size and doesn't need any skilled worker which may reduce the cost of labor and thereby increasing the productivity rate.

The motorized mechanical aids such as electric or battery-operated forklifts may impose a higher cost for purchasing and maintenance. In addition, they may require specific training and skilled workers for operation. More-over, the size of motorized mechanical aids is bulky, which may affect the practicality especially in small workshops where working areas are limited. Thus, the need of nonmotorized mechanical aid like as the smart trolley combined lifter was arised

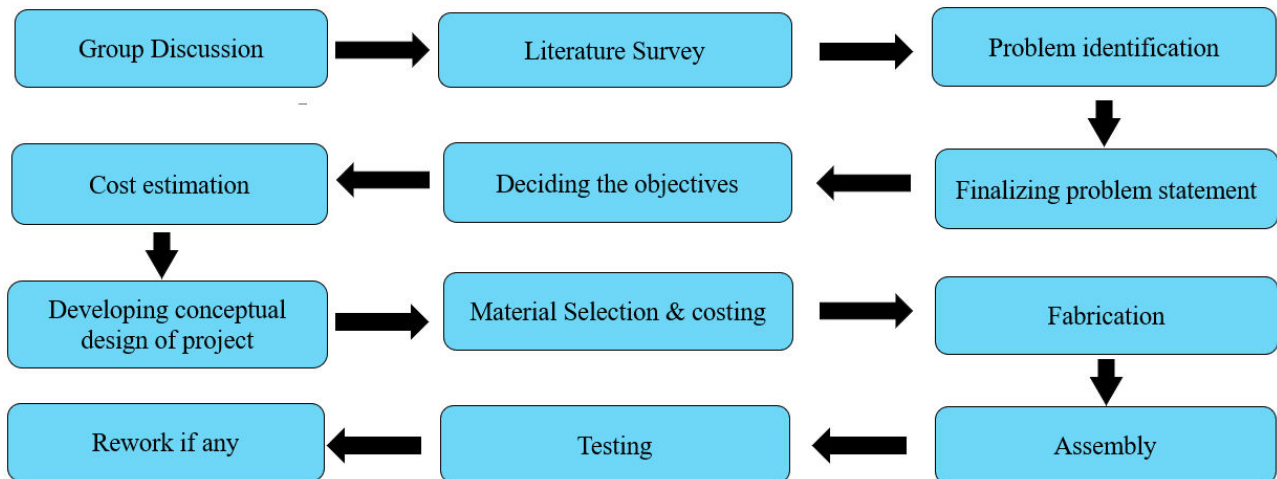
II. RELATED WORK

Manual handling of materials can be found in any workplace from offices to heavy industrial and manufacturing facilities. Often times, manual material handling entails tasks such as lifting, climbing, pushing, pulling, and pivoting, all of which pose the risk of injury to the back and other skeletal systems which can often lead to musculoskeletal disorders (MSDs). Musculoskeletal disorders can be defined as often involving strains and sprains to the lower back, shoulders, and upper limbs. According to a U.S. Department of Labor study published in 1990, back injuries accounted for approximately 20% of all injuries in the workplace which accounted for almost 25% of the total workers compensation payouts. To better understand the potential injuries of manual handling of materials, we must first understand the underlying conditions which can cause the injuries. When an injury occurs from manual handling of materials, it often is a result of one of the following underlying conditions(s).

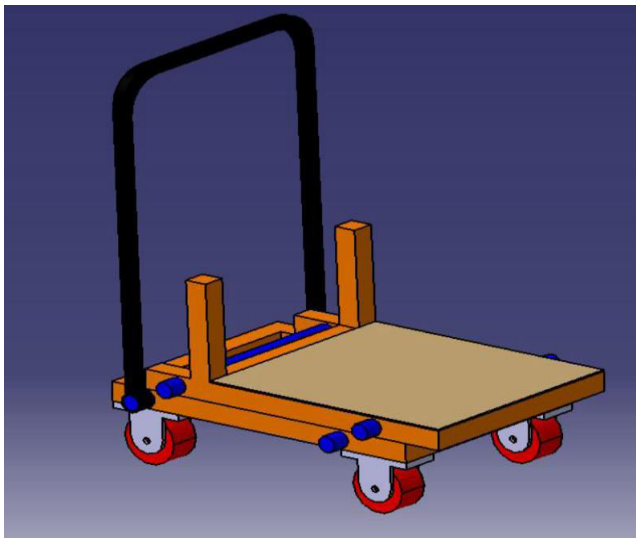
1. Awkward posture: Bending or twisting
2. Repetitive motions: Frequency of a task

3. Forceful exertions: Carrying or lifting heavy loads
4. Pressure points: The load applying pressure to select areas on the body only
5. Static postures: Staying in the same position for extended periods of time

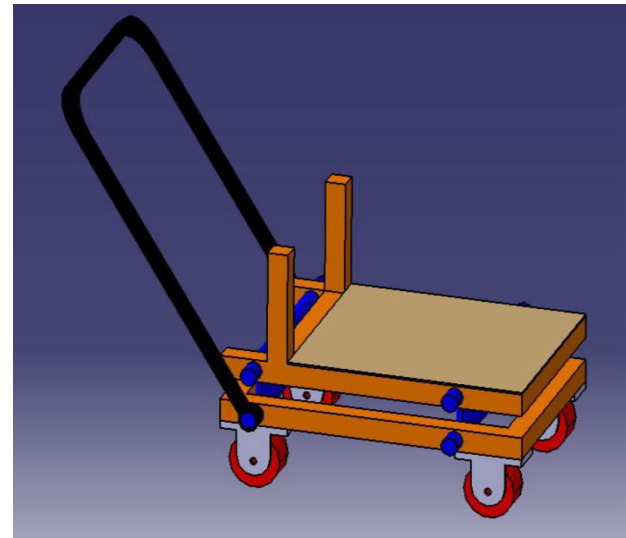
III.METHODOLOGY



IV.CONCEPTUAL DESIGN



a. unloaded condition



b. loaded condition

Fig.1. Conceptual design of Smart Trolley Combined lifter

V. CALCULATIONS

Total trolley weight should be 1/3 of the load to be carried it means. Our Required load is 1500Kg inclusive of safety load. Trolley weight = $1/3 * L$

Where L = load to be carried. Calculation = $1/3 * 300 = 100\text{Kg}$.

Our trolley weight should be 100Kg or more than this.

The Formula

$$F = f * W/R$$

F = The force required to overcome the rolling friction

f = The coefficient of rolling friction

W = Load on wheel

R = Radius on each wheel

Material POLYURETHANE 85A

Step 1

Load for each wheel is calculated as follows,

Since the max & safe load for our trolley is 300kg

$$W = 300\text{kg} = 300 * 9.81 = 2943\text{N}$$

Since 4 wheels are used, $W = 2943/4 = 735.75$

Step 2

Polyurethane wheels have the coefficient of friction as 0.8

D = Dia of wheels = 4in = 101mm & R = 50.5 mm

Step 3

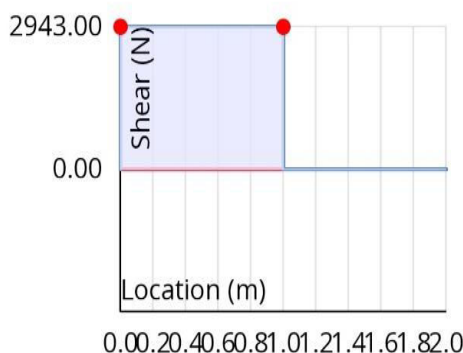
Estimate the load "F" required to overcome the friction of wheel rolling $F = f * W/R$ $F = 0.8 * 735.75/50.5$

$F = 11.65\text{ N}$ For four wheels $11.65 * 4 = 46.6\text{ N}$ in Kg $4.75 \approx 5\text{kg}$ Hence for our designed trolley Pulling or Pushing force is 46.6 N

SHEAR DIAGRAM

(Max +ve) Shear Load (N): 2943.000,

Location (m): 0.000, 1.000



MOMENT DIAGRAM

(Max -ve) Moment Load (N.m): -2943.000,

Location (m): 0.000

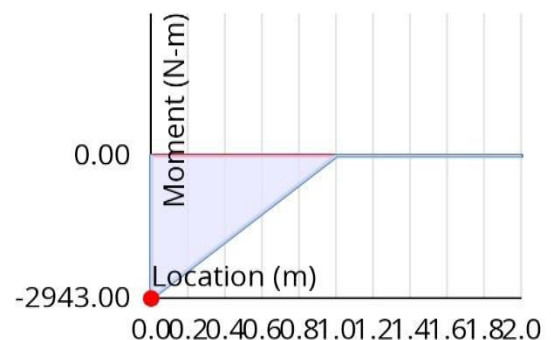


Fig.2. SFD & BMD for Smart trolley combined lifter

VI. WORKING PRINCIPLE

The working principle used in this Project is 'Lever Principle'. When one end of plank pushed down, the other end raises up due to lever principle. Due to this the Potential energy is converted into Kinetic energy as lifting platform moves Up and Down. Ex- See Saw

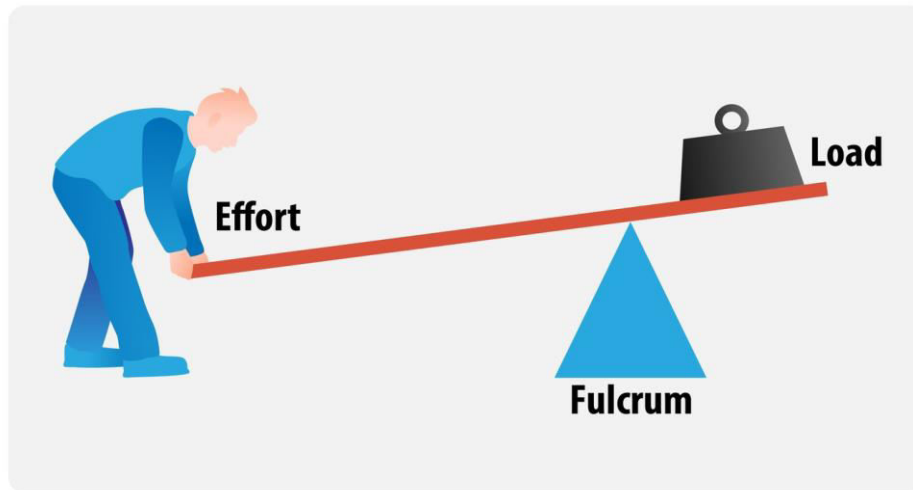


Fig.3.Lever Principle

The lever is the most familiar of all the simple machines because of its plain construction and its extensive use in numerous engineering devices. It consists of rigid beam or rod which freely rotates about fixed point, also referred to as fulcrum. By positioning the fulcrum close to a heavy object and applying an effort from away, levers can be used enormous loads with ease

VII.SCOPE OF WORK

This project will prove useful to small scale industries and workshops where the manual material handling practices are followed. This project will help to improve the work efficiency and productivity of workshops. As this project focuses on the burdensome effects of manual material handling on workers it will help to provide the healthy and better working condition to workers. This project is an alternative to automation and hence is an economic and simple solution to manual material handling.

VIII.CONCLUSION

The development and implementation of the smart trolley combined lifter represent a significant advancement in manual material handling technology. Through careful design and fabrication, the device offers a practical and effective solution for addressing the challenges associated with lifting and transporting heavy materials in small industries and workshops. The integration of automation and mechanized assistance not only enhances efficiency but also prioritizes occupational safety and health. Moving forward, continued research and refinement of such assistive devices will further revolutionize manual material handling practices, fostering safer and more productive working environments



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