

Design and Fabrication of Stair Climbing Trolley

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Abstract:

This research presents the design and performance test of a stair-climbing trolley. The aim of this project is to develop a mechanism for easy transportation of heavy loads over stairs. The need for such a system arises from day-to-day requirements in our society. In this research, the shaft diameter is calculated by using the bending strength of the beam. A mild steel shaft is selected for design to obtain high strength. Several designs were conceived that would allow a non-industrial hand trolley to travel over stairs, curbs, or uneven terrain while reducing the strain on the user. In our project, the trolley is equipped with Tri-Star wheels, enabling us to carry a load up and down the stairs. It also eases the movement of the trolley on irregular surfaces like holes, bumps, etc.

keyword

climbing mechanism", "stair-climbing design", "ergonomics of stair climbing trolleys"

INTRODUCTION

A hand trolley is a small transport device used to move heavy loads from one place to another. It is a very common tool used by a large number of industries that

transport physical products. Also a hand truck or a Dolly, the hand trolley is often used by a stock person who arranges and restocks merchandise in a retail store. when used properly, the trolley can protect people from back injuries and other health problems that can result from lifting heavy loads.

A typical hand trolley consists of two small wheels located beneath a load-bearing platform, the hand trolley usually has two handles on its support frame. these handles are used to push-pull and maneuver the device well my offer install the handles may that extend from the top layer of the frame, or one handle may curve play from the back. An empty hand trolley usually stands up in an L shape and products are usually stacked on top of the platform. When the goods are in place, it is tilted backward there you go so that the load is balanced between the platform and the support frame. Especially if heavy or fragile materials are moved, the person operating the trolley should eat and eat to an upright position carefully Google, to ensure nothing falls off the platform. The front of the fame may be squared off 4 boxes or curved for drums and 2barrels. Sometimes a hand truck also has a strap for securing loose flight during transport.

AIM AND OBJECTIVE

The aim of a stair climbing trolley is to provide an easier way to transport heavy or bulky items up and down stairs, reducing the physical effort required and minimizing the risk of injury.

Example :construction site worker

The main objective of a stair climbing trolley is to allow individuals to move objects safely and efficiently over stairs without having to lift them manually, which can cause strain and injury to the back, arms, and legs. By using a stair climbing trolley, the weight of the load is transferred onto the wheels of the trolley, making it easier to push or pull up and down stairs. Additionally, the design of stair climbing trolleys often includes features such as adjustable straps, handles, and brakes to ensure that the load is secure and stable during transport.

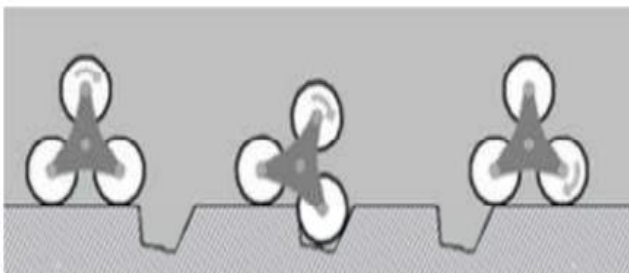
Overall, the aim and objective of a stair climbing trolley is to provide a safe and efficient solution for moving heavy or bulky items up and down stairs, while reducing the risk of injury and physical strain.



TRI-STAR WHEEL

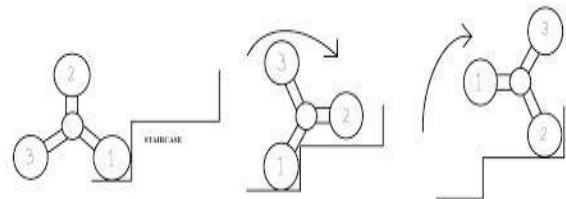
The Tri-Star wheel was designed in 1967 by Robert and John Forsyth of the Lockheed Aircraft Corporation. They were first developed as a module of the Lockheed Terrastar, a commercially unsuccessful amphibious military vehicle. A Tri-Star wheel functions as an ordinary wheel on flat ground, but can climb automatically when an impediment to rolling is encountered. This wheel design consists of three tires, each mounted to a separate shaft. These shafts are located at the vertices of an equilateral triangle. The three shafts are geared to a fourth, central shaft (to which a motor may be attached).

When geared in this quasi-planetary fashion, these triangular sets of wheels can negotiate many types of terrain, including sand and mud; they can also allow a vehicle to climb over small obstructions such as rocks, holes, and stairs. The wheel assembly may be gear-driven, with two wheels in rolling contact with the ground. The third wheel idles at the top until the lower front wheel hits an obstruction. The obstruction prevents the lower front wheel from moving forward but does not affect the motion of the driving axle. This causes lands on top of the obstruction and allows the rest of the assembly to vault over the obstruction.



APPLICATIONS OF STAIR CLIMBING TROLLEY

- ❖ It can be used in the transportation of luggage from one floor to another on stairs in shopping malls.
- ❖ It can be used in buildings under construction.
- ❖ This mechanism can be used as a stair-climbing mechanism for wheelchair.



- ❖ It can be used for material handling.

DESIGN ASPECTS



LOAD CALCULATION FOR AXLE

Length of the axle = 0.44m
Distance between welds = 0.40m

The load applied/ carried = 30 kg (distributed equally by the welds to the axle)

=15 kg through each weld =
147.15N

Weight of the trolley = 20kg (uniformly distributed throughout the axle)
=196.2 N

Neglect the overhang beyond welded points since the wheel provides only negligible reaction

From equilibrium equation $\sum F = 0$ And $\sum M = 0$

Find reaction at the supports, $R_1 = 190.314N$;
 $R_2 = 190.314N$

Calculate the maximum bending moment for the beam,

$M(\max) = 6.7155 \text{ N-m}$ Considering FOS =1.5,

$M(\max) = 10.07N -m$

Bending equation

$$\frac{M}{L} = \frac{\sigma}{y} = \frac{E}{R}$$

$$I = \frac{\pi R^4}{4} \sigma = 3.8 \frac{N}{mm^2}:$$

Bending stress for the given material can be assumed to be $0.66 \times$ yield strength Thus, the allowable bending stress for the given material is 165 N/mm^2

The calculated bending stress for the material is within the allowable bending stress for the material,

Thus the design is safe.

RESULT AND ANALYSIS

Stair climbing trolleys are designed to assist in transporting heavy loads up and down stairs. They typically have special wheels or tracks that can climb steps, making it easier for the user to move the load without having to lift it. Some models may also have additional features such as brakes, adjustable handles, and fold-able frames.

One of the main benefits of using a stair climbing trolley is that it can reduce the risk of injury and strain on the user's back and legs. Instead of having to carry the load up and down the stairs, the user can simply guide the trolley and let it do the heavy lifting. This can be particularly helpful for individuals who need to transport heavy loads frequently, such as movers, delivery drivers, or maintenance workers.

However, there are also some potential challenges associated with using a stair climbing trolley. One of the main issues is that the trolley may not be suitable for all types of loads. For example, if the load is too large or bulky, it may be difficult to maneuver the trolley up and down the stairs. Additionally, the trolley may be less effective on uneven or narrow staircases, which can increase the risk of accidents or damage to the load.

Overall, the effectiveness of a stair climbing trolley will depend on various factors, including the size and weight of the load, the design of the trolley, and the skill and experience of the user. While it can provide significant benefits for some users, it may not be the best solution for all situations.

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