Triangle Wheel Trolley For Transferring Product Over Stairs

ABSTRACT-The goal of this project is to create a method for carrying large objects easily up and down stairs. The necessity for such a system is brought on by daily needs in our society. Hand trolleys and other devices are intended to reduce the strain of lifting while on level ground, however they typically fall short when it comes to moving the weight up and down a short flight of stairs. As a result, the project aims to create a staircase , climbing a hand cart, which requires less work than carrying heavy goods up stairs manually. It also makes an effort to research the value and commercial viability of such a product.

A number of solutions were developed to make it easier for a non-industrial hand trolley to move over obstacles including curbs, stairs, and uneven ground.

Tri-Star wheels on the trolley that we're using for this project allow us to transport loads both up and down stairs. Additionally, it makes it easier for the trolley to move across uneven terrain like holes, bumps, etc.

The project's goal is to provide a method for carrying heavy loads over stairs with ease. In current society, the demand for such a system has grown as a daily necessity. Thus, our concept presents a new alternative for the transportation of load over the stairs. Using this vehicle, the labour cost may be reduced as well as a substantial quantity of load can be transferred uniformly with less power usage. With the help of its redesigned wheel structure, it has been developed to ascend a stepped path. Simple mechanical tools like hand trolleys with one or two wheels are now used in a variety of sectors as well as in domestic settings. However, they are just used to move objects from one place to another along the floors. No design that has been developed and put on the market so far meets the demand for support when shifting a weight up stairs. Stair wheels, which are combinations of three wheels, are utilised as a replacement to get rid of this problem because they require less lifting effort. The focus of the current study is on the design and production of a tri-wheel stair climbing hand trolley that can operate over uneven terrain and carry substantial weights up stairs with an enhanced wheel arrangement while requiring very little labour and manufacturing expense. Concerns about the design are highlighted, particularly the steepness of the stairs and the steadiness and speed of the trolley as it ascends. Tri-wheeled hybrid trolleys can be used to transport many products to different areas. The investigation and analysis of the stair climbing trolley are described in the current work. To transport big loads from one location to another, use a hand trolley. It is a

highly popular tool used in several industries to transport physical goods. Such a cart won't move up or down stairs. Using a single wheel to move a large weight or object from the lowest floor to the top floor is quite challenging. In the workplace, loads are moved using cranes, lifting equipment, etc. However, such a tool is not employed in

homes or on civil building sites. So it is challenging to move loads to the upper floor. Using stair wheels eliminates this obstacle.

KEYWORDS-stair wheel frame, bearings, axel, shaft, tri-star wheels, hand trolley, stair climbing hand cart, non-industrial trolley, hydraulic lifting jack, tri wheel arrangement, tri lobe wheel , Low Price

INTRODUCTION: Mechanical artefacts are widely used in modern society. They are being utilised in several application domains, including security systems, hospitals, offices, and industrial automation. It is obvious that mechanical designs help humans do their activities more efficiently.

One of the most frequent mobility problems for robotic applications is climbing stairs. Our group has been working on a project to design and construct a mechanical STAIR-CLIMBER that can ascend stairs safely. After considering several solutions, it was decided to construct a trolley that could transport loads up and down stairs and to manually power it in order to keep it within reach of a large number of people. This will make it possible to handle products across stairs effectively while using less human energy.The project involves creating a new, multipurpose trolley product from scratch. Three wheels are on each side of the vehicle thanks to its unique design. They're arranged in a triangle arrangement. This thesis focuses on the most human-beneficial ergonomic design. The current project concerned load-carrying devices that go up and down flights of stairs and are manually operated. A load carrier is a wheeled device that is often used to transport goods. It is utilised to lessen human effort. Hand truck was the original load hauler.A research team developed a rhombus-shaped vehicle of the rover type in the early 2000s with two bogies connected on each side and one wheel placed on a fork in the front and one wheel in the back. Chang Hsueh-Er invented/suggested/proposed a five-wheel trolley that may be manually controlled. Anastasios et al. and D. Helmick et al. created a robotic carriage that was belt-driven and without any connected wheels.

A lot of work has gone into redesigning these systems to make them more effective, cheap, and inexpensive.

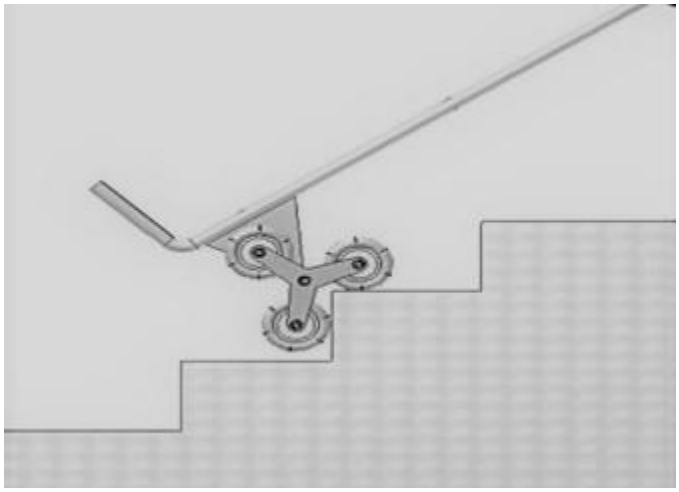
In many nations, urbanisation causes physically crowded structures in rural locations, making it difficult to use elevator facilities.

Cranes are used to transport loads even in small businesses and on building sites, which sometimes causes slips and accidents. In situations when human labour seems to be the only option, stair climbing trolleys operate as a substitute, minimising human effort. They are made to move big objects that weigh over 150 kg securely from one level to another, such as refrigerators, washing machines, cabinets, water cans, books, tiny containers, food grains, poisonous materials, etc.

The goal is to create a multi-purpose trolley that can be used for a variety of tasks, including travelling over the floor and ascending stairs. Early versions could only move

the vehicle on level ground with a single wheel or a pair of wheels on each side. Here, the modelling is done in a manner that each facet has three wheels, allowing the weight to be moved up and down steps. At the bottom of the trolley, which functions as a single unit, it consists of two sets of three wheels each coupled to a frame at 1200. To support the frame and use human effort to either push or pull the trolley, handles are supplied.On level terrain, a Tri-wheel performs like an ordinary wheel would, but when a rolling obstruction is met, it has the capacity to automatically climb. Three tyres are used in this wheel design, and each tyre is fastened to a different shaft.
The vertices of an equilateral triangle include these shafts. The third, centre shaft is geared to the other two shafts. These triangular pairs of wheels, when geared in this quasi-planetary way, may go across a variety of terrains, including sand and mud. They can also help a vehicle climb over tiny obstacles like rocks, holes, and steps. Two wheels may be in rolling contact with the ground and the wheel assembly may be gear-driven. Until the lower front tyre encounters a barrier, the third wheel is stationary at the top. The driving axle is not affected by the blockage, which only inhibits the lower front wheel from going forward. As a result, the top wheel moves forward and assumes the role of the front wheel. The remainder of the assembly may then jump over the impediment since this wheel often falls on top of it. In order to elevate the stuff put on the trolley, we have additionally installed a hydraulic jack. This might increase the trolley's efficiency.

Depending on the operating load and requirements, the trolley's size, form, choice of frame, and location may differ. The wheels are fixed on the shaft with bearing support. Another important factor is the choice of material. Mild steel is favoured [3] for intermediate weights, whereas stainless steel is often used for large loads. Figure 1 depicts the movement of a stair wheel trolley on stairs.
A trolley is a compact moving tool used to convey heavy objects from one location to another. Manual hand trolleys are ones that must be propelled by a person. It is a really typical equipment used by several sectors to move physical goods products. The hand trolley, sometimes known as a hand truck, is often used by a stockperson who organises and replenishes goods in retail stores. Trolleys, when used appropriately, may shield users from the potential for back injury and other health issues hoisting large objects.



Hand trolley is a tiny moving tool used to convey heavy objects from one location to another. Many different sectors that convey physical goods utilise it as a highly common tool. The hand trolley, which is also known as a hand truck or a dolly, is often used by stock people who organise and replenish inventory in retail businesses. Trolleys, when used appropriately, may shield users from back injuries and other health issues that might arise from lifting large objects.

TROLLEY Kinds: There are several trolley types, and the one utilised is often selected depending on the kind of item it will transport. A variety of hard materials, such as steel, aluminium, and high-impact plastic, are used to make hand trolleys. While most hand carts are used for normal loads and come in typical sizes, others are made especially for extremely little or huge items.

Wheeled trolleys constructed of stainless steel are the most often used kind of hand truck. These are used in settings where big objects must be moved, such as industries and retail establishments, and they often feature wheels made of stainless steel as well. Trolleys with welded steel and metal wheels are often lighter and used to transport lighter items.
Those with an alloy metal frame and wheels are more substantial and heavy. This kind of trolley often has a broader platform to accommodate big loads. Hand trucks built of metal alloys are often used to move bulky things, such steel-manufactured items.

Folding Trolley is a different kind of hand tool that is often constructed of rust-resistant aluminium. In addition, it may fold to save space when not in use and is often able to carry hefty loads. It may also be quickly transferred to locations where it is required thanks to this functionality.
The garden cart may be moved about by pulling on its pull handle. Since they need to fit comfortably on walkways and walks without disturbing the ground cover, garden

trolleys often have small profiles. These are made to be able to carry weights that are often found in gardens, including both dry and swampy ones.
Kitchen trolley is a service cart that doubles as a storage container. It is intended to include more than one area, allowing users to carry different utensils and for different purposes.
Sack Trolley : The terms "sack trolley" and "sack barrow" are generally ambiguous and refer to a variety of lightweight, single-person hand trucks or trolleys that are used to transport cartons, feed and grain sacks, and other stackable, light items. Sack trucks are made from a variety of materials. High impact plastics, tube steel, aluminium steel, and aluminium excursion are within this category.

PROBLEM IDENTIFICATION:
It should be noted that it is feasible to climb stairs with a regular wheel before getting into the science underlying intricate stair-climbing devices. This technique of stair climbing is relatively unattractive due to the enormous wheels required for the operation. Additionally, rolling over stairs produces a jarring rather than a smooth rising action. Additionally, the wheel's ability to grip and roll over the stair requires enough friction between it and the stair's edge. If the friction coefficient is sufficiently low, the wheel will slide up the stair instead of climbing. A drawback of previous art hand trucks or carrying carts is that it is difficult for the operator to manage the truck while travelling down stairs. Moving large loads up stairs is much more challenging since the operator is heavily pulling both the weight and the vehicle. It is typical to include braking devices that may be used to assist stop the truck from veering off while it is moving down the steps. Existing hand trucks and carrying carts also have the drawback of being inadequate for moving bulky items. Trucks normally have two ground-contact wheels, and since big loads bear straight downward on the wheels, they rapidly wear out. After prolonged usage, the wheels acquire flat areas and other abnormalities on their outside surfaces, making it challenging for the operator to manage the vehicle.

Survey of Literature:
Overview:
Instead of increasing liability, the stair-climbing hand truck is intended to decrease it. When an item has to be moved across an uneven terrain, conventional hand trucks are less helpful than they are on level surfaces. For instance, package delivery men often need to haul laden hand trucks up a few short flights of stairs in order to get to a building's front door. Using a traditional hand truck is meant to eliminate the need to lift and move big goods. Since the user must exert enough upward power to move the full weight of the cart and its contents, lifting a hand truck up the stairs negates the purpose of the tool. We conducted a market study to gather data on the usefulness of this equipment for clients in cottage industries and other small-scale businesses.

Additionally, we conducted a market analysis to determine the price of the raw materials and the completed goods needed to construct our unit. To gather knowledge for our lesson, we used a variety of books, journals, periodicals, and industrial publications.

1. HANDLE A LARGE, BULKY, OR AWKWARD ITEM

When establishing risk controls at your business, you must consider your risks, evaluate the risk, and decide if the risk can be avoided or reduced as much as practically possible. This is according to the information found on handling big, bulky, or awkward items. From January 1, 2006, employers will be required under the Occupational Health and Safety (OHS) Act 2004 (s. 35) to engage with workers in this process to the extent that it is practically possible. When searching for solutions to control hazards associated with handling big, heavy, or awkward goods, your health and safety representatives (HSRs) and workers will often be the finest source of knowledge and suggestions on workplace design, layout, work techniques, and new technologies. Additionally, they will be able to determine if the suggested remedies would result in the introduction of new hazards.

Involving professionals like designers, consultants, suppliers, and purchasing officials is something you should think about doing, especially if you're trying to figure out how to affect what happens in the supply chain upstream and downstream of your place of business. Items that meet the definition of "big, heavy, or awkward" in this guide must weigh at least 25 kg and have at least one dimension of 500mm. However, even if the products you manage do not meet these requirements, you could discover that the guidelines in this guide will help make your job safer. You should take into account the three factors below when you discuss with your staff strategies to get rid of or lessen the danger. Remember that these are not always sequential processes and that the best way to reduce hazards in your circumstance may combine redesigning or repackaging with the use of mechanical assistance and/or team lifts.

It is anticipated that team lifting will typically be the least desirable option, a temporary fix, or used to augment the handling of things once alternative non-manual handling techniques have been researched and employed where it is fairly practical to do so. This guide's content is illustrative and may not apply to every working circumstance. When determining the most practical risk controls for your specific circumstances, the Occupational Health and Safety (Manual Handling) Regulations 1999 (the "Manual Handling Regulations 1999") must always be taken into account. INDG398 created these mechanisms, which were then published in 10/13. However, the drawback of these mechanisms is that they need a substantial amount of building, thus in our project, we overcame these issues and created a highly reliable mechanism.

2. ELEVATOR TRANSPORTER:

According to the material found while searching for the term "stair climbing transporter," it is a grouping of rigid or restraint bodies that have been moulded and linked in such a way that they move relative to one another. A machine is made up of several

mechanisms that work together to transfer force from the power source to the load that has to be overcome. Robotics is a branch of automation that combines technologies from many other domains, including embedded systems, artificial intelligence, sensors, and electronic control systems. Depending on the application, the initial stage in each robot design is the synthesis of mechanisms. We created a very affordable transporter since these mechanisms are quite expensive.

3. LIFT AND HANDING ASSISTANCE:

When you look for information about lifting and handling aids, you may learn how to move a weight from one location to another. Back injuries may result from repeated, strenuous lifting and handling. However, adopting lifting and handling aids may eliminate or lessen that danger, keeping employees at work and in good health. This advice is meant for managers, staff members, and their representatives, as well as for anybody else engaged in the choice of lifting and handling assistance. We created an atrauli in our project that makes it possible to carry a weight from stairs with ease. In these mechanisms, a basic traully was created to assist in the transportation of huge loads. These issues, which cause a lot of noise when working, are resolved in our project.

4. PROJECT CONTEXT

A trolley is a piece of machinery used to transport large goods. It may lighten people's loads in their day-to-day activities. Many different sectors often move physical goods using this equipment. People who arrange and stock products in retail businesses often use trolleys. When utilised appropriately, a trolley may shield users from health issues

including back pain and other conditions that might arise from lifting and transporting large objects.

5. REVIEW OF LITERATURE

Research Goals This study aims to increase the autonomy of people who depend on mobility aids while lowering the burden on caregivers who must provide this mobility. This thesis set out to construct and test a consumer-level hand truck that could climb stairs.

A number of solutions were considered to make it as easy as possible for a nonindustrial hand truck to go over obstacles like stairs, curbs, or uneven ground. These additional design alternatives need to be looked at more thoroughly in order to create a successful product. Future work on this product should include designing and building further prototypes that use various stair-climbing techniques.

A design without a need for an electrical power source should also be extensively examined.

Md. A. Hossain Nafis investigated a brand-new avenue for the movement of goods up and down stairs. It is difficult and tedious to handle big things since the majority of the country's buildings lack elevators and are structurally crowded.

The ascent of stairs In places like libraries, hospitals, and construction sites where lifting things over a small height is necessary, a trolley may be quite useful. The Trolly is known as a stair climbing Trolly because it can run on very uneven and rocky terrain or travel up levels under pressure.

Ravi R. Mishra changed Due to the height of the stairs creating a significant obstruction in the route of the vehicle in the first design, the power transfer to the single or double wheel trolley is ineffective for climbing the stairs. Also To provide adequate drive, the straight wheel frame's design required to be changed with a curve-spherical form, which increased frictional force. To ensure smooth power transfer and enable unhindered stair climbing, three wheel sets were added to each side of the vehicle and mounted to the frame. The right frame layout may also communicate precise velocity ratios. It offered improved efficiency, a small footprint, and dependable service.

In driving mode, as described by **Lauren M. Smith**, two of each mechanism's three separate wheels are in touch with the ground and move over smooth surfaces rapidly and effectively, much as a wheeled robot would. The Tri-orientation Wheel's with respect to the robot body is not fixed, enabling the wheels to passively pivot around the central driving shaft of each mechanism. This makes it easier to respond to grades and slopes effectively. This capacity to rotate and keep in touch with a flat, sloping surface Operating Mode Driving Mode also allows for passive obstacle absorption. The leading ground wheel kicks back when it strikes an obstacle. In order to continue driving, the top wheel then moves into place as the front ground wheel. When facing a good or negative impediment, this reaction is predicted. In this mode of operation, if the Tri-Wheel is raised entirely off the ground, the frictional forces in the gears lock up the gear set

(preventing power from reaching the wheels), causing the whole assembly to revolve in the direction of the motor output without any individual wheels spinning.
Tumbling Mode was described by **William R. Tuck** and **Kyle A. Johnson**. Tumbling Mode offers a powered way to keep a robot moving when more perilous barriers (stairs, trash, loose ground, etc.) are encountered. In Tumbling Mode, a braking mechanism is activated to work upon the gearing system in such a way that it compels the three wheels to revolve around the Tri-Wheel assembly's central axle and "walk" over obstacles like a Whegs robot. To assist in moving the robot forward, this tri-spoke revolution purposefully happens in the same direction as each wheel rotation. The device that triggers Tumbling Mode may be activated manually, by an operator, or automatically based on data from sensors that indicate a stall condition, a risk of slippage, or a certain distance from the barrier to be overcome.
This vehicle uses a tiny drum brake with a cam that operates it when the operator commands it.
The Tri-Wheel climbing stairs while in tumbling mode. The Tri-Wheel approaches a step by rotating around its central axle, then rolls along the step surface until it is in a good position to flip over again and continue climbing. This is possible because of the Tri-dual Wheel's capacity to roll and climb.

6 . TRI WHEEL MECHANISM'S HISTORY

The tri-star is a unique wheel design with three wheels placed in an upright triangle, two on the ground and one above them. It was invented by Robert and John Forsyth and assigned to Lockheed in 1967. The whole system turns over the obstacle if any of the wheels in touch with the ground becomes stuck. In Damnation Alley, the Landmaster. The Landmaster, a special armoured personnel carrier (APC) from the movie Damnation Alley, was its most well-known use.
It is often used as a stair climber.
In addition, Lockheed converted an M2A2 105mm Light Howitzer from 1969 to 1977 into an Auxiliary Propelled Howitzer they called the "Terra Star" by adding a motor unit and tri-star wheel system. The Rock Island Arsenal Museum is home to the only surviving prototype.

DESIGN -

Comparability -

Old design concept	New design concept
1.In the initial design each single or Double wheel set on either side is only capable of moving vehicle on flat surface.	1.In this concept we attached set of three wheel on either side of vehicle rather than single or double wheel.
2.The plate which is mounted on the Base is not movable.	2.The plate which is mounted on the base is movable.
3.It required more human effort.	3.It required minimum human effort.
4.It was unfold able cart and difficult to carry.	4.It is compact in size and easy to Carry.

DESIGN OBJECTIVES

The apparatus should be capable of supporting up to 100 kg of weight.
A guy can lift 40 to 50 kg on average.
The gadget should cost around the same as a traditional consumer-grade hand truck.
The tool should be user-friendly and ergonomic.
The device should be easy to use and have a weight that is equivalent to traditional versions.

ADVANTAGES OF MODIFIED DESIGN

- Power transfer to the wheel is efficient.
- Greater capability for carrying weight.
- simple to manage and need little upkeep.
- It is ergonomically sound since it can be used easily by individuals of all ages and puts less strain on the muscles.

SELECTION OF MATERIALS

Mild steel rod

For machining purposes, general-purpose steel bars are excellent for weakly stressed parts including studs, bolts, gears, and shafts.
often required in situations where the skill to weld is necessary. To increase wear resistance, material may be case-hardened. Bright rounds, squares and flats, and hot-rolled rounds are all options. may be delivered in blocks of a certain size as well as sawn blanks.

Mild steel metal sheets

Metal that has been processed industrially into thin, flat pieces is known as sheet metal. It may be cut and twisted into a number of shapes and is one of the primary forms used in metalworking. Metal sheet is used in the construction of innumerable common items. Extremely thin portions are referred to as foil or leaf, while those that are larger than 6 mm (0.25 in) are referred to as plate. Thicknesses may vary greatly. There are flat pieces of sheet metal and coiled strips available. A roll slitter is used to cut a continuous sheet of metal into coils.
The classic, non-linear gauge is a typical way to describe the thickness of sheet metal. The metal is thinner the higher the gauge number. Steel sheet metal is often used in gauges ranging from 30 to around 7. Ferrous (iron-based) metals have a different gauge than nonferrous metals like aluminium or copper; for instance, copper thickness is measured in ounces (and corresponds to the thickness of 1 ounce of copper rolled out to an area of 1 square foot).

BEARING :

Single row deep groove ball geometry supporting radial and axial loads at high speeds.
Stainless steel, which resists deforming under great stress, is durable.
Usual radial internal clearance for applications without typical accuracy requirements or thermal expansion.
Metal shields on each side of the bearing keep contaminants and lubrication apart.

MACHINERY ACTIVITY

Cutting operation

A pair of circular blades are used to slit. The sheet was cut using rotary cutters either following a closed shape or a straight line. The blades through which the sheet is dragged are either powered to revolve or left idle.

A previously produced item is completed in its contour during trimming, a finishing technique that involves cutting off the superfluous burr material.

In order to make the edges smooth and provide dimensional precision, burrs from the cut edges are sheared off during the shaving finishing procedure. Cut off operations entail successively cutting on opposing sides of a sheet of metal to remove a blank from it.

PIPE BENDING

Bar bending machines are used to bend reinforcement bars and different types of round bars. They are sturdy, quick, and cost-effective. We are well-known for both the high quality of raw materials we use in the production of Rebar Bending machines and the exceptional after-sales support we provide for those products. Your steel yard's production capacity is efficiently increased by these devices, using less human work. The TMT bending machine, commonly referred to as the Bar bending machine, is brashly constructed for everlasting operation, making it exceedingly simple to operate.

SMOKING

Shielded metal arc welding (SMAW), sometimes referred to as manual metal arc welding (MMAW) or stick welding, is one of the most used kinds of arc welding. The consumable electrode rod or stick and the base material are brought together by an electric current to form an arc. The electrode rod is coated with a flux that emits vapours that act as a shielding gas and create a layer of slag, both of which protect the weld region from air pollution. The electrode rod is constructed of a material that is compatible with the base material being welded.

It is unnecessary to use additional filler since the electrode core itself serves as filler. The method is relatively adaptable, needs minimal operator training, and uses low-cost equipment.

However, since consumable electrodes need to be changed regularly and because slag, the flux residue that remains after welding, has to be removed, weld durations may be fairly lengthy.

TRI-WHEEL TROLLEY MATERIAL SELECTION AND FABRICATION:

Choosing a material is a phase in the design of any physical thing. The major objective of material selection in the context of product design is to reduce costs while achieving product performance objectives. The qualities and prices of potential materials serve as the starting point for a methodical selection of the optimum material for a certain application.

vehicle body
Used substance: mild steel
Light Steel
The most popular kind of steel is mild steel, often known as plain-carbon steel, since it is more affordable than iron while still offering material qualities that are suitable for a wide range of uses. Low-carbon steel is malleable and ductile because it has a carbon content of 0.05-0.3%. Mild steel is inexpensive and pliable despite having a relatively low tensile strength; carburizing may raise the surface hardness. When substantial amounts of steel are required, such as for structural purposes, it is often employed. Mild steel has a density of around 7850 kg/cm3 and a Young's modulus of 210 GPa (30,000,000 psi).

Tri-Star wheel
Grade 304 stainless steel was used as a material.
Steel, grade 304 stainless steel The basic 18-8 grade, Type 302, is modified into Type 304 with a greater chromium and lower carbon content. Lower carbon reduces chromium carbide precipitation from welding and reduces intergranular corrosion vulnerability. It may often be used "as-welded," but Type 302 has to be annealed to maintain appropriate corrosion resistance. With a maximum carbon percentage of 0.03%, Type 304L is a very low-carbon variant of Type 304 that prevents carbide precipitation during welding. This alloy may thus be utilised in the "as-welded" form even in highly corrosive environments. Most of the time, it does away with the need to anneal weldments unless a particular application calls for stress relief. Compared to Type 304, it has somewhat worse mechanical characteristics.

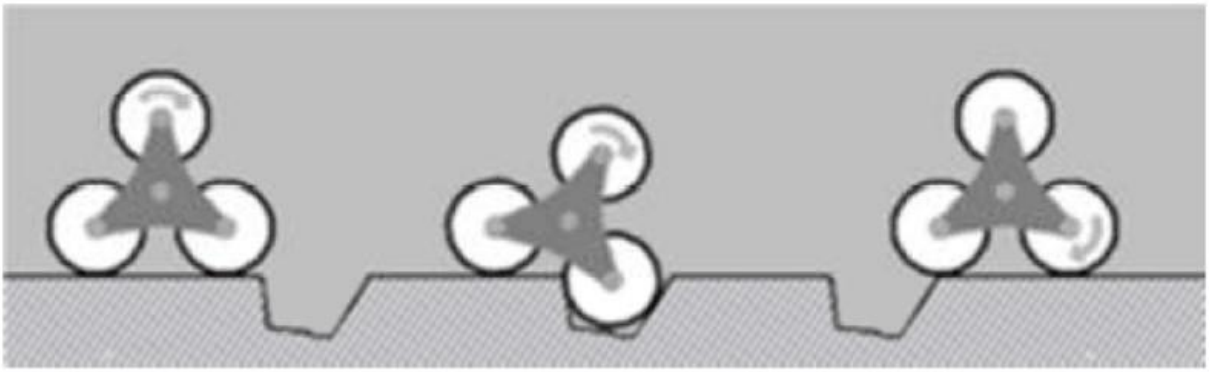
SELECTION OF BEARINGS: Ball bearing:
A ball bearing is a specific kind of rolling-element bearing that employs balls to keep the bearing races apart. A ball bearing's main functions are to sustain radial and axial loads and lessen rotational friction. In order to confine the balls and transport the stresses via the balls, at least two races are used. In the majority of applications, one race is coupled to the rotating assembly, while the other is immobile. The balls also spin as a result of the rotation of one of the bearing races. The balls' coefficient of friction is substantially lower than it would be if two flat surfaces were moving against one another since they are rolling.
choose a ball bearing with a minimum inner diameter of 30mm, a minimum radial load carrying capability of 50kg, and a speed higher than 100rpm
Selected Bearing: SKF 6006 Open 30x55x13mm deep groove ball bearing
30mm internal diameter
56mm outside diameter
Width:13mm

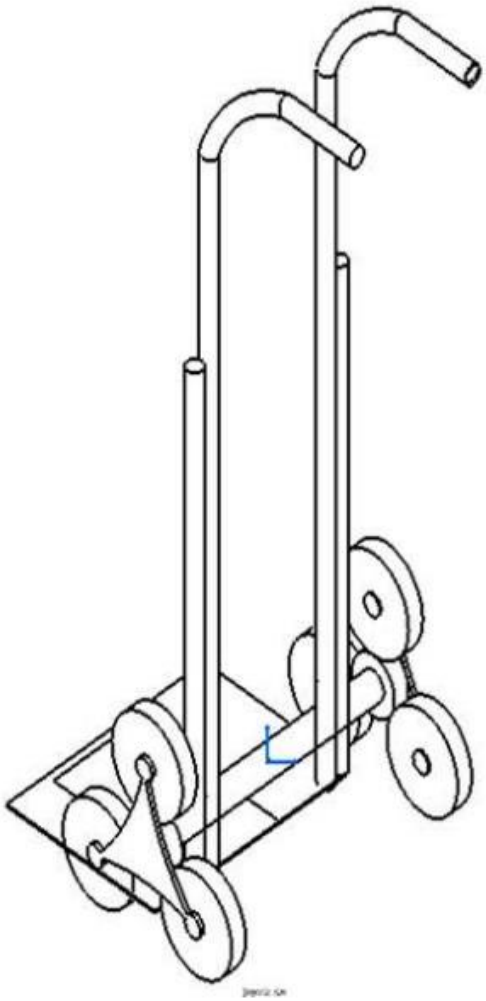
Deep groove design allows this sealed ball bearing with dimensions of 30x55x13 millimetres to operate at high speeds while sustaining radial and axial stresses. This bearing is pre-lubricated from the manufacturer, requiring no further lubrication, and includes rubber seals on both sides to keep lubricant in and impurities out. This deep groove sealed ball bearing is intended for use in applications requiring great running accuracy at high rotating speeds and combined radial and axial stresses. Clutches, drives, gearboxes, compressors, pumps, turbines, as well as printing and textile machinery are a few examples of such uses.

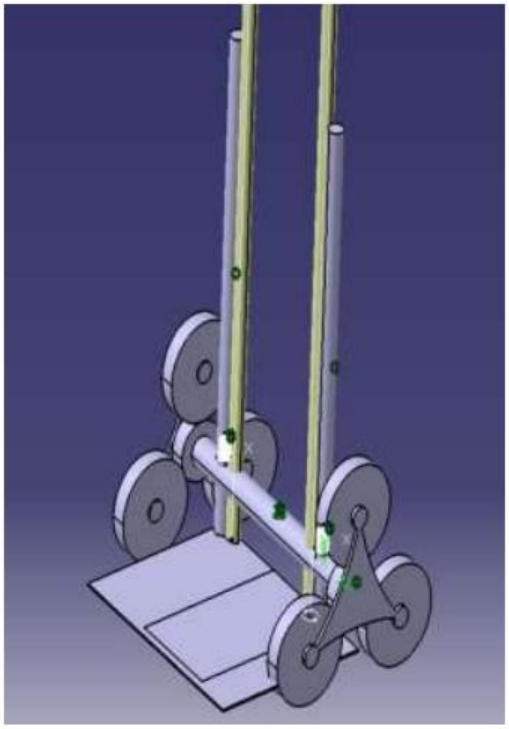
WHEEL SELECTION:
Filled rubber was chosen as the wheel material.

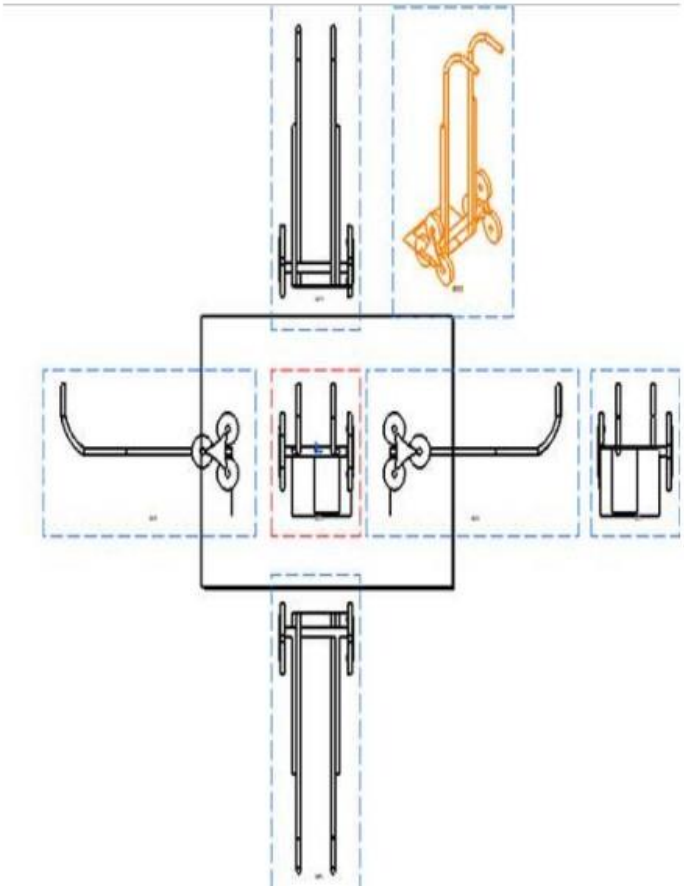
Wheel Material Types:
1. Rubber filled:
Rubbers included in tyres are often impregnated with silica or carbon black. They are made up of a tread and body. The area of the tyre that makes contact with the ground is known as the tread. The section that is now in touch with the road is known as the contact. Treads are often created to satisfy certain product marketing perspectives.

2. Polyurethane:
A chain of organic units connected by carbamate (urethane) linkages makes up polyurethane (also known as PUR or PU). There are also thermoplastic polyurethanes, albeit the majority of polyurethanes are thermosetting polymers that do not melt when heated. Isocyanates and polyols are the major components of polyurethane. To assist in processing the polymer or to alter the polymer's characteristics, other components are added.
3. Steel : is an alloy of iron, with up to 2.1% by weight of carbon serving as the main alloying ingredient. Natural dislocations in the iron atom crystal lattices are prevented from moving by the hardening effects of carbon, other elements, and inclusions in the iron.
CAD MODEL OF TROLLEY:









TECHNICAL DATA: The following components were utilised in the construction of the "stair climbing hand truck" project.

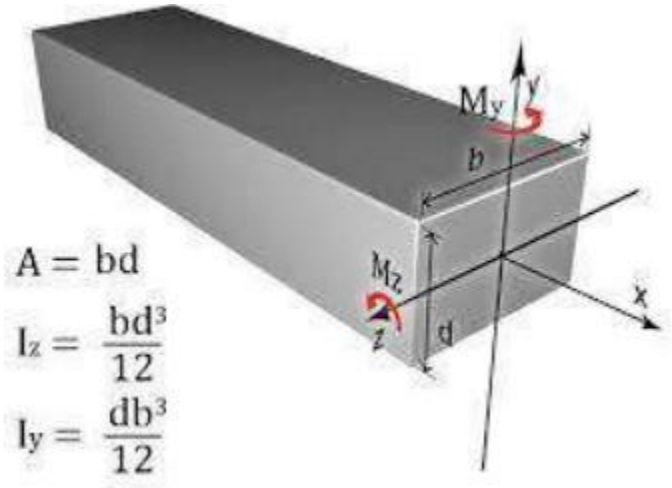
- Cast iron square bar pipe.
- Round bar shaft.
- Caster wheels.
- Rubber rest (industrial rubber).
- Steel plate
- Lengthy guzzon pin

The information below is used in the design of our hand truck:
SHAFT: A rotating element often utilised to transmit power.

AXLE: Typically, an AXLE is a STATIONARY member that supports other rotating members, such as wheels, bearings, idler gears, etc.
Consider the headstock spindle of a lathe, which is rather massive and often has a hole straight through its centre.

SPINDLE: A short shaft, typically of small diameter, that is typically revolving, such as a valve spindle for a gate valve.
A shaft that is a part of an engine, motor, or prime mover is referred to as a "stub shaft" and should have the right size, shape, and projection to allow for simple connection to other shafts.

DESIGN STEPS:
ASSUMING DATA:
N= 43 RPM
Weight=W=539N
Power=P=Weight * velocity
P=539*v P =539N * V (m/s)
But, V= (ΠDN)/60
Here assume, D=0.01m
V= (π*0.01*43)/60
V=0.0225 m/s
Therefore, P=539*0.0225 P=12.12 Watt
DESIGN OF SHAFT:



Step: 1
Design Torque, Td, N-m Td = (60*P*Kl)/ (2ΠN)
Where, Kl=1.0
Td= (60*12.12*1.0)/2π43
Td=2.69 N-m

Step: 2
Reaction calculations:
ΣFY =0
VA-270sin45-270sin45+VD=0
VA+VD=381.83N ……. (1)
Taking moment about A,
ΣMA=0
270sin45*80+270sin45*380-VD*460=0
VD=161.03N
Put this value in eqn 1
VA+161.03=381.83
VA=220.8N

HORIZONTAL BENDING MOMENT CALCULATION:
Taking B.M. about A
MA=0
B.M. at B, MB
MB=0
B.M at C, MC
MC=270cos45*300
MC=57275.64N-mm
B.M. at D, MD

MD=270cos45*380+270cos45*80
MD=15764.42N-mm

VERTICAL BENDING MOMENT CALCULATION:
Taking V.B.M at A, VA
VA=0
Taking vertical B.M at B,
VB VB=220*80
VB=17664 N-mm
Taking V.B.M at C,
VC VC=220*380-270sin45*300
VC=26628.35 N-mm
Taking V.B.M at D, VD
VD=220*460-270sin45*380-270sin45*80
VD=13745.33 N-mm

RESULTANT BENDING MOMENT CALCULATION:
RMA=0
RMB= (02+176642)1/2 =17664 N-mm
RMC= (57275.642 + 26628.352) =63163.02 N-mm
RMD= (15764.422 + 13745.332)1/2=20915.33 N-mm
Taking maximum resultant bending moment:
M=RMC =63163.02 N-mm

MATERIAL FOR SHAFT:
Assume shaft material as
SAE-1030 Sut=527 N/mm2
SYt=296 N/mm2 Sys=183 N/mm2
Assume factor of safety is 1 Bending stress,
6b=Syt/F.O.S =296/1 =296
N/mm2 T̲MAX=0.30 Sytor
t̲MAX=0.18
Sut =0.30*296 or =0.18*527 =88.8 N/mm2 or =53.28 N/mm2
So take t̲MAX= 88.8 N/mm2
For solid shaft, t̲MAX=16*103/Пd3 *
(M2 + TD2)1/2 88.8=16*103/Пd3 *
(63.1632+2.692)1/2 d=15.36 mm

Establishing the Fundamental Dimensions-

Only a literature review was used to determine the fundamental exterior dimensions . However, the proportions of the intended model are determined by the step size (height

and breadth) where the tested model will be built. Because of the vehicle's understated form, many people may use the stairs at once.

- The solid shaft's exterior diameter is set at 25 mm.
- The shaft's length is 825 mm.
- Six rubber wheels and two sets of quasi-static frames are used [5].
- The wheel's diameter is set at 120 mm for staircases that are between 300 and 350 mm deep and 140 to 150 mm in height.
- Tri-Star clamp inter-lobe angle is assumed to be 120 degrees.
- The two wheel centres' separation was measured at 190 mm.
- The measurement for the separation between two wheel frames is 635 mm.

Design Techniques

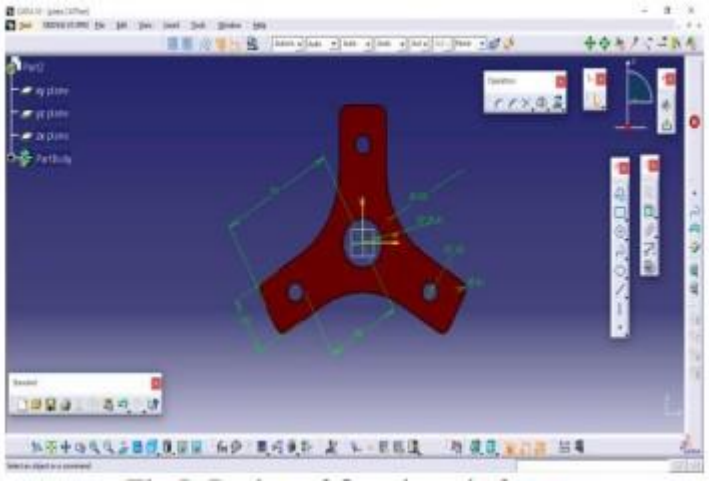
The tri-star wheel trolley seen here was created using CATIA P3 V5 R11.
A multi-platform mechanical design package is CATIA.
It is a parametric solid modelling design tool with characteristic-aided help. Phases covered by CATIA include conceptualization, design, engineering, manufacturing, and PLM.
CATIA's user-friendly graphical interface makes it simple to convert 2D designs into 3D components. Complete 3-D replicas are built with or without limitations by employing automated or user-described relations to restrict design objectives. The many elements employed in this design are Pad, Pocket, Revolve, Rib, Slot, Loft, etc. to conduct operations like add, remove, rotate, sweep, and cut the material when modelling.

Designed Components

Each component of the stair climber is developed using CATIA once the fundamental design dimensions have been determined. Below is a detailed description of every planned component. **a). Body**
The body is made of mild steel after being developed at a height of about 650mm. The handle is mounted at a 200-degree angle (with respect to vertical) to the extreme rails of the trolley body on each side. The trolley's foundation is built of mild steel and is welded together.

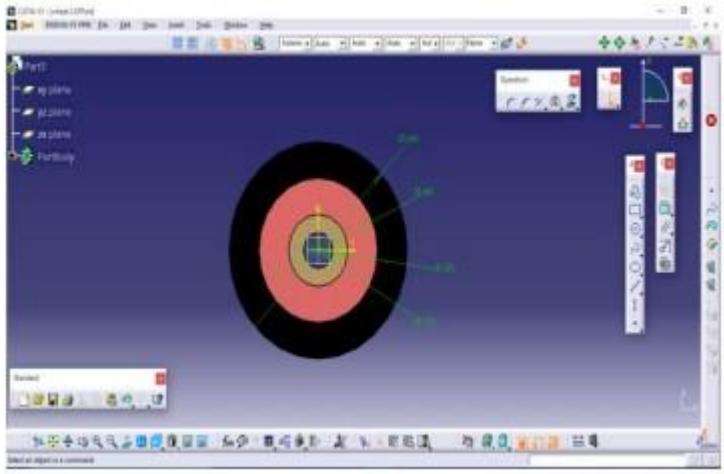
The Tri-Star wheel frame - which binds the three wheels together, is shown in the following picture according to its measurements. The project's primary job is the alteration of the wheel frame.

It is tiresome to ascend stairs with a single wheel. As it climbs the stairs, the tri-wheel configuration turns in accordance with how the wheels are positioned in relation to the frame.



Wheels

Stair-wheels are made to move up and down steps that are 300mm wide and 140mm high. Each wheel shall have an exterior and internal diameter of 60mm and 40mm, respectively, in accordance with the stair measurements. The same design is made in CATIA.



Wheel, frame, and body assembly

The wheel that is attached to the side frames is then put together and attached to the solid shaft.

Both shaft ends have external thread cuts. The wheel assembly is locked to the shaft using a nut and bolt.

Materials choice and fabrication

Making a quasi-Tri-Star frame configuration is the first step in making the trolley. Welded and bolted joints are used to connect various links.

Tri Star Wheel Frames

The wheels are held together by it. Tri-Star configuration turns when it approaches the edge of the steps because the wheels are attached to each of the frame's arms. Oxy-fuel gas cutting, grinding, drilling, and boring are the order of processes used to construct the Tri-Star frame configuration. Although it is simple to make a straight wheel frame, a quasi-static wheel frame is chosen with a 50mm radius curve in between two arms to provide the wheel's strength and stability, and the angle between two wheel axes is 1200 for smooth operation. The 5mm upper limit on thickness is still in place. In order to reduce corrosion and carbide precipitation from welding, high chromium and low carbon content stainless steel is used.

Cutting of the Tri-Star wheel structure

Wheel

When choosing the material for the wheels, the coefficient of friction between the floor and the wheels should be taken into consideration. Among the potential materials, rubber has a higher coefficient of friction compared to concrete floors than steel, polyurethane, etc. As a result, rubber is the material of choice for the wheels. Deep groove ball bearings are chosen and installed as illustrated in Fig. 8 based on the needs of the wheel.

Cartwheel body

For the trolley body, mild steel was used rather than iron since it has more versatile material features. Mild steel has a density of around 7850 kg/cm3 and a Young's modulus of 210 GPa. Mild steel is affordable and pliable despite having a relatively low tensile strength.

As a result, the handle and body are made from mild steel metal pipe with a circular cross section and a one inch diameter.

Working Principle -

A trolley with a revolving wheel that can be drawn or pushed up and down stairs is known as a fabrication of staircase climbing. Stair aids are often seen in walker, wheel, and track variations. Wheels may be attached to a frame and, as their name suggests, are intended to help move objects up and down stairs. The typical wheel on each side is replaced with three triangle-shaped wheels. Turning is more simply accomplished in a manual climbing trolley than in an automated trolley.

ADVANTAGES:

- They are inexpensive to purchase, easy to load and carry, and may be used for household tasks when there is no elevator.
- The product we created only carries one heavy thing at a time, which is disadvantageous.
- Project goals include reducing labour costs and manpower, as well as making weights easier to carry and requiring no external energy.
- It is used for carrying things up stairs.
- If there was no elevator, it would be utilised for household tasks.

CONCLUSION

The project work that has been completed so far has produced the anticipated results and has made carrying cargo up and down stairs quite simple.

This kind of project work may be sent with new homes and be extremely useful for industry.

A new chair with three mechanics, including a starwheel and a straightforward driving mechanism, will help to create a chair that can climb chairs with or without assistance. This chair will make it easier to ascend a chair of a certain height and breadth. We may alter the proportions of a chair's component sections depending on the size of the steps.

- The project's primary objective is to develop a load carrier stair ascending system with reduced effort.
    - The primary goals of humans in every discipline have been to get greater results with less effort.
    - With the primary project as a foundation, we want to demonstrate a load carrier for automated stair climbing with reduced effort.
    - A stair climbing device in the load carrier for stair cases that aids in carrying loads up and down stairs.
    - We gave the job our best effort.

During testing, the main goal of supporting a large weight of 120–150 kg is accomplished. When the straight frame was tested for different step sizes, the performance was a little more challenging. However, the vehicle performed better even for steps of various sizes when tested with a quasi-static frame. The results of a static structural study show that it can move large loads with little distortion and without breaking.

A motor may be added to the vehicle so that it can be operated easily. Typically, its loudness is a minor drawback. However, using it on stairways, elevation, and uneven terrain is highly ergonomic. It is effective, affordable, and simple to put together. It is suggested for handling materials. The machine's benefits include the simplicity with which heavy items of furniture and baggage may be moved from one level to another. Bricks of various kinds and sizes are light and portable, making them ideal for building sites. With consistent steps, the vehicle's overall performance is seen to be high.

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