"DEVELOPMENT AND ANALYSIS OF LIFTING JACK FOR TRACTOR TROLLY"

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Abstract: Available jacks present difficulties for the elderly. Whenever we going to lift the axle of vehicle generally use the screw jack or some this types of jacks. There are specially disadvantageous under adverse weather condition .This presently available jacks further required the operator to remain in prolonged bent or squatting position operate the jack doing work in a bent squatting position for a period of time is not ergonomic to human body. It will give back problem in due of time. Moreover, the safety feature is also not enough for operator to operate the present jack. Present vehicles jack do not have a lock for extra beam withstand the massive load of the vehicle. It is necessary to reduce the effort to lift the heavy load as well as time. The purpose of this project in to encounter these problems.so, we will going made a lift jack for tractor trolley in which zero human efforts required for the modelling we will use CATIA software and analysis will done in ANSYS software.
Keywords: screw jack, lifting equipment, CATIA, ANSYS.

1. INTRODUCTION

In today's day to day life different types of lifting equipment's are used in automobile sector. Now days there are different types of lifting equipment for different vehicles.This equipment's are primarily working on human effort as well as their cost is also more. In a workshop environment where a heavy load 4 axle tractor trolley requires repairs (e.g. changing tyre), using conventional lifting systems requires more effort than using this lifting jack. The transport sector is a highly specialized field and requires professional and experienced individuals to identify risks and provide practical solutions. Heavy commercial trailers themselves should be regarded as specialized equipment, as each trailer type is responsible for the carrying specific goods. By using the hydraulic jack that is locked in the trailer's tool box, wheels are often stolen from a heavy commercial vehicle that is parked while the driver sleeps. Our Jack requires the driver to start and drive the vehicle to lift axles. This is a deterrent to a driver's participation in a theft. Whether you are stuck next to the road or waiting in a workshop, this Jack can get you back on the road in less time. A single side can be lifted in less time literally means money. So by this project in future it is the best solution for automobile sector for saving time.

2. METHODOLOGY:

i. Problem Identification
In generally used conventional jacks for lifting the vehicle is take lot of effort as well as time .also these are uses different energies.

ii. Design

a. Material selection –In that project to select the material in such a way that it has high compressive strength as well as high buckling resistance.

b. Design of jack-In that topic project designing the jack as per the specifications.

iii. Modeling
Creation of model for jack in modeling software as per design specification.

iv. Analysis
After modeling the buckling test in analysis software.

v. Manufacturing
After that the next step is fabrication of model.

3. DESIGN:

i. Curved guide-It is a curved shaped metal plate which will help to take the trolley axle on the supportive cup with rolling motion.

ii. Flat base-It is a flat plate which will support all the load of trolley after taking axle on supportive cup. iii. Vertical beam-It is a vertical hollow metal pipe which has optimum thickness and supported by flat base.

iv. Supportive ribs-These are supportive components for vertical beam to avoid buckling in beam.

v. Axle supporting cup-It is curved shape cup which help to support the axle of trolley without slip.

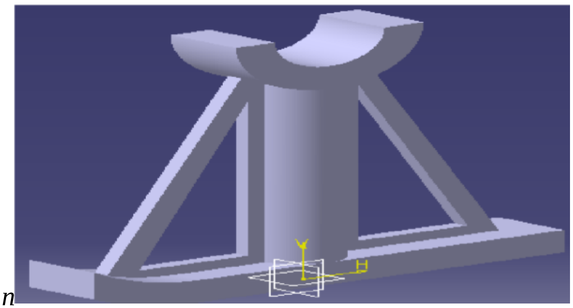

Fig. 1 Conceptual model of lifting jack

Material Selection

There are for study purpose taken two materials and search the properties of that material on internet. From internet following information is about properties of that respective material. This is given as below:-

Plain carbon steel or mild steel (40C8)

i. Compressive strength=250 N/mm^2
ii. Modulus of elasticity=207000 N/mm^2
iii. yield stress = 465N/mm^2
iv. hardness = 201 to 255 brinell

Calculation

After defining the objectives for project from survey and tractor trolley is taken as the application of jack. During survey we got following information and from that information following steps are taken.

Dimensions of Tractor Trolley

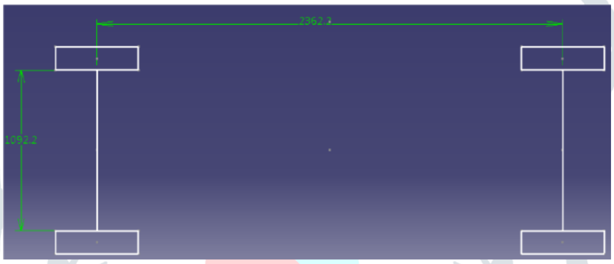

Fig 3.2 Dimensions of trolley from top view

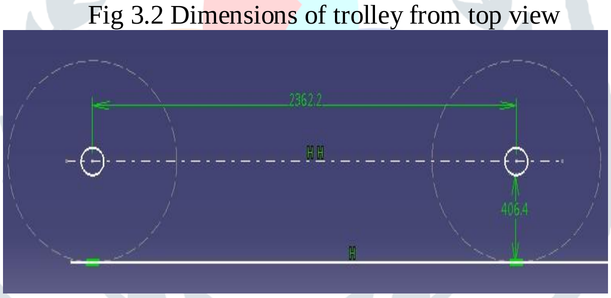

Fig. Dimensions of trolley from side view

The dimensions of trolley as follow

a = distance between two leaf spring of trolley =43inch=109.22cm=1092.2mm.
b = distance between two axles of trolley =93inch=236.22cm=2362.2mm.
h = distance between axle and ground surface =16inch=40.64cm=406.4mm.
x= distance between axle and ground after lifting jack =20inch=50.8cm=508mm

Conceptual Application of Jack

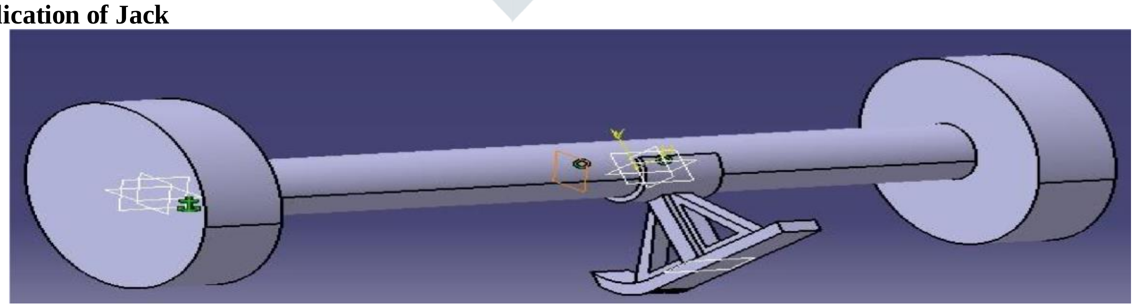

Fig. Conceptual application of jack

Let, y = distance between vertical axis of axle and axis of jack column meeting at ground.

θ = angle made by axis of jack column and ground surface when applying. Then,

$$\sin\theta = \frac{h}{x} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

θ = 55.08° Also,

$$\tan\theta = \frac{h}{y} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

y = 300mm.

Calculation for column buckling analysis

Let,
σ_{yc} = Yield compressive stress for mild steel in N/mm^2.
Fs = Factor of safety.
σ = Design stress N/mm^2.
E = Modulus of elasticity in N/mm^2.
L = Length of column in mm.
K = Radius of gyration in mm.
I = Moment of inertia in mm^4.
A = Cross section area of column in mm^2.
D = Diameter of column in mm.
P = Load applied on column in N. Here, m = Mass of tractor trolley assumed with some load in kg. g = acceleration due to gravity in mm/s , m = 2500 kg.
g = 9.810 mm/s^2
Since,
Load applied on column,
P = mg = 2500 * 9.81 = 24,525 N…………………………………………………….. (3)
Now,
σ_{yc} = 250 N/mm^2
Fs = 2.5
$\sigma = \frac{\sigma yc}{Fs}$=250/2.5 =100 N/mm^2……………………………………………………… (4)
Now we know that,
Design stress (σ) = $\frac{\text{Load applied on column (P)}}{\text{Cross section area of column (A)}}$
$100 = \frac{24{,}525{,}000}{A}$………………………………………………………………………. (5)
A = 245,250mm^2
But,
A= $\frac{\pi}{4}$ *d^2 ……………………………………………………………………………….. (6)
Therefore diameter of column, D = 558.80mm ≈ 560mm.
L = 460 mm.
Since area of column
A = $\frac{\pi}{4}$ D^2 =246,300.86 mm^2 ………………………………………………………….. (7) Since moment of inertia for column,
I = $\frac{\pi}{64}$ D^4= 4,827,496,935 mm^4……………………………………………………… (8)
Therefore radius of gyration is,
K = $\sqrt{\frac{I}{A}}$= 140 mm…………………………………………………………………… (9)
Therefore slenderness ratio for column,
U = $\frac{L}{K}$= 3.28 ………………………………………………………………………….. (10)
Since when the slenderness ratio is less than 30, then there is no effect of buckling on column and such components are designed on the basis of compressive stress.

Calculation for column on the basis of compressive stress

We know that,
$\sigma = \frac{P}{A} = \frac{24525}{246300.86}$= 0.0996 N/mm^2…………. ………………………………………(11)
Since the calculated design stress is 0.0996 N/mm^2,which is very less than allowable design stress 100 N/mm^2.
0.0996N/mm^2 <<<<<<< 100 N/mm^2.
It is convenient for us to reduce the diameter of column.so for our consideration we consider the diameter of column rod is 50mm.
If D = 50mm.
Then,
A = $\frac{\pi}{4}$ D^2 = 1963.49 mm^2………………. …………………………………………….. (12)
So design stress correspond to this diameter is,
$\sigma = \frac{P}{A} = \frac{24525}{1963.49}$= 12.49 N/mm^2…………………………………………………….. (13)
From above calculation we can see that the calculated 12.49 N/mm^2 stress is very less than allowable stress100 N/mm^2. So we can conclude that design is safe. We can use 50mm mild steel bar for manufacture our project.

4. Manufacturing

Metal fabrication is the creation of metal structures by cutting, bending, and assembling processes. It is a value-added process involving the creation of machines, parts, and structures from various raw materials. Typically, a fabrication shop bids on a job, usually based on engineering drawings, and if awarded the contract, builds the product. Large fab shops employ a multitude of value-added processes, including welding, cutting, forming and machining.

Metal fabrication usually starts with drawings with precise dimensions and specifications. Typical projects include loose parts, structural frames for buildings and heavy equipment, and stairs and hand railings. As with other manufacturing processes, both human labour and automation are commonly used. A fabricated product may be called a fabrication, and shops specializing in this type of work are called fab shops.

Electric arc welding

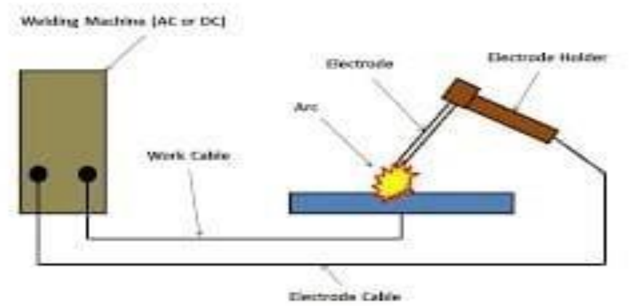

Fig. electric arc welding

Arc welding is a welding process that is used to join metal to metal by using electricity to create enough heat to melt metal, and the melted metals when cool result in a binding of the metals. It is a type of welding that uses a welding power supply to create an electric arc between a metal stick ("electrode") and the base material to melt the metals at the point of contact. Arc welders can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes.

The welding area is usually protected by some type of shielding gas, vapour, or slag. Arc welding processes may be manual, semi-automatic, or fully automated. First developed in the late part of the 19th century, arc welding became commercially important in shipbuilding during the Second World War. Today it remains an important process for the fabrication of steel structures and vehicles. The following figure shows systematic representation of electric arc welding equipment.

Procedure :

Arc welding is the process of joining two metal work pieces together using a flux covered electrode which is melted in an electric arc and becomes a fused part of the pieces being welded. Arc welding requires time, effort and patience to master as the weld rod position is very delicate to the position of the work piece. The following is a simple guide to learn the basic technique of arc welding

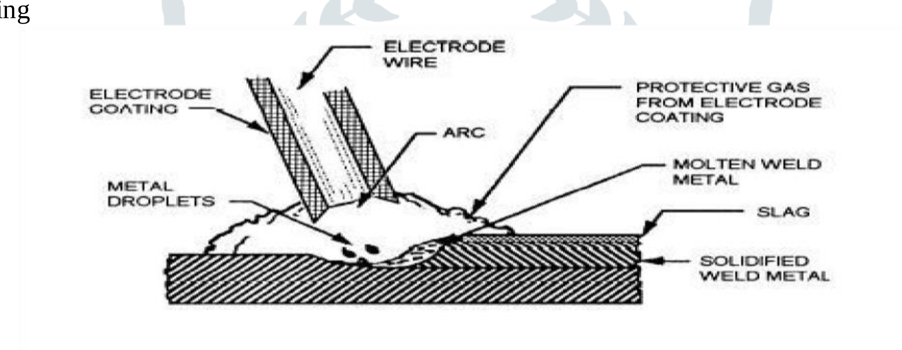

Fig . Arc welding

There are 4 basic steps to perform an arc welding:-

- **i** Strike the arc. This is the process of creating an electric arc between the electrode and the work piece.
- **ii** Moving the arc to create a bead. The bead is the metal from the melting electrode flowing together with molten metal from the base metal to fill the space between the pieces being joined by welding.
- **iii** Shape the weld bead. This is done by weaving the arc back and forth across the weld path either in a zigzag so the metal spreads to the width that you want your finished weld bead to be.
- **iv** Chip and brush the weld between passes. Each time you complete a pass, or trip from one end to the other of your weld, you need to remove the slag, or the melted electrode flux material, from the surface of the weld bead so only clean molten metal will be filling the weld on the subsequent passes.

5. Working

It is seen that this project is designed for specific application of tractor trolley. After manufacturing it is applied to take practical result for this project. For that first of all arrange one tractor trolley with tractor. After that place the jack in incline position below the axle of tractor trolley as shown in below figure.

6. Conclusion:

Whenever you need to change a tyre or repair brake linings or bearings on a heavy load tractor trolley, we can rely on the vehicle lifting jack for tractor trolley. It lifts trolley axle faster than any conventional system in fact, the entire process can be achieved in less than 10 seconds. The vehicle lifting jack uses driving motion from the tractor to lift and lower trolley axles. Because nobody is allowed close to or underneath the trolley for the lifting and lowering procedures, the result is a far safer working environment. Once the lifting jack is upright, it transforms into an axle support stand with a safe working load of 5 tons. Where a complete axle or empty trailer needs to be lifted, we will need to use two lifting jacks per axle.

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