JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

DESIGN AND OPTIMIZATION OF TRESTLE JACK

Prashant S. Patil [1], Rushikesh D. Patil [2], Harshal Y. Patil [3], Harshwardhan V. Patil [4]

Department of Mechanical Engineering, Smt. Kashibai Navale College of Engineering Pune.

Abstract- Mobility With the increasing levels of technology, the efforts being put to produce any kind of work has been continuously decreasing. The efforts required in achieving the desired output can be effectively and economically be decreased by the implementation of better designs. A jack is a device, which is used to raise part of vehicle in order to facilitate vehicle maintenances or breakdown repairs. In normal jack system, a mechanical jack is used for lifting the vehicles. The most common form is a car jack, garage jack, floor jack which lifts vehicles so that maintenance can be performed. Jacks are generally used to increase mechanical advantage (lifting the vehicle). . This design helps to make of the thrust force of the vehicle to lift the load. In this work designed a new type of hydraulics jack with trestle features.The model of trestle jack is created by using catia software according values. The FEA model was meshed and analyzed with loading condition using FEA in ansys software. The trestle jack is suitable for lifting the heavy load up to approximate 8,000 N automobile vehicles.

Index Terms- Trestle jack, Material Properties, Design and Analysis.

I. INTRODUCTION

The project work is focused on the design and development of the Trestle jack, to provide effortless lifting of vehicles, such as, hatchbacks, sedans, Multi-Purpose vehicles by using vehicle motion itself to jack up and down. The redesigned jack will be not having the complicated parts like hydraulic jack hear the working principle of redesigned jack is much more easier than that of hydraulic jack .hear the push load of the vehicle is use to convert the lifting load to lift the payload or vehicle .the axial load is converted into vertical load by a proper design of a jack and such a jack is named as “trestle jack”.

METHODOLOGY

1. Create the geometry in catia.
2. Material selection.
3. Finalizing concept 3D model and analysis of Ansys.
4. Apply boundary condition, solution and plotting result.

LITERATURE REVIEW

Chaudhary S, Ravi Kumar D- he works on the car jack operate on motorized energy. Tire puncture can be commonly observed now-a-days. Car jack comes with vehicles requires users to apply manual force to lift a vehicle. He is targeted to analyse the development in existing scissor car jack in order to make load lifting easier by utilizing Car battery (12V) which can be used in emergency situations. He can control contractions or expansion movement of car jack can be controlled by a joystick as per requirements. This modified car jack can be easily operated by any person and it saves time, hence reduce wastage of human efforts and time. The design of this car jack is being developed in Solid Works 2010 software. Manufacturing and fabrication work have been done using milling, drilling, grinding and threading machines. He tested and implementing of his design. It can solve ergonomics problems. He developed existing car jack by making small adjustments and using an electric motor to rotate power screw. The car battery (12V) is power source to motor, to make load lifting easier. The advantages of his modified jack are that it will save time, human efforts and easier to operate. Thereby effectively eliminating the problems related to Ergonomics-which is most fundamental concept of designing process. The objectives are to design a car jack that is safe, efficient, reliable and able to function with easy operating. Based upon testing and calculations, his car jack is considered safe to use under some specifications. Furthermore, the torque supplied to the system is more than enough to lift a car weighing around 1000 kg. This jack has also certain disadvantage which can be solve.

C.R. Gagg-he work on the failure of components and product due to manufacturing defects. This paper is case study on product manufactured form raw material to finish component. Manufacturing necessitates the transformation of raw materials from their initial form into finished, functional products. This change is achieved by a variety of processes, each of which is designed to perform a specific function in the transformation process. Implicit within the design and operation of such processes is a required understanding of the properties of engineering materials and their specific response to such manufacturing methods. The design or process engineer will endeavour to

positively utilise these properties during different stages of the manufacturing process. However, various defects can be in-built during the transformation cycle, dependent on factors such as materials, part design, and processing techniques. It must be said that manufacturers do not intentionally set out to make faulty or dangerous products and almost always operate rigorous quality control and burn-in procedures at the production line. It is therefore unusual for faulty products to enter service. However, on occasion faulty products do manage to slip through the most rigorous of checks and enter service. While some inherent defects affect only the appearance of parts, others can have major adverse influence on structural integrity and/or service lifetime of the component or product in question. At this point, failure engineer may well be instructed to determine the cause or causes of such product demise. With potential litigation ever present, the focus of such investigation may well centre on foreseeability of the event, requiring sound findings and a conclusion that clearly describes what happened and why. To this end, a review of the major routes in the production of engineered components will be presented, highlighting the possibilities of introducing defects at each stage.

Pandra Uday Kumar, G. Ramanjulu- They work on the design and analysis of centre jack. He tried to reduce efforts required in achieving the desired output can be effectively and economically be decreased by the implementation of better designs. He uses Power screws to convert rotary motion into translator motion. A screw jack is an example of a power screw in which a small force applied in a horizontal plane is used to raise or lower a large load. The principle on which it works is similar to that of an inclined plane. The mechanical advantage of a screw jack is the ratio of the load applied to the effort applied. The screw jack is operated by turning a lead screw. The height of the jack is adjusted by turning a lead screw and this adjustment can be done either manually or by integrating an electric motor. Pneumatics is a branch of technology that deals with the study and application of pressurized gas in affecting mechanical motion. In this project they work on "Mechanical Project Report on Centre Jack for Cars" is designed to make a pneumatic jack that can lift a complete car or an automobile when placed at the car's bottom. These systems are mainly used in industries, factories and are generally plumbed with compressed air. They select pneumatic systems is because a centrally and electrically powered compressor is used to power cylinders through solenoid valves and provides motion in a cheaper and flexible mode. The best point of the project is that it can drive a complete system with the aid of Compressed air without any part of the automobile touching the ground. In this project, an electric motor will be integrated with the screw jack and the electricity needed for the operation will be taken from the battery of the vehicle and thereby the mechanical will be increased.

Jong-Min Lee, ChangKyoo Yoo- They work on the process of system and component analysis by ICA method. In this paper they propose a new statistical method for process monitoring that uses independent component analysis (ICA). ICA is a recently developed method in which the goal is to decompose observed data into linear combinations of statistically independent components. Such a representation has been shown to capture the essential structure of the data in many applications, including signal separation and feature extraction. The basic idea of our approach is to use ICA to extract the essential independent components that drive a process and to combine them with process monitoring techniques. I2, I2e and SPE charts are proposed as on-line monitoring charts and contribution plots of these statistical quantities are also considered for fault identification. The proposed monitoring method was applied to fault detection and identification in both a simple multivariate process and the simulation benchmark of the biological wastewater treatment process, which is characterized by a variety of fault sources with non-Gaussian characteristics. The simulation results clearly show the power and advantages of ICA monitoring in comparison to PCA monitor

Luciano Mendes Bezerra, Cleirton André Silva de Freitas- In this paper they can be study on various shape of the truss member. Steel space trusses are generally made of tubular section members. There are several types of links to connect these members. The most popular is the end-flattened connection. The advantages of such connections are reduced costs and fast assemblage of the truss. However, they present disadvantages such as eccentricities and stiffness reduction of members. Global and local collapses are, respectively, associated with the ultimate limit state and serviceability limit state. This research paper presented numerical and experimental studies on steel space trusses made of tubes with end-flattened connections. This type of truss is very popular in many countries but its behaviour has not yet been completely understood. End-flattened tubes linked with one bolt form trusses which are easy to manufacture, fast to build, inexpensive and aesthetically acceptable. However, they present disadvantages at the connections: nodal eccentricities and flattening of the tube section. These disadvantages produce a substantial increase in the bending moment and loss of rigidity in the connections thus decreasing the efficiency of this type of truss. The goal of their research was to improve the load carrying capacity of such trusses with simple constructive alternatives that could be used by practitioners. They use of spacers and reinforcement plates were suggested to increase the load carrying capacity of this type of truss. Spacers and the reinforcement plates may be circular or squared, and the article also presented an equation to calculate the size of the spacers. In this research, to test the effectiveness of using spacers and reinforcement plates, nine finite element models and nine prototypes made of steel tubes, under a central point load were considered. Different types of connections on the prototypes were analysed. There results showed that correcting the eccentricities with spacers and using reinforcement plates on the connections increase substantially the strength of the prototypes. Just using spacers on the end-flattened connections, the experimental tests showed that the local collapse strength of the prototypes increased in 53%, and using spacers and reinforcement plates the increase was 68%. For global collapse, just using spacers the increase in strength was 7% and when spacers and reinforcement plates are utilized, the increase in strength was 17%. This alternative can be easily applied to a new truss design or in strengthening actual
trusses. This investigation will proceed with the tests of different types of materials to manufacture inexpensive spacers.

Prof. Nitin Chandra R. Patel, Sanketkumar Dalwadi– They design a toggle jack with considering material selection of nut and bolt. Toggle jacks are simple mechanisms used to drive large loads short distances and to lift the heavy loads. It also has the advanced feature of rotating the parts about their axis where there is not enough space to move the load. The power screw design of a common Toggle jack reduces the amount of force required by the user to drive the mechanism. In this paper, they realized Most of the Toggle jacks are similar in design, consisting of eight main members out of whom four are driven by a power screw and rest of four by loading condition. In this report, a unique design of a Toggle jack is used to lift the heavy loads at the stable state with the unique condition. In toggle jack screw and nut are main components. A screw is moving part and nut is a stationary part.

Both the parts always work in meshing condition. Therefore, there are stresses like shear and tensile stresses induced in materials which are responsible for failure of screw. While a nut has bearing stress. Different materials of screw and nut can induce different magnitude of stresses so it is necessary to select a pair of material combination in such a way that a pair gives induced stress within safe limit. Here they have taken different material combinations of screw and nut & based on that analytical design is done for on different loading condition from 1KN to 5KN. It is also they assumed that the nominal diameter of screw and material for link are same for all loads.

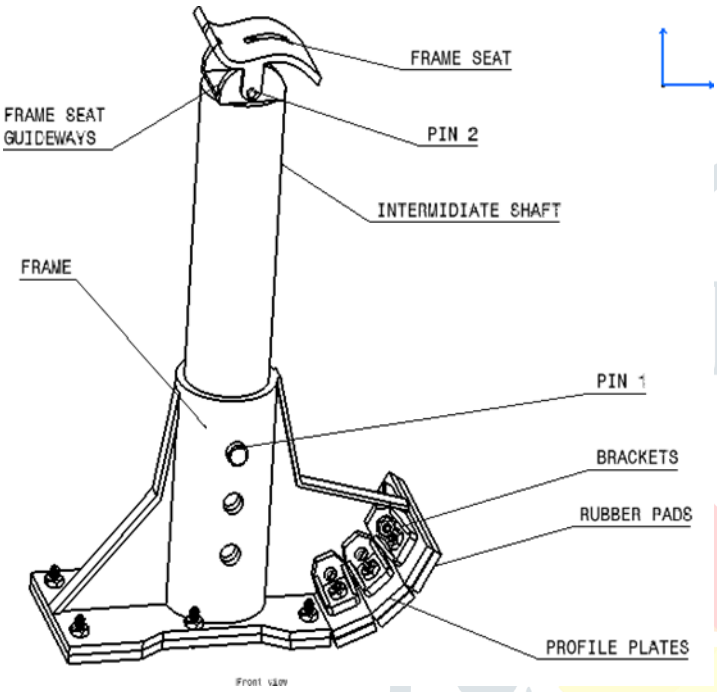

Figure1: Nomenclature of Jack

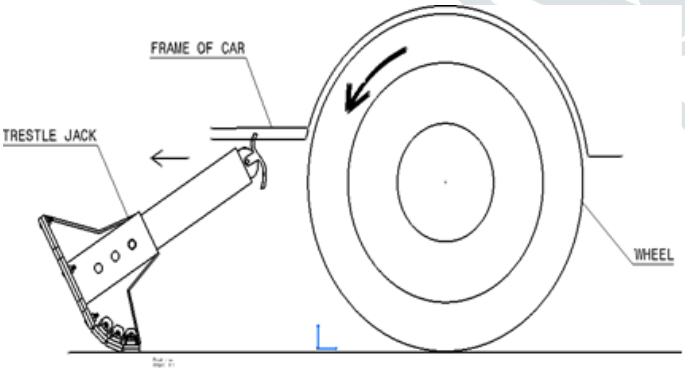

Figure 2 (A): First Position of Jack

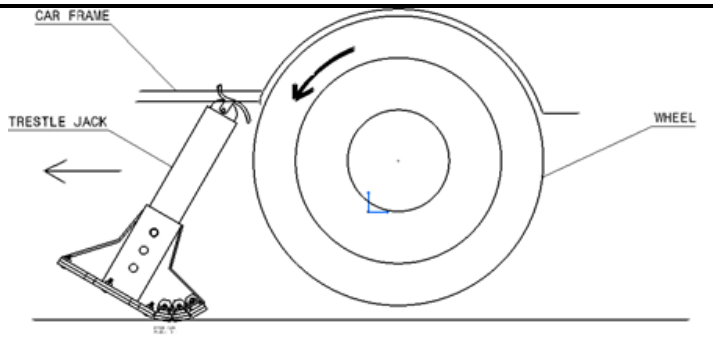

Figure 2 (B): Second Position of Jack

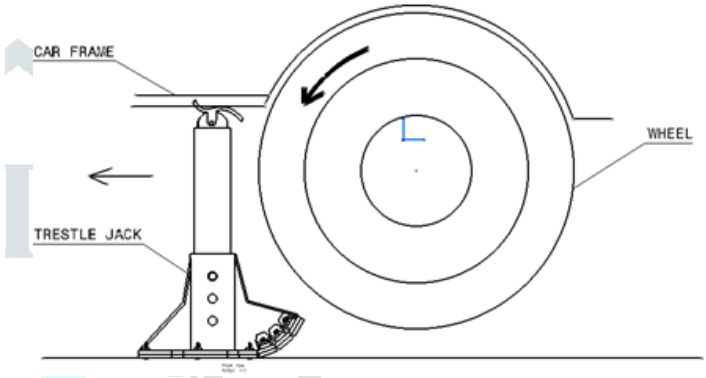

Figure 2 (C): Final Position of Jack

II. USE OF SIMULATION SOFTWARE

After the assembly of the parts the jack it will act as the structure to lift the vehicle. So, the structural analysis is done to verify the theoretical design. Finite Element Method is used for the Analysis, in that the Global coordinate system is used for defining the coordinates of each plane and the finite elements discretized of Trapezoidal shape.

The Static Structural Analysis is divided in two steps i.e. Static Structural Analysis and Dynamic Structural Analysis.

I. Static Structural Analysis:

The frame of the jack where it is during its final position after the lift up is fixed at the bottom. The forced is applied on the frame seat in downward direction of the calculated magnitude of 18000 N. This force is only due to the weight of the vehicle body.

II. Dynamic Structural Analysis

The force acting when the jack is in inclined position and it is completely based on the plate of the curve part of the frame. Only this force is considered in the second condition for static structural analysis. It is assumed that only force due to the weight of the vehicle in downward direction is acting hence the full load in acting only on plate.

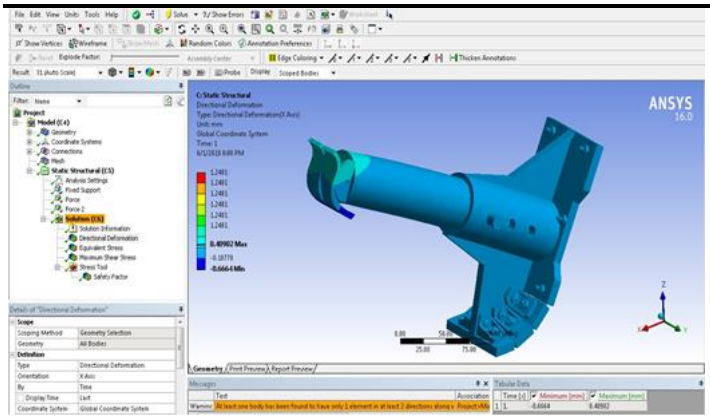

Figure 3: FEA Model

III. IDENTIFY, RESEARCH AND COLLECT IDEA

we have concluded that our design is optimum and has also satisfied all the design conditions. In his chapter we are moving towards the manufacturing of the jack. The whole manufacturing is carried out in the workshop has all the facilities needed for the development of the jack. The most crucial part of the jack is development of its frame having three different profiles. These profiles are given considering two main objectives i.e.,

1)it minimize the weight of the frame.

2) To make it to look attractive as far as ergonomics of jack is considered.

CONCLUSION

The trestle jack is flexible enough to jack up light motor vehicle to heavy duty vehicles. It can be easily carry by any person and easy to handle. It should be the replacement of toggle jack which is widely used now-a-days. It is also enough compact that it acquires minimum boot space. Thus, the jack has been developed considering all the above requirements. This particular design of the trestle jack will prove to be beneficial in lifting and lowering of loads. It is experimentally proved that this jack can work on various different surface conditions and the results of experiments shows there may be negligible variation in time of lifting as the surface condition varies

AUTHORS

First Author – Prashant Subhash Patil
Second Author – Rushikesh Deepak Patil
Third Author – Harshal Yuvraj Patil
Fourth Author – Harshwardhan Vijaykumar Patil

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