National Conference in Mechanical Engineering Research and Postgraduate Students (1st NCMER 2010)
26-27 MAY 2010, FKM Conference Hall, UMP, Kuantan, Pahang, Malaysia; pp. 198-203
ISBN: 978-967-5080-9501 (CD ROM); Editors: M.M. Rahman, M.M. Noor and K. Kadirgama

ANALYSIS OF AUTO CAR JACK

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ABSTRACT

Side road emergency is always a common headache especially during the tire punctured. This paper discussed the development of the car jack for emergency usage with using internal cigarette lighter power (12volts). The automatic easy car-jack utilized this power source to save individuals internal energy. Gear ratio was used to increase the lifting power. The car jacker was developed utilizing the Solidworks® and analyzed using Finite Element Analysis to check safety factor and force acting. The car jacker tested on real car and it proven it can be used commercially.

Keywords: automatic car jack, cigarette lighter, Solidworks, gear ratio

INTRODUCTION

Car jack is commonly used to jack the car during maintenance or changing the tire. An automotive jack is a device used to raise all or part of a vehicle into the air in order to facilitate vehicle maintenances or breakdown repairs. Most people are familiar with the basic car jack (manually operated) and it's included as standard equipment for most of the new cars. Vehicle owners who would like to rotate their tires themselves either front to back and so forth or who may install snow tires before the winter and remove them in the spring need to use a jack to perform the job (ALI, 2004). Changing a flat tire is not a very pleasant experience. Nowadays, a variety of car jacks have been developed for lifting an automobile from a ground surface. Available car jacks, however, are typically manually operated and therefore require substantial laborious physical effort on the part of the user. Such jacks present difficulties for the elderly and handicapped and are especially disadvantageous under bad weather conditions (ACCC, 2007). Noor et al. (2008) were developed auto car jack using 12 volts internal car power.

In light of such inherent disadvantages, commercial automobile repair and service stations are commonly equipped with large and hi-tech car lift, wherein such lifts are raised and lowered via electrically-powered systems (BJC, 2008). However, due to their size and high costs of purchasing and maintaining electrically-powered car lifts, such lifts are not available to the average car owner. Such electrical-powered portable jacks not only remove the arduous task of lifting an automobile via manually-operated jacks, but further decrease the time needed to repair the automobile. Such a feature can be especially advantageous when it is necessary to repair an automobile on the side of a roadway or under other hazardous conditions (Lonon, 2007).

There also reports on car jacks which lead to a serious number of accidents. A specified jack purposed to hold up to 1000 kilograms, but tests undertaken by Consumer Affairs has revealed that is fails to work after lifting 250 kilograms and may physically break when it has a weight close to its 1000 kilograms capacity (BJC, 2008). Tests have proven that the jack has the propensity to buckle well under the weight it is promoted to withstand, and it doesn't meet the minimum or performance requirements of the Australian Standard for vehicle jacks (Razzaghi and Douglasville, 2007). The purpose of this project is to develop a car jack which is easy to be operated, safe and able lift and lowering the car without involving much physical effort. This paper discussed the analysis of newly developed Jackcar.

EXPERIMENTAL SET-UP

Newly developed Jackcar prototype is shown in Figure 1. It also included a switch buttons system to raise and lowering the jack (Head load). According to Farhad, the pneumatic and hydraulic jack is not safe because usually need maintenance and sometime leaked (Rankine, 2007). The development will be based on scissor jack. Besides that, the screw shaft which can be rotated and raise the head load up and down is used. The screw shaft is a critical part because in this design it needs a system which can withstand the load and lock the raised level of the jack. The manufacturer and calculated value for the motor torque, it supplied 5.877N.m torque which is high enough and suitable for the project (Heizer and Render, 2006). The usage of the gearing system as shown in Figure 2 is to increase the torque up to17.631N.m (Shigley, 2004). Lastly, the stabilizer base is to support the weight of the motor and to stabilize the scissor jack. It is also good for flat surface when jacking the car (Kalpakjian and Schmid, 2001).

Figure 1: Developed prototype

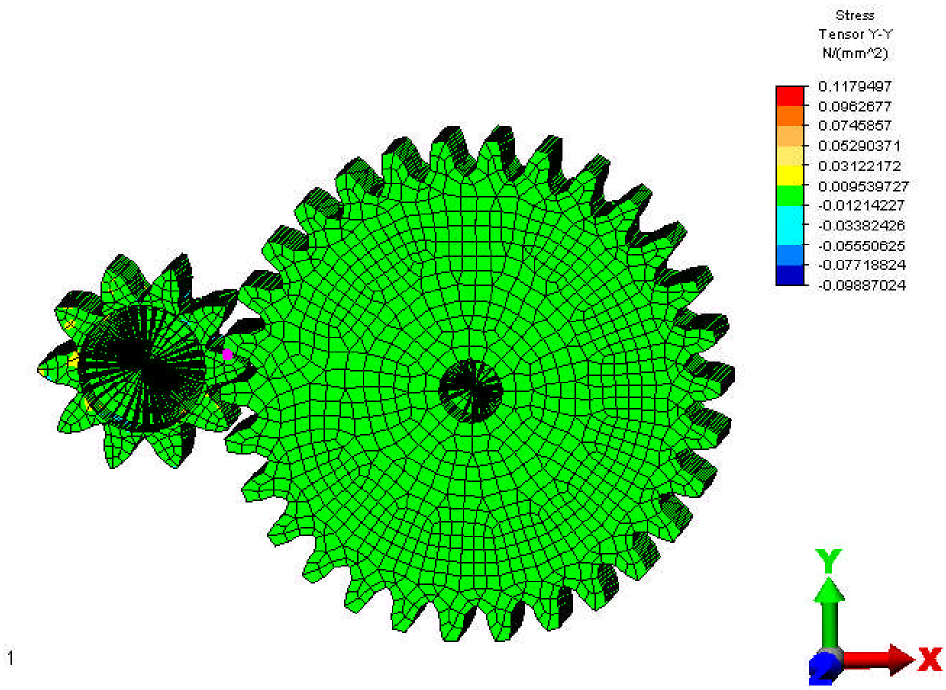

Figure 2: Gearing system

The mechanism lifting system was applied on the scissor jack. The scissor jack specific description is it can withstand the maximum load of 850kg which is the best because the test car for this project is a PERODUA Kancil® (682kg) (Owens, 1998). ALGOR software is used to determine the failure when optimum force is applied on the scissor jack on the gears and on the scissor mechanism. The scope of the weight of the car is about 681 kg for kancil's car which equal to 6690.42 N. In the analysis of the scissor mechanism, the weight will be a variable factor which 2943N (300kg) will be the maximum weight because when a car is jacked on one point which less than the weight of the car (Lonon, 2007). In this section, only upper part of the scissor jack will be analyzed because the shape duplicate with lower part of the scissor jack. The force direction will be on the head of the jack because the load become distribution loads (Heizer and Render, 2006).

RESULTS AND DISCUSSION

Based on the analysis on Finite Element Analysis, it shows that the maximum nodal displacement magnitude on the system car jack is around 0.053 as shown in Figure 3 when maximum load (2943 N) applied Furthermore, it observed that maximum Von Misses stress stand at 102.6439N/mm^2, where this indicates the stress values in safe point because $\sigma_{vm} < \sigma_y$ since tensor stress for low carbon steel is 250 MPa (Heizer and Render, 2006). Table 1 show the load varies with Von Misses stress and Nodal displacement. Figure 4 show the load versus Von Misses stress. The maximum torque that can be reached respectively increases of the height of the lifting is shown in Figure 5. The height is measured on Kancil 660 cc car (PDL 146).The actual car height from the ground to the base of the car is 0.13 m. The torque needed is obtained from the torque wrench where inserted into the shaft of the scissor jack. The torque is increased parallel to the height until at point 0.23m to 0.29 m the torque maintain constantly at

9 Nm. According to Razzaghi and Douglasville (2007), the maximum a car can be lifted under a safety condition is 0.32. Tables 2 show the specification for the newly developed Jackcar.

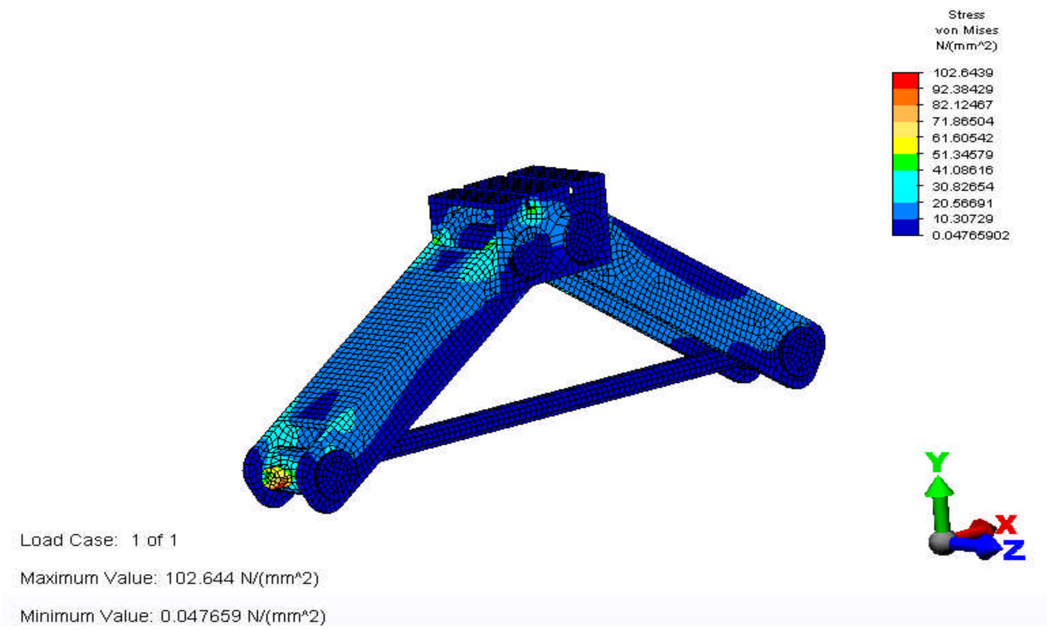

Figure 3: Maximum value for load 2943.0 N= 300kg for nodal displacement and stress Von Misses

Table 1: Load varies with Stress Von Misses and Nodal displacement

Load (N)	**Stress Von Misses (N/mm^2)**	**Displacement (mm)**
490.5	17.107	0.0088568
981	34.214	0.0177136
1471.5	51.321	0.0265704
1962	68.429	0.0354272
2452.5	85.536	0.044284
2943	102.6439	0.0531408

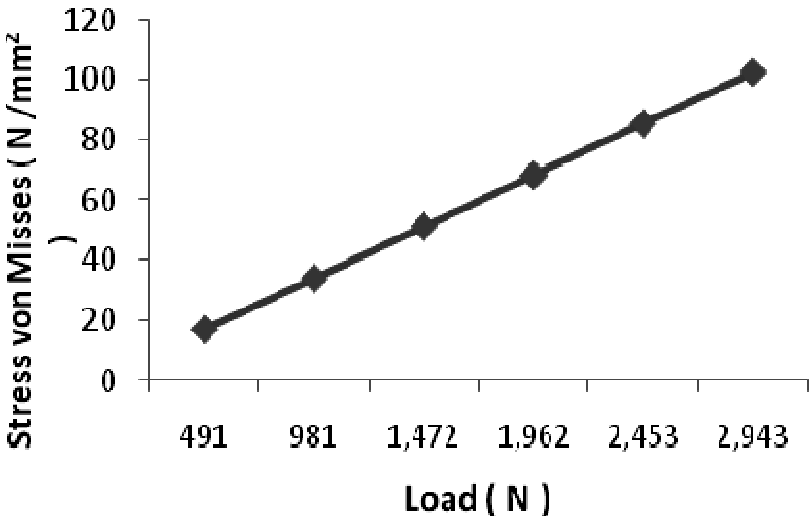

Figure 4: Load versus Von Misses stress

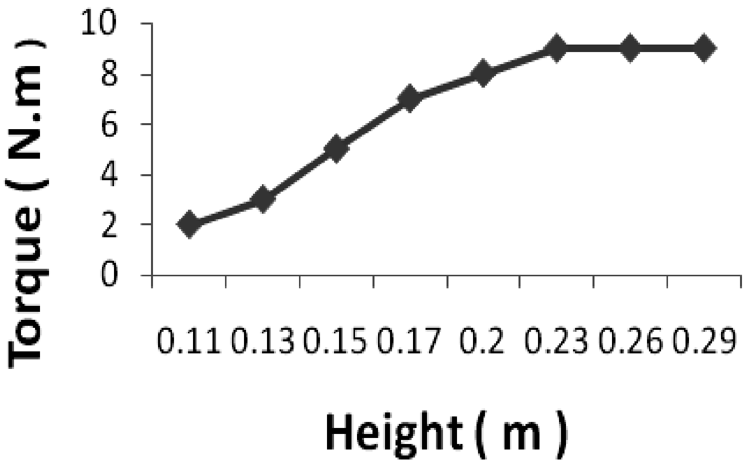

Figure 5: Height versus Torque

Table 2: Specification for the newly developed Jackcar

Item	Specification
Working	12 V , 4 A
Length (lifting)	480.73mm
Width	386.15mm
Maximum Lifting Height	290mm
Mass	4.6 kg
Cable length	6m
Operative load (car)	681 kg
Lifting Time	106 seconds

CONCLUSION

Based on the testing and results from the analysis, it is considered safe to use Jackcar work under certain specifications. Furthermore the torque supplied on the system is more than enough to lift a Kancil car. There are certain weak point that can be improved based on gear, motor and design.

ACKNOWLEDGMENT

The authors would like to thank the faculty of Mechanical Engineering, Universiti Malaysia Pahang for provides laboratory facilities. The authors also appreciate Mr. Shuhaizal Mohd Noor for the support given in the study.

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