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RESEARCH ARTICLE OPEN ACCESS

Design And Analysis Of Edrive Truck

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ABSTRACT
The main aim of this project is to design and develop electro-mechanical truck driving system having hydraulic piston cylinder suspension. The model has been designed on the measurement data of actual dump truck. It can be used as for any type of truck and whole system is design to achieve proper turning on the sharp corner of the roads and making it electrical as more economic. SolidWorks (CAD software) is used for appropriate design and development and ANSYS FEA for simulation of the design. The work described in this paper is based on the elimination on the cost of truck and increasing the turning efficiency by replacing the whole driving system of the vehicle with separate motor of each wheel.
Keywords - eDrive truck, hydraulic suspension, induction motor, Finite element analysis, gear pump.

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I. INTRODUCTION

Trucks are either operated on automatic transmission or manual transmission, smaller trucks basically have automatic transmission but the trucks carrying heavy load like bigger truck with more powerful engine has manual transmission. A truck different type of frames like two parallel boxed or C-shaped rails, or beams, head together by cross members and the strength of frames hold most of the weight of the truck[1]**.**

Different types of suspensions can be used on the lorry like air, spring, hydraulic according to size and needs of the vehicle. Suspensions are used to reduce the vibrations, ensure driving safety[2].

This paper describes the truck which is having 6-wheeles, with independent electric motor on it attached to a steering mechanism and hydraulic piston cylinder suspension one end of which is connected to tire axle and other to the covering of the electrical motor. And the whole mechanism operates on electrical system.

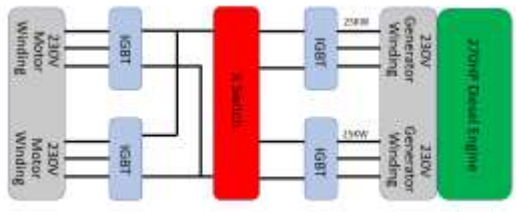

Fig1: Block dia. of eDrive working

When the engine with 270HP starts it rotates the generator which is coupled to the engine.

The generator has two windings which generates each of 25kW of power and through the motor winding the power is taken to the IGBT circuit and rectifier from where the 230V AC is converted to 325V DC and the passes through the X switch which connects the windings either in parallel or series, at start we need more current to switch on the motor so parallel connection helps to do it[3]. After starting, more voltage is required to run motor, so X switch convert the connection to series. As the motor start running it actuates the gear pump which triggers the valves to control pressure in suspension. And on the other hand, steering resolver is used to turn the wheels.

II. CAD MODELLING

The design of the six-wheel truck is done by using SolidWorks. Based on actual dimension of the dump truck the frame and the tire assembly are designed. This single motor tire system can be used for:

1. Easy turning of the tire on sharp turn.
2. Replacing the tire in any condition very easily: just by using suspension system.
3. Making the system more economical and efficient using electrical system**.**

Fig:2 Cad Model

As the engine start it transmit 202 kw of power to the generator and then form the generator the power is transfer to the motor trough IGBT and rectifier where AC power is converted to DC power to run the AC induction motor and then the motor runs the wheels[3]. And the power from the generator is also used to trigger steering mechanism, operation of gear pump which controls oil flow through the suspension system.

Fig:3 Outer Covering

III. DESIGN CALCULATIONS

Consideration:

1. Weight of the truck F = 60000lb
2. Wheels on the truck = 6
3. Pressure generated by gear pump = 7000psi

Hydraulic Cylinder Dimensions:

1. Piston rod: Diameter D (1) = 3in
   Length L (1) = 25.5in
2. Piston: Diameter D (2) = 4in
   Thickness T (2) = 1.25in
3. Cylinder: Outer diameter OD (3) = 6in
   Inner diameter ID (3) = 4in
   Length L (3) = 20.75in
4. Cylinder head:
   Outer diameter OD (4) = 4.5in
   Inner diameter ID (4) = 3in
5. End Cap: Outer diameter OD (5) = 6in
   Inner diameter ID (5) = 3in

Pressure required to lift the piston

Pressure = Weight on the single wheel/Area of piston on which fluid pressure is acting (EQ1)

Weight on the wheel = Weight of the truck/number of wheels
= 60000lb/6
= 10000lb (EQ2)

Area of piston on which fluid pressure is acting
= Π/4* [D (2)] ^2 - Π/4*[D (1)] ^2
= Π/4*4^2 - Π/4*3^2
= 5.497in^2 (EQ3)

From EQ1, EQ2, & EQ3
Pressure = 10000lb/5.497in^2
Pressure = 1819.17psi
From above equation we can say that pressure required to lift the piston is 1819.17PSI

IV. FINITE ELEMENT ANALYSIS

Finite element analysis is performed on the design to measure the capacity of the design that it is feasible that the design can be practically use or not. In this report Ansys workbench is used to do so. In FEM we can determine stress, strain, deformation, FOS of the design[4, 5]. It converts the complex designs into nodes and elements and then solve for the result. For this design static structural analysis is done using ductile iron as the material.
Static structural analysis for eDrive truck suspension and motor.

The main objective of the design is to sustain 10000lb to 15000lb of load with 1819.17psi (Calculated in design calculations) hydraulic pressure is applied to it

1. Stress:

As 10000LB force act on the piston rod, stress will induce in the whole design and for the material the stresses should be bearable by the body. When the simulation was run for this design, the design was good enough to carry amount of load required[4]. It is found that at the top the stress is maximum 2.08e5psf and it gradually decreasing. Under 10000lbf the design is safe, shown in fig below.

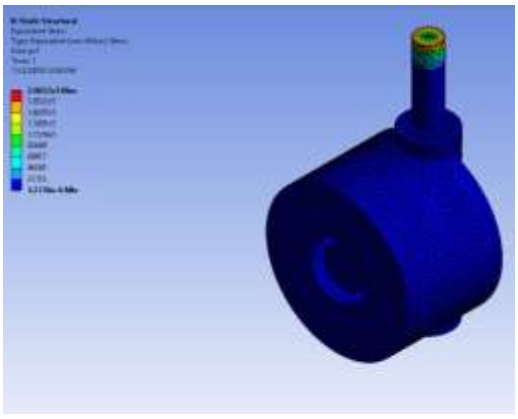

Fig:4 Stress analysis

2. Strain:

It is the expansion in the body due to mechanical stress. As the stress is less in the body therefore strain is also almost same. And the minimal amount of strain is good and increases the strength of the body. The maximum amount of train is 5.38*e-5.

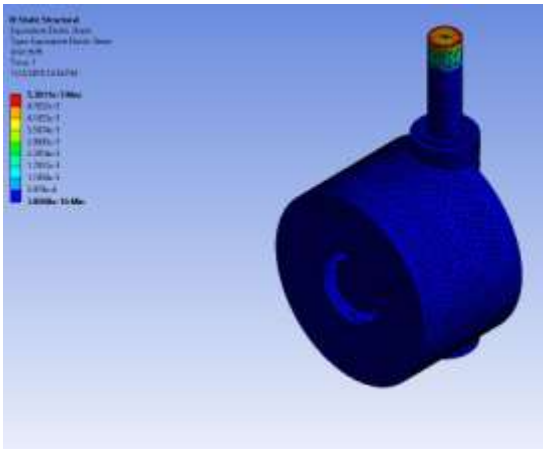

Fig:5 Strain analysis

3. Deformation:

It is the change in the shape of body due to action of various stresses and strain in the body. In this design the deformation of the design is due to force and pressure acting on the body.

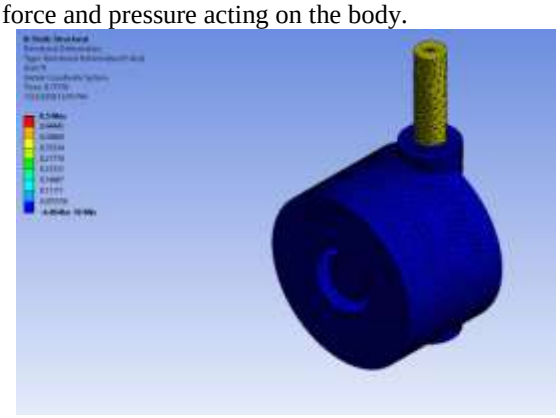

Fig:6 Deformation

4. **Factor of Safety**:

It is the structural strength for the intended load and it should always greater than the design safety factor. For this design, safety factor is 4 and by the analysis it is found that FOS varies between 8.64-15. Therefore, it shows that the design is good for the applied conditions.

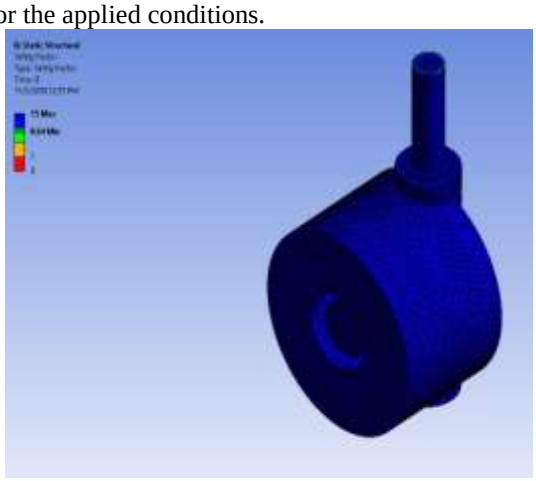

Fig:7 Factor of safety

V. CONCLUSION

In this paper electrically, operated truck using hydraulic suspension is design. The main aim of the paper is to design a reliable system. Instead of using gear transmission electrical motors are used to drive the wheels due to which there is reduction in the weight of the truck and reduction in cost of manufacturing. Hydraulic suspension is used as a suspension which is very efficient and oil pressure of which is controlled by the gear pump which is installed inside the stator rotor assembly. Gear pump is design to achieve 7000psi pressure and which can be in case of increase of weight. As this is all wheel drive truck it could offer more traction on all the axels. In case of flat tire hydraulic suspension can be used to lift the tire. And in any failure of any motor, other motor power can be used to drive the wheel.

REFERENCES

[1]. Bugra Selenbas; Hasan Gunes; Kenan Gocmen; Uygar Bahceci; Bertan Bayam, "An Aerodynamic Design and Optimization of a Heavy Truck for Drag Reduction,," Biennial Conference on Engineering System Design and Analysis, July 2018.

[2]. A Chinnamahammad bhasha; N Vijay rami reddy; B Rajnaveen, "Design and Analysis of Shock Absorber,," International Research Journal of Engineering and Technology, vol. 04,, no. 01, Jan - 2017.

[3]. A.S. Ba-thunya; R. Khopkar; Kexin Wei; H.A. Toliyat, "Single phase induction motor drives - A literature survey,," IEEE

International Electric Machines and Drives Conference , June 2001.

[4]. Saigowtham Ponnathi; Lokanadham R, "Design and Analysis of Piston, Piston Rings and Cylinder Liners by Using Aluminium-Flyash-Alumina Composite,," International Journal of Emerging Technologies in Engineering Research, vol. 3, no. 3, December 2015.

[5]. H G Phakatkar; Chinmay Potdar; Vrushabh; Sushrut Jadhav, "Design of Suspension system of Formula Student Car,," International Journal of Mechanical and Production Engineering, vol. 04, no. 2, Feb - 2016.

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