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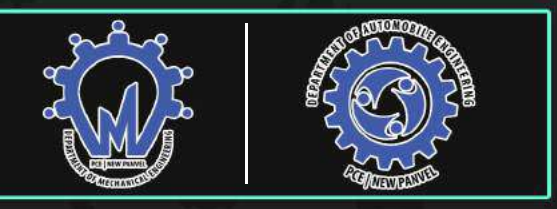

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EDITORIAL

CONTENTS

REMOTE CONTROLLED SEED SOWING VEHICLE

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Abstract— **Indian modern agriculture development does not have sufficient skilled labour to trade off new technology. The problem focused here is direct seeding. So, it is mandatory to revolutionize this sector and a progressive innovation becomes necessity for raising the demand on agro product quality. To give elucidation to these problems, an electronically guided rover for digging, precise seed positioning and sowing has been proposed to reduce the human effort and also to increase the yield. The rover's navigation is performed by remote guiding devices fortified with the positioning system. The rover is propelled by high torque DC motor fitted with the available seed storage hopper and digging tool. It can be amalgamated with a fertilizer spray unit which enriches Indian agricultural field.**

Keywords— agriculture; revolutionize; innovation; rover; remote guiding device

I. INTRODUCTION

In the current generation, most of the countries do not have sufficient skilled manpower specifically in agricultural sector and it affects the growth of developing countries. In India, there are 70% people dependent on agriculture. Seed plantation in our day to day life is done by tractor in farms. The conventional method for seeding is the manual one. But it requires more time and the manpower shortage is faced continuously. So using our knowledge we need to contribute some or the other way in this field.

The basic idea of our project is to reduce the human effort and increase the yield in the process of sowing seeds. In this project, we are just trying to sow seeds in a simplest and effortless way possible. Thus, the sowing process that takes place through our vehicle is simply by the rotation of the wheels. This helps in sowing the seeds at a particular distance and in a certain amount. Our vehicle also saves some time required to fertilize the plant, as a provision can given for fertilization as well.

The other factors that make our project reliable are energy required and pollution. It's obvious that where manpower is reduced their energy consumption is also reduced. Though there is a requirement of electrical energy but comparatively it would not affect the overall consumption. If we sow seeds with the help of tractor another problem arises i.e. of pollution. Thus, there is no requirement of fuel in our vehicle this problem is also vanquished.

So it's time to revolutionize the sector to overcome this problem with the help of proper and reliable sources available and at the cheapest way possible. Thus affordable to each and every farmer in our country.

II. METHODOLOGY

The construction of this prototype is done in the following procedure.

A. Identification of problems

Our country comes under developing nations category & in our country agriculture is a profession of lots of people. Most of Indian farmers use traditional/manual sowing because technology in our country is not so much developed and use of machines for sowing purpose and agricultural equipment and machineries are expensive. Indian farmers use tractors to farm their lands, they use tractors for tilling, ploughing, harrowing, planting and also they use manual broadcaster to spray anti-bacteria liquid on plants to grow them safely. But all this necessary things which should be done in farming a land takes a lot of time and required large amount of man force to fulfill the all these activities in order to get large production.

B. Development of concept

To reduce/eliminate such problems which farmers are facing, we came up with a concept of a remote controlled seed sowing vehicle. A robotic vehicle which is able to perform number of operations such as digging, seed sowing, water spraying etc. at the same time in a simple way possible.

C. Designing the proposed concept

On the basis of certain calculations and layout of the model the development of the prototype took place. In this phase the plough and the dispenser was designed using design software named 'SOLIDWORKS'.

D. Programming of ECM

Electronic control module (ECM) helps in movement of the vehicle by providing necessary signals. Manoeuvring of the vehicle was done by programming the Arduino. The power supply to the motor is controlled by the motor driver and the vehicle is driven with the help of any android phone with Bluetooth connectivity. As the ECM consists of a Bluetooth

module which receives the signal given through the android phones.

III. IMPLEMENTATION

After doing certain research and referring various project works our ideas were implemented in three stages.

1. Design and Analysis
2. Programming and Electronics
3. Fabrication

DESIGN AND ANALYSIS

Engineering Design is the process of designing a system component or process to meet desired needs. It is the decision-making process (often iterative) in which the basic sciences, mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, syntheses, analysis, construction, testing and evaluation.

E. Design of plough

Assumptions:

i. Vehicle is moving at constant velocity.

ii. Neglecting frictional forces.

iii. Neglecting aerodynamic and weather effects.

iv. Forces applied are constant and do not change with respect to time and velocity

Calculations for applied force by the ploughs on the ground

Mass of vehicle, m = 6 kg

Speed of vehicle, N = 45 rpm

Therefore, angular velocity, $\omega = 2\pi N/60$. = **4.71 rad/s**

Linear velocity, $v = r\omega$. = **2.36 m/s**

Considering distance travelled to be s = 1 m, initial velocity, u = 0

Therefore acceleration a,

$$v^2 = u^2 + 2as.$$

$$\mathbf{a = 2.785\ m/s2}$$

Thus, force exerted by plough on ground

$$F = ma. = \mathbf{16.71\ N}$$

Considering 33 percent increase in above load.....[static structural analysis consideration from Patel – Sikh Vol-1]

Therefore design load,

$$F_d = 1.33 * F$$

$$= \mathbf{22.22\ N}$$

F. Analysis of plough

On the basis of above calculations and solutions obtained the analysis of plough was done using analytic software 'ANSYS'. The results obtained here are foe mild steel material

Below are the images of the conditions applied and results obtained.

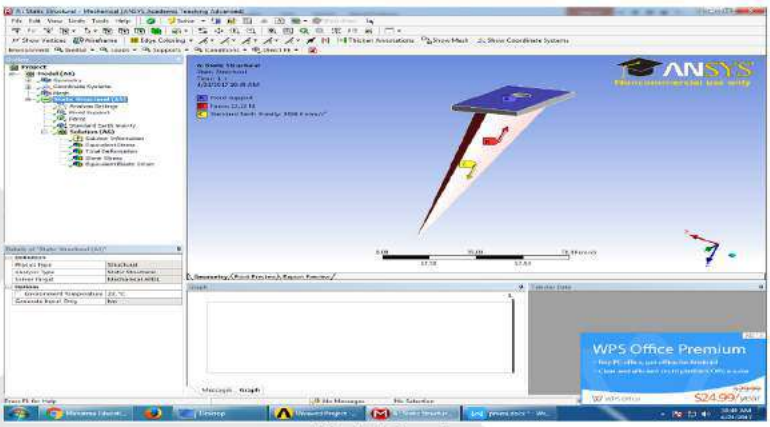

Fig 3.1 Loads

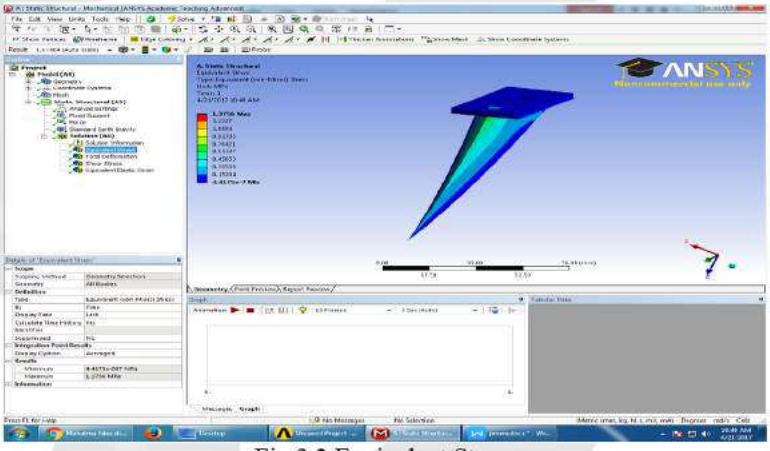

Fig 3.2 Equivalent Stress

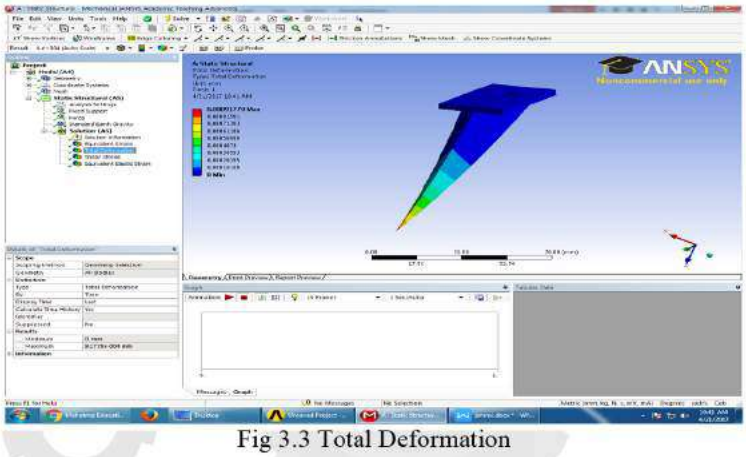

Fig 3.3 Total Deformation

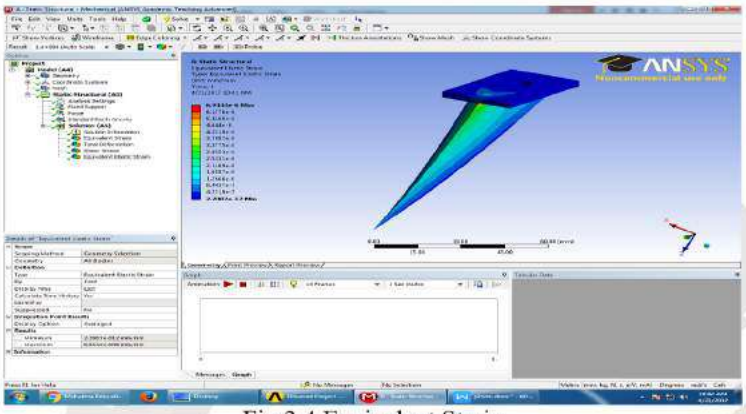

Fig 3.4 Equivalent Strain

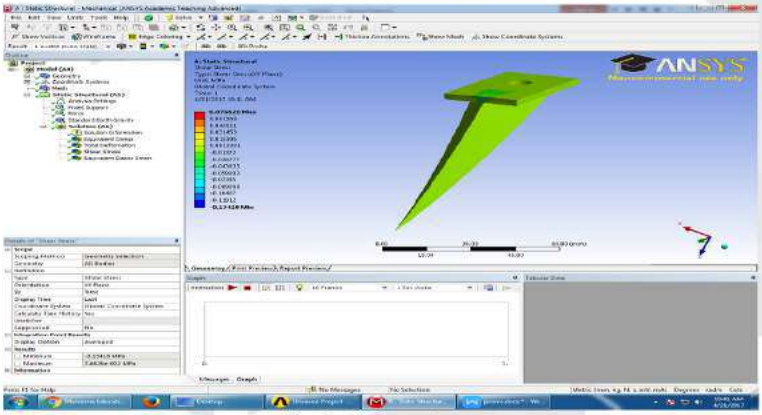

Fig 3.5 Shear stress

G. Design of dispenser.

According to the diameter of the wheels the dimensions of the dispenser was decided as it is an integrated part of the wheel. As the diameter of wheel is 100mm, the diameter of dispenser was kept 80mm. This is divided into four equal sectors thus giving space for seeds and equal spacing could be maintained without wastage of seeds.

Diameter of dispenser,

$$d = 80 \text{ mm}$$

Therefore,

$$\text{circumference} = \pi d = \pi * 80 = 251 \text{ mm}$$

$$\text{length of one sector} = 251/4 = 63 \text{ mm}$$

Thus distance between dispensed seeds = 63 mm

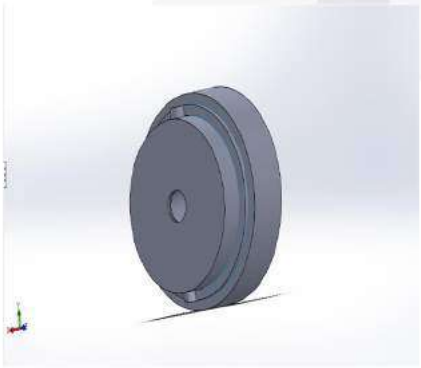

Fig. 3.6 Dispenser Design (Assembly)

PROGRAMMING AND ELECTRONICS

Arduino UNO, a programmable circuit board which runs to receive and transmit signals to the vehicle. A Bluetooth module HC05 has been put in cohesion with the Arduino digital pins in required format for operation of the vehicle. Due to the Bluetooth Module, the maneuvering of the vehicle can be controlled using any android device consisting of mobile application to run the program. The electronic assembly of the vehicle is as shown in figure 3.7

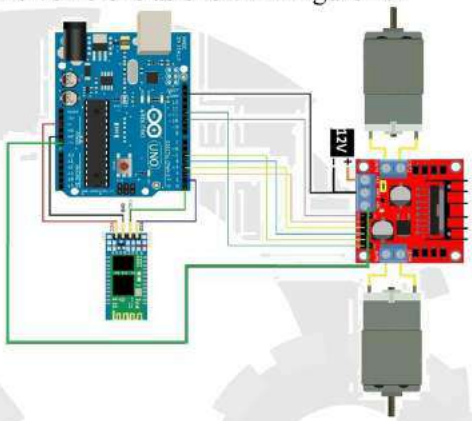

Fig 3.7 Connections of Electronic assembly

FABRICATION

Plough

Fabrication of plough was done with respect to the design calculations using mild steel material. As it is a prototype not much loads would be applied on the part. Thus mild steel material was selected.

Dispenser

Dispenser mechanism needed to be light in weight and durable in all conditions with intricate designs. For fabrication of intricate design the option of 3D printing was most effective and feasible. Using Polylactic Acid grade plastic for manufacturing the dispenser which was designed using Solidworks software. Plastic was used for fabrication of dispenser as it is light in weight and resistant to corrosion. The option of 3D printing was chosen because manufacturing the component by any other material and method of construction would have taken much more time and would increase the cost of production.

Fig. 3.8 Dispenser

After completion of all these processes the assembly of the robot is as shown in Fig. 3.9

Fig. 3.9 Assembly

IV.RESULTS

A new agricultural model of a tractor has been developed. Testing and analysis were done on the components. The model is fitted with 45 rpm motors which has a high torque level. Multiple operations such as sowing, tilling, water spraying and equal distribution of seeds were carried out by the maneuver. The vehicle is controlled wirelessly with the help of a Bluetooth module connected to the mobile phone. The vehicle can maintain space between two seed is **63 mm**.

Analysis were done and forces acting on ploughs were calculated with the help of analytical software (ANSYS) and the values obtained were safe. Given below are some of the values

Total deformation = **0.000917 mm**
Equivalent stress = **1.3756 MPa**
Equivalent strain = **6.966e-6 MPa**
Shear stress = **0.0766 MPa**

V. CONCLUSION

In comparison to the conventional process of farming which was less effective, time consuming, less economic and space consuming.

As per the test conducted, due to the effective design of dispenser the seeds sowed are equally placed and wastage of seeds were reduced. Depending on various other parameters the effectiveness of the product can be increased. As the process of ploughing and dispensing is done at a same time effectively.

With the use of 45 rpm motors the vehicle can withstand soil forces experienced by the ploughs and tills the land in a linear trajectory. Due to the use of small, less power motors and Bluetooth-Module it can be used in small size farmlands. But is feasible for usage in large farms with the help of long range modules and high torque motors. Manual labour is primarily eliminated as the vehicle is driven automatically with the help of your mobile phones.

TABLE I. Comparison Between Seed Sowing Methods

SR NO.	PARAMETER	MANUAL	TRACTOR	SEED SOWING VEHICLE
1	MAN POWER	MORE	MORE	LESS
2	TIME REQUIRED	MORE	MODERATE	LESS
3	DIGGING AND SOWING TECHNIQUE	MANUAL	MANUAL	AUTOMATIC
4	ADJUSTABLE SEED DISTANCE	NO	NO	YES
5	SEED WASTAGE	MODERATE	MORE	LESS
6	ENERGY NEEDED	HIGH	VERY HIGH	LESS

ACKNOWLEDGMENT

We take immense pleasure in thanking **Prof. Basawraj Talikotti** our beloved guide for having guided us to carry out this project work. We wish to express deep sense of gratitude to the teaching staff of our department for being able to guide us and helped us in completing the project. Special thanks to the **Principal Dr. R.I.K. Moorthy** and **Head of the department Prof. Mrs. Divya Padmanabhan** for providing us with required resources in the college. Words are inadequate in offering our thanks to the workshop staff for letting us work freely in the workshop and for providing us with necessary help whenever required. Finally, yet importantly, we would like to express our heartfelt thanks to our friend's for their help and wishes for successful completion of project.

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Design And Fabrication Of Smart Helmet For Safety

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***Abstract*— As the bikers in our country are increasing, the road mishaps are also increasing day by day, due to which many casualties, most of them are caused due to most common negligence of not wearing the helmets, and also many deaths occur due to lack of prompt medical attention needed by the injured person.**
This motivates us to think about making a system which ensures the safety of biker, by making it necessary to wear helmet, as per government guidelines. The proposed system is a smart helmet. A module affixed in the helmet, such that, the module will sync with the module affixed on bike and the mechanism will thus ensure that the biker/motorcyclists has to wear a helmet. It will in turn increase the safety factor of the ride.

***Keywords*: Safety, Sensor, Accident, Helmet, RF transceiver.**

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I. INTRODUCTION

Here is an alarming increase in the morbidity and mortality due to two wheeler road traffic accidents. In India, it is estimated that one accident takes place every 2 minutes. Data from the National Crime Records Bureau indicates that deaths and injuries related to road traffic accident has increased two and four fold respectively during the period of 2009-2015. Reportedly 1, 25, 874 persons were killed in 2015 on Indian roads. The occupants and riders of two wheeler vehicles are among the majority to be affected in road traffic accidents. Two wheeler accidents have also been shown to have maximum case fatality in accidents.

Despite of the safety rules made by the government, many riders fail to abide by them. The riders in India often bypass the prime rule of wearing the helmet while riding bike. This leads to fatal injuries (especially head injuries) during an unfortunate incident of an accident. Head injuries have lasting and detrimental effects on people's lives. Of the 1,453 two-wheeler riders who died in road accidents in the city of Mumbai between January 1, 2013 and June 28, 2015, 1,434 were not wearing a helmet. This is the story more or less of whole India. In the same period, just 19 two wheeler riders wearing a helmet were killed in road accidents. A whopping 98.6% bikers who died after an accident did not wear a helmet. Motorcyclists are 26 times more likely to die in a road crash than drivers of passenger cars. Wearing an appropriate helmet improves their chances of survival by 42% and helps avoid 69% of injuries to riders. If the head is protected from such fatal injuries, the purpose of helmet is served

A. Objectives:

- To ensure that the motorcyclist always has a helmet on his/her head while riding.
- To increase the total safety factor.
- Decrease the intensity of accident fatalities to a great extent.
- Enforcing the law of wearing helmets efficiently.

B. Problem Statement:

In India road accidents stand among the leading cause of human death. Most of the fatal accidents happen to motorcycle users. These accidents can prove to be very dangerous for the motorcyclist. This problem can be exceptionally grave in India since most of the motorcyclists don't use or wear a helmet, which causes serious injuries. Most of the motorcyclists in India don't wear due mere negligence. A whopping 98.6% bikers in Mumbai who died after an accident did not wear a helmet. Motorcyclists are 26 times more likely to die in a road crash than drivers of passenger cars. Wearing an appropriate helmet improves their chances of survival by 42% and helps avoid 69% of injuries to riders. If the head is protected from such fatal injuries, the purpose of helmet is served. This problem can be solved by designing a system which will make it mandatory for the user to wear a helmet in order to start the bike

II. LITERATURE REVIEW

The available papers on this particular topic were collected, analyzed and reviewed. The different techniques were reviewed and the differences are pointed out by author Kaustubh Padwal [1] in a journal. In this thesis, there has been no mentioning on practical applications and realistic scenarios which plays a key role in safe riding experiences for the rider on Indian roads and riding conditions. The whole demo setup was based on less efficient and operationally ineffective indicating techniques using LED's. This could have been practically applied on a bike itself to give a much prominent results. Low dependent mechanism based on Telemetry system was used in this analyzing technique. Mere single

trigger system was used, whereas more reliable double trigger mechanisms could have been used. This paper presents the smart helmet that makes sure that the rider cannot start the bike without wearing it. This helmet replaces the cable connections for wirelessly switching on a bike, so that the bike would not start without both the key and the helmet. An indicator is used to demonstrate the working of the model. The system is a simple telemetry system, which is activated with the help of a pressure that is applied to the inner side of the helmet when the rider wears it. The framework model uses a electromechanical relay and hence there is some time lag in wearing the helmet and switching on of the circuit.

Other research paper on this project was discussed in a report by Nitin Agarwal [2]. The report is more emphasized on post-accident investigation; to analyze information causing the accident, rather on preventive mechanisms for a better and effective safety features. A major counter effective feature in the study shows, the bike can be started even when a helmet is not worn by the biker, which results in unsafe and unreliable riding conditions, which surpass the primary requirement of the system itself. The system eventually focuses more on data collection which would help gain more clarity in analyzing of accident conditions. This is a report about a smart helmet which makes motorcycle driving safer than before. The aim of this project is to give information at accident to ambulance and family members. This is implemented using Arduino. This smart helmet was implemented by placing vibrations sensors in different places of helmet where the probability of hitting is more which are connected to arguing board.it consisted of just one trigger to for sending the signal from the transmitter.

Also a third research paper studied which was relevant to smart helmet authored by Bhagyashree Jagadish Nikharge [3] was studied. Again the single trigger system was used, whereas more reliable double trigger mechanisms should have been included. The report is analyzing information causing the accident, rather on preventive mechanisms for a better and effective safety features. The volume describes and highlights the feature where it stresses that the bike cannot be started without rider wearing the safety helmet; this supports the primary requirement of the system. This paper presents the smart helmet that makes sure that the rider cannot start the bike without wearing it. This helmet replaces the cable connections for wirelessly switching on a bike, so that the bike would not start without both the key and the helmet. But this technique has just one mode of trigger which may not be enough to make the mechanism foolproof.

III. METHODOLOGY

A. Proposed system

The proposed system is a smart helmet. The system ensures the safety of the biker, by making it necessary to wear the Helmet, as per the government guidelines. A module is affixed in the helmet, such that, the module will sync with the module affixed on the bike. The system will bear following functionalities:

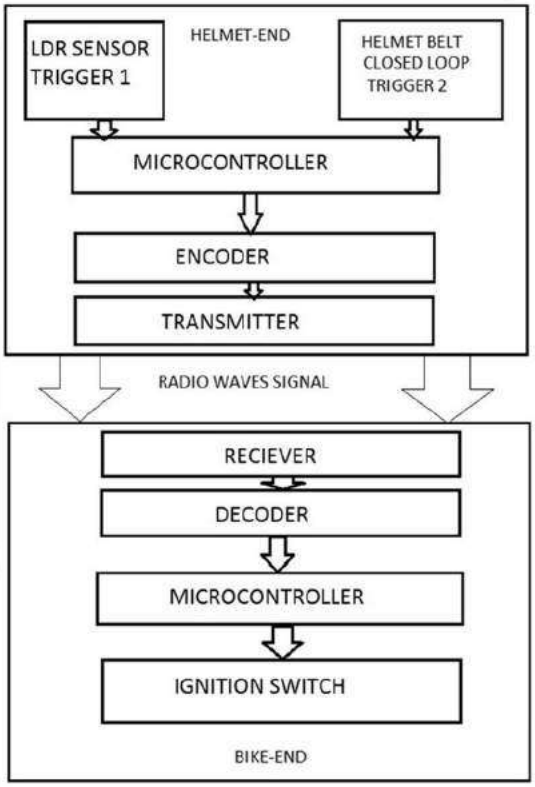
- It will ensure that the rider has worn the helmet. If he/she fails to do so, the bike won't start.

It will consist of two parts:

- Module on helmet and
- Module on the bike.

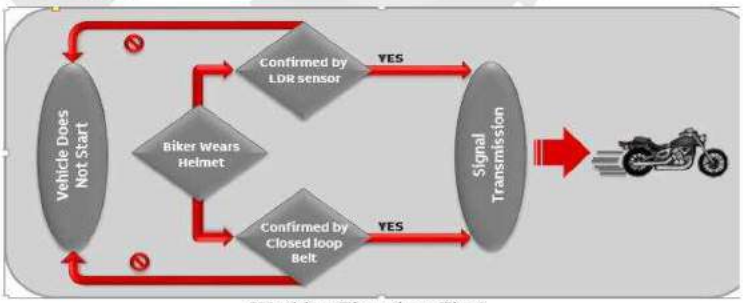
When a biker wears the helmet, the LDR sensor inside the helmet senses almost no light which leads to the first trigger. When the biker tightens the helmet belt and clips it, that will ensure a close loop leading to the second trigger, after both the triggers the transmitter on the helmet-end sends a RF signal while the receiver at the bike's ignition-end receives the signal and puts on the ignition 'ON', which along with the key in the 'on' position starts the bike.

B. Block diagram



Block diagram Fig 1

C. Working



Working Flowchart Fig 2

The flowchart shown in Fig 3 explains the workflow of the system.

- The rider wears the helmet.
- When the helmet is worn, the LDR sensor detects an obstacle and gives LOW output. The output data is sent to the microcontroller, this leads to the first mode of trigger.
- If the output is a 'NO' then the signal is not triggered and thus the vehicle does not start
- When the biker clips the helmet belt after tightening it, a closed loop is formed through wire connections, this leads to the second mode of trigger and the same is sent to the microcontroller.
- When the belt is not clipped the output is a 'NO' and thus the vehicle does not start.
- The microcontroller transmits the data to the transmitter only when it confirms that both the conditions are satisfied and ensures that the there are two modes of trigger.
- The receiver on the bike receives the signal, the decoder decodes it and the same is sent to the microcontroller.
- The microcontroller makes the relay switch loop closed and the vehicle STARTS.

Hence the bike runs smoothly or does not start in accordance with wearing the helmet.

IV. FABRICATION SETUP

Helmet setup Fig 3

Bike Setup Fig 4

A. Hardware Components:

1. Voltage Regulator (Lm 7805)
2. Microcontroller (At89s52/At89c51)
3. Led
4. Push Buttons
5. Resistor
6. Capacitor
7. Relay (L293D)
8. Transmitter And receiver (Tx-Rx)(433 Mhz)

Microcontroller :

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry.

Relay:

Features:

- Wide supply-voltage range: 4.5V to 36V
- Separate input- logic supply
- Thermal shutdown
- High-Noise-Immunity input
- Output current 1A per channel (600 mA for L293D)

B. Software requirements (chronologically)

- C Programming
- Checking code Keil cross compiler
- Converting C code into hex files using keil compiler
- Inserting the hex files in protuse virtual hardware and performing a simulation check
- After the simulation check burning the IC with ISP software.
- Final testing on a bread board before installing
- Final installation of the microcontroller in the PCB

V. RESULT

A. Continuity Test

In electronics, a continuity test is the checking of an electric circuit to see if current flows (that it is in fact a complete circuit). A continuity test is performed by placing a small voltage (wired in series with an LED or noise-producing component such as a piezoelectric speaker) across the chosen path. If electron flow is inhibited by broken conductors, damaged components, or excessive resistance, the circuit is "open".

This test is performed just after the hardware soldering and configuration has been completed.

B. Power On test

This test is performed to check whether the voltage at different terminals is according to the requirement or not. A multi meter was used and put it in voltage mode. Remember that this test is performed without microcontroller. Then this voltage was applied to the power supply circuit. Note that this test was done without microcontroller because if there is any excessive voltage, this may lead to damaging the controller input to the voltage regulator Then the is checked i.e., are we getting an input of 12v and an output of 5v.

Hence the project was successfully tested for power on test and continuity test

VI. CONCLUSION

The project of Design and fabrication of Smart helmet was successfully designed, fabricated and tested for its use. With this system one cannot start the bike without wearing a helmet and attempt has been made to make it highly efficient and foolproof. This project aims at increasing the number of people wearing the helmets and thereby increasing their overall safety factor. So this helps in curbing the road accidents by implementing mandatory Helmet protection while starting on of the bike. With two modes of trigger in the mechanism care is taken to make it fool proof as much as possible. This project here is undertaken keeping in view of traffic, the traffic rules and also the safety of people. This serves greatly the basic purpose of implementation of a rule which is flunked by many causing serious life destroying head injuries and deaths, thus protecting precious lives.

ACKNOWLEDGEMENT

The completion of this undertaking could not have been possible without the participation and assistance of so many people whose names may not all be enumerated. Their contributions are sincerely appreciated and gratefully acknowledged. However, the group would like to express their deep appreciation and indebtedness particularly to the following Prof Shilpa Mondkar for her support as the project guide, Prof Divya P. for proper guidance and support as the HOD and Dr Dhanraj Tambuskar for their support. We would like to thank Prof Amey Marathe for his valuable inputs. We would also like to take this opportunity to thank our project coordinator Prof Gajanan Thokal and our principal Dr R.I.K. Moorthy for their endless support, kind and understanding spirit during our case presentation.

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‘Modeling and analysis of MR (Magneto Rheological) Damper’

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Abstract: Magneto-Rheological fluid is a smart fluid in which magnetizable particle are suspended in a carrier fluid. The viscosity of MR fluid changes with the application and removal of magnetic field. In this silicon oil is used as a carrier fluid and is mixed with carbonyl iron powder. In this Finite Element Analysis of Magneto-Rheological Fluid (MR) damper is presented and a FEM model for calculation of damping force based on magnetic flux density for a test MR damper. A 2D-axi-symmetric FEM model is thus build on ANSYS 14.0 platform to analyze and examine a prototype of the MR damper. In this geometrical parameters for a test damper and magnetic flux density at the clearance space are analyzed for calculating the Damping force parameter. The analysis has indicated that the FEM modeling is effectively portraying the behavior of a MR damper and is adequate enough for estimation of the damping force, its control and design. The results obtained will be helpful to the future designers to predict the damping force of any given damper.

I. Introduction

The Indian Automobile Industry is amongst the largest automobile markets in the world. It is up-and-coming as one of the fastest growing passenger car markets in the world. In recent days, the automobile industry in India is witnessing a flat and even negative growth rates. It is also the second largest two wheeler manufacturer country in the world. India is also the fifth largest commercial vehicle manufacturer. India has some roads and highways in pretty bad condition so if you are planning on travelling somewhere you’ve never been to before, especially rural areas. Sometimes due to the extremely bad road conditions which as result largely affects the vehicle conditions such as comfort, ride and safety. To overcome this problem suspension are used in vehicles.

The suspension system is one of the most important parts in vehicles, while the damper is the most important part in suspension system of the vehicles. Hit a bump without dampers, and the suspension would continue to bounce up and down uncontrollably. The job of a car suspension is to maximize the friction between the tires and the road surface, to provide steering stability with good handling and to ensure the comfort of the passengers besides it also provide a safety to a driver. For a clothes washing machine, damper function is to reduce the noise make by that machine.

A magneto rheological damper is a damper filled with magneto rheological fluid, which is

controlled by a magnetic field. This allows the damping characteristics of the shock absorber to be continuously controlled by varying the force of the electromagnet. The application of magneto rheological (MR) dampers to give damping by the shear stress of MR fluids for reduces the shock vibration of mechanical system. A MR Fluid damper has the property that's damping changes quickly in response to an external magnetic field strength. This type of shock absorber has several applications, most notably in semi-active vehicle suspensions which may adapt to road conditions, as they are monitored through sensors in the vehicle. A typical MR fluid consists of 20-40 percentage by volume of relatively pure 3-10 micron diameter micron sized magnetizable particles such as iron oxide, iron carbide, iron nitride, unreduced carbonyl iron, reduced carbonyl iron, chromium dioxide, low-carbon steel, silicon steel, nickel, cobalt, and combinations thereof, suspended in the carrier fluids such as mineral oil, synthetic oil, water or ethylene glycol. in vehicle MR damper have been employed for semi-active control suspension, and it can offers quick response (less than 10 millisecond), real-time, continuously variable control damping, high dissipative force independent of velocity, Minimal power usage (typically 12V, 1A max current), if battery backup is fails , it becomes passive damping mode. Devices that use MR fluid can be work under three basic operation modes such as valve mode (flow mode), squeeze film compression mode and direct shear mode (clutch mode). Rich literature available in the field of Magneto rheological Fluid damper and it being noticed that though there is lot of work is being done in this field, but shell minimal investigations are carried out which leads to the development of the MR damper.

The primary objectives of this research were as follows: (1) to study different designs that are commonly used for MR dampers; (2) to provide recommendations for the effective Modeling and Analysis of MR dampers. To accomplish these goals, typical MR damper model were built in Ansys 14.0 software to determine their suitability and performance for specific applications.

II. MODELING OF MR DAMPER

The magnetic field in an MR damper is produced by an electromagnet. Here in the ANSYS simulation model the excitation coil is considered to be the electromagnet, and the magnetic field provided by this excitation coil is considered to be electromagnet, and the magnetic field provided by this excitation coil is needed to energize the MR fluid. By varying the current through excitation coil, the magnetic flux density can be varies and the MR fluid is energized accordingly.

- The main objective is to develop an FEA model of MR damper while maintaining the maximum performance of the MR effects.
- The performance of the MR damper is limited by the magnetic flux saturation phenomenon occurring in the magnetic circuit.
- The purpose of the finite Element Analysis is to identify the saturation phenomenon occurring in the magnetic circuit. The damping force produced by the MR damper mainly depends on the magnetic field induced in the working fluid clearance space.

Based on critical literature review, the dimensions of the MR damper as listed in Table 1. Are selected.

Typical magnetic loop of MR damper is shown in fig.1

Sr. No	Parameters	Dimensions(mm)
1	Pole length(L)	23
2	Distance between the poles(l)	22
3	Radius of the piston (R)	23
4	Piston rod radius(r)	06
5	Radial distance from piston rod to coil width (H)	07
6	Clearance between piston and cylinder (h)	01
7	Thickness of the cylinder (t)	08

Table 1: Various dimensions of the MR Damper Prototype

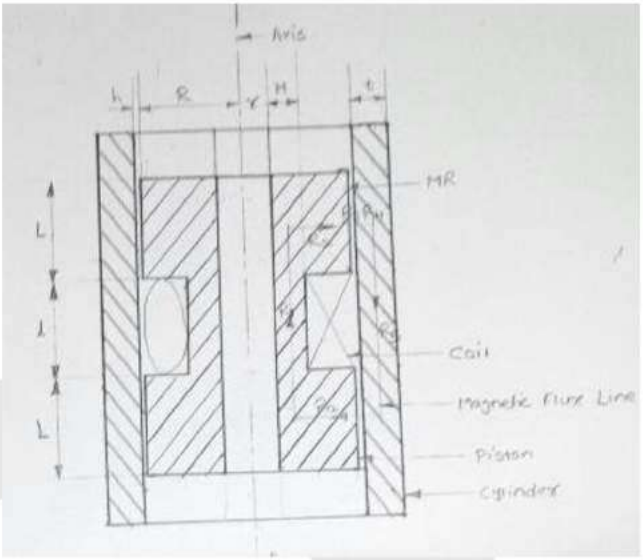


Fig.1Typical Loop of MR Damper

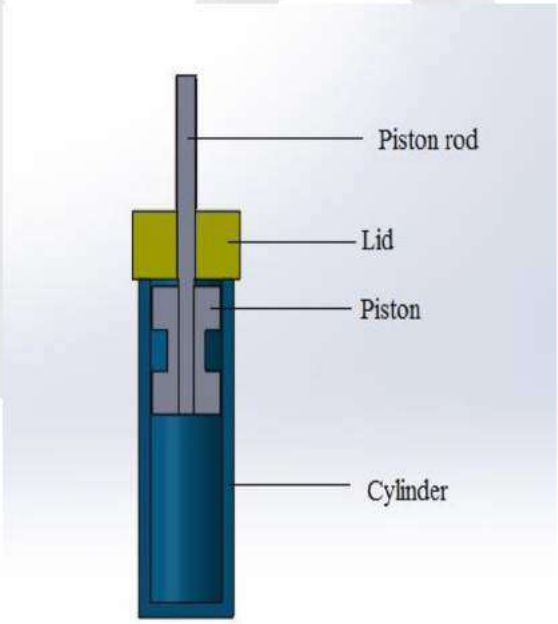


Fig. 2 Typical MR damper model

B. FEA Modeling of MR Damper

MR damper is a promising topic for the automotive industry particularly in the field of automobile

suspension. To perform the experiment analysis of MR damper is very costly, the reason behind this is the cost of the MR fluid us around US $750 and the whole MR damper manufacturing cost around 200 US$. Finite Element Model (Ansys 14.0) has been used to analyze and examine a 2-D axisymmetric MR damper

An MR damper is to be analyzed as a 2-D axisymmetric model. For a given current, we can determine the magnetic flux density at the Engine, MR Fluid and the Damper Housing.

The MR damper is a class of problem of an axisymmetric solid subjected to an axis-symmetric loading and thus a 2-D FEM modeling is sufficient enough to analyze it.

Following steps are generally used in the ANSYS for a static magnetic analysis of the MR damper: - • Create the physics environment

- Build & mesh the model and assign physics attributes to each region within the model
- Apply boundary conditions and loads (excitation)
- Obtain the solution
- Review the results

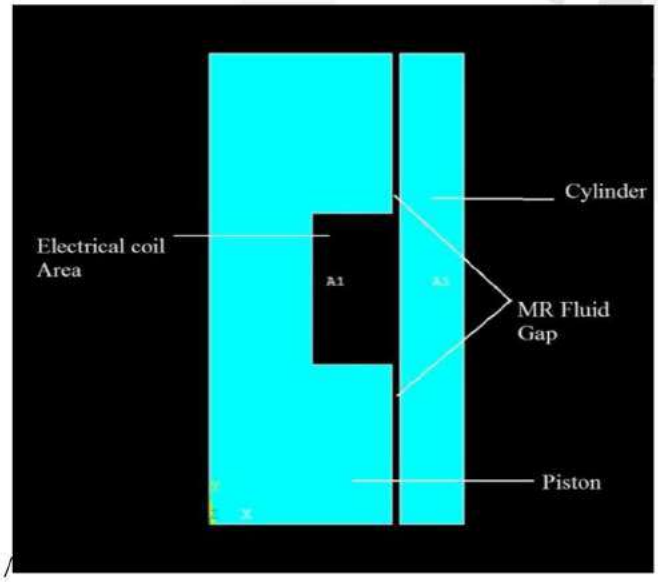


Fig 3 2D axis-symmetric Model of MR damper in ANSYS

C.Assumptions:

In the 2-D axis-symmetric model, there are assumptions which are used to create the model. The assumptions made for this study are as under:-

- The area of the element must be positive
- The element must lie in a global X-Y plane
- Y-axis must be the axis of symmetry for axis symmetric analysis
- An axis-symmetric structure should be modeled in the +X quadrants
- The element used in the model has only magnetic and electric field capability
- The element does not have structural, thermal or piezoelectric capability
- The only allowable material properties are the magnetic and electric properties (μo, μx)

D.Input Data

The piston, MR fluid in the clearance space and the cylinder are assumed to be stationary component and completes the magnetic circuit. In the ANSYS modeling, 350 turns for the electromagnetic coil are used to calculate the magnetic flux density. The electrical current is varied, in the coil, to get the corresponding value of the magnetic flux density. In

this modeling, the piston and cylinder material is taken as steel having relative permeability 2000 while the

L_i(m)	μ(H/m)	A_i(m^2)	R(A-turns/weber)
0.045	2.512×10^{-3}	4.275×10^{-4}	41.942×10^3
0.0135	2.512×10^{-3}	3.105×10^{-4}	17.308×10^3
0.001	7.536×10^{-6}	3.4×10^{-3}	3.388×10^3
0.004	2.512×10^{-3}	5.44×10^{-4}	2.92×10^3
0.045	2.512×10^{-3}	1.8×10^{-4}	99.52×10^3

relative permeability of electromagnetic coil is taken as 1. The relative permeability of the MR fluid is taken as 6. The Magnetic permeability of free space (μo) is taken as $4\pi \times 10\text{-}7$ H/m. For an electromagnetic static analysis through ANSYS, one needs to give DC current as an input to the software. This is given in the form of current density (J) which can be given as:

$$J = \frac{N_i}{A_e}$$

Where J is the current density,

Ni is numbers of turns,

I is the applied current and

Ae is the electrical coil cross-sectional area

The magnetic circuit parameters, according to magnetic ohm's law are magnetic reluctance R_i, Magnetic flux ϕ, magnetic potential their relationship given as:

$F=R_i$.

The magnetic reluctance is written as:

$$R_i = \frac{L_i}{\mu_i A_i}$$

Where L_i, A_i and μ are the length, cross-sectional area of the component and permeability of element.

The magnetic reluctance of various parts of the magnetic circuit as shown in table.

Table 2.Reluctance of various parts of designed magnetic circuit

E.Output Data

The output solution associated with the problem is in the following forms:

- Nodal degrees of freedom included in the overall nodal solution.
- Additional element output e.g. electromagnetic components.

The element output directions are parallel to the element coordinate system. In the ANSYS, one defines the magnetic flux density as B_x and B_y along the x and y axes respectively. The term Bsum is the vector sum of these magnetic flux densities and is given as

$B_{sum} = \sqrt{B_x} + B_y$

F.Element Solution

Figure.4 shows the results of ANSYS analysis in the form of 2-D flux lines around the electromagnetic coil.

As we have made an initial assumption while

modeling that there is no leakage at the boundary of the model, the magnetic flux will be acting parallel to the surface of the model. The boundary condition which enforces or helps apply it is "flux parallel" condition from the model.

This boundary condition is used for models in which the flux is contained in an iron circuit. The flux path is surrounding the coil and if we look closely at the MR fluid gap, we can see the concentration of many flux lines. Additionally, the lines shift as soon as they hit the gap, therefore indicating the effect of the MR fluid on the electric circuit. Since the properties of the MR fluid are different than the engine and damper housing, the magnetic induction vectors are changing in directions once they hit the MR fluid gap. These magnetic flux lines represent. The magnetic flux density vectors. So we have a high magnetic induction along the gap, as was observed. These concentration lines of magnetic flux will decrease by the time rheological saturation is reached.

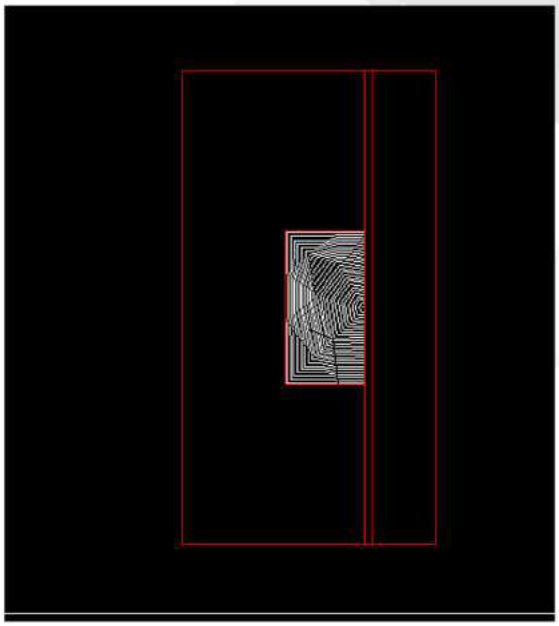
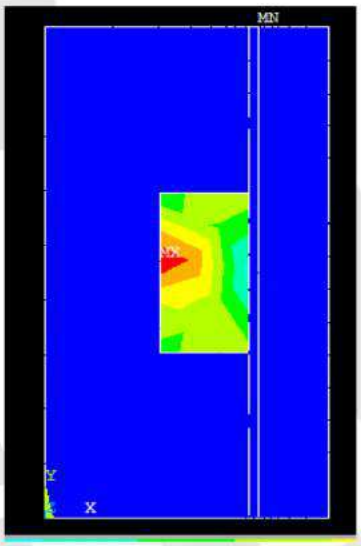
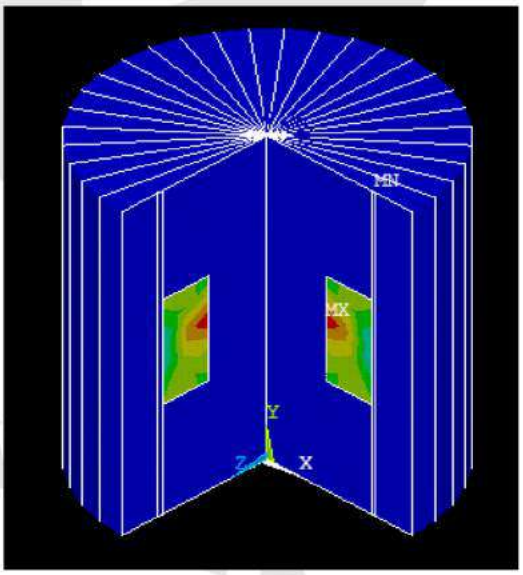


Fig 4 2D flux lines around the magnetic coil of MR damper

Fig 5 (a) shows an axi-symmetric 2D element solution of the magnetic induction distribution while Fig 5 (b) shows the spatial view of the same.



(a)



(b)

Fig 5 elemental solution of the magnetic induction distribution (a)2 D solution and (b) A spatial view

Table no. 3 Magnetic Flux density of FEA Model of MR damper

Current (A)	Magnetic Flux Density(Tesla)
0.1	0.045
0.2	0.091
0.3	0.136
0.4	0.182
0.5	0.227
0.6	0.273
0.7	0.318
0.8	0.364
0.9	0.409
1.0	0.455
1.1	0.500
1.2	0.546
1.3	0.591
1.4	0.637
1.5	0.682
1.6	0.728
1.7	0.773
1.8	0.819
1.9	0.864
2.0	0.910

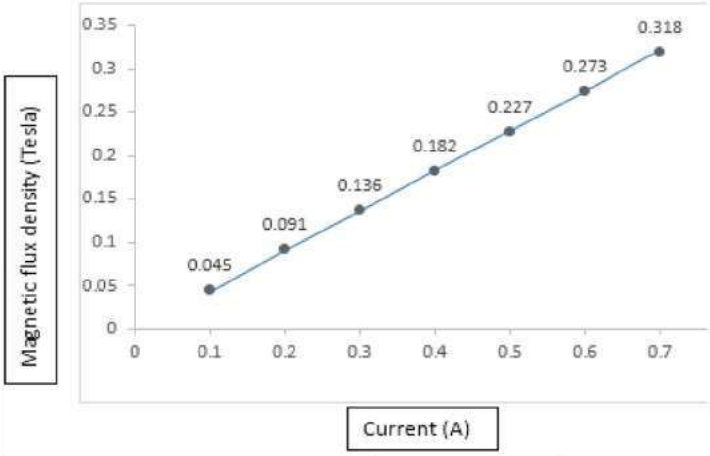


Fig 6 Magnetic flux density vs. current for the mathematical model

III. Calculation of Total Damping force

To determine the relationship between the yield shear stress and magnetic flux density, data is extracted from the graph supplied by the LORD Corp.Inc.USA [13] by using Data from graph software. The relationship between desired parameters is determined and is given by equation:

$$\tau_y = (6.9 \times 10^2) + (4 \times 10^2)B - (1 \times 10^5)B^2 + (9.1 \times 10^4)B^3$$

The damping force for the FEM modeling is calculated using the magnetic flux density as determined at different current levels (Table 2). The yield shear stress (τ_y) relationship with the magnetic flux density (B) for MR fluid MRF-122EG of Lord Corp. [14] is shown in Fig. 10. For the magnetic flux densities computed in the previous section, the

corresponding yield shear stress is found by using Fig.10. This can then be substituted in the following equations to get the total damping force. According to the plate model of Bingham plastic model, the damping force, FD, can be divided into an induced yield stress $\mathbf{F_\tau}$ and viscous $\mathbf{F_\eta}$ components i.e.:

$$f_d = \left(2.07 + \frac{2Q\,\eta}{12Q\,\eta + 0.4wh^2\tau_y}\right)\frac{\tau_y LA_e}{h} + \left(1 + \frac{whv}{2Q}\right)\frac{12\,\eta\,QLA_e}{wh^2}$$

Where

$$Q = A_p \times v$$

$$A_p = \frac{\pi}{4}(D^2 - {d_o}^2)$$

where Q is the volumetric flow rate, A_p is the effective cross-sectional area of piston, D is the diameter of the piston, d0 is the diameter of the piston rod, υ is the piston velocity, τ_y is the yield shear strength of the MR fluid, η is the off-state (no magnetic field) viscosity of the MR fluid, L is the effective axial pole length, h is the gap between piston and cylinder, Lt is the total axial pole length, w is the mean circumference of the damper's annular flow path.

Table no.4.Damping force for analytical model

Current (A)	Damping force (N)
0.1	279.60
0.2	323.38
0.3	354.71
0.4	376.84
0.5	393.66
0.6	403.05
0.7	409.78

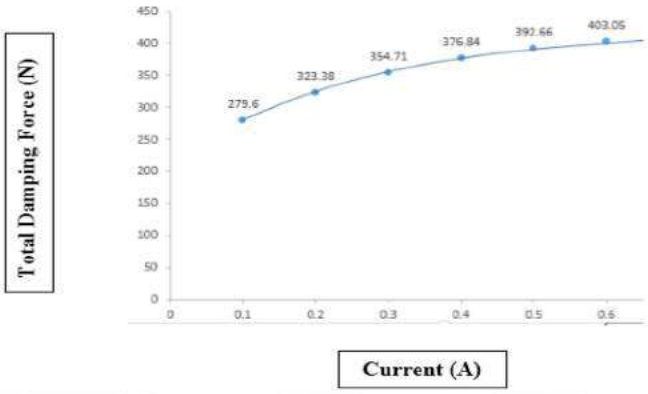


Fig 6 Total Damping Force of mathematical modeling at the different current level

IV. CONCLUSION

This study provided an axisymmetric model of a MR damper using ANSYS (14.0). For a 2-D model of a MR damper, we generated the magnetic flux density along the MR fluid gap. The model has helped with the design in MR dampers and tried to prove the force velocity characteristics. The Force-velocity plot depended on the magnetic flux density

In this report, FEA Software analysis is done to determine the Magnetic Flux density at various voltage regarding to calculate Damping Force. From the graph we conclude that:

- We are able to vary the strength of magnetic field by varying the voltage.i.e strength of magnetic field increases with increase in

current.

- As the current goes on increasing displacement goes on decreasing.
- Magnetic flux density depends upon the current density in the coil. As we move away from the coil the magnetic field decreases

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Design And Fabrication Of Turning Mechanism For Trailers

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Abstract

Multi-axle vehicle in India have at least three non-turning axle at present. They only contribute in taking loads. For example: driving thrust, side thrust, weight of the vehicle, etc. In general, the number of axle on the trailer, their relative placement, and other design factors such as whether the extra axles are suspended independently of rear tandem are usually more important with regards to the weight they can carry than it may be steerable or fixed. Handling of multi-axle vehicles becomes important when it comes to curved roads or tight turns. Also turning radius factor becomes important. So, axles of trailer play an important role in handling of the vehicle on curved roads. Fixed axles causes tire wear as they scrub against the road while the vehicle is turned and also the driver needs a large turning radius. At this point, it is the skills of the driver that comes into consideration.

Steerable axles allow smaller turning radius as the axles follow the path of the front driven axle. The primary benefit of steerable rear axle is that the truck's handling improves while loaded and operating on the street. The mechanism of this rear axle allows the vehicle to carry load without overturning while carrying the payload. These axles can be lifted up when not required or when vehicle is unloaded. But when the vehicle is loaded the lifted axle is brought on the ground, which carries the sum of the loads, but because of this the other axle causes considerable drag which can result in high tire wear, high lateral stress on the wheel and chassis component.

The steerable rear axle eliminates all the problems arising because of fixed rear axle. Steerable rear axle gives better vehicle handling. They can be steered by the driver. Due to the turning mechanism on the rear axle, it can be steered with respect to the front tires, because of which there are less stresses developed on wheels and reduces the tire wear considerably.

Keywords : Multi-axle, turning radius, tire wear, steerable axles, lifted axle, tire wear.

I. INTRODUCTION

1.1 Need and Background

A trailer can be termed as an unpowered vehicle which is towed by a powered vehicle which is commonly used for transporting goods, materials etc. It can also be termed as an articulated vehicle. Articulated vehicles or trailers have proven their economic profitability, but as the number of these vehicles grows, it becomes evident that there is a substantial need to improve their handling control performance. Heavy articulated vehicles lack the maneuverability when they need to ride on narrow roads and tight corners. Because of this, smaller vehicles have to be used for transportation, which causes increase in handling of freight and reduces operational efficiency of the transport system. Modern articulated vehicles have multi-axle groups which don't steer. This causes tire scrub against the road while turning, which damages both tires and road surface.

Heavy vehicles industry in India has reflected a steady growth over the last decade by with the upgrade in their technology and production processes. Heavy vehicles in India are mostly made by companies like Tata motors and Ashok Leyland. Heavy Vehicles or (HCVs) however form an indispensable part of the Indian automobile industry.

Over the years, the Indian market has witnessed many new heavy vehicles, the Volvo is one such example which is a luxury heavy vehicle,. The demand for heavy vehicles in India is increasing day by day due to the expansion and the growth of the Indian economy as a whole. This demand for heavy vehicles has in turn resulted in the manufacture of a series of heavy vehicles by the heavy vehicle manufacturing companies.[1]

A semi-trailer is a trailer without a front axle. A large proportion of its weight is supported either by a road tractor or by a detachable front axle assembly known as a dolly. A semi-trailer is normally equipped with legs, called "landing gear", which can be lowered to support it when it is uncoupled.

A full trailer is a term used in the United States for a freight trailer supported by front and rear axles and pulled by a drawbar.

A trailer has 3 axles. Each axle can handle a weight of 5.7 tons. An empty trailer weighs approximately 4 tons. While carrying the empty unladden vehicle, even a single axle is enough to carry the weight of the entire trailer. So by lifting the remaining 2 axles we can reduce the tire wear and increase the tire life. Also more number of axles affects the steerability and also causes large tire wear. This problem can be reduced by providing steering and lifting mechanism to the rear axles.

1.2 Objectives

Considering a multi-axle vehicle. If the rear axles are not steered the lines drawn from the rear wheels will not meet the steering axis. This means that wheels on these axles will not only roll but also slide sideways. This has many adverse effects:

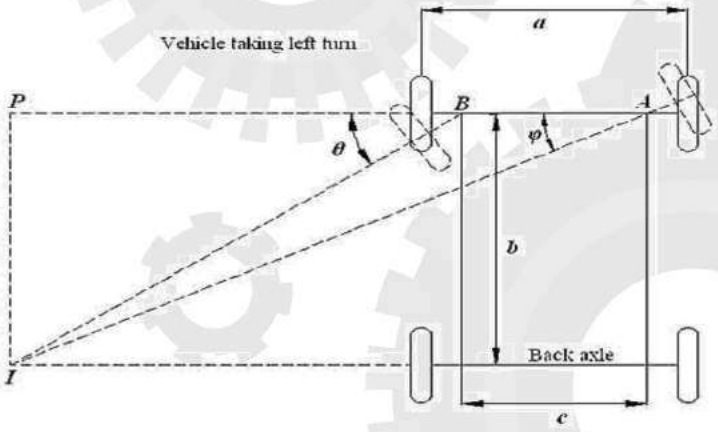

Fig 1.1 Ackerman steering geometry [2]

1. First and foremost this will lead to excessive tire wear considering the immense load per wheel and the sideways slippage. The below image shows an estimate of tire mileage with and without steering in one of the axles (third axle) in a three axle trailer. This of course also causes additional wear of the pavement surface.
2. The vehicle swept path i.e. the area that a vehicle requires while making a turn is substantially increased with rigid axles.
3. The sliding of wheels increases resistance to motion. This increases the engine effort to pull the same load at the same speed which in turn increases the fuel consumption.
4. The slipping and sliding of wheels will also exert excess lateral forces on chassis which can limit the load carrying capacity of it as the maximum load that it can carry without these unnecessary forces will surely be higher.

In order to improve the overall vehicular maneuverability, performance by reducing load on per wheel which will reduce tire wear and sideways slippage, improve vehicle swept path, reduce sliding of wheels and avoiding unnecessary forces acting on chassis. Hence, suitable design modifications have to be made or some mechanical components have to be implemented. Steerable axles on trailers are an option to not only improve maneuverability, but also reduce the risk of accidents and decrease fuel consumption and tire wear.

Thus, this study aims

- To redesign the existing trailer design.
- To optimise the running cost of the vehicle.
- To reduce the rate of tire wear and increase the control.

Consequently, this develops an appropriate trailer model for the ease of controlling and also aid owners to reduce the running cost by providing some key recommendations that will increase the vehicle's life and profit.

II. LITERATURE REVIEW

2.1 Introduction

This chapter provides an overview of different types of steering and lifting mechanisms for the axle of trailers and their usage to understand the relevance of the topic of research in analytical and practical perspectives regarding our project. This complete chapter is built around the previous inventions and designs of trailer axle steering and lifting mechanisms, which has been gathered from various sources and records such as patented papers , websites, which could be easily and usefully accessed in order to find any associated information.

Development of Automatic Lift Axle System for Trucks with Mechanical Suspensions

Usually, A lift axle system comprises of the air compressor, air balloons, valves and a few mechanical coupling elements. The air compressor provides pressured air to the air balloons in order to push or pull the axle to position it in either its lifted or lowered condition. Valves control the air flow between the air balloons and the air compressor and are also used for exhausting the air from the air balloon. Mechanical linkages are used for transmitting power to the liftable axle. The user controls this system by controlling the valves with an assigned button which sends an electrical signal to the valves.

Automatic lift axle system shows the capability to maintain the working of this system automatically. Automatic lift axle system includes a controller which decides on whether the axle(s) will be allowed to lift, or not. This decision stage needs the axle loads to be calculated. Axle loads can be obtained easily by air pressure of the pneumatic system of trucks having air suspension system. However, this is different in trucks with mechanical suspension. Weight information can be obtained from sensors such as strain gauge, force sensor or displacement sensors. But these sensors give indirect information and their output needs to be converted to axle load. The use of force or strain sensors is both costly and hard to assemble and maintain. Displacement sensors are cheaper and easily installed and hence are used in the system. However, it is more difficult to convert displacement information to axle load. In this paper, Automatic Lift Axle System accompanied by displacement

sensors is applied to heavy trucks with mechanical suspension.[3]

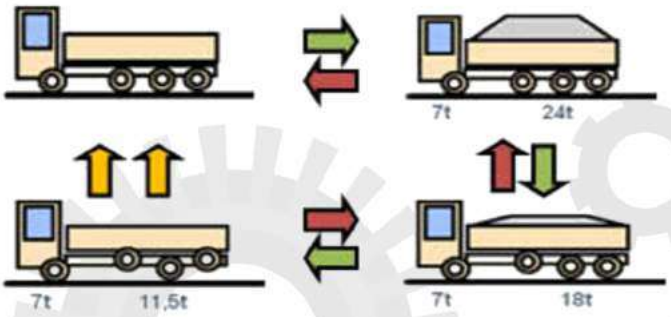

Fig 2.1 Automatic lift axle [3]

IMPLEMENTATION OF ACTIVE REAR STEERING OF A TRACTOR – SEMI-TRAILER

A new active steering controller was developed for articulated heavy goods vehicles. This design had the aim of achieving the 'perfect' path-following under all conditions. An experimental tri-axle trailer, with three actively-steered axles was built and used to compare the performance of the new controller with a passive 'command steer' steering strategy, and a conventional trailer with fixed axles. The 'path-following' steering controller derived in this project aims to make the rear of the trailer , follow the path defined by the fifth wheel.[4]

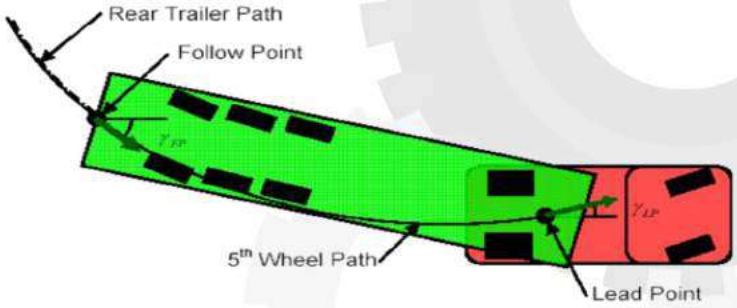

Fig 2.2 5th wheel steering [4]

The hydraulic actuators on each axle are operated with the help of an electrically driven hydraulic powerpack. A 'local controller' (LC) in the control system performs closed loop control of steer angles, and a global controller (GC) generates the demand steer angles based on sensor information. The GC and the LC are linked by CANbus. The test vehicle is equipped with many sensors including those measuring: hitch pin articulation angle, wheel steer angles, yaw rates of tractor and trailer, wheel speeds, and sprung mass angular velocities and accelerations. A video camera based line tracking system was fitted to the vehicle to record the position of each vehicle unit relative to lines painted on the road surface. Cameras were mounted so as to monitor the front of the tractor, directly beneath the 5th wheel and the rear of the trailer.[4]

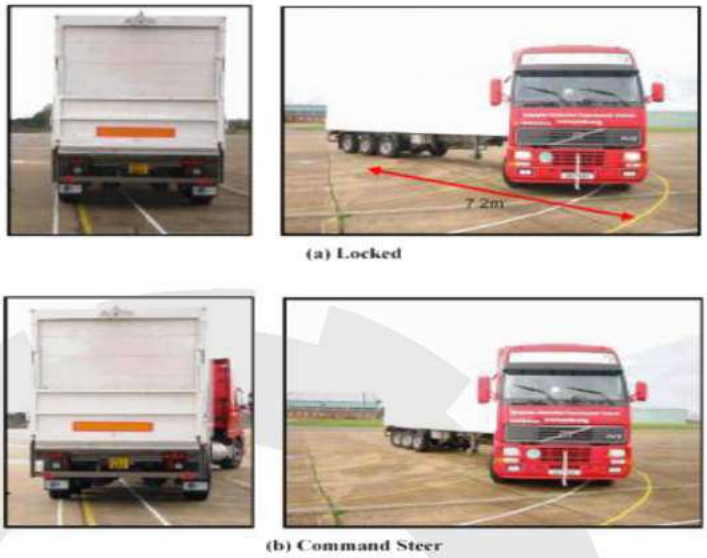

Fig 2.3 Command steering [4]

PERFORMANCE MEASURE	LOCKED	COMMAND STEER
Roundabout Swept Path Width	7.23m	5.45m
Steady State Off-tracking	4.25m	1.60m
Tail Swing (Entrance)	0.17m	0.61m
Peak Tyre Force	36.6kN	5.3kN
Exit Settling Distance	23.5m	8.8m

Fig 2.4 Performance measure [4]

III. PROBLEM STATEMENT

Trailers in India are heavily loaded because of which tires are under constant high pressure. Many forces act on the tires; the normal force due to weight at contact patch, side/ lateral force etc. To balance all these forces tires need to be in good condition always, especially for safety of the trailer. When a trailer takes a turn, this is the time when tires should act perfectly or give optimum performance, because while turning much load is acted on the tires than while travelling straight ahead. Turning of the front cabin of trailer is done with steering mechanism of rack and pinion which is attached to steering column. But for the trailer there is no such mechanism. So while taking a turn, the tires of the trailer turn directly at its own place, giving rise to more friction at the tire contact patch, which ultimately leads to tire wear. Heavily loaded of trailer when turns at its place creates more pressure on tires and with force acting on it , which in worst condition, may lead to tire burst .

Also while turning on a curved path, the trailer tends to go off track or the trailer needs to take a turn from extreme end of the curved road which means that the trailer needs a large turning radius. For this the driver of the trailer must be highly skilled, so that he can manage to take a proper turn. Empty trailers do not need all the axles running i.e. unloaded trailer can travel on one rear axle, rest of the axles can be

lifted, which in turn can reduce the tire use or tire wear while travelling.

From the above problems, it is essential to manage or reduce the tire pressure & forces on the tires while turning. The objective is to steer the rear axle of the trailer during turning, so that the tires will not turn on their own place and will follow the path of the front cabin tires. Turning of the tires when in motion will reduce the forces acting on them. Also due to this, turning radius will be decreased. The driver can take a turn with minimum turning radius which reduces his difficulty. Lifting of the axle can be done to avoid tire friction or tire wear when trailer is unloaded. Only one axle will have to be used, rest two axles will be lifted up so this can increase tire life and reduce wear.

IV. METHODOLOGY

In India, it has been seen that rear steerable trailers are not available or it is in process of CMVR (Central Motor Vehicle Rules) regulation. TATA 3118 has a self steering type tires, where it automatically turns in opposite direction to that of cabin tires, due to force acting on it. Also, lifting is provided to the same axle. But this steering and lifting is done to one axle only. Some of the trailers in India can lift axle but it has no proper mechanism. In short, in India, trailers do not have any proper mechanism which can lift and steering the axle. Seeing the road conditions and driver's skill, there is a need for such steerable and lifting axle trailers.

For this, a new concept design is proposed where out of the three axles of trailers; two axles are steerable and can be lifted as well, while one remains fixed to take the load. Its main components are steel ropes, strong hydraulic system and curved groove.

This concept mostly uses all mechanical components for steering the axles and hydraulics to lift the axles. The strong steel ropes are connected to the front and rear axle of the trailer in cross manner and the rest of the rope are connected in parallel to the cabin. So as the cabin takes a turn, tension is developed in the steel ropes which force the first axle to take turn in the direction on turn, while the last axle takes a turn in the opposite direction due to cross connection of steel ropes between two axles. This is how rear axle steers according to the cabin turn.

For lifting, four hydraulic cylinders are provided, two on each axle, near the tire. The hydraulic cylinders are connected to the curve grooves above them. The curved grooves are attached with the main frame of the trailers.

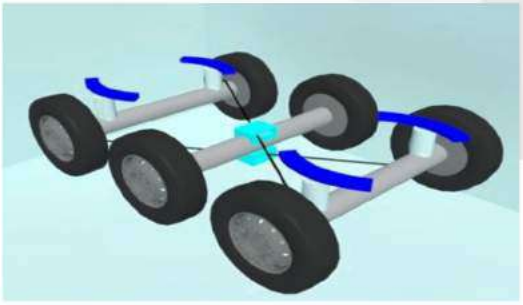

Fig 4.1 New design model

So, to look as a whole working system, when the cabin takes a turn, first axle of the trailer turns in direction of cabin while last axle turn in the opposite direction. This turning movement happens within the curved grooves. The Hydraulic cylinders help to transfer the turning movement to the axle. And when the trailer is unloaded, the hydraulic cylinders can lift the axle off the ground. So the hydraulic cylinders help in turning as well as lifting. Therefore, strong hydraulics is needed with strong materials which can take the forces. Both the axles (first and last) of the trailer perform two movements i.e. steering according to the cabin and lifting whenever needed.

Available trucks in India have either steering operation or lifting operation on one axle only and none of the operation is available in trailers. In this proposed concept design, two axles perform both the operations (steering as well as lifting). All this aims to increase the tire life and reduce wear and to reduce the turning radius for better maneuverability

V. DESIGN & FABRICATION

5.1 Introduction

Articulated vehicles have a good economic profitability, so the need for such vehicles is growing. But as the number of these vehicles grows, it becomes important that their stability and handling performance needs to be improved. A different approach has been taken into consideration, with a proposal for some design modification or implementation or improvement of mechanical components which will improve the overall vehicle maneuverability performance. Steerable axles on semi- trailers are an option which not only improves maneuverability but also reduces risk of accidents and decreases fuel consumption and tire life.

5.2 The Turning Circle

The turning circle is the measure of how the vehicle will perform a U-turn . The term 'turning circle radius' means a minimum arc a vehicle will turn with steering wheel turned to full lock position. In general term it is the minimum radius/ turn of the vehicle, where steering wheel is rotated to maximum limit.

5.3 Steering Ratio

Steering ratio refers to the ratio between the rotation of steering wheel (in degrees) to the turn of the wheels (in degrees).A steering ration of x:y means turning of steering wheels in x degrees which causes the wheels to turn by y degrees. A higher steering ratio means that the steering wheel needs to turn more to get the wheels turn. A lower steering ratio means steering wheels is turned larger & heavy vehicles will often have higher steering ratio, in these turning a steering wheel is easier than low steering ratio vehicles. So if heavy vehicles or trucks had a low steering ratio, it would be very hard to turn the steering wheel.[13]

Heavy vehicle steering ratio can be as high as 36:1. So assuming that the tri – axle trailer has steering ratio as 30:1 i.e. 360°: 12 °, which means that when steering wheel is rotated by 360°, the wheels will turn by 12°. From this we can say that the steer angle of the front wheels is 12 degrees.

Based on the above assumptions to calculate the turning circle radius (TCR), we have,

TCR = wheelbase/ sin (steer angle)

This will give us a rough estimation of turning radius. Therefore from fig no. 5.1 for non - steerable trailer, taking wheelbase as 35 ft

∴ TCR = 35/ sin (12)

TCR = 168.34 ft

Now, from fig no. 5.2 for steerable trailer, taking wheelbase as 30 ft

∴ TCR = 30/ sin (12)

TCR = 144.29 ft

Therefore from the above two values of TCR, it is seen that the value of TCR is less in the trailer with steerable rear axle as compared with the trailer without a steerable rear axle. Though the values of TCR are rough values, it can still be said that the turning radius is less for trailers with steerable rear axle. Because of this maneuverability and control of trailer is improved and because of steerable rear axle the tire wear is reduced too.

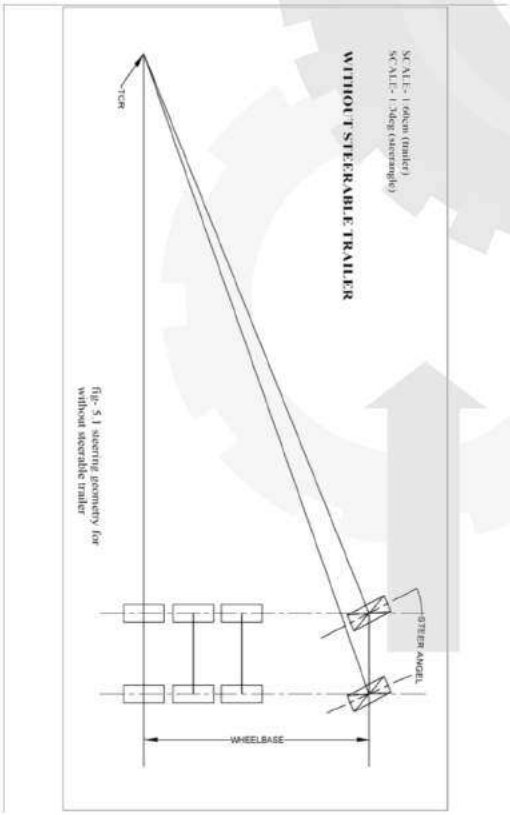

fig- 5.1 steering geometry for without steerable trailer

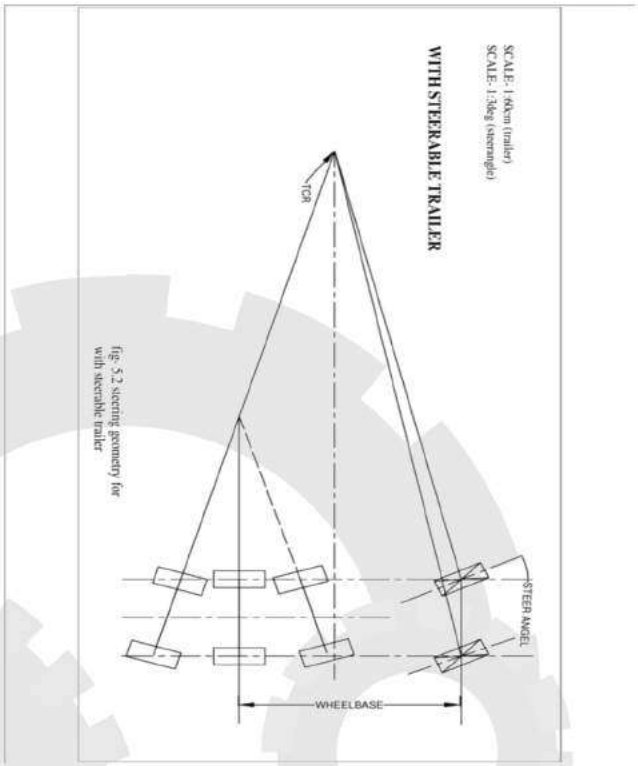

fig- 5.2 steering geometry for with steerable trailer

5.4 Fabrication of Demo model

The mechanisms for steering and lifting of rear axles for tri-axle trailer was designed and fabricated. The fabricated mechanisms mostly include mechanical linkages and parts. These mechanisms have been incorporated in the scale model of the tri-axle trailer .Wood was the raw material used for building the model. Wood was selected as the raw material because it is light in weight, easy to be worked upon, cheap etc. No high-end equipments or machines were needed to work upon wood. The fabrication of the trailer model needed less time, which would have increased substantially with the use of mild steel as the raw material.

The fabricated model includes a cabin, a trailer and steering & lifting mechanisms under the trailer. The most integral part of the model are the mechanisms. The mechanisms include three axles of which the centre axle is fixed and the other two a free to rotate about their centers with the help of screws/bolts. Springs are attached to the two axles to lift them and the lifting happens with the help of hydraulics, while in the fabricated model, the two axles are lifted as the bolts are tightened. The actual proposed model is a little different from the fabricated one. This modification was done just to reduce the complication incurred by installing hydraulic units and also to reduce complex mechanical linkages.

The steering mechanism is almost the same as in the design. The operation takes place with the help of metal ropes of small thickness, which is connected in cross manner to the two outer axles of the trailer, and connected to the cabin along its length . So as the cabin turns, the metal ropes

induce & display the turning movement of the two axles, due to the induced tension. The main purpose of the fabricated model is just to display and explain the working of the design for better understanding.

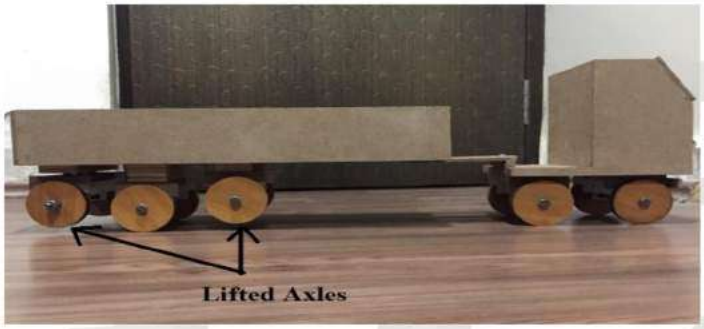

Fig 5.3 Demo model with lifted axles

VI. CONCLUSION

6.1 Conclusion

Lifting and steering the rear axle contributes in reducing the tire wear, increase the payload

capacity and also improves handling of the vehicle. As the tires of trailers are in motion

instead of standing still while taking the turn, tire wear reduces. In India, the payload capacity

is decided on number of axle attached to trailer, so payload capacity is increased as the trailer

has three axles. Two axles can be lifted up or lowered according to the load the trailer has to

carry . Because of the steerable rear axles, the turning radius is also improved.

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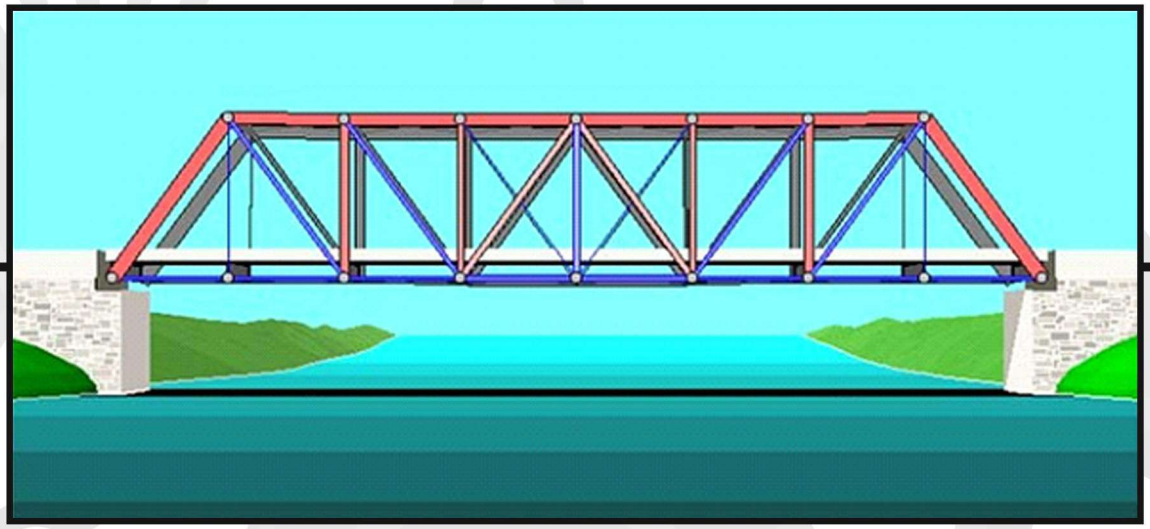
TRUSS BRIDGE



INTRODUCTION :

Recently there have been many cases of bridges collapsing very easily and not being able to hold enough weight. There was a clear need to find a new way to scale out this error to perfection. So to motivate students to get a hands on experience with solving real problems and as a learning activity for Semester 3, we were assigned a project to design, build, and test a model truss bridge. The knowledge from the core subjects like Strength Of Materials (SOM), Production Process-1 and Mathematics were to be put into use. The main focus was to see how students implement the basic laws, calculus, engineering concepts, experimental data, and assumptions during the designing process.

TRUSS BRIDGE

THE PROJECT aka The problem statement

A Truss is more like a structure that consists of two-force members only, where the members are organized in such a way that the whole assemblage would behave as a single object. It basically helps a bridge to distribute the load evenly and prevent it's failure. So the main aim was to build a Truss Bridge which would satisfy the mentioned metrics:

- Clear span of 1 m and free standing with the ends of the bridge relying on simple supports only (no horizontal reaction).
- Bridge deck must be continuous and at least 80 mm in width (to accommodate a loaded toy truck/vehicle).
- Any construction material or a mix of various materials can be used, but the total bridge mass must be limited to 300 gram
- The bridge should be capable of carrying a worst case scenario load of 1.2 kg placed at its mid span without appreciable deformation.

Main approach adapted

At first, each and every student revised the basics that they had learnt in Mechanics. Then they did some research on different types of truss bridges built till now. While some groups adapted the old and already invented truss structures, few implemented their own ideas and did some necessary modifications. The designing and analysis of the prototypes was then done on SolidWorks (it's a CAD software). Material selection, by far, was the most important aspect to be fulfilled. Once the analysis part provided the much needed green signal, different materials were selected and certain calculations were done in order to meet the project metrics. Finally , after selecting the material, the final model was constructed. The graphs, procedure and the other necessary informations were documented. The project was then presented in front of the faculty for the final testing purpose.

REVIEWS

"As it was our first PBL we were very much excited.We were given an opportunity for practical application of what we had learned from our books.It was indeed a wonderful experience and a successful event."

~Mukil Vasudevan Nai (SE MECH B)

Team - Aditya Nambiar, Monish Pillai, Shubhang Rajput, Vishal Stephens

"This was our very first PBL experience and it was undoubtedly the best. It helped us to understand the concepts that we had learnt in the theory lectures more deeply. We would like to thank our faculty members for providing such a wonderful opportunity where we got a chance to come together and brainstorm different ideas to build something innovative."

~Anand Rane (SE MECH A)

Team - Rushikesh Patil, Vinayak Mane, Karthik Nair, Sankalpa Hirlekar

WINDMILL

INTRODUCTION :

With the depletion of conventional resources of energy, it is high time we make full utilisation of non-conventional resources of energy. Well, we may be familiar with the use of windmill for power generation but windmills may be used for other applications like lifting of weights. With such a problem defined, we were assigned a task to do the same with the knowledge gained from subjects studied in the course of Engineering.

WINDMILL

THE PROJECT aka The problem statement

The problem was to design and fabricate a working prototype of a windmill which could lift a known weight (max 100 gms) by a known height (50 mm) in minimum time possible, when the input is a constant flow of air provided by a table fan.

Main approach adapted

The design required some basic knowledge about subjects like fluid dynamics, production process, material technology and not to mention machine shop practice. To achieve the given target, the major difficulty was the design of the blades of windmill. The blades had to be aerodynamic in nature to assist the windmill in lifting the weight in minimum time. Also the number of blades required was needed to be calculated. After the required calculation, 3D model of the given structure was made in order to simulate the actual working of the windmill and if required the necessary changes were made in order to optimise the time.

After this, the actual structure was manufactured to the required dimensions and was presented before the judges.

A report was produced including the points such as properties of the materials used for fabrication, the calculations and the observations recorded.

All in all, It was an amazing experience and it helped the students to gather immense knowledge and command over the subject.

REVIEWS

"PBL provided us an opportunity to apply the theoretical knowledge to solve a real time problem. Our first PBL topic was windmill and it was quite challenging. Overall, it was a tedious job but with the help of our professors, we achieved the desired output."

~Ashish Singh (TE MECH B)

Team - Shivam Singh, Mayur Vadhel, Krushna Thombare, Sanjay Vaishnav

"The PBL concept imparted upon us but by the Faculty members proved really useful. When introduced, the first project we worked on was this Windmill. We had to think a little longer on design than fabricating the actual model. It was one of the best and the most interesting project we ever worked on and we hope that we would get many such mini projects in the coming semesters."

~Ketan Jain (TE MECH A)

Team - Sagar Ganjale, Abrar Khot

A VISIT REPORT TO

ARAI,PUNE

Introduction

ARAI is co-operative industrial research association by the automotive industry which is affiliated to Ministry of Industry, Government of India established in the year 1966. It is located in the western part of Pune spread over 250 acres land housing various laboratories, test facilities. The institute has been set up by the Indian Vehicle and Automotive ancillary manufacturers as a co-operative research body to provide services to the industry in the fields of applied research and product development in automotive engineering.

Symposium on International Automotive Technology (SIAT) is a widely covered biennial international event organized every 2 years by ARAI. SIAT serves as an important forum for sharing ideas and knowledge concerning promising areas of Automotive Engineering and Technology. An exposition was also organized from 18-21 January 2017, where a spectrum of worldwide companies will showcase Automotive Products, Equipments, Services and Technology Solutions across the facility of ARAI.

Visit To The Plant

Industrial Visit to ARAI, Pune was organised by AESA MESA, PCE for the students of TE Mechanical and Automobile. The group of 100 Students and 3 Faculty Members Prof. Shilpa Mondkar, Prof. K.S. Anish and Prof. Krishnamohan Menon visited the EXPO on 20th January, 2017.

Itinerary of visit:

The student left the college campus at 8.00 am by bus and reached Kothrud, Pune(ARAI) 11 am. Refreshments were provided on our way to visit. We assembled near registration desk and students were divided into group of 10 students with accompanying faculty members. Students were allowed to enter the facility after giving a brief introduction of the premises and instructions about the safety precautions to be taken while on the exposition.

The exposition showcased over 180 exhibition stalls by various Engineering service providers and organisation. During visit we saw various automotive products that focused on recent advances in various automotive areas such as Safety, Emissions, Engines, Noise, Alternate Fuels, Electronics, Simulation & Modelling, etc. We also saw different mechanisms and functions of products practically which we are only able to visualize during our theory lectures in college. After the visit, we again assembled at reception and had lunch. We were very thankful to the entire management staff of ARAI for such a wonderful exposition. We left the institute by 3.30 pm and reached college by 7 pm.

About the companies in the Expo:

Global Automotive Research Centre (GARC):

GARC is a unit of NATRiP, Under Ministry of heavy Industries & PE, Govt. Of India located in Chennai which facilitates Vehicle Evaluation Lab & Test Tracks, Certification Lab, Fatigue Lab, Passive Safety Lab - CoE, Powertrain Lab, Infotronics – CoE & CAD/CAE, EMC & EMI – CoE, End of Life Vehicle (ELV – Recycling Unit), and much more.

Noumenon Multiphysics

Noumenon Multiphysics is an applied physics and mathematics consultancy specializing in providing modeling and simulation services to the industry. Using modeling and simulation, the industry can gain insight into various processes and products and hence improve and optimize them.

Gestamp:

Gestamp is an international group dedicated to the design, development and manufacture of metal automotive components. The Group specializes in developing innovatively designed products to achieve increasingly safer and lighter vehicles, thereby reducing energy consumption and environmental impact.

Gantner Instruments:

Since it was founded in 1982, Gantner Instruments has specialized in distributed measurement and I/0 systems as well as the measurement of mechanical, thermal and electrical quantities. Our know-how is reflected in all our products and associated services. Despite their outstanding performance and flexibility, they remain simple to operate and provide clear results even in complex applications.

Mahindra & Mahindra:

Mahindra & Mahindra is a key player in the utility vehicle manufacturing and branding sectors in the Indian automobile industry with its flagship Mahindra XUV500 and uses India's growing global market presence in both the automotive and farming industries to push its products in other countries.

Over the past few years, the company has taken interest in new industries and in foreign markets.

Ansys:

Founded in 1970, ANSYS employs nearly 3,000 professionals, many of whom are expert M.S. and Ph.D.-level engineers in finite element analysis, computational fluid dynamics, electronics, semiconductors, embedded software and design optimization. Our exceptional staff is passionate about pushing the limits of world-class

simulation technology so our customers can turn their design concepts into successful, innovative products faster and at lower cost.

Dassault Systemes:

Over the years, Dassault Systèmes improved its software and expanded to the US, Japan and Germany. This rapid growth triggered a chain of products, acquisitions, and partnerships beyond the company's core 3D CAD/CAM software and led to what is known today as Dassault Systèmes.

Conclusion:

The visit to above expo resulted in increasing the knowledge of students about the vehicle safety and importance of knowledge of the subject in the acedemics and promised in safer cars in our near future.

We sincerely thank our guide, Prof. Shilpa Mondkar. Prof. K.S. Anish & Prof. Krishnamohan Menon for guiding us through this visit.