

# Design and Fabrication of Three Axis Rotating Trailer Using Pneumatic System

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**Abstract-** This project work "design and fabrication of Three axis rotating trailer using pneumatic system" has been conceived having studied the trouble in emptying the materials. Our review in the respect in a few automobile garages, reveals the fact that generally some troublesome strategies were embraced in emptying the materials from the trailer. The trailer will empty the material just in one direction only. It is hard to empty the materials in small compact roads and small streets. All the three sides are effectively to unload the trailer in our task are rectified. Automobile engine drive is coupled to the compressor engine, the compressed air its stores when running the vehicle. the pneumatic cylinder are is used to activate this compressed air, when activate the valve. Spur gear is used for rotating the trailer in three directions & easy for unloading the materials in small compact streets and roads.

**Keywords-** Design , fabrication, automobile garages, Automobile engine etc.

## I. INTRODUCTION

Trailer measure has wide applications in areas like farming, development and garbage transportation, etc. Conventional trailer has restriction of instrument which don't permits it to dump the material at rear side only. It is highly inconvenience for vehicles to reposition as shown by dumping side in narrow lanes and limited spaces. This inconvenience is overcome by different sides trailer system by using single actuator. The trailer exhausts the material only one way. This difficulty is overcome by new strategy segment as the multidirectional trailer. This instrument is a way to reduce the actual time to settle the trailer.

The material is unloaded in three ways band accordingly can be firmly communicated as "Three way trailer." The major outcome of three way directional trailer has defeated space necessity which frequently bring about road blocking. Hence we have inversion in the current mechanism giving the unloading in three directions. This mechanism prevents road blocking, lessen time and increment efficiency at low cost. As considering the mines space accessible is extremely less.

Accordingly it is simple for the driver to dump the trailer and furthermore it decreases time and fuel utilization. For making tipper system with such above conditions pneumatic system can be utilized. The compressed air is going to the pneumatic chamber through the because of which dumping material on left or right side is not possible to expect to take this as an issue, Multisided tipper tilting is he need of time. To beat one side shifting

of trolley, multisided shifting mechanism is come into focus. This will help to dump free material one side of tipper. Presently dropping unloader has been brought about by noticing the trouble in emptying the materials. Dropping trailer can dump just in one side by utilizing pneumatic mechanism.

By this project, essentially we focused on above trouble direction control valve and flow control valve. The direction control valve is utilized to control the flow direction of the pneumatic cylinder in both the way and flow control valve is utilized to control the flow of fluids towards chamber.

## II. LITERATURE REVIEW

**A. Ajithkumar, P. Dhivya, D. Surendar, R. Srinivas-** describes that their projects works on the Principles of pneumatic mechanism along with micro controllers then efficiency of dumping trailers will increase. The three direction of unloading an material can be done and useful for shipping industry. they have chosen this project for decreasing the man power and time. The combination of pneumatics and microcontrollers can be seen in their project.

**Dr. Sushila Rani** says that the dumping is a important role of bulky load for carrying construction loads & the materials unloading the particular site of proper direction. Unloading the material is difficult and assigned position in dump of the materials. To overcome these problems some modified designs are easy to dump the materials & pneumatic cylinder are along with a chain sprocket mechanism .In this dumper it has been designed by using the finite element based the ANSYS software. The static

structural analysis can maximum equivalent to stress, shear stress, elastic stress and total the deformation of the pneumatic dumper.

**S. Durail, R. Vignesh, R. Vignesh, S. Vignesh, P. Vignesh** they described that the tipper has lot of applications in today's world about industrial and domestic considerations. Tippers can pull a variety of products including sand, grain, fertilizer, etc. The old model tipper has been conceived by observing the difficulty in unloading the materials. The modern trailer will unload the material in three directions. It is difficult to unload the materials directly at elevated place (such as top floor of a building) from the ground and also in small compact street. In their project these are rectified to unload the materials.

**Albert Praveen kumar. j, Gowtham. R, Gruraam. V, P Rabhakaran. G** says that in the modern three axis tipper which works in all axis like A truck is used for transporting loose material such as dirt, or gravel, sand for construction and the dump truck another name is UK dumper/tipper truck. An open-box bed is equipped in typical dump truck, which is joined at the rear and hydraulic pistons equipped to lift the front, the bed to be deposited in the allowing the material the delivery of the truck site behind on the ground. Off-road construction plant only in the UK and Australia to the term applies, and the road vehicle is called as tip truck (AU), tipper lorry (UK), a tipper. x,y,z.

**Atul R. Ghuge, Sagar S. Abhale, Vishal M. Bangale, Vikas B. Jadhav and Swapnil H.** describes that the Conventional trolley mechanism an unload materials only at the backside of the trolley using hydraulically operated cylinder which may cause the problems of road blockage in the limited space area. This paper has mainly focused on above difficulty. The Unidirectional trolley is developed and tested for its movement in all possible angle to unload the materials in the trolley. This concept saves time & energy which leads to efficient working

**Deore Vinod, Endait Sunit, Prajapati Mahesh, Attarde Bhushan** says that there are new three way rotating trolley has been conceived by observing the problems in unloading the materials. So that, The survey in this relates in several automobile garages which revealed the facts that mostly some difficult methods were adopted for unloading the materials from the trailer. This paper has mainly focused on above problems. Therefore, In this a model of suitable arrangement has been designed. The vehicles can be unloaded from the trailer in three axes without application of any impact force.

**M. Shanmugam, G R. Arunkumar, K. Ganesh, V. Gopalakrishnan, M. Hariharan** reveals that in today's world Trailer had many uses in industrial and internal purpose. Trailer used to transfer stone, sand, agriculture

products etc. Trailer can unload the material in one direction in current system. By this project we can unload the material in 3 directions and it used to decrease the time and unload the material in small areas. That project mostly focused current problems for unload the material.

**Shinde Akshaykumar, Shinde Akshay, Kadam Aniket, Dhanavi Nilesh, Pawar Prashant, Mr. Patil S.P** describes that their project "Design and Fabrication of Three way dumping trailer" has been considered having the trailer will empty the material just one single way. It is hard to empty the materials in little conservative roads and little streets. In their project it is easy to unload the material in 3 directions. And vehicles can be dumped from the trailer in three ways without utilization of any Impact power. By squeezing the Direction control valve actuated. The compacted air is goes to the pneumatic chamber through valve. The ram of the pneumatic chamber acts as a lifting the trailer cabin. The automobile engine drive is coupled to the compressor, with the goal that it stores the compacted air when the vehicle running. This packed air is utilized to initiate the pneumatic chamber, when the valve is activated.

**Dharmala Venkata Padmaja, Yalagada Aravind Kumar, Kallepalli Rambabu, Pradhan Hemanta Kumar, Jami Rajesh Babu, Mandangi Dilip Kumar,** says that the objective of their paper is to assess the trouble in unloading the materials. The loading and unloading of material using trailer is just in one direction only. Also, loading and unloading of material, in little reduced roads and little streets, is finished with high trouble. And three possible direction are loading and unloading the materials. The a control possible in three ways by enacting the course control valve. Compressed air is utilized in controlling the valve. The trailer cabin is lifted, by utilizing the ram of the pneumatic chamber as lifter. The Compressor engine is combined with automobile engine, so that, when vehicle is running, compressed air is stored. Pneumatic cylinder is activated by utilizing the compressed air, when the valve is activated.

**Vinamra Agnihotri, Shoaib Rabbani, Shankaran Pillai, Vivek Patel, Sarvanan V** reveals that their project name is three axis modern trailer and having study of methods employed and difficulty in dumping materials. The normal trailer are unloading the materials in only one direction may problem of blockage and work area is limited. They used a gear arrangement for all possible three direction.

**A. S. Pal, A. G. Shahu, D. P. Mand aokar, R. I. Meshram, Ms. U. T. Dhanre** says that an dumper is a vehicle use for conveying different materials starting with one spot then onto the next and dump to a specific place. A Dumper is a vehicle intended for conveying mass material, regularly on building sites such rock, sand, trash or rubbles. An unloader is normally an open 4- wheeled

vehicle, has its cab before the load. The current dump truck drop the material in backside direction only. In any case, there is an issue when we need to place the material in right and left half of tippler at congested place or area. So in this project, we made the unloader which can empty the material in three way.

**Dr. Lalit. K. Toke, Dakshant. Y. Sharma, Uday. A. Maliye, Kalpesh. S. Bodke, Uday. M. Rathod** describes that the modern dumping system has been created by identifying the trouble in emptying the material. In today's world there is a variety of items like modern waste, agrarian items, stones fertilizers, rocks, rock and so for trailers can dump the material in one direction only. The model of the unloading component which can work or empty the products in three ways easily without the use of impact force. In this we will utilize pneumatically worked framework utilizing heading control valves. This system forestalls impeding of the street and increases the productivity of the trailer and shortens the time of unloading with small increment in cost.

**Devendra P. Mungmode, Prof. Praful Lanjewar,** reveals that their project has mainly concentrated on the difficulties arises while unloading the material from dumper or trailer and hence a suitable arrangement has been design. And the trailer unloading the materials in three possible with application. By pressing the Direction control valve activated. And the compressor air passed through to a pneumatic cylinder. And cylinder is lifting the trailer in three possible direction using a pneumatic system and unloading the materials.

**Prof. R. S. Ambade, Shubham D. Navghare, Bhushan S. Kamatkar** describes that their overview in the respect in a few auto carports, uncovered the realities that for the most part a few troublesome strategies were embraced in emptying the materials from the trailer. The trailer will empty the material in one direction only. It is used of a small least place and street. In their undertaking these are corrected to empty the trailer in each of the three sides without any problem. Ordinary unloader vehicle dump materials just one way only which may cause the issues of blockage when the work area is restricted. The multidirectional unloader beats the issue small least place. The multidirectional unloader is created and tried for its development in each of the 1800 potential point to unload the materials in the tipper trolley and monitor the inclinations for its gradualism

**Omkar Mule, Omkar Dumbre, Rushikesh Dhavale, Dipak Aware** says that there are numerous utilizations of trailer through the globe. Overall just as applications whosever are utilized in businesses, tippers have tendency to take a variety of elements which are gravel, grain, sand, fertilizer, heavy rocks, so forth mulling over huge extent of the title, it is fundamental to do break down and research on the subject of tipper mechanism. So as to

make it beneficial and proficient. By this study it is most effortless for the driver to unload the trailer and also it decrease time and fuel consumption. The body can be dumped from the trailer in three direction without applying of sudden force. The DCV which energies the ram of the cylinder which lift the trailer.

**M. Viswanath** says that this project work three axis pneumatic modern trailer has been conceived having studied the difficulty in unloading the materials. Their survey in the regard in several automobile garages, revealed the facts that mostly some difficult methods were adopted in unloading the materials from the trailer. The trailer will unload the material in only one single direction. It is difficult to unload the materials in small compact streets and small roads. All the three sides unloading the materials.

**Sivasubramanian S, Anandhu G K, Adarsh P, Joshua O, Logeshwaran K** says that this project work Three axis pneumatic modern trailer has been conceived having studied the difficulty in unloading the materials. Our survey in the regard in several automobile garages, revealed the facts that mostly some difficult methods were adopted in unloading the materials from the trailer. The trailer will unload the material in only one single direction. It is difficult to unload the materials in small compact streets and small roads. All the three sides are very easily to unload the trailer and using pneumatic system

**Tapobrat Pani, Shubham Warate, Ritesh Chandrakar, Vaibhav Adulkar, Akshay Pawnarkar, Lecturer G. D. Gosavi** describes that nowadays, many areas are used in hydraulic system. Hydraulic cylinder needs to be change periodically because it get wear as hydraulic have some disadvantages such as the seal. The price is too high the hydraulic system. So, they are pneumatic replaced it.

Advantages from this system so we can use it to obtain the mechanical. Two gears, D.C. Motor and mechanical linkages, it consists of three pneumatic cylinders. The cylinders are used to give movement to the arms and to give rotary movement of 360 degrees are used the gears. Agriculture sector it can be used and purpose for industrial where low tonnage capacity work is require.

**S. N. Waghmare, N. J. Kamble, A. S. Dhamankar, A. A. Shinde, D** says that the normally conventional trailer are unloading the materials are only one direction is difficulty the unloading materials. And the loading the materials is very difficulty in normally trailer. This paper has mainly focused on above difficulty. Hence a prototype of suitable arrangement has been designed. The vehicles can be unloaded from the trailer in three axes with application of any impact force. This concept saves time & energy which leads to efficient working.

**Vijay prajapati, 1,2,3,4 UG Assistant Professor** says that the trailer has lots of applications in today's world. In

industrial and domestic considerations, trailer can haul a variety of the loading the materials such as crones ,sand ,grain and etc. In existing system, tipper can unload only in one side by using hydraulic jack or conveyor mechanism. In our project we will use 3 way trailer mechanisms the trailer to unload in 3 directions. They used worm and worm gear, pneumatic system in which we use pneumatic cylinder and DCV valves for this project.

### III. CONCLUSION

A Prototype which exhibits the expected results is developed the analysis of working with help of pneumatics system. Pneumatics cylinder lifts the trailer easily it carried out without a much effort. spur gear arrangement are used for rotating a trailer.

This mechanism is not only applicable in dumping trucks but also for various manufacturing industries. Thus, we have developed three axis pneumatic modern trailer which helps to know how to achieve a low cost automation. The working of this system is simple process.

Then, in future modified a system would be developed according to the applications.

| S. No. | Author Name                                     | Year of journal | Findings  |
|--------|---|-----------------|---|
| 1.     | A.Ajithkumar, P.Dhivya, D.Surendar, R. Srinivas | March 2019      | Efficiency of dumping trailers it increase unloading an material can bedone in three direction and it can usedfor shipping industry it is the combination of pneumatic componentand microcontroller |
| 2.     | Dr. Sushila Rani                                | March 2018      | Important role is for carrying bulk load like construction load and unloading or dumping in proper direction usually unloading consumesmore time to overcome this problem modification is made      |

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|----|--|------------|---|
| 3. | S.Durai1, R. Vignesh, R.Vignesh, S. Vignesh, P. Vignesh                                | March 2016 | Tipper has lots of applications in industries and domestic purposes theold model tipper has conceived by observing the difficulty in unloading in modern trailer unload material inthree direction.   |
| 4. | Albert Praveen Kumar,J,Gowtham,R,Gru Raam.V,Prabhakaran.G                              | April2017  | In modern three axis tipper works in all direction like truck it is used for transporting loads material another name is uk dumper/tipper truck   |
| 5. | Atul R. Ghugel1, Sagar S. Abhale2, Vishal M. Bangale3, Vikas B. Jadhav4 And Swapnil H. | April 2015 | Conventional trolley mechanism it is used to unload the material at the backside of trolley using hydraulic operated cylinder it can use problem of road blockage this concept saves time and energy it is efficient working  |
| 6. | Deore Vinod.1, Endait Sumit2, Prajapatimahesh3, Attrardebhushan 4                      | June 2017  | There is a new three way rotating trolley that has been consumed by observing the problems in unloading mostly difficult methods for unloading this paper focus on the above problem and the model has been designed for unloading the trailer in three axis without the application of any impact force. |
|    |  |            | Design and fabrication of modern trailer  |
|    |  |            | Design and fabrication of three axis modern pneumatic tipper  |

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| <p>10.</p> <p>Vinamraagnihotri,<br/>Shoitbrabbani,<br/>Shankaranpillai, Vivek Patel,<br/>Sarvanan V</p> <p>May 2017</p> <p>Development and fabrication of three directional modern Trailer using Pneumatic</p> <p>The normal trailer machines are unloading the materials in only one direction so the problems will occur. To overcome these problems they made a gear arrangement for all possible three direction.</p> | <p>9.</p> <p>Dharmalavenkatapad Maja*<br/>Yalagadaaravind Kumar**<br/>Kallepallirambabu*** Pradhanhemanta<br/>Kumar**** Jami Rajesh Babu</p> <p>Dec 2017</p> <p>Design and fabrication of three axes pneumatic trailer for shipping goods</p> <p>Loading and unloading of material using trailer is just in one direction only three possible direction are loading and unloading the materials the objective of this paper unloading of material in three possible direction compressed air is used to controlling the pneumatic circuits the compressor is combined with automobile engine.</p> | <p>8.</p> <p>#1shinde Akshaykumar, #2shinde Akshay, #3kadam Aniket, #4dhanavi Nilesh, #5pawar Prashant, #6mr. Patil S.P</p> <p>April 2017</p> <p>Design and development of 3 way dumping trailer</p> <p>Conventional trolley mechanism it is used to unload the material at the backside of trolley using <math>\sigma C = \bar{f} + 1</math> hydraulic operated cylinder it can use problem of road blockage this concept saves time and energy it is efficient working</p>   | <p>7.</p> <p>M. Shanmugam1, G. R. Arunkumar2, K. Ganesht, V. Gopalakrishnan2, M. Hartharan2</p> <p>April 2013</p> <p>Fabrication of three axi hydraulic modern traile</p> <p>Trailer used to transfer stone, sand, agriculture products etc. Trailer can unload the material in one direction in current system can unload the material in 3 directions and it used to decrease the time and unload the material in small areas. In this project mostly focused current problems for unload the material.</p> |
| <p>14.</p> <p>Prof. R.S. Ambade,<br/>Shubham D. Navghare,<br/>Bhushan S. Kamatkar</p> <p>March 2018</p> <p>Universal modern trailer: a review</p> <p>The trailer will empty the material in one direction only. It is used of a small least place and street. The multidirectional unloader is created and tried for its development to unload the material.</p>  | <p>13.</p> <p>Devendra P. Mungmode1 Prof.<br/>Praful Lanjewar2</p> <p>March 2019</p> <p>Design &amp; development of three axis pneumatic modern trailer by using cad fea model</p> <p>Project has mainly concentrated on the difficulties arises while unloading the material from dumper or trailer and hence a suitable arrangement has been design .and the trailer unloading the materials in three possible with application.</p>  | <p>12.</p> <p>Dr.Lalit.K.Toke1, Dakshant.Y.Sharma2,<br/>Uday.A.Maliye3, Kalpesh.S.Bodke4,<br/>Uday.M.Rathod5</p> <p>April 2018</p> <p>Design and fabrication of pneumatic three axis dumping trolley</p> <p>Modern dumping system has been created by identifying the trouble in emptying the material the model of the unloading component which can work or empty the products in three ways easily without the use of impact force this system forestalls impeding of the street and increases the productivity of the trailer and shortens the time of unloading with small increment in cost.</p> | <p>11.</p> <p>A.S.Pal1,A.G.Shahu2,D.P.Mandaokar3,<br/>R.I.Meshram4, Ms.U.T.Dhanre5</p> <p>March 2017</p> <p>Three direction dumper</p> <p>Dumper is a vehicle use for conveying different materials starting with one spot then onto the next and dump to a specific place an unloader is normally an open 4- wheeled vehicle, has its cab before the load. In this project, we made the unloader which can empty the material in three way.</p>  |

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| 15. | Omkar Mule, Omkardumbre, Rushikeshdhavale, Dipak Aware   | April 2015 | 15 development of three axis pneumatic dumping trailer a | It is fundamental to do break down and research on the subject of tipper mechanism. By this study it is most effortless for the driver to unload the trailer and also it decrease time and fuel consumption. The body can be dumped from the trailer in three direction without applying of sudden force.                            |
| 16. | M. Viswanath1  |            | Three axis pneumatic modern                              | The trailer will unload the material in only one single direction. It is difficult to unload the materials in small compact streets and small roads. All the three sides unloading the materials. This project work three axis pneumatic modern trailer has been conceived having studied the difficulty in unloading the materials. |
| 17. | Sivasubramanian S1 Anandhu G K, Adarsh P3, Joshua O4, Logeshwarank5  | April 2018 | Design and Fabrication of Three way tipper mechanism     | Survey in the regard of several automobile garages, revealed the facts that mostly some difficult methods were adopted in unloading the materials from the trailer all the three sides are very easily to unload the trailer and using pneumatic system  |
| 18. | Tapobrat Pani1, Shubham Warate2, Ritesh Chandrakar3, Vaibhav Adulkar4, Akshay Pavnarkar5, Lecturer G.D.Gosavi6 | March 2016 | Design and fabrication of two axis pneumatic arm         | Nowadays, many areas are used in hydraulic system. The cylinders are used to give movement to the arms and to give rotary movement of 360 degrees are used in the gears. Agriculture sector it can be used and purpose for industrial where low tonnage capacity work is required  |

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| 19. | S.N. Waghmare 1, N. J. Kamble2, A. S. Dhamankar2, A. A. Shinde2, D. Vishwasrao2 | April 2016 | Three directional dumping system for trolley/dumper: a proposed work. | The normally conventional trailer are unloading the materials are only one direction is difficult the unloading materials this paper has mainly focused on above difficulty. This concept saves time & energy which leads to efficient working.  |
| 20. | Vijay Prajapati5 1,2,3,4ug 5 Assistant Professor                                | April 2018 | Development of three axis pneumatic modern trailer a                  | The trailer has lots of applications in today's world. In existing system, tipper can unload only in one side by using hydraulic jack or conveyor mechanism. In our project we will use 3 way trailer mechanisms the trailer to unload in 3 directions used worm and worm gear, pneumatic system in which we use pneumatic cylinder and dcv valves for this project. |

#### IV. COMPONENT SPECIFICATIONS

##### 1. Compressor:

- Motor power = 5.5KW/7.5HP
- Working pressure = 9.5 bar
- Maximum pressure = 9.7 bar
- Free air delivery = 0.57 m<sup>3</sup>/min
- Tank capacity = 220(lit)

##### 2. Double Acting Cylinder:

- Piston Diameter (Ø)=32 mm
- Length of the piston rod(stroke length) (L)=160mm
- Maximum working pressure = 10 bar = 10\*10<sup>3</sup>Kpa

##### 3. Spur Gear:

- Material = C45(steel)
- Teeth = 70
- Outside diameter = 15cm

##### 4. Pinion:

- Material = steel (C45)
- Teeth = 25
- Outside diameter = 15cm =150mm

##### 5. Battery:

- Voltage = 12volt

### 6. Dc Motor:

- Speed : 400rpm
- Voltage : 12v
- Power : 0.035kw

$$\sigma_B = 1400 \text{ kgf/cm}^2,$$

$$\sigma_c = 5000 \text{ kgf/cm}^2$$

## V. DESIGN CALCULATION

### 1. Force Required to Lift the Trailer:

Piston diameter (d1) = 32cm=0.32m

Piston rod diameter (d2) = 14cm=0.14m

$$\text{Force} = \text{Pressure} * \text{Area}$$

$$\text{Area} = (\pi/4) * (d1^2 - d2^2)$$

$$\begin{aligned} \text{Force} &= 600 * (\pi/4) * ((0.32)^2 - (0.14)^2) \\ &= 600 * 0.0650 \end{aligned}$$

$$\begin{aligned} \text{Force} &= 390\text{N} \\ &= 390/9.81 \\ &= 39.01\text{kg} \quad (g=9.81) \end{aligned}$$

### 2. Calculation of Gear:

Diameter of the pinion (d) = 6cm

Diameter of the spur gear (D) = 12cm

Speed of the pinion (n) = 400rpm

Power (P) = 0.035KW

#### 2.1 To Find Gear Ratio:

$$\begin{aligned} i &= D/d \\ &= 12/6 \\ i &= 2 \end{aligned}$$

#### 2.2 To Find the Gear Speed:

$$\begin{aligned} i &= n/N \\ 2 &= 400/N \\ N &= 200\text{rpm} \end{aligned}$$

#### 2.3 To Find the Module:

##### 2.3.1 For Gear:

$$\begin{aligned} &= \text{diameter of gear/no of teeth} \\ &= 12/70 \\ &= 0.17 \end{aligned}$$

##### 2.3.2 For Pinion:

$$\begin{aligned} &= \text{diameter of pinion/no of teeth} \\ &= 6/25 = 0.24 \end{aligned}$$

### Step 1: Material Selection for Pinion and Wheel:

[Psg Databook Pg. no:8.5]

I have selected the materials for PINION C45 steel from [Psg Databook Pgno: 8.5]

$$\sigma_B = 1400 \text{ kgf/cm}^2$$

$$\sigma_c = 5000 \text{ kgf/cm}^2$$

I have selected the materials for GEAR WHEEL: C45 STEEL from [Psg Databook Pgno: 8.5]

### Step 2: Calculation Minimum Centre Distance:

$$a \geq (i + 1) \times \sqrt{\left(\frac{0.74}{\sigma_c}\right)^2 + \frac{E(mt)}{iT}}$$

[Psg Databook Page no:8.13]

$$E = 2.15 * 10^6 \text{ kgf/cm}^2$$

$$T = b/a$$

$$T = 0.3 \text{ from page 8.14 } [Mt] = Mt * kd * k$$

[PSG Databook Pg. no:8.15]

$$Mt = 97420 \text{ kw/n}$$

$$97420 \times \left(\frac{0.035}{400}\right)$$

$$Mt = 8.52$$

$$kd * k = 1.3$$

[Psg Databook Pgno:8.15]

$$Mt = 8.52 \times 1.3$$

$$Mt = 11.076 \text{ kgf/cm}^2$$

$$a \geq (2 + 1) \times \sqrt[3]{\left(\frac{0.74}{5000}\right)^2 + \frac{2.15 \times 10106 \times 11.076}{2 \times 0.3}}$$

$$a \geq 2.5 \text{ cm}$$

### Step 3: Calculation Of Minimum Module:

Module of gear = 0.17

Module of pinion = 0.24

### Step 4: Corrected Centre Distance:

$$[a] = \frac{m \times z_1}{2} + \frac{m \times z_2}{2}$$

$$\frac{0.24 \times 25}{2} + \frac{0.17 \times 70}{2}$$

$$[a] = 8.9$$

$$[a] > a$$

$$8.9 > 2.5$$

calculated centre distance [a] is higher than the minimum a value.

### Step 5: Calculation of Face Width:

$$T = \frac{b}{a}$$

$$0.3 = \frac{b}{0.17}$$

$$b = 2.6$$

$$T_m = \frac{b}{m}$$

$$10 = \frac{b}{0.17}$$

$$b = 1.7$$

Select the minimum 'b' = 7.815cm

#### Step 6: Calculating Design of twisting Moment:

$$[M_t] = Mt * k_d * k$$

$$[Mt] = 8.52 \text{ kgf/cm}^2$$

$$K \rightarrow d1 = m1Z1$$

[Psg Databook Pg no:8.22]

$$= 0.24 \times 25$$

$$= 6\text{cm}$$

$$T_p = \frac{b}{d1} = 7.81/6$$

$$K = 1.3\text{cm}$$

$$kd \rightarrow$$

$$v = \frac{\pi d1 n}{60}$$

[Psg Databook Pgno:8.22]

$$v = \frac{\pi \times 6 \times 400}{60}$$

$$v = 125.5\text{cm/s}$$

$$[Mt] = Mt * k_d * k$$

$$[Mt] = 8.52 \times 0.9 \times 1.3$$

$$[Mt] = 9.96$$

$$[Mt] = 10 \text{ kgf/cm}^2$$

#### Step 7: Checking for Induced Compressive Stress:

$$\sigma_c = 0.74 \left( \frac{i+1}{a} \right) \sqrt{\frac{E[M]_t}{ib}}$$

[Psg Databook Pg. no:8.13]

$$i = 2$$

$$a = 8.9 \text{ cm}$$

$$E = 2.15 \times 10^6 \text{ kgf/cm}^2$$

$$b = 7.81 \text{ cm}$$

$$= 0.74 \left( \frac{2+1}{8.9} \right) \sqrt{\frac{2+1}{2 \times 7.81} * 2 * 10^6} [10]$$

$$= [0.74 (2+1) \sqrt{2 + 18.92 * 7.81}]$$

$$488.79 \leq [\sigma_c] (5000)$$

∴ Design is safe; the induced stress is lower than the permissible stress.

$$\sigma_c = \frac{i+1}{a \times m \times b \times y} [M_t]$$

$$\sigma_c = \frac{2+1}{8.9 \times 0.24 \times 7.81 \times 0.359} [10]$$

$$\sigma_c = 5.09 \text{ kgf/cm}^2$$

$$\sigma_c < \sigma_b$$

" Hence the Design is Safe"

#### IV. DESIGN

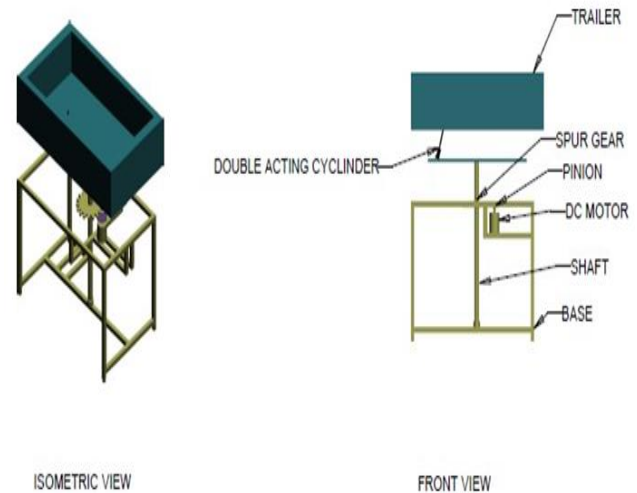


Fig 1. Text Here Your Fig title.

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