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Development of tipper unloading mechanism

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Abstract:- *Tipper truck is a damp truck which is used to transport sand, gravel, dirt, coals, etc. from one place to another place. Generally tipper truck is used in mines to transport heavy materials. But limitations of tipper truck to unload material is only in one direction reduces its efficiency and effectiveness in today's era. Also to unload material in specific area, tipper has to be parked and accordingly more time consumed. Tipping requires safety consideration. If truck is not parked at relatively horizontal ground, overturning of tipper and slipping of tipper occurs. To overcome these problems it is necessary to study the existing unidirectional unloading technique. To overcome these problems proposed design of tipper which requires three hydraulic cylinders instead of one , each situated on lateral side of tipper truck to unload the material in left or right side along with the existing rear side material unloading. This paper is focused on the theoretical calculations with necessary modification. The values of various parameters was found to understand the nature of the existing system. It is required to understand theoretical calculations, so further we can go for software based analysis and can provide redesigning to get three way unloading tipper.*

Keywords:- **tipper, dump truck, hydraulic cylinder's,etc..**

1.INTRODUCTION

The tipper truck is highly popular in transportation of heavy materials such as sand, gravel, coals, etc.Tipper truck is the advanced version of conventional trucks. Conventioanal trucks can also transport heavy materials from one place to another but huge difference is that , in conventional truck man power is required to unload the material from the truck. While unloading the material, employees just open the side walls of the trolley and with the help of spade. This process is from last few decades. But this method is time consuming. Extra cost of man power is to be paid for unloading the material. Also the existing tipper can not perform effectively in small and congested area such as small roads, construction sites, mines,etc. It also consumes more time and more fuel which ultimately reduces efficiency of the system.

To overcome these problems tipper truck was invented. This truck having hydraulic member in it which lifts the trolley upward to unload the material on rear side. The arrangment was just backside of cabin head, the hydraulic cylinder is placed which provides the power to hydraulic member which is situated just below the top of the trolley and the chasis frame. With the help of hydraulic member , trolley get lifted upward at front ,which allows the material in truck to unload at the rear side. This kind of trucks are much popular uptill due to the unloading mehanism.

But it has also its own drawbacks. Truck has to be parked well according to site where material is to be unloaded. This consumes more time and cost of fuel which leads to reduction in efficiency. Also there are chance of sudden slipover or turning of trucks if is not parked properly in uneven sites such as coal mines,etc.

For safety consideration of life of human being and material safety these drawbacks are need to be resolve. So keeping these in mind, we are proposing three way unloading mechanism of tipper. In this mechanism, need to parked vehicle at right place will be resolve. We can easily parked vehicle and according to requirment, we will be able to unload the material , whether it is on right side or left side of the truck. We are suggeting instead of using one hydraulic cylinder use three, so as to give the trolley three way unloading mechanism. Which will increase effictiveness and efficiency of the system. Risk of life in overturning of vehicle will get reduced. Ultimately this new proposed design will change tipper truck working to provide better to performance.

But to devlope this three way unloading mechanism, we first have to go for safety design consideration of existing system, the results of this will help us to go for further feasibility checking of our three way unloading mechanism. This paper focused on existing design calculations of unloading mechanism of tipper.

2. Overview

For suggesting multiside unloading mechanism, first of all, we have to study the existing unidirectional unloading mechanism of tipper.

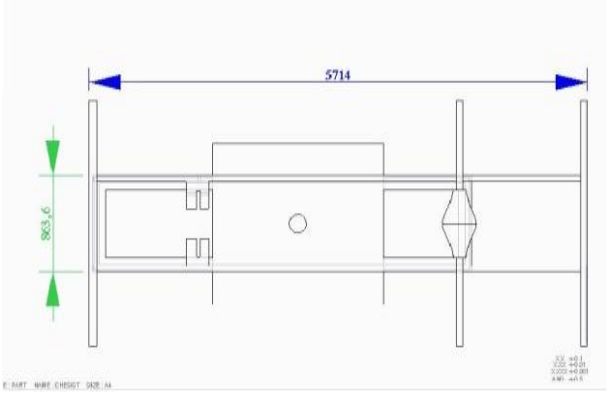
For this ,we have to taken in consideration, specifications of tipper truck, Input parametres and theorotical calculations for this.

In This paper we will discuss, existing mechanism i.e. rear tilting mechanism of tipper and its necessity components such as hydraulic cylinder, hydraulic motor, hinge and pin design, etc.

3. Specifications

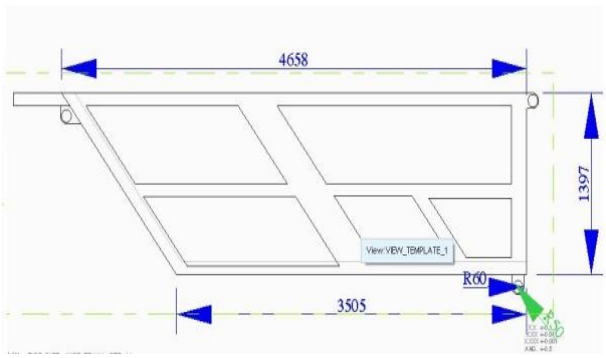
6 wheeler rigid tipper Model: 1616
For Chasis

Total length	:	5714mm
Total width	:	863.6mm
Length from hydraulic Cylinder to chasis end	:	4658mm



For Trolley

Total height	:	1397mm
Total width	:	2489.2mm
Length(upper length L1)	:	4658mm
Length(lower length L2)	:	3505mm



Vehicle load specification

Max vehicle weight(fully loaded)	:	16.2 ton
Typical load capacity	:	8.5 ton
Total load to be delivered	:	10 ton

4. Calculations

4.1 Input parameters

- For design, maximum load to be delivered by trolley = 8.5 ton
- From studying literatures and discussions with ashok leyland , volvo , etc. to lift design load of 8.5 ton , maximum pressure required is 230 bar.
- From observations and studying literature, we found that maximum tilting is 45 degrees, so that the load can be easily dropped by gravity.
- Now calculation for existing tipper system,

  maximum load capacity of tipper trolley =8.5+1.5=10 ton
- Here 1.5 ton is weight of the trolley.

4.2 Design for hydraulic cylinder

- From literature study and discussion with ashok leyland , volvo , tata, etc. it is found that to lift the load of 10 ton, the cylinder of 230 bar maximum pressure is required.
- It is assumed that load is uniformely distrubuted. Calculate area of hydraulic cylinder
- P=F/A
- Force = maximum load to be lifted *g
  =10000*9.81
  =98100 N
- Force =98.1 KN
- Now,
- P=F/A
  A=F/P
  A=98100/230
  A=426.52cm^2
- NOW
  A=426.52cm^2
  d=23.30cm
  d=233mm

  Considering standard diameter
- Therefore d=240mm
- Now,
  Let us consider that,

- Ts = starting time for lifting up the trolley
- Tf = end/finish time while lifting up the trolley
- Tf-Ts = total time to lift the trolley

- From literature review, survey and discussion with ashok leyland, volvo, etc. manufacturer, average time to lift the trolley to its maximum height i.e. time for evacuation can be taken as 3.5 minute.

- Tf-Ts = 3.5 min

- Now power calculation of hydraulic motor;

- Flow quantity Q=Area*speed

- Now,
  Speed (V) = (max. stroke of back side tilting hydraulic)/(cylinder max. evacuation time)

  Speed=3500/3.5
  =100 cm/min

  Flow quantity Q = area* speed
  Q =426.52*100/1000
  Q =42.65 litres per min

4.3 Power calculations for motor

Power = P*Q/1000
Power = 230*42.65/1000
HP = 9.80KW

Now,
- 1HP=745W
- 9809.5W = 13.17 HP
- Existing Power of motor P =13.17 HP

Note:
- Hydraulic Oil used in tank servo system HLP 46 (IOCL make)
- Hydraulic pump used for operating hydraulic cylinder is fixed displacement vane pump.

4.4 Design of hinge

- Load acting on hinge =10 ton

- (diameter selection round bars)
- Inner Diameter of hinge Di =100 mm
- Outer Diameter of hinge Do= 120 mm

- Material selection for hinge and pin

- From design data for machine elements by B.D. SHIWALKAR

- EN-8 (C-40) SAE 1040 used for hinges, hooks ,axles ,etc.)

- Properties of EN8

  Bending stress=260MPa
  Shear stress =210 MPa

- Load acting on hinge =10000kg
- Load acting for 1 hinge =5000kg
- Length of pin =300mm

- Moment acting on hinge =5000*300*9.81
  =14715KN

- Ƭ=W/(л/16)*(Do-Di)^3
- Ƭ=5000*9.81/[(3.14/16)*(120-100)^3]
- Ƭ=31.23 MPa

- As induced shear stress is 31.23 MPa is less than the permissible stress 210 MPa of EN8.

- Hence design is safe.

4.5 Design for pin

Available data,

- Dia. of pin =90 mm
- effective length of pin =300mm
  main load acting on pin is in bending shearing and crushing load both are combine

- capacity of truck =8.5 ton
- Total weight for design of pin =10 ton
- Now, bending moment=Mb =WL/2
- Total trolley load =10 ton
- But weight acting on each pin =10000*9.81/2
  =49.05KN
- 6b=Mb/Z

- Mb=WL/2
  =49050*300/2
  =7357500Nmm

- Z =(л/32)*d^3

- 6b =Mb/ (л/32)*d^3
  6b =7357500/(л/32)* (90)^3
  6b =102.80 Mpa

  Value of 6b is 102.80 MPa which is less than max. bending stress , so, design is safe.

- Now checking pin for shear failure and crushing failure

- **checking for Shear failure**

- Ƭ=(W*d/2)/(л/16) *d^3
- Ƭ=(49050*90/2)/(л/16)*(90)^3
- Ƭ=15.42Mpa

- Since the induced shear stress is 15.42Mpa which is less than the permissible stress 210 Mpa of EN8.
- Hence design is safe for shear failure.

- **Now checking for crushing failure**

- 6cr =2*6s
- =2*210
- =420 Mpa

- Force=surface area of pin*6cr
  F = (L*л*d)*6cr
- 49050 = (300*л*90)*6cr
- 6cr = 0.578MPa

- Since the induced crushing stress is 0.578 MPa which is less than the permissible stress i.e. 420 Mpa.
- Hence the design of pin is safe under crushing.
- pin is safe for shear and crushing for material EN8

5. Conclusion

The functioning of existing unloading mechanism of tipper is safe for material En8.
By studying the design calculations and checking feasibility of three ways unloading mechanism of tipper leads towards atomization and meets the desired goal.

6. Future scope

- We can go for feasibility checking of our proposed three way unloading mechanism of tipper in ANSYS software so that we can check that our system will work properly or not.

- Automation of tipping i.e. unloading in all three direction will be possible by using a power pack with plc control (device provides automated working system) or some similar kind of automation devices.

- Engage and disengagement of hinges at the time of side tilting can be possible with automation according to requirement.
  Engagement/disengagement of main hydraulic cylinder with trolley during side unloading can be operating through automation.

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References

1. Sudhakar Amboji, Yogesh Humne, Rohan Chavan, Jyotsna Patil, Prashant Kshirsagar ,"Design And Fabrication Of Three Way Tipper Mechanism" IJRAT , Vol. 2, No. 4. April 2014

2. Prof. S A Deshmukh ,Pradip Lonkar, Tushar Bhong, Dadaso Kale"Three Axis Pneumatic Modern Trailer By Using Single Cylinder" IJRRCMF Vol.2, Issue 2, PP: (111-126) October 2015/ March 2016

3. Prof. Akshay Pachpore, Ajinkya Gharote, Virendra Paulzagade "Design And Fabrication Of Three Way Trolley Mechanism" Ijiet, Vol 5, 3 june 2015 ISSN 2319-1058

4. Prof. Mrs. R.S. Tupkar , Aditya Malewar, Rohit Ramteke, Harshal Lakhade, Shubham Navghare"Design And Fabrication Of Unidirectional Dumper" IJSRD Vol. 3, 2/2015

5. B.D. Shiwalkar, "Design data for machine elements" January 2013