

Design of Three Directional Dumping Trailers

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Abstract - By observing the older dumper or tipper trailers, the major difficulty is, unloading the construction materials. Our research in the several building sites, uncovered the fact that the materials were unloaded from the trailer in the most difficult way possible. Traditional trailers dump materials just one way that is at the posterior of the vehicle. It is hard to empty the materials in little minimized roads and little streets. In our task, these are corrected to empty the trailer on the whole three sides by using hydraulics. The hydraulic pump is connected to internal combustion engine, with the help of engine power, the working fluid were pressurized. This compressed fluid is utilized to enact the chamber, when the valve is turned on. By this project work, it is simple for the driver to empty the dumping trailer and it decreases the energy and time.

Keywords-unloading, trailer, materials, combustion engine, compressed fluid.

I. INTRODUCTION

A Dumper trailer is a vehicle which is intended for conveying mass materials, regularly on construction destinations and development works. They are normally diesel-powered vehicles which can pull an assortment of items including rock, grain, sand, compost, substantial rock etc. In 1896, Thornycroft built up a tipper mechanism which is fitted to a steam dust-truck. In the United States, the first mechanized dump trucks were designed by small hardware firms, for example, the Fruehauf Trailer Partnership. A trailer is an essential component of any construction project, and its function is critical to the success of any construction site. The material must be loaded, handled, stacked, transported, and unloaded correctly. Materials are loaded onto a dumper and transported to the appropriate venue, in which they are unloaded. An typical dump trailer has an open-box bed that is pivoted at the back and outfitted with pressure-driven rams to raise the front, allowing the material to be placed ("unloaded") behind the truck, on the field at the point of transport. The major problems here are the asymmetry of the site with the totally stacked dumper, which causes the trailer to take a long time to settle to better coordinate the materials and transportation time to arrive at its place.

A. Early Dumpers

For unloading, the earliest models of truck-mounted dump bodies relied on the standard of gravity. The unloader body pivots off center and is secured in place when it is level. The body would dump to the back side if the lock was opened. The technological advancement of dump trucks had reached its pinnacle by the 1940s. By the 1950s, base dump trucks had taken over the earthmoving industry in the United States. As the company moved away from relying on rail to transport materials, the need for locally distributed construction site tippers became apparent. Faun manufactured one of the heavy-duty dump trucks at the time. The truck, which had a 180-horsepower engine, could handle up to 20 tonnes. Because of their width and axle weights, the dump trucks were classified as off-highway dump trucks. When Robert T. Mawhinney hooked a dump box to a level bed truck in Holy Person

John, New Brunswick in 1920, the dump truck was born. A winch was connected to a linkage that took care of an over sheave (pulley) mounted on a mast behind the cab as the lifting unit. The connection was attached to the lower front finish of the wooden dump box, which was linked to the back of the truck outline by a rotate. To lift and lower the container, the operator used a wrench. Today, almost all dump trucks are operated by hydraulics, and they come in a variety of configurations, each built to carry out a particular function in the construction materials supply chain.

II. METHODOLOGY



Fig.1 Methodology

- Problem has been identified; the main objective of this project is to increase efficiency of unloading of materials in compact area.
- Studied about the concepts and drawbacks from previous paper.
- Design and calculation of the idea, and analysis the idea.
- Conclusion and future works

Initially the volume of dumper has been fixed, and then calculated the cylinder capacity, fluid flow rate, etc.

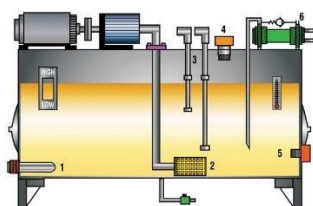
2) Reservoir

The hydraulic reservoir is a storage compartment for unpressurized fluids, which is necessary to supply the system, as well as a reservoir to cover any spills or convection losses.

III. EXPERIMENTAL SETUP

A. Hydraulic System

Hydraulics is the study of fluids, the function of fluids,



3) Pump

Fig.4 Reservoir

and behaviours of the fluid. Hydraulics systems work on the Pascal's law, as pressure is applied to a fluid enclosed in a limited space, the pressure is distributed in all directions without decreasing areas, from computing peripherals (disc drives, printers), hand-held control devices, and automobiles ranging from model planes to automobiles. Mechanical energy is converted into hydraulic energy using a hydraulic pump (hydrostatic energy for example flow, pressure). These pumps are driven by IC engines and pressurize the fluids which is stored in a reservoir.

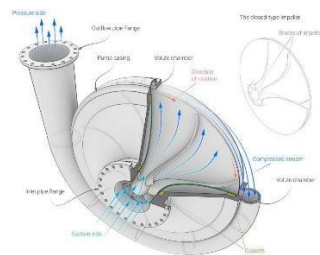
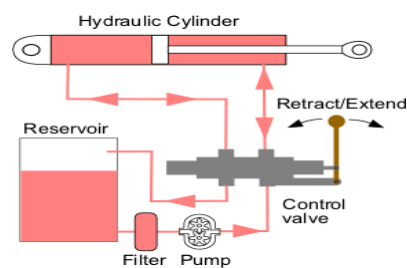


Fig.2 Hydraulic System Arrangements

4) Valves



B. Componentsofhydraulicsystem

1)Cylinder

Cylinderusedtorisethetrailerwithhelpofpressurized fluid. Double acting cylinders are used for better efficiency. Fluids push on one side of the piston rod, and pullsoutinanothersideofthepistonrod.

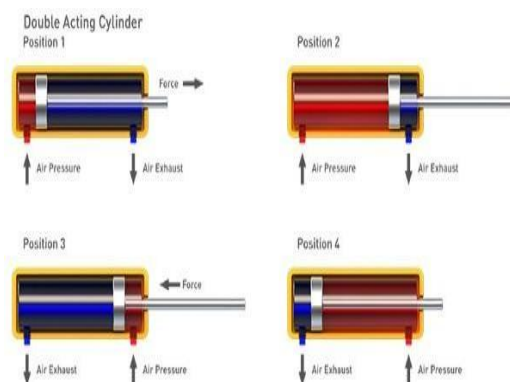


Fig.3Doubleactinghydrauliccylinder

Thevalvesinthehydraulicsystemaremanipulatedfunctions of the system and directs the flow of liquid. Valvesdecides thedirectionoffluid.

5)Fluids

A hydraulicfluid or hydraulicliquid playsamajorroleintransferringpowerin hydraulicmachinery.Theessentialfunctionofahydraulicfluidistopassthepower.

C. Hinge Joints

Hinge joints are pivoted joints. Six hinges are used, two hinges are placed on each side. Other two hinges on backside.

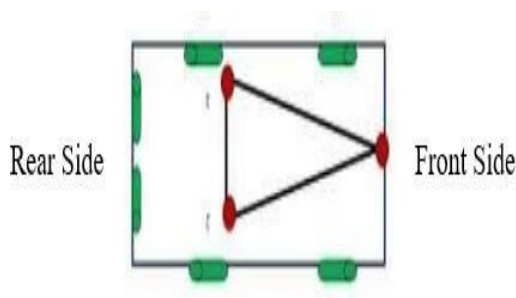


Fig.6 Hinge Joints

For backside dumping of material, rear two pins are locked, other four pins are unlocked. right side dumping of material, right side two pins are locked, other four pins are unlocked. Same as for left side dumping. Pins are inserted or taken out manually.

IV. Result AND DISCUSSION

A. STROKE LENGTH

The stroke is the measure of piston rod travel from top of the cylinder to the bottom of the cylinder.

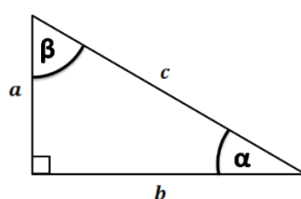
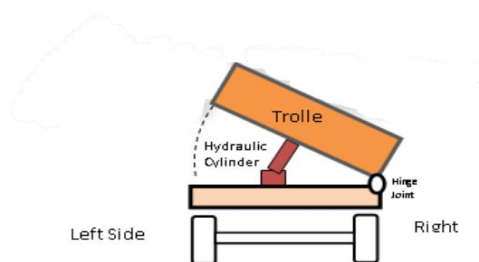


Fig.7 Sidedumping

To calculate, hydraulic cylinder's stroke length (L_s) = $\sin(\alpha) \times (b)$

$$\text{Stroke Length}(L_s) = \sin(45^\circ) \times (1430/2)$$

$$= 505.58 \text{ mm}$$

The hydraulic cylinder's stroke length for side tipping is 505.58 mm.

And for rear tipping, stroke length is,

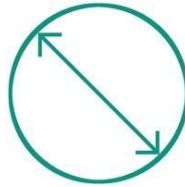
$$\text{Stroke Length}(L_r) = \sin(45^\circ) \times (2140/2)$$

=756.60mm

The stroke length of the hydraulic cylinder for reartipping is 756.60mm

B. BORE DIAMETER

The bore size decides how much force the cylinder produces. Greater bore sizes create more power, and furthermore movement of fluid is more gradually.



Modest bore sizes are quicker and generate weak force.

Fig.8 Bore diameter

Take into consideration that, the maximum working pressure is 3000 Psi (20.68 N/mm²) owing to the limitations of a large number of hydraulic valves

$$P = F/A$$

$$20.68 = ((1500 + 144.92) \times 9.81) / (\pi \times d^2)$$

$$20.68 = 16136.66 / (\pi / 4 \times d^2)$$

$$d = 31.52 \text{ mm}$$

Selecting diameter of 40mm from hydraulic cylinder.

C. WORKING PRESSURE

Working pressure" is characterized as the pressure that a line, tubing, or other part is under during standard working procedures.

$$P = F/A$$

$$P = (16136.66) / (\pi / 4 \times (40)^2) P = 12.84 \approx 13 \text{ N/mm}^2$$

The working pressure in the line is 13 N/mm²

D. DISCHARGE OF OIL

The amount of fluid flowing through a given cross-section area per unit time which is defined as the volume flow rate Q of a fluid.

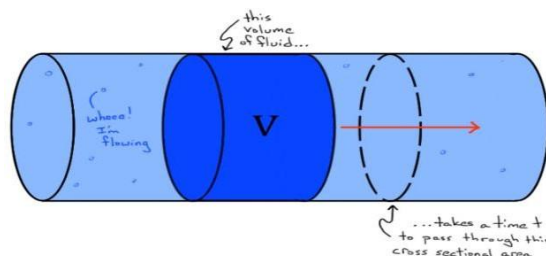


Fig.9 Fluid flow in line

First calculating speed of the fluid flow,

$$\text{Speed} = (\text{Maximum Stroke of hydraulic cylinder}) / (\text{Maximum evacuation time})$$

$$= 505.58 / 2$$

$$= 252.79 \text{ mm/min Rate of Discharge } Q = A \times V$$

$$Q = \pi/4 \times (40)^2 \times 252.79$$

$$Q = 317.66 \times 10^3 \text{ mm}^3/\text{min}$$

E. *DESIGN* Length: 2140 mm Width: 1430 mm Height: 290mm
 Payload on Trailer = 1000Kg
 Capacity for design considering overloading = 1500Kg

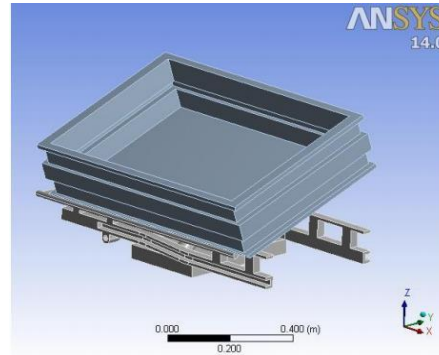


Fig.10 CAD Model of the trailer

V. CONCLUSION

From our calculation we have attained expected results. Unloading operations can be carried out without much trouble with the aid of a working analysis and a hydraulics system. This mechanism is applicable not only to dumping trucks, but also to a wide variety of manufacturing industries.

- Easy to move the material effectively: Thus, it becomes easy to perform.
- Ease of use in tight spaces: where reversing and turning the vehicle is difficult.
- Accommodate when working on the dam site.

We had no trouble unloading the materials. Problems that emerged during the trolley's unloading in sensitive

areas will be resolved. As a result, the total time and fuel consumption for unloading the trailer is decreased. Three-Directional dumping trailer can be helpful for site construction, garbage collector, farmers as well for dumping gravel, sand etc. Construction work necessitates reliable and user-friendly equipment, resulting in a rise in the use of three-way dumping trailers.

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