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Design and Fabrication of Prototype of Three Way Pneumatic Dumper Mechanism

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Abstract - *There is a rapid development in the advancement of foundation these days, yet the Conventional unloaders are utilized to dump the materials like sand, rock, lattice and so forth on building locales. In regular unloader, water powered framework is utilized to push the unloader and dump the material just in back side of the vehicle. According to our study, numerous individuals think that its badly designed in regards to the dumping of vehicle. In regular day to day existence ordinary unloader isn't reasonable to dump the material in smaller spaces. Likewise vehicle can't get adequate turning sweep at little roads .The way toward emptying the unloader turns out to be more basic, impeding and tedious. To manage the issue of turning vehicle and furthermore dumping of a vehicle, a system could be utilized which will figure out how to dump the material three distinctive way.*

Key Words: **Pneumatic system , Dumper , Hydraulic system , Conventional , Fabrication**

1.INTRODUCTION

Unloading measure has wide applications in zones like horticulture, development and trash transportation and so forth customary unloading framework has limit of component which do permits it to dump the material at back side as it were. It is profoundly badly designed for vehicles to reposition as per unloading side in slender paths and restricted spaces. The unloader empties the material only rear side. However, this incapability can be full new strategy component as the multidirectional unloading trailer. This system is a way to deal with diminish the inactive opportunity to settle the unloader. The material is dumped in three ways and subsequently can be strikingly expressed as "Three way unloader." The significant results of three way directional unloader has defeated space necessity which regularly bring about street impeding. Consequently, we have reversal in the current system giving the dumping in three ways. This system forestalls hindering of street, decrease time and increment efficiency at most minimal expense.

This will assist with decreasing the endeavors to dump free material one side of tipper. Presently days dropping unloader has been brought about by noticing the trouble in emptying the materials. Dropping unloader can dump just in one side by utilizing pneumatic/water driven jack system. By this venture, principally we zeroed in on above trouble. In this manner it is simple for the driver to empty the unloader and furthermore it diminishes time and fuel utilization. For making tipper system with such above conditions pneumatic instrument can be utilized

2. Literature review

Ganesh Shinde et al studied the „Modern 3 Ways dropping dumper‟ which has been conceived by observing the difficulty in unloading the materials. The survey in this regards in several automobile garages, revealed the facts that mostly some difficult methods were adopted in unloading the materials from the trailer. They have 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 without application of any impact force. The Direction control valve which activates the ram of the hydraulic cylinder which lifting the trailer cabin in require side. Further modifications and working limitations will put this work in the main league of use. This concept saves time & energy which leads to efficient working.

Waghmare et al (2015) suggested that the trolley's sideways movements would be very useful in applications where there is space constraint. By using this mechanism, blocking of the road is prevented and it also results in time saving and increased productivity. Three way dumping trolley is very useful for farmers, site garbage collectors as well for sand, dumping gravels, etc. It does the work in less time as compared to traditional dumpers.

Amboji Sudhakar R. et al studied that Tipper has lots of applications in today‟s world. In industrial and domestic considerations, tippers can haul a variety of products including gravel, potatoes, grain, sand, compost, heavy rocks, etc. By considering wide scope of the topic, it is necessary to do study and research on the topic of tipper mechanism in order to make it more economical and efficient. In existing system, tipper can unload only in one side by using hydraulic jack or conveyor mechanism. By this research it is easy for the driver to unload the trailer and also it reduces time and fuel consumption. For making tipper mechanism with such above conditions both mechanisms namely hydraulic jack and conveyor mechanism can be used. But eventually it comes with question that how both systems can arrange in single set up? Answer to this question is nothing but this research work.

Bhoite et al (2017) has come up with the concept of tipper trolley and it is partitioned in two parts, namely Rotation

and Dumping. Worm and gear mechanism is used for rotation of tipper. cxWorm is coupled at horizontal position with the electric motor. Electric motor is powered by using Double Pole Double Throw switch to complete the circuit of battery and motor. Spur gear is having 40 teeth on its profile. When 10 teeth of spur gear are moved forward then trolley gets rotated by 90̊ from its initial position in 20 second. When the trolley completes its required angle then material is dumped with the help of pneumatic cylinder.

3. WORKING

The compressed air from the compressor reaches the direction control valve. The direction control valve changes the direction of flow according to the valve position handle. The compressed air pass through the direction control valve and it is admitted into the front end of the cylinder block. The air pushes the piston for the lifting stroke.

At the end of the lifting stroke air from the valve reaches the rear end of the cylinder block. The pressure remains the same but the area is less due to the presence of piston rod. This exerts greater pressure on the piston, pushing it at a faster rate thus enabling faster return stroke.

The stroke length of the piston can be changed by making suitable adjustment in the hand liver valve operating position.

4. CALCULATION

1. Dumper

Length = 24" = 0.6096 m

Width = 14" = 0.3556 m

Height = 11" = 0.2794 m

Volume = l × b × h

V = 0.6096 × 0.3556 × 0.2794

V = 0.0605 m^3

Sand to be filled inside the dumper of Density

δ = 1600 kg/m^3

Mass of sand to be carried

m = δ×V

m = 1600 × 0.0605

m = 96.8 kg ≅ 100 kg

Force = mass × acceleration

F = 100 × 9.81

F = 981 N

Pressure provided by the cylinder

P = 5 bar = 0.5 Mpa

2. Diameter of Cylinder (D)

A = Area of cylinder

$$A = \frac{F}{P}$$

$$\frac{\pi}{4} \times D^2 = \frac{981}{0.5}$$

D = 50 mm

Minimum Rod Diameter ($d_{min.}$)

Assuming

FOS = 4 (FOS = Factor of Safety)

Material of Rod = C 45 SAE 1045

Yield stress (σ_y) = 306 Mpa

Endurance limit for Bending

$\sigma_{B_{Max}}$ = 286 N/mm^2

Design stress (σ) = $\frac{\text{Yield stress}}{\text{FOS}}$

$$\sigma = \frac{\sigma_y}{\text{FOS}}$$

$$\sigma = \frac{306}{4}$$

σ = 76.4 N/mm^2

$$\frac{\pi}{4} \times d^2 = \frac{981}{76.4}$$

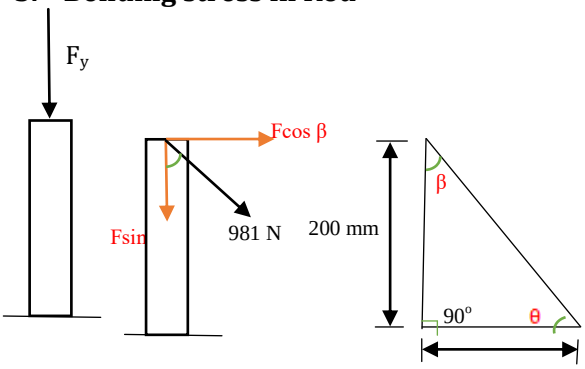
d = 4.04 mm

Available size of Pneumatic Cylinder

Bore Diameter (D) = 60 mm

Rod Diameter (d) = 20 mm

3. Bending stress in Rod



β = Angle between rod and dumper

θ = Angle between frame and dumper

Stroke = 200 mm

$\tan\theta = \frac{\text{opposite}}{\text{adjecent}}$

$\theta = \tan^{-1}(\frac{200}{304.8})$

$\theta = 33.27^{o}$

$\beta = 90 - 33.27$

$\beta = 56.73^{o}$

3.1 Axial stress (σ_a)

$$\sigma_a = \frac{Fy}{A}$$

Area of Rod

$$A = \frac{\pi}{4} \times d^2$$

$$A = \frac{\pi}{4} \times 20^2$$

$A = 314.15\ mm^2$

Axial Force acting on Rod (F_y)

$F_y = F\sin\beta$

$= 981 \times \sin(56.73)$

$F_y = 820.2\ N$

$$\sigma_a = \frac{Fy}{A}$$

$$= \frac{820.2}{314.15}$$

$\sigma_a = 2.62\ N/mm^2$

3.2 Bending stress (σ_b)

$$\sigma_b = \frac{M}{z}$$

σ_b =Bending Stress

M = Bending moment

Z = Polar moment of inertia

Bending moment (M)

M = Fcos β × perpendicular distance

$M = 981\cos(56.73) \times 200$

$M = 104188\ Nmm$

Polar moment of inertia (z)

$$z = \frac{\pi}{32} \times D^3$$

$$z = \frac{\pi}{32} \times 20^3$$

$z = 785.39\ mm^3$

Bending stress (σ_b)

$$\sigma_b = \frac{M}{z}$$

$$= \frac{104188}{785.398}$$

$\sigma_b = 132.65\ N/mm^2$

Total Bending Stress

$\sigma_B = \sigma_a + \sigma_b$

$= 2.52 + 132.65$

$\sigma_B = 135.179\ N/mm^2$

$\sigma_{B_{Max}} = 286\ N/mm^2$

$\Rightarrow$ **$\sigma_B < \sigma_{B_{Max}}$**

Rod of diameter 20 mm, Force exerted 981 N will not fail under Bending.

Assumption

Factor of safety

(FOS)= 4

Calculated Parameters

Diameter of Cylinder

(D) = 49.17 mm

Diameter of Rod

(d_{min}) = 3.97 mm

Axial stress on road

(σ_a) = 2.52 N/mm ^{2}

Bending stress

(σ_b) = 132.65 N/mm^2

Total Bending stress

(σ_B) = 135.17 N/mm^2

Angle of Lift

(θ) = 33.27 ^{o}

Selected parameters

Diameter of Cylinder

(D) = 60 mm

Diameter of Rod

(d)= 20 mm

Pressure inside the cylinder

(P) = 0.5 N/mm^2

5. Cad Model

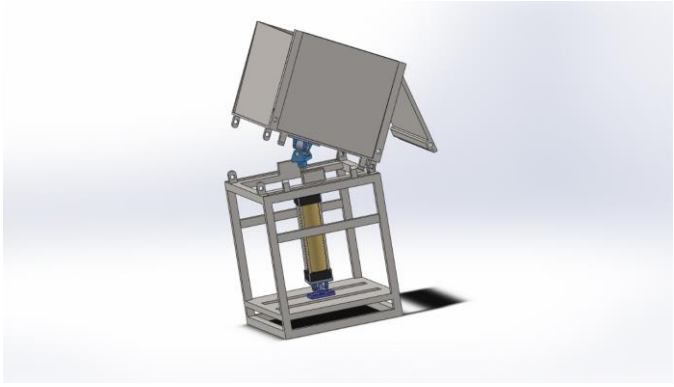


Fig1:- Rear Tipping

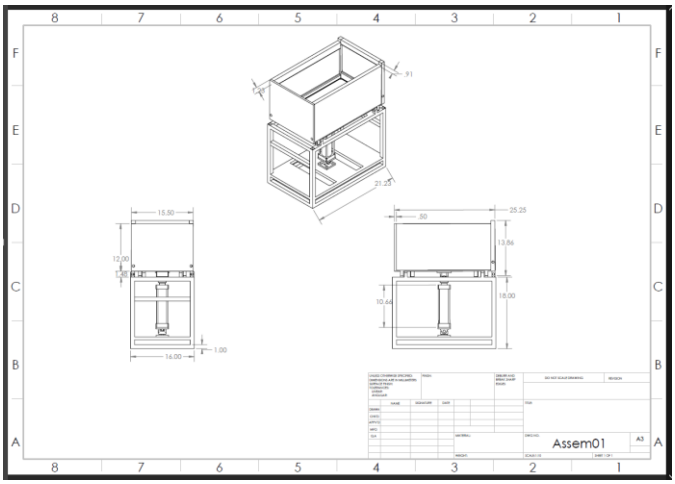


Fig2:- Drawing Sheet

6. CONCLUSIONS

This project work has provided us an excellent opportunity and experience, to use our limited Knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries. The “three way pneumatic dumper mechanism” is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities. Thus, we have developed a “three way pneumatic dumper mechanism” which helps to know how to achieve low cost automation. The operating procedure of this system is very simple, so any person can operate. By using more techniques, they can be modified and developed per the applications. that allows you to result in increasingly more use of 3 manner losing dumper.

7. FUTURE MODIFICATION

As the world progressing at faster rate we meet mover and mover huge construction which head to be dig big and big amount of the earth and thus more efficiently working equipments are to be required and hence the Development of Three Axis Lifting Modern Hydraulic trailer may be used more than the two way or one way. India is progressing at higher rate and hence infrastructural development is on its high. Hence the future of this project work seems promising.

The project work can be modified further more on following basis:-

- Dual stage cylinders can be used.
- Oil pump can be used instead of powered cylinder.
- Capacity can be increased.
- Wheel steering can be adopted for avoiding the lifting of vehicle along with trailers.

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