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# Design and Frabrication of Dump Truck Tilting System

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***Abstract***--- *With the advancement of the transport technologies, companies are trying to find ways to find simpler and cost effective technologies. In today scenario dump trucks are used to transportation of materials till now they are operating by hydraulic cylinders. The hydraulic cylinders used for the dump truck tilting system are very long so that it can be lifted to a good height. It also requires a cylinder with greater diameter so that is can bear the weight of the materials in the truck. This requires a large space to house the cylinder and also the cylinder is prone to damages as it has to bear heavy loads. This not only occupies more space, but also increases the weight of the vehicle, which indirectly affects the fuel economy of the truck. Thus there is a surge to find possible methods for improving the mechanism of the dump truck hydraulics. This project proposes the idea of using a folding mechanism coupled with pneumatics to tilt the trolley of the dump truck. The system employs the use of a linkage hinged to together and a pneumatic cylinder is attached to the hinge. Thus when the pneumatic cylinder works in the forward direction, the linkages are stretched and when it is made to return, the linkages get folded up*

***Keywords***--- *Dump Truck, Kinematic Link, Pneumatic Pressure, Tilting System.*

## I. INTRODUCTION

Existing model dump truck

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***Existing model dump truck***

Dump trucks are used worldwide for handling ore and waste in most of the opencast mines. The energy consumption in dump trucks accounts for about 32 % of the total energy requirement in opencast mines. In this paper a modeling framework is developed to analyze a generic mine transportation problem with multiple dump trucks operating between multiple crushers and excavators.

The minimum specific fuel consumption (SFC) of dump trucks for a specified pay load and material handling rate is optimized. The model investigates the variations of SFC with operating parameters like pay load, speed, wind speed etc. A case study of down gradient opencast limestone mine of capacity 2600 t/h shows a fuel savings of 15%. An achievable minimum SFC of 86 g/ton of ore handled is estimated using proposed model.

***Function/use***

Dump trucks or production trucks are those that are used for transporting loose material such as sand, dirt, and gravel for construction.

A dump truck (or, UK, dumper/tipper truck) is a truck used for transporting loose material (such as sand, gravel, or dirt) for construction. A typical dump truck is equipped with an open-box bed, which is hinged at the rear and equipped with hydraulic pistons to lift the front, allowing the material in the bed to be deposited ("dumped") on the ground behind the truck at the site of delivery. In the UK and Australia the term applies to off-road construction plant only, and the road vehicle is known as a tipper, tipper lorry (UK) or tip truck (AU).

***History***

The dump truck is thought to have been first conceived in the farms of late 19th century Western Europe. Thornycroft developed a steam dust-cart in 1896 with a tipper mechanism. The first motorized dump trucks in the United States were developed by small equipment companies such as The Fruehauf Trailer Corporation|), Galion Buggy Co. and Lauth-Juergens among many others around 1910.

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Hydraulic dump beds were introduced by Wood Hoist Co. shortly after. Such companies flourished during World War I due to massive wartime demand. August Fruehauf had obtained military contracts for his semi-trailer, invented in 1914 and later created the partner vehicle, the semi-truck for use in World War I. After the war, Fruehauf introduced hydraulics in his trailers. They offered hydraulic lift gates, hydraulic winches and a dump trailer for sales in the early 1920s. Fruehauf became the premier supplier of dump trailers and their famed "bathtub dump" was considered to be the best by heavy haulers, road and mining construction firms.

Companies like Galion Buggy Co. continued to grow after the war by manufacturing a number of express bodies and some smaller dump bodies that could be easily installed on either stock or converted (heavy-duty suspension and drivetrain) Model T chassis prior to 1920. Galion and Wood Mfg. Co. built all of the dump bodies offered by Ford on their heavy-duty AA and BB chassis during the 1930s. Galion (now Galion Godwin Truck Body Co.) is the oldest known truck body manufacturer still in operation today.

The first known Canadian dump truck was developed in Saint John, New Brunswick when Robert T. Mawhinney attached a dump box to a flatbed truck in 1920. The lifting device was a winch attached to a cable that fed over sheave (pulley) mounted on a mast behind the cab. The cable was connected to the lower front end of the wooden dump box which was attached by a pivot at the back of the truck frame. The operator turned a crank to raise and lower the box. The first dump bed apparatus on a wheeled vehicle patented in Canada.

***Standard dump truck***

A standard dump truck is a truck chassis with a dump body mounted to the frame. The bed is raised by a vertical hydraulic ram mounted under the front of the body, or a horizontal hydraulic ram and lever arrangement between the frame rails and the back of the bed is hinged at the back of the truck. The tailgate can be configured to swing up on top hinges (and sometimes also to fold down on lower hinges) or it can be configured in the "High Lift Tailgate" format wherein pneumatic rams lift the gate open and up above the dump body.

In the United States, a standard dump truck has one front steering axle, and one or two rear axles which typically have dual wheels on each side. Tandem rear axles are virtually always powered in the U.S., far less often in Europe. Most unpowered rear axles can be raised off the pavement, to minimize wear and tear when the truck is empty or lightly loaded, and lowered to become load-bearing when the truck needs the extra support. These are referred to as lift axles or drop axles. Lift axles can be steerable or non-steerable; steerable lift axles are always configured with single wheels on each side, instead of dual wheels. Lift axles positioned in front of the powered axles are called pushers; lift axles positioned behind the powered axles are called tags.

Common configurations for a standard dump truck include the four wheeler.(4x2) which has one powered rear axle, the six wheeler (6x2 or 6x4) with one or two powered rear axles, the tri-axle with one lift axle and two powered axles, and the quad with two lift axles and two powered axles. The largest of the standard European dump trucks is commonly called a "centipede" and has seven axles.

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The rear two axles are powered, the front axle is the steering axle, and the remaining four are lift axles. The intermediate axles are present to support the weigh over the length of the chassis and sometimes to provide additional braking power. In the European Union, the dump truck configurations are 2, 3 and 4 axles.

The 4-axle eight wheeler has two axles at the front and two at the rear and is limited to 32 metric tons (35 short tons; 31 long tons) gross weight in most EU countries. In the U.S. the most common large dump trucks, the "semi-dumps", have a 6x4 semi-tractor and a two axle trailer. Although theoretically able to have a gross weight of 80,000 pounds, bridge formula laws usually reduce this.

The shorter wheelbase of a standard dump truck often makes it more manoeuvrable than the higher capacity semi-trailer dump trucks.

Transfer dump

Standard dump truck

***Transfer dump***

A transfer dump is a standard dump truck pulling a separate trailer with a movable cargo container, which can also be loaded with construction aggregate — gravel, sand, asphalt, klinkers, snow, wood chips, triple mix, etc. The second aggregate container on the trailer ("b" box), is powered by an electric motor, a pneumatic motor or a hydraulic line.

It rolls on small wheels, riding on rails from the trailer's frame into the empty main dump container ("a" box). This maximizes payload capacity without sacrificing the maneuverability of the standard dump truck. Transfer dump trucks are typically seen in the western United States due to the peculiar weight restrictions on highways there.

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Another configuration is called a triple transfer train, consisting of a "b" and "c" box. These are common on Nevada and Utah highways, but not in California. Depending on the axle arrangement, a triple transfer can haul up to 129,000 kilograms (284,000 pounds) with a special permit in certain American states. As of 2007, a triple transfer costs a contractor about $105 an hour, while a/b configuration costs about $85 per hour.

Transfer dump trucks typically haul between 26 and 27 short tons (23.6 and 24.5 t; 23.2 and 24.1 long tons) of aggregate per load, each truck is capable of 3-5 loads per day, generally speaking.

***Truck and pup***

A truck and pup is very similar to a transfer dump. It consists of a standard dump truck pulling a dump trailer. The pup trailer, unlike the transfer, has its own hydraulic ram and is capable of self-unloading.

Truck and pup

***Superdump***

A Superdump is a straight dump truck equipped with a trailing axle, a liftable, load-bearing axle rated as high as 13,000 pounds (5,897 kg). Trailing 11 to 13 feet (3.35 to 3.96 m) behind the rear tandem, the trailing axle stretches the outer "bridge" measurement—the distance between the first and last axles—to the maximum overall length allowed. This increases the gross weight allowed under the federal bridge formula, which sets standards for truck size and weight.

Depending on the vehicle length and axle configuration, Superdumps can be rated as high as 80,000 pounds (36,287 kg). GVW and carry 26 short tons (23.6 t; 23.2 long tons) of payload or more. When the truck is empty or ready to offload, the trailing axle toggles up off the road surface on two hydraulic arms to clear the rear of the vehicle. Truck owners call their trailing axle-equipped trucks Superdumps because they far exceed the payload, productivity, and return on investment of a conventional dump truck. The Superdump and trailing axle concept was developed by Strong Industries of Houston, Texas.

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Super dump

***1) Semi-trailer end dump truck***

A semi end dump is a tractor-trailer combination wherein the trailer itself contains the hydraulic hoist. A typical semi end dump has a 3-axle tractor pulling a 2-axle semi-trailer. The key advantage of a semi end dump is rapid unloading. A key disadvantage is that they are very unstable when raised in the dumping position limiting their use in many applications where the dumping location is uneven or off level.

Semi-trailer end dump truck

***2) Semi trailer bottom dump truck***

A semi bottom dump (or "belly dump") is a 3-axle tractor pulling a 2-axle trailer with a clam shell type dump gate in the belly of the trailer. The key advantage of a semi bottom dump is its ability to lay material in a windrow (a linear heap).

In addition, a semi bottom dump is maneuverable in reverse, unlike the double and triple trailer configurations described below. These trailers may be found either of the windrow type shown in the photo, or may be of the "cross spread" type, with the gates opening front to rear instead of left and right. The cross spread gates will actually spread gravel fairly evenly the width of the trailer. By comparison, the windrow gates leave a pile in the middle. The cross spreads tend to jam and may not work well with coarse materials.

Semi trailer bottom dump truck

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### *3) Double and triple trailer bottom dump truck*

Double and triple bottom dumps consist of a 2-axle tractor pulling one single-axle semi-trailer and an additional full trailer (or two full trailers in the case of triples). These dump trucks allow the driver to lay material in windrows without leaving the cab or stopping the truck. The main disadvantage is the difficulty in backing double and triple units. The specific type of dump truck used in any specific country is likely to be closely keyed to the weight and axle limitations of that jurisdiction.

Rock, dirt and other types of materials commonly hauled in trucks of this type are quite heavy, and almost any style of truck can be easily overloaded. Because of that, this type of truck is frequently configured to take advantage of local weight limitations to maximize the cargo.

For example, within the United States, the maximum weight limit is 40 short tons (36.3 t; 35.7 long tons) throughout the country, except for specific bridges with lower limits. Individual states, in some instances, are allowed to authorize trucks up to 52.5 short tons (47.6 t; 46.9 long tons). Most states that do so require that the trucks be very long, to spread the weight over more distance. It is in this context that double and triple bottoms are found within the United States.

### *4) Side dump truck*

A side dump truck (SDT) consists of a 3-axle tractor pulling a 2-axle semi-trailer. It has hydraulic rams which tilt the dump body onto its side, spilling the material to either the left or right side of the trailer. The key advantages of the side dump are that it allows rapid unloading and can carry more weight in the western United States.

In addition, it is almost immune to upset (tipping over) while dumping, unlike the semi end dumps which are very prone to tipping over. It is, however, highly likely that a side dump trailer will tip over if dumping is stopped prematurely. Also, when dumping loose materials or cobble sized stone, the side dump can become stuck if the pile becomes wide enough to cover too much of the trailer's wheels. Trailers that dump at the appropriate angle (50° for example) avoid the problem of the dumped load fouling the path of the trailer wheels by dumping their loads further to the side of the truck, in some cases leaving sufficient clearance to walk between the dumped load and the trailer. Many winter service vehicle units are based on dump trucks, to allow the placement of ballast to weigh the truck down or to hold sodium or calcium chloride salts for spreading on snow and ice covered surfaces.

Side dump truck

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***Off-highway dump trucks***

Off-highway dump trucks are heavy construction equipment and share little resembles to highway dump trucks. Bigger off-highway dump trucks are used strictly off-road for mining and heavy dirt hauling jobs. There are two primary forms: rigid frame and articulating frame. The term ‘dump’ truck is not generally used by the mining industry, or by the manufacturers that build these machines.

The more appropriate U.S. term for this strictly off road vehicle is "haul truck" and the equivalent European term is 'dumper'. The term ‘dump’ truck is not generally used by the mining industry, or by the manufacturers that build these machines. The more appropriate U.S. term for this strictly off road vehicle is "haul truck" and the equivalent European term is 'dumper'.

***Haul trucks***

Haul trucks are used in large surface mines and quarries. They have a rigid frame and conventional steering with drive at the rear wheel. As of late 2013, the largest ever production haul truck is the 450 metric ton BelAZ 75710, followed by the Liebherr T 282B, the Bucyrus MT6300AC and the Caterpillar 797F, which each have payload capacities of up to 400 short tons (363 t; 357 long tons).

Most large size haul trucks employ Diesel-electric powertrains, using the Diesel engine to drive an AC alternator or DC generator that sends electric power to electric motors at each rear wheel. The Caterpillar 797 is unique for its size, as it employs a Diesel engine to power a mechanical powertrain, typical of most road going vehicles and intermediary size haul trucks. Other major manufacturers of haul trucks include Hitachi, Komatsu, DAC, Terex and BelAZ.

Haul trucks

***Articulated dumper***

An articulated dumper is an all-wheel drive, off-road dump truck. It has a hinge between the cab and the dump box, but is distinct from a semi-trailer truck in that the power unit is a permanent fixture, not a separable vehicle. Steering is accomplished via hydraulic cylinders that pivot the entire tractor in relation to the trailer, rather than rack and pinion steering on the front axle as in a conventional dump truck. By this way of steering, the trailers wheels follow the same path as the front wheels. Together with all-wheel drive and low canter of gravity, it is highly adaptable to rough terrain. Major manufacturers include Volvo CE, Terex, John Deere and Caterpillar.

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Articulated dumper

***1) Collisions***

Dump trucks are normally built for some amount of off-road or construction site driving; as the driver is protected by the chassis and height of the driver's seat, bumpers are either placed high or omitted for added ground clearance. The disadvantage is that in a collision with a standard car, the entire motor section or luggage compartment goes under the truck.

Thus, the passengers in the car could be more severely injured than would be common in a collision with another car. Several countries have made rules that new trucks should have bumpers approximately 40 cm (16 in) above ground in order to protect other drivers better. There are also rules about how long the load or construction of the truck can go beyond the rear bumper to prevent cars that rear-end the truck from going under it.

***2) Tipping***

Another safety consideration is the leveling of the truck before unloading. If the truck is not parked on relatively horizontal ground, the sudden change of weight and balance due to lifting of the skip and dumping of the material can cause the truck to slide, or even to tip over.

***3) Back-up accident***

Because of their size and the difficulty of maintaining visual contact with on-foot workers, dump trucks can be a threat, especially when backing up.[ Mirrors and back-up alarms provide some level of protection, and having a spotter working with the driver also decreases back-up injuries and fatalities.

***Proposed model***

This project proposes the idea of using a folding mechanism coupled with pneumatics to tilt the trolley of the dump truck. A dump truck or trailer for hauling and dumping dry bulk solids conventionally by gravity and also having the capability of conveying the solids upward to a storage facility. The unit includes a container mounted to a frame on wheels. A hydraulic ram tilts the container for dumping through a rear outlet. A pneumatic conveyor is carried by the frame with an intake at the rear of the container. A gate allows the solids to be dumped conventionally by gravity, or to be blown to a storage facility by the pneumatic conveyor.

The system employs the use of a linkage hinged to together and a pneumatic cylinder is attached to the hinge. Thus when the pneumatic cylinder works in the forward direction, the linkages at stretched and when it is made to

return, the linkages get folded up. Hand lever solenoid valve get the air and passed through the pneumatic cylinder depend upon the hand lever directional changed

## II. LITERATURE REVIEW

Applications of metal matrix composites in defense, aerospace and light vehicles have been reported by Rittner (2001). She has concluded that the scope for MMC in all the above areas were optimistic and suggested further improvement in processes, selection of alloy, selection of reinforcement and selection of components to reduce the cost of end product.

**Robert (2001)** has presented various forms of aluminum alloys and their applications. Based on his survey on the growth of aluminum alloys, he concluded that 32.2 % of the aluminum was consumed in transport industry in different forms. Foltz and Charles (1991) have presented various matrix alloys, reinforcements and their applications in space, defense, automotive and electronic packaging.

They also presented the possible applications of MMCs in making automotive components like pistons, cylinder sleeve, connecting rod and brake discs. Many Researchers (Suresh et al.1993; Kevorkijan 1999; Rohatgi 1991; Nakanishi et al. 2002) have presented the applications of MMCs for the automotive components and the feasibility of manufacturing these materials.

**Surappa (2003)** has presented an overview of aluminum matrix composite material systems on aspects relating to processing, microstructure, properties and applications. Many challenges of using the metal matrix composites are producing high quality and low cost reinforcements, developing simple economical and portable non-destructive kits to quantify undesirable defects, developing less expensive tools for machining and cutting and also developing re-cycling technology.

**Hemant A. Gaikwad, Nilesh P. Awate**

**“Design of multi side tipper tilting mechanism”**

Truck, tipper, dump truck are used to transport loose material from one place to another place at construction site in mines or in dump yards to accomplish the actual site requirement. If one can understand the ground condition and availability of space in mines and on construction site, it is very tough task to unload loose material at appropriate place, adjustment of truck is needed which take considerable time and effort to unload loose material. As everyone knows that tipper is mostly used for unloading loose material on construction site, mines and dump yards. The Existing system available is to unload material on back side. As considering the mines space available is very less due to which unloading material on left or right side is not possible to take this as a problem Multi side tipper tilting is the need of time. To overcome one side tilting of trolley, multi side tilting mechanism is come into focus. This will help to reduce the efforts to unload loose material one side of tipper. Propose work is on placing three hydraulic cylinders each on front side, right side and left side of trolley to unload loose material on back side, left side and right side of trolley respectively. Some design modification is needed in existing system to work on multi side tipper tilting mechanism

**Prof. Mrs. R. S. Tupkar, Aditya R. Malewar, Rohit A. Ramteke, Harshal S. Lakhade, Shubham R. Navghare**

**"Design and fabrication of unidirectional dumper"**

Conventional tipper mechanism an unload materials only at the backside of the tipper using hydraulically operated cylinder which may cause the problems of road blockage in the limited space area. The unidirectional dumper overcomes the problem of unloading the vehicle on side way by using hydraulic cylinder. By using cylinder the material can be unloaded in 1800 as per requirement. The Unidirectional dumper is developed and tested for its movement in all 1800 possible angle to unload the materials in the tipper trolley and monitor the inclinations for its gradualism (linearity).

The technology of pneumatics has gained tremendous importance in the field of workplace rationalization and automation from old-fashioned timber works and coal mines to modern machine shops and space robots. It is therefore important that technicians and engineers should have a good knowledge of pneumatic system, air operated valves and accessories.

The air is compressed in an air compressor and from the compressor plant the flow medium is transmitted to the pneumatic cylinder through a well laid pipe line system. To maintain optimum efficiency of pneumatic system, it is of vital importance that pressure drop between generation and consumption of compressed air is kept very low.

***Details of Components Used***

- Hand Lever solenoid valve Solenoid valve
- Flow control valve
- Hose and connectors
- Linkages
- Tilt-able Trolley
- Frame

***Pneumatic cylinder***

Cylinder is a device which converts fluid power into liner mechanical force and motion. These cylinders are widely used in industrial pneumatic systems. These cylinders are also called as linear motors and reciprocating motors pneumatic cylinders are designed for a variety of services.

Pneumatic cylinders are designed for a variety of services. Pneumatic cylinders transforms the flow of pressured fluid into a push or pull of the piston rod since out system uses double acting cylinders we shall see some details about them.

Double acting cylinders are in one in which fluid force can be applied to the movable element in two directories. The force exerted by the compressed air moves the piston in two directories in a double acting cylinder. They are used particularly. The piston is required to perform work not only on the advance movement but also on the return. In principle, the stroke length is unlimited, although bucking and bending must be considered before we select a particular size of piston diameter, rod length and stroke length.

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The main component of any pneumatic system is the cylinder, which receivers air under pressure and the pressurized air helps to move the piston to and fro. The force acting on the piston will be equal to the product of the pressure of air and the area of the cylinder.

The amount of air delivered into the cylinder into the cylinder decides the rate of doing work. A cylinder is a hollow circular section with the top and bottom flange provided to prevent the leakage of air.

The compressed air is used to actuate the piston. In order to move the piston to and fro, the air is supplied to the top and bottom of the cylinder alternatively.

Cylinder is mainly classified into two types namely,

- Single acting cylinder.
- Double acting cylinder.

In single acting cylinder, using the spring provided around the piston rod attains the return stroke, but it is not efficient. So, the double acting cylinder is used in which the return stroke is attained using compressed air.

***Double Acting Cylinder***

In this the force exerted by the compressed air moves the piston in two directions. They are used partially when the piston is required to perform work not only on the advance movement but also on the return stroke. This principle, the stroke length is unlimited, although bucking and bending must be considered before selecting the particular size of piston diameter, rod length and stroke length.

***Double acting pneumatic cylinder***

- Stroke length : Cylinder stoker length 160 mm = 0.16 m
- Quantity : 1
- Seals : Nitride (Buna-N) Elastomer
- End cones : Cast iron
- Piston : EN – 8
- Media : Air
- Temperature : 0-80 º C
- Pressure Range : 8 N/m².

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***Solenoid Valve***

The directional valve is one of the important parts of a pneumatic system. Commonly known as DCV, this valve is used to control the direction of air flow in the pneumatic system. The directional valve does this by changing the position of its internal movable parts.

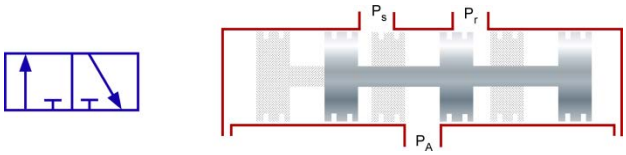
This valve was selected for speedy operation and to reduce the manual effort and also for the modification of the machine into automatic machine by means of using a solenoid valve. A solenoid is an electrical device that converts electrical energy into straight line motion and force. These are also used to operate a mechanical operation which in turn operates the valve mechanism.

Solenoids may be push type or pull type. The push type solenoid is one in which the plunger is pushed when the solenoid is energized electrically. The pull type solenoid is one in which the plunger is pulled when the solenoid is energized.


3/2 Solenoid Valve

The name of the parts of the solenoid should be learned so that they can be recognized when called upon to make repairs, to do service work or to install them.

***Working of Solenoid Valve***




The solenoid valve has 3 openings. This ensure easy exhausting of 3/2 valve. The spool of the 3/2 valve slide inside the main bore according to spool position; the ports get connected and disconnected. The working principle is as follows.

***Position-1***

When the spool is actuated towards outer direction port ‘Ps’ gets connected to ‘Pa’ and ‘Pr’ remains closed.

***Poisition-2***

When the spool is pushed in the inner direction port ‘Pr’ and ‘Pa’ gets connected to each other and ‘Ps’ remains closed.

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***Hose and Fittings***

It is provided for the passage of compressed air from the compressor outlet to the operating valve.

Two separate pipes also connect the operating valve with the working cylinder pressure drop through and airline depends on the flow rate, pipe diameter, and pipe length and pipe geometry. It can be determined directly for straight pipes of any given length. A small chaining bore size can have marked effect on pressure drop, whereas even doubling the pipe length, will only result in doubling the pressure drop.

Pressure drop through bends and fittings can only be determined by empirical tests, since it is specific to the internal geometry involved. Rigid pipes however are less manipulated through remain form of bends with arrangements increase and variable air have to flow and the flow itself may be of fluctuating or pulsating nature. In this case it is thus normally based on practical recommendation.

***Flow control valve***

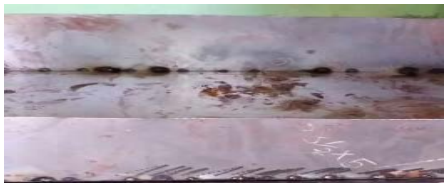
Flow Control Valves are fitted to all the distribution tubes. This valve is made of brass. Both the ends have stepped surface to insert hoses. A handle is provided to control the flow of oil in every valve.

***Purpose***

This valve is used to speed up the piston movement and also it acts as a one – way restriction valve which means that the air can pass through only one way and it can't return back.

By using this valve the time consumption is reduced because of the faster movement of the piston.

***Tilt-able trolley***



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The trolley is attached to the frame.

Material : Mild steel and sheet metal.

Length : 120 cm

Width : 74 cm

Load capacity : 15 kg (our fabrication model).

***Frames***

- Material : Mild steel
- Length :120 cm
- Width : 75 cm

***Air compressor:***

An **air compressor** is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches its upper limit the air compressor shuts off. The compressed air, then, is held in the tank until called into use. The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank.

***Construction & Working Principle***

***Construction***

Our proposed model “MODIFIED DUMP TRUCK TILTING SYSTEM” need so many raw materials which are mentioned in above chapter.

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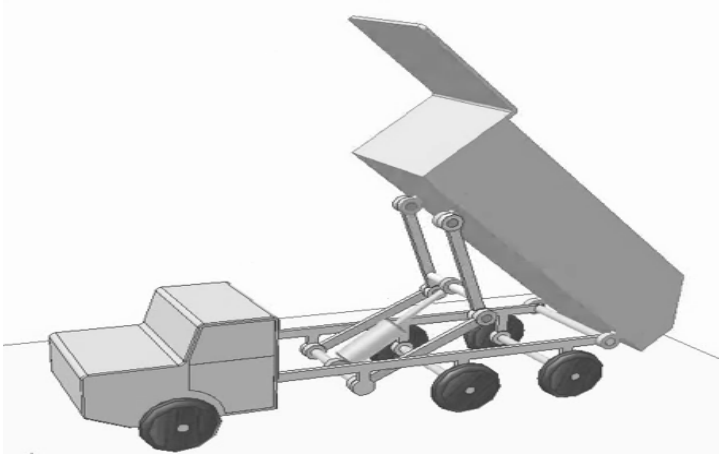
For that materials first of all we purchased the raw materials based upon requirement and for that we've planned to how to buy. After bought we cut raw materials in required dimensions in precise manner by using hand wheel cutting machine. After that we've gone for some rough turning and finishing by using lathe and grinding machines. After that for assembly purpose we went for welding for permanent joint wherever we require and joined with rivets wherever we require rigidly fixed joints. Up to this, mechanical operations and assembly had done the main thing is need to give connections of pneumatic cylinders to the our model at the last time we had given connections to the pneumatic cylinder and solenoid valve, thereafter we joined that pneumatic cylinder to tilting truck to perform it's function on tilting truck.

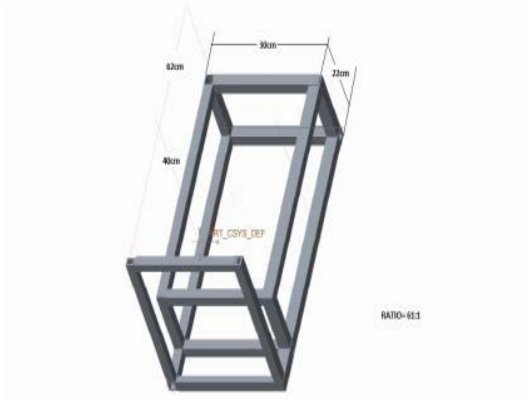
***Working principle***

The system employs the use of a linkage hinged to together and a pneumatic cylinder is attached to the hinge. Thus when the pneumatic cylinder works in the forward direction, the linkages at stretched and when it is made to return, the linkages get folded up.Hand lever solenoid valve get the air and passed through the pneumatic cylinder depend upon the hand lever directional changed. The linkages are those that support the trolley against the frame and they are hinged at the center.

***Block Diagram***



***Cad diagram***

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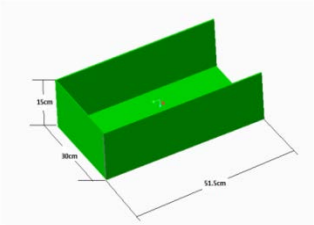
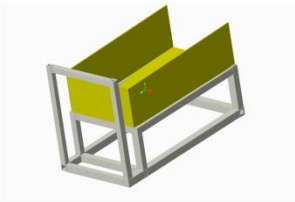
***Frame***

***Trolly***




***Sample diagram***



***Advantage and Application***

***Advantage***

- Free from wear adjustment.
- Less power consumption
- Less skill technicians is sufficient to operate.
- It gives simplified very operation.
- Installation is simplified very much.
- Less time and more profit.
- Reduced stroke length of cylinder
- Reduced cost in pneumatics
- Simple construction
- Reduced weight of the system.
- Ease of operation

***Applications***

- It can be used for dump trucks.
- It can be used in factories for tilting large equipment.

## III. CONCLUSION

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.

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We feel that the project work is a good solution to bridge the gates between institution and industries.

We are proud that we have completed the work with the limited time successfully. The "**MODIFIED DUMP TRUCK TILTING SYSTEM**" 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. In conclusion remarks of our project work, let us add a few more lines about our impression project work.

Thus we have developed a "**MODIFIED DUMP TRUCK TILTING SYSTEM***"* 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 according to the applications.

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