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A Review on Different Type of Brakes Defect in Hydraulic Brakes

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Abstract –

The tractor trolley is a detachable trolley carrying loads around 6-7 tons. It is found that due to excessive load carried out on the trolley in India there are uncertain or unrequired jerks on the tractor. The tractor and the trolley have the possibility to breakdown or fall. This causes harm on the driver, road, and the life of the people who are around the tractor while accident takes place. The mechanism is totally dependent on the braking system, where the only difference is that the normal trolleys axle is been changed with the new axle and the front portion of the trolley i.e. the connecting rod of the trolley and tractor is been given an additional component. This component is the master cylinder which is the main component to operate the brakes. When the tractor applies an urgent brake due to inertia it comes over the tractor. As it comes in front the spring compresses and the rod moves in front, moving the piston rod. As the piston pushes the oil forward it applies the brakes. And the trolley stops with the tractor. The accidents are avoided with it.

Keywords- A review on different type brake defect in hydraulic brake.

1. INTRODUCTION

Farm vehicles like any other vehicle must comply with Road Traffic Regulations, a lot of which have been in Legislation since the 1960's. The increasing number of fatalities on our roads, together with the demand for action on road safety, has resulted in stricter enforcement of these regulations. Many farmers and contractors are discovering that their trailers do not fulfill the requirements laid down in the Road Traffic Regulations. The need for such braking system is even more important with the introduction of 30 km/h tractors. The service brakes of the tractor and those of the trailer are required to be operated simultaneously by a single control (brake pedal).The service brakes on trailers are either of the hydraulic or air type. Hydraulic braking system would be adequate up to 30 km/h. An efficient vehicle braking system is central to safety during transport operations, be they on or off-road, but agricultural trailer (and trailed appliance) braking systems are frequently given insufficient consideration, both at the time of purchase and subsequent level of in-service maintenance frequently now proving to be inadequate for safe use behind modern 'conventional' tractors. As safety feature in any vehicle plays the vital role in designing that vehicle. Braking system in any vehicle is thus must be designed with accuracy. The tractors used are nearly driven with speed of 30 km/h. Tractor Trolley's used in now a-days vehicle are without brakes various loads are applied on trolleys when it is loaded. During the inclinations stresses are developed on the joint between the tractor & trolley. This may cause the deformation of the joint due to stresses. In order to avoid all these problems, there is a need to apply brakes on the trolley also. In the project an analysis of different braking systems would be done and a suitable braking system would be identified for the trolley. The most suitable braking system for the trolleys would be a hydraulic braking with the introduction of fifth wheel to connect the tractor with the trolley. The fifth wheel will assure the required constrained relative motion of the trolley with the tractor. The project work includes design of various components of the hydraulic brakes and the selection of fifth wheel coupling from the standard lot. A CAD model of the entire system will be made We Use Hydraulic Braking System In Trolley: - The speed of tractor is generally up to 40kph. So for this speed limit use of hydraulic braking system in trolley is proper. The hydraulic brake system should be applied smoothly on trolley. The hydraulic braking system has not been damaged in any way & the connection can be than the air brake systems. Hydraulic fluid should be in-compressible. Also the hydraulic system should be air tight such that no vapor is introduced in the system. Hydraulic fluid must resist vaporization at high temperatures. The fluid that is used should be non-corrosive for the surrounding material.

A typical brake system component is as shown in fig 1 given below. In a hydraulic brake system (HBS), when the brake pedal is pressed, a pushrod exerts a force on the piston(s) in the master cylinder, causing fluid from the brake fluid reservoir to flow into a pressure chamber through a compensating port. This results in an increase in the pressure of the entire hydraulic system, forcing fluid through the hydraulic lines toward one or more calipers where it acts upon one or two caliper pistons sealed by one or more seated O-rings. The brake caliper pistons then apply force to the brake pads, pushing them against the spinning rotor, and the friction between the pads and the rotor causes a braking torque to be generated, slowing the vehicle. Heat generated by this friction is either dissipated through vents and channels in the rotor or is conducted through the pads, which are made of specialized heat-tolerant materials such as Kevlar or sintered glass.

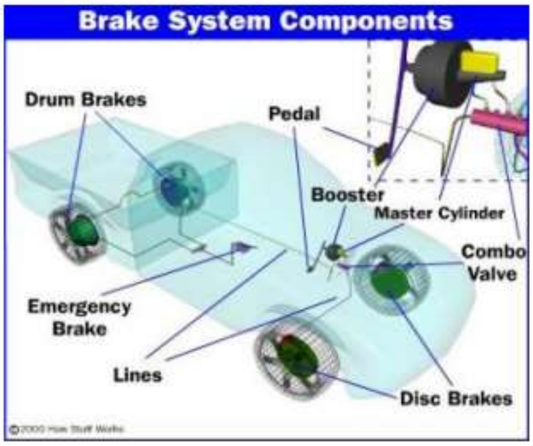

Figure 1 - Hydraulic brake system

1.1 PROBLEM STATEMENT

As the most critical application of braking is during sudden stopping of a vehicle, the condition of decelerating from a reference speed to zero speed is used to calculate braking force. Consider a vehicle moving at an initial speed of u m/s and time in which the vehicle should be stopped is t seconds. Let the braking acceleration or deceleration is ab m/s2 and mass of the vehicle is m kg. For calculating ab , kinematic equations are used. From the first kinematic equation

$$0 = u - a_b \times t$$
$$\therefore a_b = \frac{u}{t}$$

In equation the time t is exclusive of driver's reaction time as well as system response time[1]. Also, from these calculations and second kinematic equation we can find out the stopping distance s m

$$u^2 = 2 \cdot a_b \cdot s$$
$$\therefore s = \frac{u^2}{2 \cdot a_b}$$

In figure 1, the force body diagram of a stationary vehicle is shown. The normal reactions by the ground on the vehicle at the tires at the front and rear are Nf and Nr respectively. The position of center of gravity is at a height of h denoted by G. Also, p and q denote the horizontal distance of G from the front and rear tire contact points respectively. The weight of the car is W N.

From the Newton's third law of motion

$$N_f = \frac{W \cdot q}{p+q}$$

$$N_r = \frac{W \cdot p}{p+q}$$

$$x_1 = \frac{N_f}{N_f + N_r} \times 100$$

The static normal reaction distribution on the car on front two wheels with respect to rear two wheels is x1 , is expressed as a percentage in equation.

Now, consider that the vehicle is decelerating by abm/s2 . In this case the car is acted upon by frictional force. The force body diagram is shown in the Figure

The normal reactions at the tires are different from the initial static condition. The normal reactions in this case are Nf ' and Nr ' calculating using equations and The frictional forces at the front and rear tires are Bf and Br respectively. These values are given by equations

REQUIRED BRAKING FORCE Figure 1: Force Body Diagram (FBD) of a vehicle in static condition

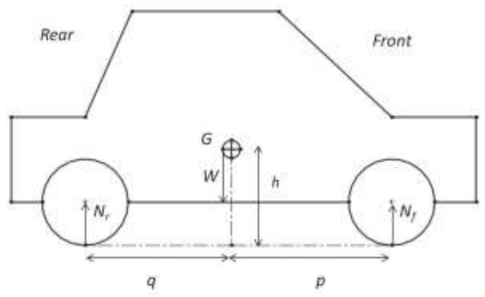

Figure 2: Force Body Diagram (FBD) of a vehicle in static condition

Figure 2 Force Body Diagram (FBD) of a vehicle in dynamic condition

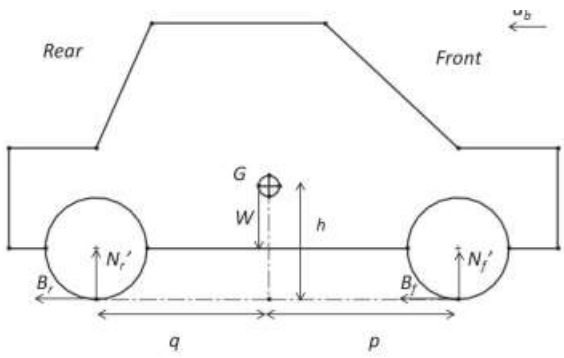

Figure 3: Force Body Diagram (FBD) of a vehicle in dynamic condition

$$N_f' = \frac{W \cdot q}{p+q} + \frac{m \cdot a_b \cdot h}{p+q}$$

$$N_r' = \frac{W \cdot p}{p+q} - \frac{m \cdot a_b \cdot h}{p+q}$$

$$B_f = \mu_t \cdot N_f'$$

$$B_r = \mu_t \cdot N_r'$$

In equations to µt is the co-efficient of friction between tires and the road surface. Thus, Bf and Br are the required braking forces at the front and rear tires respectively. The generated braking force must be more than the required force to account for inefficiencies in mechanical linkages and hydraulic systems.

This pressurized fluid applies a force on the caliper piston which causes it to move and transmit the force on the rotor. The force applied by caliper piston and the other side of caliper on two opposite sides of rotor are in exact opposite directions, both forces will cancel out each other and but torques on the rotor will add[2]. This can be understood clearly from Figure

So the force by caliper piston (assuming the caliper has only one piston) on the rotor can be expressed as

$$F_p = p_m \times \left(\frac{\pi}{4} d_p^{\ 2}\right)$$

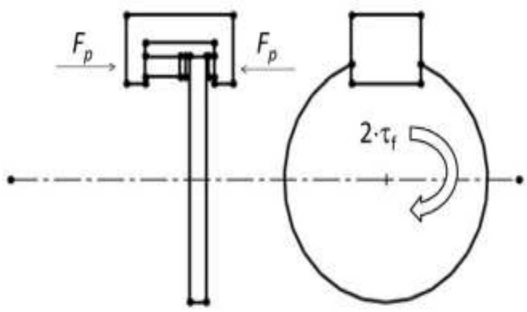

Figure 4: FBD of and torque applied to the rotor

2.2 BRAKING ASSEMBLY AND APPLIED BRAKING FORCE

In the dynamic state, the required braking forces on front and rear tires may or may not be equal. Hence some method for biasing braking forces needs to be introduced in the design. The most preferred methods for the same are:

1) Pressure Distribution Valve

2) Different Brake Assemblies at the front and rear wheels

A combination of both the methods may also be used successfully to achieve the most accurate results. We shall limit our discussion to the second method owing to its popularity and ease of design. In this paper, the design will involve biasing by distinct set of assemblies for front and rear parts. The following notations will be used in the further part of the paper.

d_{mc} =Master Cylinder Diameter	(m)
r =Pedal Ratio	
d_{cp} =Caliper Piston Diameter	(m)
d_{rf} =Front Rotor Diameter	(m)
d_{rr} =Rear Rotor Diameter	(m)
μ_{br} =Friction Coefficient between Brake Pad and Rotor	
d_{tf} =Front Tire Diameter	(m)
d_{tr} =Rear Tire Diameter	(m)
F =Applied Force	(N)
B_{fa} =Applied Braking Force on Front Two Tire	(N)
B_{ra} =Applied Braking Force on Rear Two Tires	(N)

The mechanical force applied by the driver is amplified by the pedal arrangement. The final force which acts on the master cylinder is given by equation.

$$F_{mc} = F \times r$$

$$p_{mc} = \frac{F_{mc}}{\frac{\pi}{4} \times d_{mc}^{\ 2}}$$

This force causes a fluid pressure to be exerted on the piston-cylinder arrangement, given by

Unless a pressure distribution valve is used for biasing, the pressure remains constant throughout the hydraulic circuit according to Pascal's law of constant pressure. This pressurized fluid applies a force on the caliper piston which causes it to move and transmit the force on the rotor. The force applied by caliper piston and the other side of the caliper on two opposite sides of the rotor is in exactly opposite directions, both forces will cancel out each other and but torques on the rotor will add.This can be understood clearly from Figure 3. So the force by caliper piston (assuming the caliper has only one piston) on the rotor can be expressed.

$$F_p = p_m \times \left(\frac{\pi}{4} d_p^{\ 2}\right)$$

3. BRAKE PERFORMANCE TRIANGLE

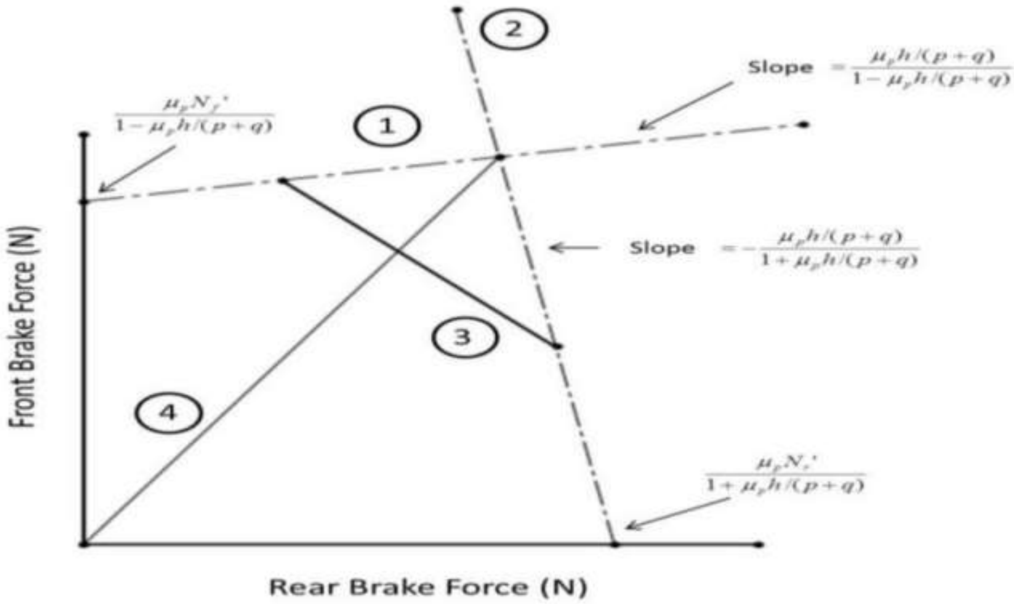

Figure : Brake Performance Triangle Graph

This is a test to check the performance of any braking system after its design. In figure 4, the four lines represent

1) Front Lockup Line

2) Rear Lockup Line

3) Constant Deceleration Line

4) Proportionating Line

The area inside the two lockup lines i.e. front/rear lockup lines individually signifies the efficient working of front/rear brakes. The triangular area enclosed by the two lockup lines and constant deceleration line represents the range where both of the brakes will work for the deceleration below the deceleration line limit.

The proportionating line (line 4) represents ideal braking. If the point representing the designed braking system falls inside the triangle as well as on the proportionating line, the design can be considered to be optimum. The validity of every braking system can be checked using this triangle and system performance for various values of coefficient of friction, deceleration rate, etc. can be corroborated.

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The subsequent release of the brake pedal/lever allows the spring(s) in my master cylinder assembly to return the master piston(s) back into position. This action first relieves the hydraulic pressure on the caliper then applies suction to the brake piston in the caliper assembly, moving it back into its housing and allowing the brake pads to release the rotor. The hydraulic braking system is designed as a closed system unless there is a leak in the system, none of the brake fluid enters or leaves it, nor does the fluid get consumed through use.

All the input values are added in software named “netbeans” and one calculate button is provided over there. By clicking that button output of given vehicle data is calculated. Graphs obtained from buttons that are provided on the output page. Name of the button is similar to that of the graph. By clicking that button graphs can be plotted in the form of smooth curves

A brake is a device used to generate an artificial frictional which is applied to moving member of the machine, for stopping motion. For the execution of the braking operation, the brakes pad and disc absorb the kinetic energy from the wheel. The energy absorbed by brake is generating heat. This heat is passing into the atmosphere and stops the vehicle, so the braking system should have the following ability

1) The brake disc having the ability to transfer heat to the atmosphere and maintain a constant temperature to improve the performance of the disc.
2) Anti-wear property of the brakes must be good.
3) The driver must have had proper control of the vehicle during brake applied and the vehicle should not skid.
4) The brakes must be having enough power to stop the vehicle with in a minimum distance in case emergency.

4. RESULT

The braking force acting on the vehicle depends on specifications of rotor, caliper piston, master cylinder, pedal ratio and co-efficient of friction.

5. Discussion and Conclusions

For the brakes to work effectively, the applied braking force should be more than required braking force. There are various methods to achieve this, each having distinct advantages.

6. Acknowledge

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