Review on Parking Brake Lateral Play in Four Wheeler

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Abstract- A parking brake (PB) system is a type of mechanical brake-by-wire system that is the conventional lever parking system by generating a clamping force for parking using lever system. At the push of a button, a driver can easily apply or release the parking brake; this enables elderly or disabled persons to easily apply a full braking load. The PB system operates quickly and over a wide force range through the use of electrical components It is sometimes also used to prevent a vehicle from rolling when the operator needs both feet to operate the clutch and throttle pedals. Automobile hand brakes usually consist of a cable directly connected to the brake mechanism on one end and to a lever or foot pedal at the driver's position. The mechanism is often a hand-operated lever (hence the hand brake), on the floor on either side of the driver or a pull handle located below and near the steering wheel column, or a (foot-operated) pedal located far apart from the other pedals. Although sometimes known as an emergency brake, using it in any emergency where the footbrake is still operational is likely to badly upset the brake balance of the car and vastly increase the likelihood of loss of control of the vehicle, for example by initiating a rear-wheel skid. Additionally, the stopping force provided by using the handbrake is small and would not significantly aid in stopping the vehicle.

Index TermsBy compensating for the inertia effect through the novel on–off control method, our control logic can be implemented using a simple control unit without a PWM driver. After whole study on parking brake system we will work on lateral play in parking brake which is requirement of customer we are facing problem in the parking brake system regarding the lateral plays requirements. Customer desires the lateral play in parking brake (at 0th notch and at 11th notch of ratchet) should be in the specified limits. For that they want to modify the existing assembly of parking brake.

I. INTRODUCTION

The most common use for a parking brake is to keep the vehicle motionless when it is parked. Parking brakes have a ratchet locking mechanism that will keep them engaged until a release button is pressed. They are recommended always to be left with the handbrake engaged, in concert with their lowest gear (usually either first or reverse). It is operated by pushing the lever down with one's hand to apply the brake, and pulling it upwards to release it. However, this has been known to cause severe back problems in drivers who do this regularly and many choose to push it up with their feet. Some cars with automatic transmission are fitted with automatically releasing parking brakes. For Large vehicles are usually fitted with power operated or power assisted handbrakes. Power assisted handbrakes are usually found on large vans as well as some older heavy vehicles. These operate in the same way as a conventional handbrake, but pulling the lever will operate a valve that allows air or hydraulic pressure or vacuum into a cylinder which applies force to the brake shoes and makes applying the handbrake easier. A recent variation is the electric parking brake. It is expected that these systems will incorporate other features in the future. BMW, Renault, already have a system where the emergency brake initiates when the car stops and then goes off as soon as the gas pedal is pressed preventing the car from rolling. The new feature is called a hill hold. The vehicle operator can easily turn off the system. However, this method requires an additional electric circuit to drive a DC motor here use an on–off control method for the force control logic to supply the maximum voltage until the clamping force reaches the desired final force. Using this method, the DC motor Continues to rotate after the power is cut-off due to its momentum, resulting in an excessive clamping force. For functions that need fast or repeated apply-release operations such as anti-lock brake systems (ABS) and drive-away release, the excessive clamping force may cause a longer release time. Thus, the excessive force caused by the inertia effect should be compensated for.

The one of the up growing industry in developing and producing brake systems and body parts for their valuable customers. Company is facing problem in the parking brake system regarding the lateral play requirements. They are unable to meet the following requirements of the customer.

A load of 4.5-5 N to be applied laterally from both left to right and right to left sides at 40 mm grip point ‘G’ when the lever is at initial position and the lateral play should be within 5 mm.

i. A load of 222 N to be applied laterally from both left and right sides at 40 mm grip point ‘G’ when the lever is at 75% full apply means 11th notch (consider initial position as 0th notch) and the lateral play should be within 20 mm. (While perform this test do not connect the rope to the lever)

Now it is the time to articulate the research work with ideas gathered in above steps by adopting any of below suitable approaches:

In this approach combine all your researched information in form of a journal or research paper. In this researcher can take the reference of already accomplished work as a starting building block of its paper.

Jump Start

This approach works the best in guidance of fellow researchers. In this the authors continuously receives or asks inputs from their fellows. It enriches the information pool of your paper with expert comments or up gradations. And the researcher

feels confident about their work and takes a jump to start the paper writing.

There are numbers of software available which can mimic the process involved in your research work and can produce the possible result. One of such type of software is Matlab. You can readily find Mfiles related to your research work on internet or in some cases these can require few modifications. Once these Mfiles are uploaded in software, you can get the simulated results of your paper and it easies the process of paper writing.

As by adopting the above practices all major constructs of a research paper can be written and together compiled to form a completeresearch ready for Peer review.

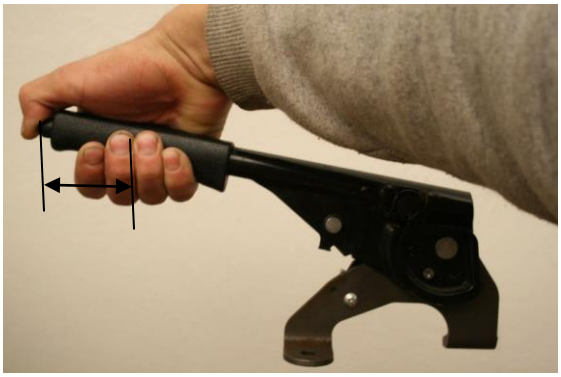

Fig.1 parking brake G'Point

Customer desires the lateral play in parking brake (at 0th notch and at 11th notch of ratchet) should be in the specified limits. For that they want to modify theexisting assembly of parkingbrakeAccording to the policy of the company, they have permitted for the sponsorship for this project to solve the above problem for their customer. In this project, the modification of parts will be carried out by undergoing different stages of design and analysis. The FEA analysis software for simulation will be used during the project work. Validation and testing through available test rig will be carried out at the industry. The existing 3D model of parking brake which is already used in customer vehicle having problem in lateral play of brake which affect on performance of braking and ergonomics aspect during operation. Existing 3D model is created in catiav5 (we can also make the model in Pro-E). Model and actual part snap of this part shown below is checked for lateral play in both side and which is not meeting customer's requirement. We have taken this part as a base model for solving the customer requirement.

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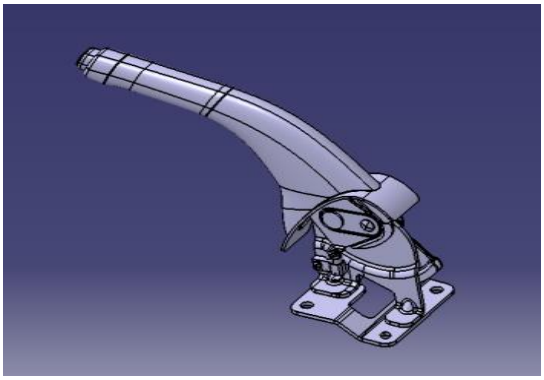

Fig.2 3D & Actual Part model for the existing parking brake assembly

The existing assembly has been tested for the above requirements of the customer by using test rig shown in the fig.4which is able to measure the lateral play for the engagement of each teeth of the ratchet with the lever of the parking brake for certain applied load during each engagement of teeth. Lateral Play test rig consists of load cell, sensor and digital force display unit.

II. DMU AND ANALYSIS

DMU it is digital mock up in which we can check the model with main assembly. In this, the designed model will be checked in software for any fouling with other components and fitment of the part in mechanism stage from that we can get theoretical idea about the operation and expected result of part or the checking possible clearance is available or not after completion of total checking through DMU.We can move further for the analysis of design to the different load condition in Ansys or any other analysis software for simulation results will give the optimized design. Validation will be carried out by checking the samplepiece on test rig.

III. EXPERIMENTAL ENVIRONMENTS

This topic focuses on a low cost and simple mechanism for both Force estimation and control of a power brake system. The importance of force sensor is to take measurement of initial contact point (where the force starts increasing) Measuring the

lateral displacement of brake in both side displacements will be measured. So need to propose an initial contact point detection method. They demonstrate through theoretical analysis that contact occurs when the angular velocity of the DC motor reaches its maximum value. The clamping force can then be estimated as a function of the effective angular displacement, of lever from the initial contact point. According to requirement of load application we can give the load to the brake for movement of brake lever in angular displacement at that time we can get displacement readings with help of force sensor for that particular load applied through the load cell system it will shown on the digital display screen it is connected to the controller to control the displacement of brake in lateral for the given control load such set development is needed for checking the lateral play in parking brake assembly For low-cost control, we use a simple on–off control, which applies the maximum input signal until the estimated clamping force reaches the target force for braking force application. The input signal becomes zero when the estimated force reaches or exceeds the target force.

Where u(t) is the input voltage for the motor, umax is the maximum voltage of the battery, and e is the error between the target force, and the estimated clamping force,

This topic focuses on a low cost and simple mechanism for both Force estimation and control of a power brake system. The omission of a force sensor leads to the problem that the initial contact point (where the clamping force starts increasing) between the brake pads and the brake disk cannot be sensed. Measuring the displacement is not sufficient to complete clamping force estimation without knowledge of the brake pads' So need to propose an initial contact point detection method using only the angular Velocity of the DC motor. They demonstrate through theoretical analysis that contact occurs when the angular velocity of the DC motor nears its maximum value. The clamping force can then be estimated as a function of the effective angular displacement, from the initial contact point.

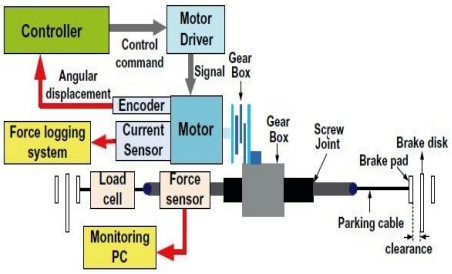

Fig.3 General Layout of lateral play checking set up.

IV. EXPERIMENTATION

a) Initial Reading

The brake is fitted in test rig. for the purpose of checking the lateral play, it is properly fitted in instrument and ready to take the load this instrument consist of sensor for measurement of lateral displacement of brake and the load cell gives the required load to the lever operation, with the help of digital display we can seen the actual readings of load and displacement of brake laterally.

Below picture shows the test rig set at initial reading.

Fig.6 Initial & Final Reading set up

b Final Reading

At 11th notch (i.e. 222 N force and 75% full apply load), the reading shown on display screen for the lateral play at one side is 15.5.mm. Similarly, for other side, the reading was 18 mm. cumulative lateral play is 15.5+18=33.5 mm, which is not met the requirement of the customer (i.e. 20 mm).

c Readings for lateral play

Table 1 Readings for play checking on lateral play test rig

Sample part Reading	Measured Value		Pass or Fail
	LP-1	LP-2	
1	18.4	15.5	Fail
2	18	15.4	Fail
3	18.4	15.4	Fail

LP1: Force applied from left to right side, LP2: Force applied from right to left side. Above mentioned readings were taken when customer was given requirement for lateral play limitation but the readings were not met the 20mm lateral play condition at 222N load which shows fail readings, so need to study and workout on this existing brake assembly, we will take it as a base assembly for further modification after modification we can take readings on same test rig in same way and compare with requirement of customer.

V. RESULTS AND DISCUSSIONS

To compare the estimated forces with the measured forces, which are obtained from the force sensor embedded in the module of the system,. We repeated the application and release 30 times for five different target forces using the two on–off control methods (the simple on–off and the novel on–off). The negative error indicates that over-clamping force was applied. [14]The differences in the deviation of the error are due to mechanical vibrations of the test bench. We observed that the misalignment between the gear and screw could cause vibrations. These vibrations appear in the current and force sensors signals as low frequency signals. As the braking force increased, this vibration and the error deviation also increased. However, no significant vibration was observed in the Manufacturing Verification Test (MVT) PB systems. Therefore, use of our novel on–off controller in manufactured parking brake systems could provide more regular and decreased error deviation compared to that in the test Rig.

VI. FUTURE PLAN OF ACTION

Parking brake system is very essential for the safe parking of any vehicle and also used as a emergency brake at critical conditions. Lateral play is the factor which affects the performance of the parking brake system. Hence, it is required to design the parking brake system such a way that it should not give more lateral play than the desired. In this project, the emphasis will be on the following requirements of the Customer

1. To maintain the lateral play within specified limit of 20 mm (cum.).
2. By using the data available with the existing model and its results, we need to change the design for the parking brake assembly.
3. The methodology may involve DFMEA and FEA analysis.
4. The available test rig facility will be used to measure the lateral play for the further design modification.

In the further stage of the project, we will be focusing on the preparation of DFMEA and Design modification. In order to satisfy the customer's requirement, we need to modify the basic structure of the product and to carry out such modifications; we need to depend on trial and error basis. These changes in design will be carried out in 3D model created in either CATIA v5 or Pro-E.

The modified 3D models will be analyzed by using FE simulation software like Ansys. Based on the results obtained from the simulations, the design parameters will be finalized.
Sample piece will be produced based on the optimized design and the experiments will be carried out on the sample piece with the help of lateral play test rig. While carrying out these experiments, the lateral play for the position of 0^{th} notch and 11^{th} notch of ratchet will be checked and will be compared with the customer's expected lateral play.

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