Design and Analysis of Brake and Gas Pedal

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Abstract**—***The requirement of pedal mount have become increasingly complex in recent years due to the expansion of global markets and diversification of the conditions under which vehicles are used in different parts of the world. It is also becoming increasingly important to ensure that vehicles offer adjustability, ergonomical for the driver, light weight, serviceability, secure and better braking effect which are expected by drivers, but can also provide less aggressive feel to driver while severe braking. We designed it with keeping all the requirements of pedal system and driver in mind. The chances of condition of pedal fail is also reduced in ours design and also the weight of whole assembly is very less than the conventional ones. The aim of this study is to design and analyse the brake pedal and accelerator using Solidworks and ANSYS software*

Keywords—Automotive brake pedal, accelerator, Light weight, adjustable.

I. INTRODUCTION

An automobile or other road vehicle may have two to three pedals. They can be either hanging from the firewall (bulkhead) or standing on the floor; the latter is usually used in off-road vehicles and sports car. The arrangement is the same for both right- and left-hand traffic. From left to right:

- Normally operated by the left foot:

Parking brake pedal (in some newer vehicles, in place of a hand brake lever)

- Normally operated by the right foot:

Throttle (known as the accelerator or gas pedal), controls fuel and air supply to the engine. It is usually narrow and close to the floor allowing the drivers heel to rest on the floor. It has a fail-safe design in that it automatically returns to the idle position when not depressed by the driver.

1.Floor Mounted Pedals

If the pedals are mounted at the floor then the only adjustment would be the length of the pedals and you may compromise driver ergonomics if you make the pedals too short or too long.

2. Advantage of floor mounted pedals

- Lower CG is obtained.
- It has more natural foot movement.
- Floor mounted assemblies are typically more compact (out of necessity).
- It provides simpler line routing
- Floor mounted assemblies typically has less mounting options.

II. PURPOSE

- The essential purpose of the brake and throttle systems of the vehicle are extremely simple. The throttle needs to make the car accelerate at the driver's will, and the brake system needs to make the car decelerate at the driver's will. However, the overall capability of the system transcends this simple definition.
- Other considerations that must be taken into account in a braking and throttle system is are ergonomics and component interference.
- In terms of ergonomics, the driver must be able to comfortably use the brake and throttle pedals for an extended period of time.

III. WORKING

1.Brake System:-When you push the brake pedal it depresses a piston in the master cylinder, forcing fluid along the pipe The fluid travels to slave cylinders at each wheel and fills them, forcing pistons out to apply the brakes. Fluid pressure distributes itself evenly around the system. The combined surface 'pushing' area of all the slave pistons is much greater than that of the piston in the master cylinder. Consequently, the master piston has to travel several inches to move the slave pistons the fraction of an inch it takes to apply the brakes. This arrangement allows great force to be exerted by the brakes, in the same way that a long-handled lever can easily lift a heavy object a short distance.

2. Accelerator system:-The gas pedal in your car is connected to the throttle valve -- this is the valve that regulates how much air enters the engine. So the gas pedal is really the air pedal. When you step on the gas pedal, the throttle valve opens up more, letting in more air. The engine control unit (ECU, the computer that controls all of the electronic components on your engine) "sees" the throttle valve open and increases the fuel rate in anticipation of more air entering the engine.

IV. MATERIAL

After performing detailed study of the different materials that have been used in the pre-existing pedal mount, we formulated the properties that were required to be possessed by the material chosen for our pedals.

- It should possess high fatigue strength.
- It should have good machining properties.
- It should have high strength.
- It should possess resistance to corrosion.
- It should be cheap and easily available

After detailed research of all kinds of material which fit properly in the above properties, we decided upon our material which could be used for our turbine.Aluminium alloy 7075 as our pedal material because it possessed the perfect balance between corrosion strength, cost, machinability and fatigue ability possesses, less density (i.e. low weight) than that of stainless steel and is less costly than stainless steel.

Table.1 : Properties

Properties	Values
Hardness, Brinell	150
Ultimate Tensile Strength	572 MPa
Tensile Yield Strength	503 MPa
Modulus of Elasticity	71.7 GPa
Fatigue Strength	159 MPa
Poisson's Ratio	0.33
Shear Strength	331 MPa

V. METHODOLOGY

The design of the pedal is carried out as per the flow chart given in fig. In this flow chart, the initial step starts with the material information, machine specifications, geometric dimensions and tolerances required to be achieved on the component, and different parts of the head end sub-assembly and their cad drawings which are modeled using the software Solidworks.

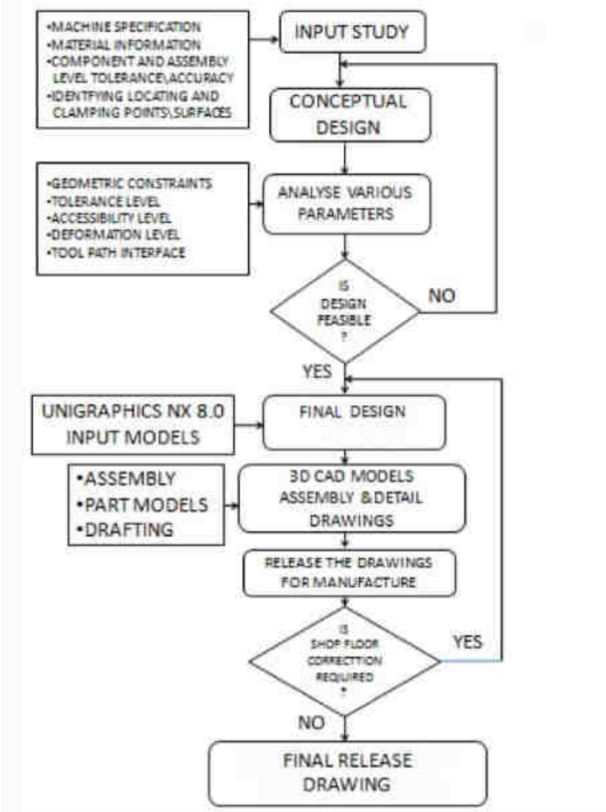

Fig 1:-Methodology

Before the design of the pedal, some requirements have to be considered.

Pedal design Requirement:-

1.Size: In view of the limited space available for the driver's feet, the dimensions should be small as possible but must comply with safety and ergonomics standards. For dimensional reference, existing model of Wilwood pedal is taken.

2. Weight: In view of reducing the weight of accelerator pedal, it should have minimum weight.

3. Safety: The component must be free from sharp edges. The system must comply with all relevant parts of India and international legislation. The maximum force on the accelerator pedal is 40 N with a maximum deflection of 10 mm.

4. Environment: The accelerator pedal must be capable of use in all weather conditions and should be non corrosive. It must be resistant to fuel slippage, greases and should not degrade by ultra violet radiation.

5. Ergonomics: The distance between steering wheel and accelerator pedal are kept sufficeintly. The return force should be between 40-60 N. The dimensions of pedal should not be too short so that drivers feel difficult to

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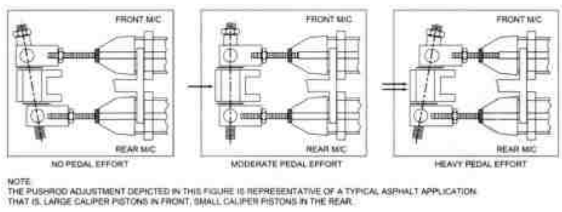
depress the pedal. The design must provide comfort and enough space installing and removal of the pedal. Design dimension should account factors for easy accessibility and women driving with high heeled shoes

6. Brake pedal ratio:-Pedal assembly ratio, or mechanical leverage, is the ratio calculated as the length from the pivot point of the pedal to the center of the foot pedal (A), divided by the length from the pivot point to the master cylinder pushrod. Mechanical leverage is simply a means of increasing the brake force without increasing your leg effort. the mechanical leverage increases brake force without pushing harder on the pedal.

Fig 2:-Holes for variable pedal ratios

7. Balancing bar: The balance bar is an adjustable lever (usually a threaded rod), that pivots on a spherical bearing and uses two separate master cylinders for the front and rear brakes. Most balance bars are part of a pedal assembly that also provides a mounting for the master cylinders. When the balance bar is centered, it pushes equally on both master cylinders creating equal pressure, given that the master cylinders are the same size bore. When adjusted as far as possible toward one master cylinder it will push approximately twice as hard on that cylinder as the other.



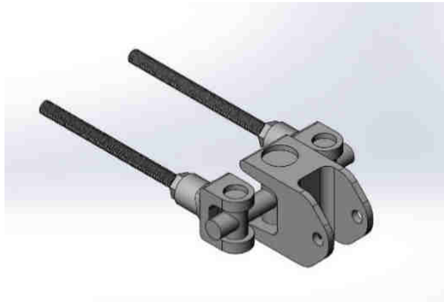


Fig 3:-Balancing Bar

VI. RESULTS

1.Brake Pedal:-

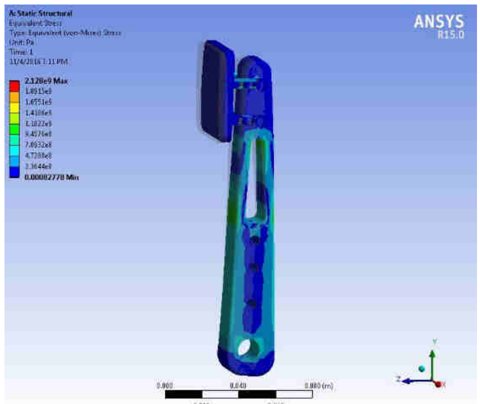


Fig 4:-Equivalent Stress

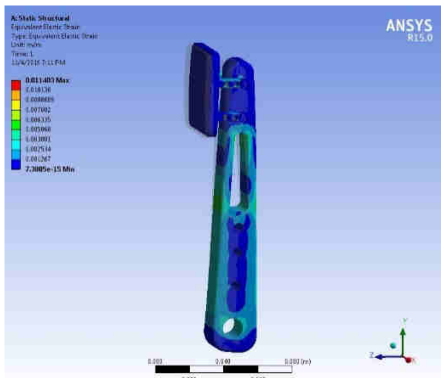


Fig 4:-Equivalent Strain

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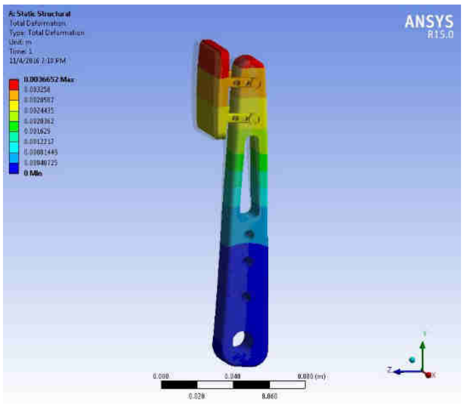


Fig 6:-Total deformation

Table.2: Results for Brake Pedal

	Maximum	Minimum
Equivalent Stress	2.128e+009 Pa	8.2778e-004 Pa
Equivalent Strain	1.1403e-002 m/m	7.3885e-015 m/m
Total Deformation	3.6652e-003 m	0 m

2. Gas Pedal:-

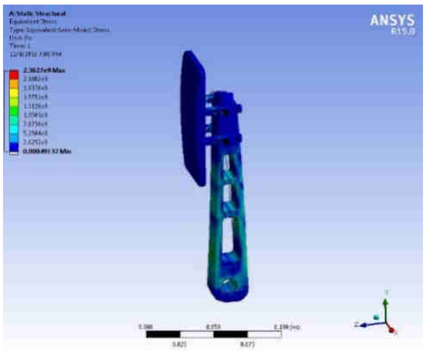


Fig 7:-Equivalent Stress

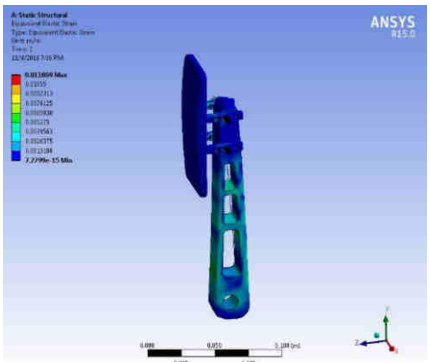


Fig 8:-Equivalent Strain

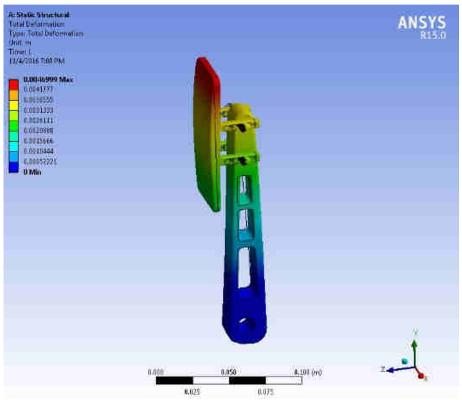


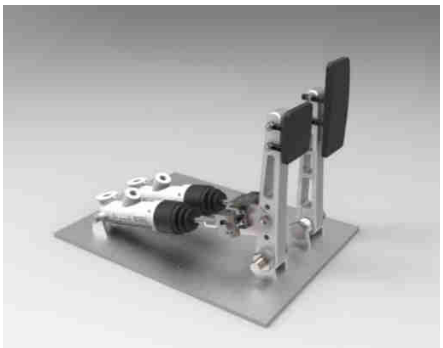
Fig 9:-Total deformation

Table.3: Results for Gas Pedal

	Maximum	Minimum
Equivalent Stress	2.3627e+009 Pa	4.9132e-004 Pa
Equivalent Strain	1.1869e-002 m/m	7.2799e-015 m/m
Total Deformation	4.6999e-003 m	0 m

VII. CONCLUSION

The development process of pedal has been carried to replace the existing Standard pedal for various benefits. It is observed that there weight reduction of Due to use of aluminum alloy 7075. It is produced as a single unit so gives lower manufacturing complexities, better fit and better finish. Moreover, it is also found to be dimensional stable that makes it suitable for usage in a wide range of temperature. It is non-corrosive and could be worked without requirement paint coatings. It has an inherent resistance to fuel, oil and greases suitable for usage. It is inherently better sound insulator than steel.



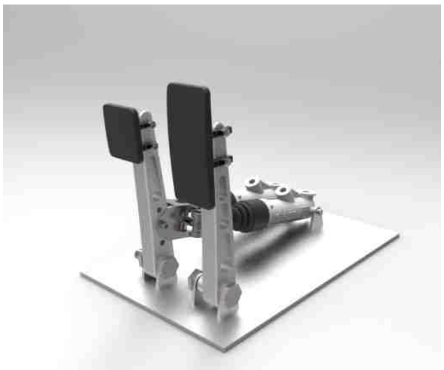


Fig 10:-Final Assembly

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