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Design and Analysis of Braking and Suspension System of E-Bike

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ABSTRACT

A brake is a mechanical device which inhibits motion. A drum brake is a brake that uses friction caused by a set of shoes or pads that press against a rotating drum-shaped part called a brake drum. The Suspension system is the most important part in any vehicle. It handles shock impulse and dissipates kinetic energy. It reduces the amplitude of disturbances and improved ride quality. In this paper, A two-wheeler suspension system is designed and modelled in 3D modelling software CATIA. Structural analysis is done on suspension system at different loads 175Kg, 250Kg and 325Kg. Modelling of drum brake and drum brake pads are done in CATIA design software. Thus both files are saved as igs to import into ANSYS workbench Structural analysis is carried on drum brake in ANSYS workbench First structural analysis of pressure of 1.5 Mpa is applied with three different materials such as cast iron, stainless Steel, aluminium alloy 7475.

Keywords:

1. INTRODUCTION

A drum brake is a brake that uses friction caused by a set of shoes or pads that press outward against a rotating cylinder-shaped part called a brake drum. The term drum brake usually means a brake in which shoes press on the inner surface of the drum. When shoes press on the outside of the drum, it is usually called a clasp brake. Where the drum is pinched between two shoes, like a conventional disc brake, it is sometimes called a pinch drum brake, though such brakes are relatively rare. A related type called a band brake uses a flexible belt or "band" wrapping around the outside of a drum.

Drum Brake in Operation: This is where it gets a little more complicated. Many drum brakes are self-actuating. Figure 1 shows that as the brake shoes contact the drum, there is a kind of wedging action, which has the effect of pressing the shoes into the drum with more force.

The extra braking force provided by the wedging action allows drum brakes to use a smaller piston than disc brakes. Pneumatic and hydraulic shock absorbers are used in conjunction with cushions and springs. An automobile shock absorber contains spring-loaded check valves and orifices to control the flow of oil through an internal piston.

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Fig. 1: Drum brake.

One design consideration, when designing or choosing a shock absorber, is where that energy will go. In most shock absorbers, energy is converted to heat inside the viscous fluid. In hydraulic cylinders, the hydraulic fluid heats up, while in air cylinders, the hot air is usually exhausted to the atmosphere. In other types of shock absorbers, such as electromagnetic types, the dissipated energy can be stored and used later. In general terms, shock absorbers help cushion vehicles on uneven roads.

2. LITERATURE REVIEW

Allan Michael Lang [1] in his research concluded that no simple relationship exists between the natural frequencies of the brake components and the squeal frequency and during squeal both the drum and shoes hold complex modes, which can be best visualized as the superposition of pairs of similar normal modes phase shifted both spatially and in time relative to each other. Mohd Zald Bin Akop [2] in his project concluded that safety aspect in automotive engineering has been considered as a number one priority in development of new vehicle and it is a must for all vehicles to have proper brake system. Ramesha. D. K et al [3] in his thesis concluded that the maximum temperature obtained for aluminum alloy brake drum is less as compared to the cast iron brake drum for a truck. Also, concluded that thermal deformation is less for aluminum alloy brake drum than the cast iron brake drum. As his study states that the weight of Aluminum is lesser than the Cast iron, it is better to use the Aluminum material in the construction of brake drum.

3. MODELING AND ANALYSIS

Computer-aided design (CAD), also known as computer-aided design and drafting (CADD), is the use of computer technology for the process of design and design-documentation. Computer Aided Drafting describes the process of drafting with a computer. CADD software, or environments, provide the user with input-tools for the

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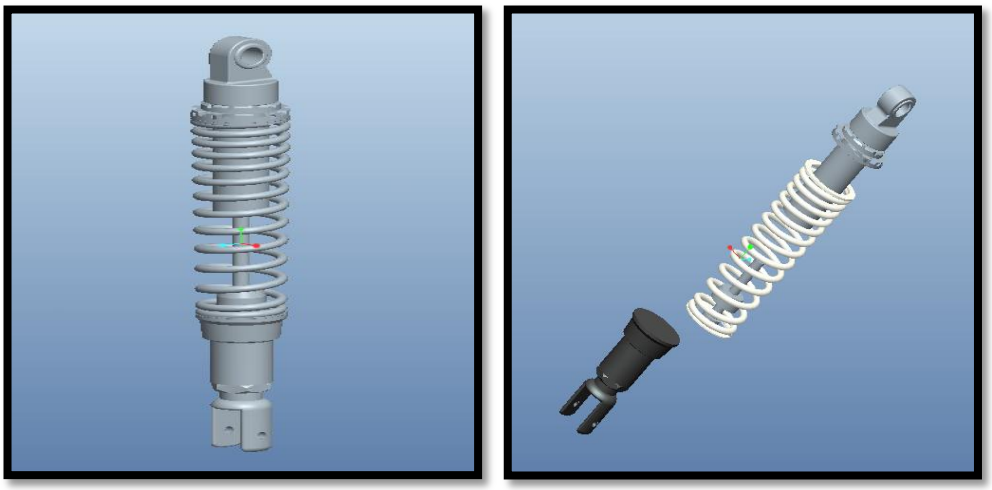
purpose of streamlining design processes, drafting, documentation, and manufacturing processes. CADD output is often in the form of electronic files for print or machining operations. The development of CADD-based software is in direct correlation with the processes it seeks to economize; industry-based software (construction, manufacturing, etc.) typically uses vector-based (linear) environments whereas graphic-based software utilizes raster-based (pixelated) environments.

CATIA is an acronym for Computer Aided Three-dimensional Interactive Application. It is one of the leading 3D software used by organizations in multiple industries ranging from aerospace, automobile to consumer products.

CATIA provides the capability to visualize designs in 3D. When it was introduced, this concept was innovative.

3D model

Assemble product



(a) (b)

Fig. 2: (a) Solid model of suspension system. (b) Exploded view of suspension system.

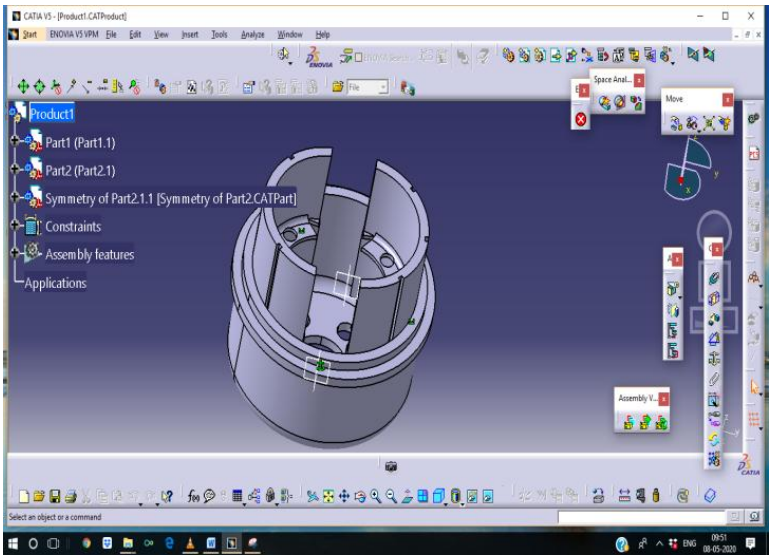


Fig. 3: Model of drum break .

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4. RESULTS AND DISCUSSION

Static Analysis of Drum Brake

Imported model

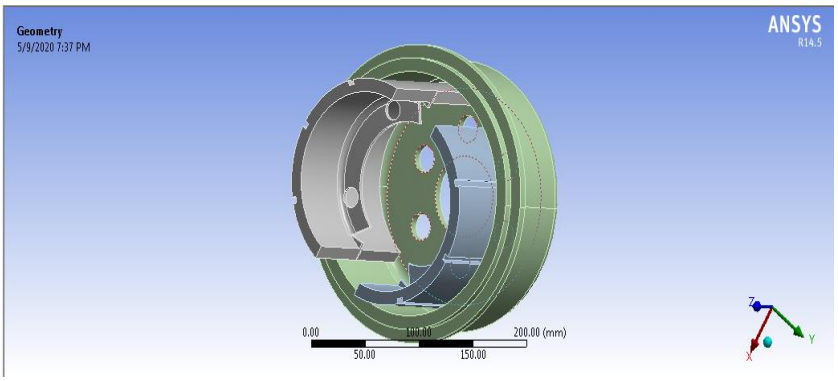

Fig. 4: Imported model form modelling software.

Meshed model

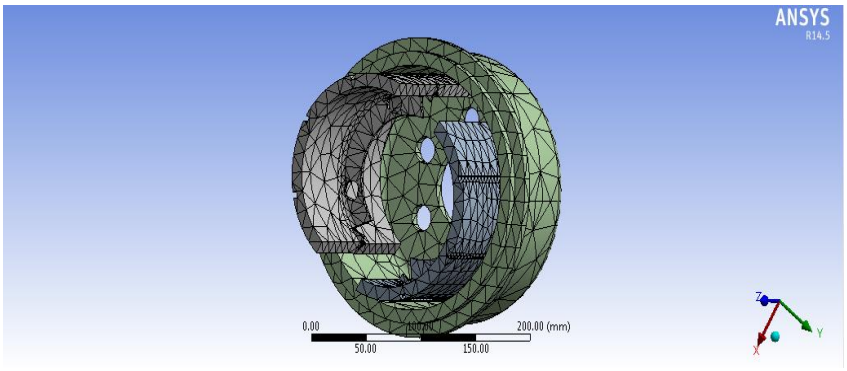

Fig. 5: Meshing model.

According above figure shows divided by elements through fine meshing.

Material-Aluminium Alloy

Total deformation

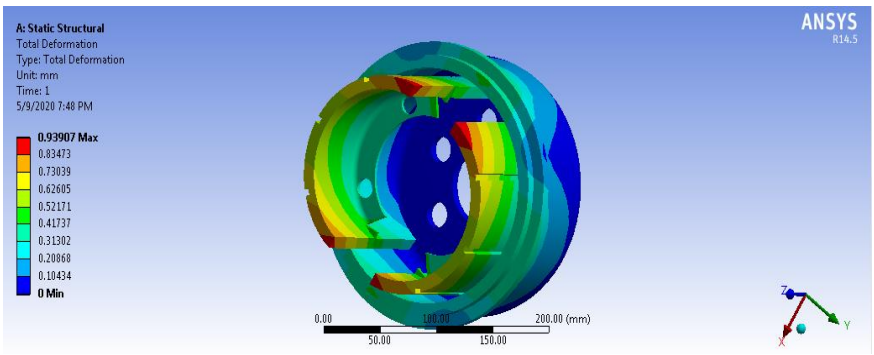

Fig. 6: Deformation.

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Equivalent stress

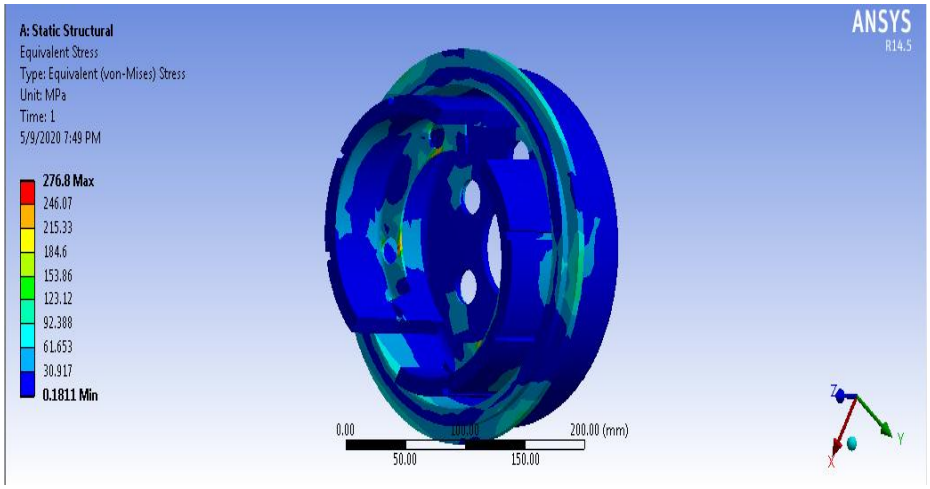
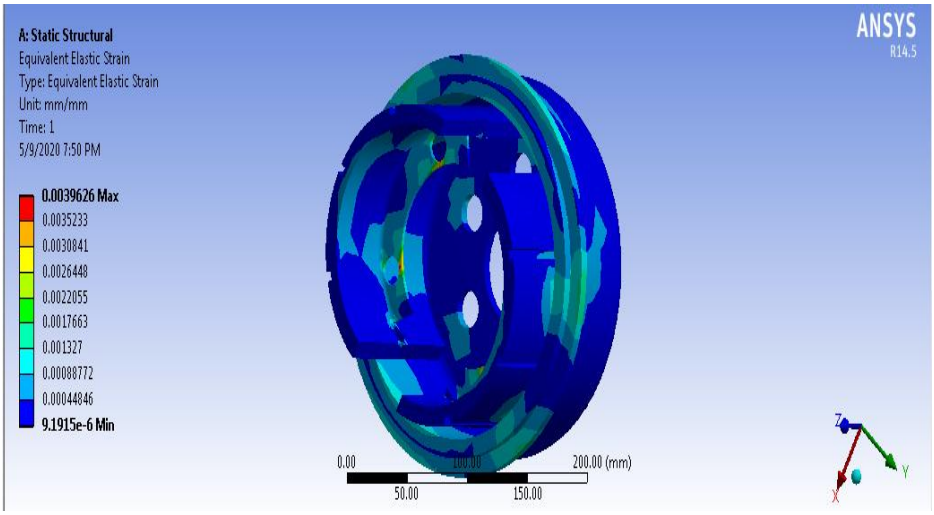


Fig. 7: Stress.

Equivalent strain



Static Analysis of Suspension System

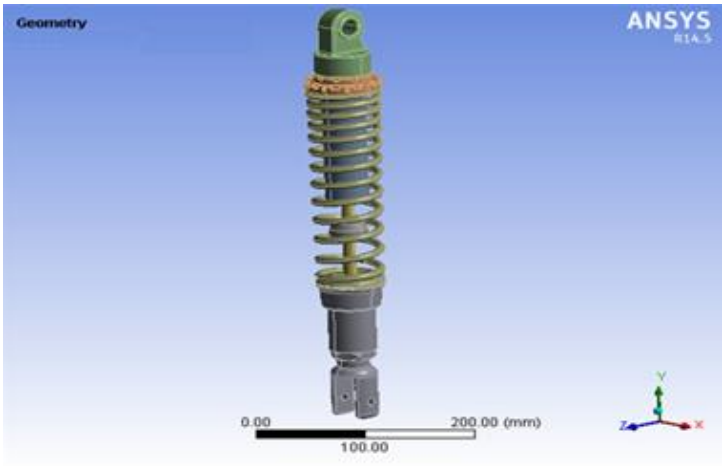


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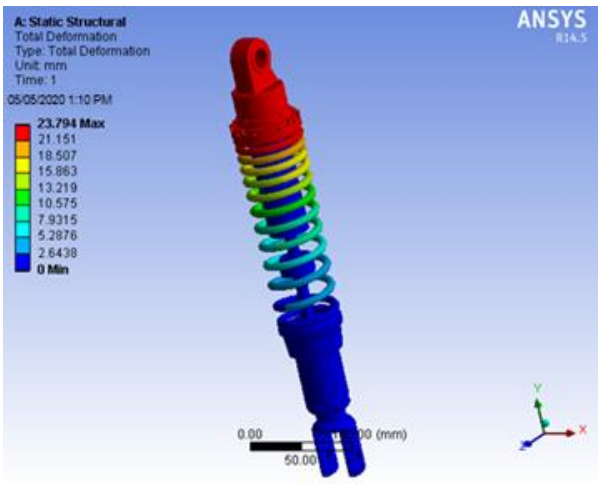
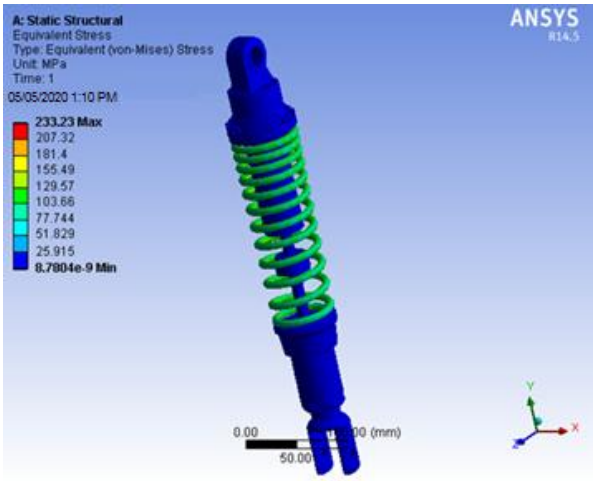
Fig. 8: Imported model.

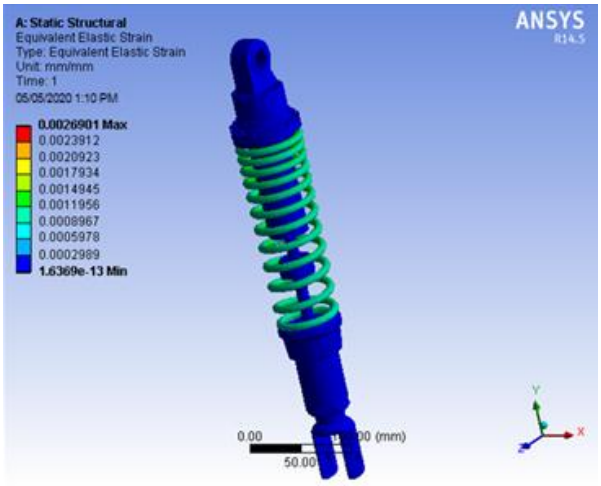
Total deformation



Stress



Strain



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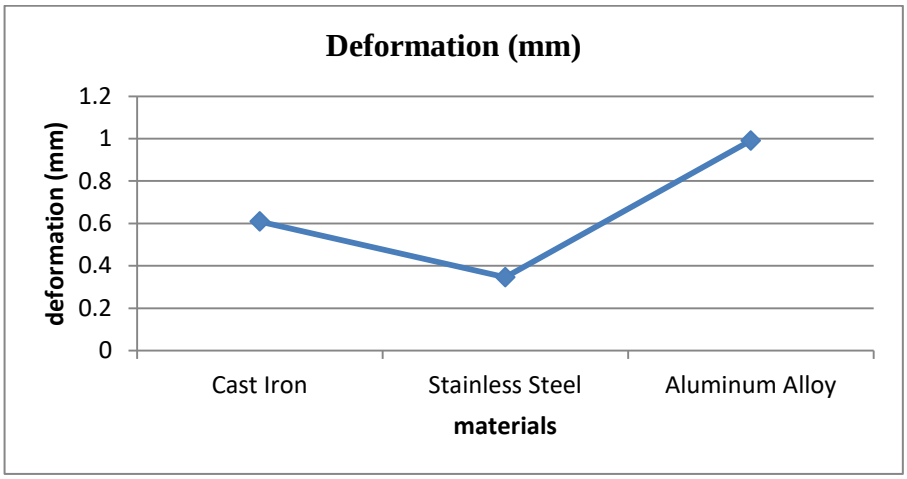
Static Results of braking system

Materials	Deformation (Mm)	Stress (N/Mm^2)	Strain
Cast Iron	0.60938	282.5	0.0026102
Stainless Steel	0.34637	279.2	0.0014703
Aluminum Alloy	0.9907	276.8	0.003926

Static Analysis Results of suspension system

Load (Kgs)	Deformation (Mm)	Stress (N/Mm^2)	Strain
175	23.794	273.23	0.0026901
250	22.74	377.89	0.0025092
325	31.875	529.68	0.003504

Static analysis Graphs



Stress

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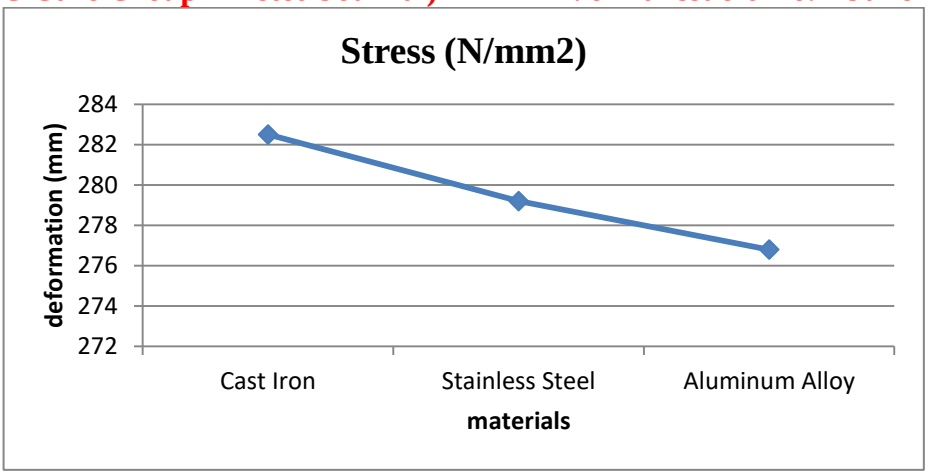

5. CONCLUSION

A two-wheeler suspension system is designed and modelled in 3D modelling software CATA. Structural analysis is done on suspension system at different loads 175Kg, 250Kg and 325Kg. By observing the structural analysis results, the stress value is less for Single person load than other loads. Modelling of drum brake and drum brake pads are done in CATIA design software. Thus both files are saved as igs to import into ANSYS workbench Structural analysis is carried on drum brake in ANSYS workbench First structural analysis of pressure of 1.5 Mpa is applied with three different materials such as cast iron, stainless Steel, aluminum alloy 7475. By observing the structural analysis results, the stress value is less for aluminum alloy than other materials such as stainless steel and castiron.

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