International Journal of Modern Developments in Engineering and Science
Volume 2, Issue 4, April 2023
https://www.ijmdes.com | ISSN (Online): 2583-3138


# Design and Development on Brake Fail Indication and Emergency Braking System

Rittumon Yeldo Mathew[1*], Om Prakash Shukla[2], Nikhil Kulkarni[3]
[1]M.Tech. Scholar, Department of Mechanical Engineering, Parul University, Vadodara, India
[2,3]Assistant Professor, Department of Mechanical Engineering, Parul University, Vadodara, India

***Abstract*: In today`s world with modern technology and era of smart vehicles in which day by day we are about to see new advancements in science resulting in the change of the vehicle structures and features even changing its mode of emissions and going to greener mode of vehicle. Even just a decade ago vehicles were having few sensors and in today`s era it has been brought up to 80-100 sensors even it might double in coming few years which will be based on Human comfort and safety values. Even due to this there is a huge possibility of accidents causing human injuries or even deaths, which in most cases are observed due to rash driving or malfunctioning of automobile parts. Other than that, there is poor anticipation, distraction, traffic law violation, poor lane marking, unclear traffic signs, bad road quality with dense potholes and so on. By introducing this new system, we tend to reduce the road accidents by providing a mode of passive safety feature as when the brakes are shot off emergency braking system comes to the play and its rear indication feature alerts the driver beside us so that there is no chance of direct collision with any other vehicle avoiding casualties and damages.**

***Keywords*: brake fail indication, emergency braking system.**

## 1. Introduction

In today's world with uprising in industries sector there is a huge demand for transportation which is been achieved by sea or land such as ships, trains, airplanes but there is one of the most reliable sector automobiles or we call it as vehicles on road which is having a drastic role in long as well as short range limits. Even after so much features brought in there is a lack of role in safety part due to which there is casualties and injuries Without further more negligence we tend here to bring a new type of system for cars

*Existing system (safety):* Active (before impact), passive (after impact) in active the vehicle is made to take selective steps so that there is no accident occur some of the system includes Anti-lock braking system which prevents loss of traction & control, Electronic stability and control helps the car from skidding and losing control in corners, Lane keeping assistance alerts the driver when the vehicle is moving out of lane and so on then comes passive safety which is activated after collision of the vehicle which tries to minimize the impact sustained, seatbelts in which there is an opposing force to driver and passenger to prevent them from falling out, airbags are also in this in which it opens up an inflated air filled cushion bag which protects head and other upper part during collision, crumpled zone located in front parts used to withstand an impact during collision by controlled deformation. Even after this much advancement in safety road accidents keeps on increasing. But in many cases the vehicle is not solely responsible for this, some factors such as potholes, slippery roads, sign indication are also not properly provided.

## 2. Implication of the New System and Why to Stop the Vehicle

According to a data in USA 5% of car crash are due to brake failure that comes to about 5.6 million. Even if USA being such a developed country so many accidents occur due to this so think of other countries how many accidents might have occurred over there. No matter how many safety steps are been taken but at the end it may occur one way or the other, even by introducing this new system we don't tend to completely stop the vehicle but definitely it will decrease the impact while having collision, and in this matter, driver has to be wise and calm even in this panic situation so that the vehicle can be brought to complete stop without affecting other person and our self. The need of stopping the vehicle completely in slope or in a normal road with less slope and if we have immense Load on the vehicle and suddenly the vehicle losses its brakes then with the help of EBS we can definitely make the car stop. It can be achieved even without the ebs but if the vehicle if fully loaded then it will be difficult to control its movement so here ebs can help along as it's based on the chain pulling mechanism that is been used in the train braking and pressure in its brakes won't be released via which won't allow the vehicle to move in any direction if the person don't release its pressure valve.

## 3. Proposed Work and Implementation Challenges

In today's world itself many of the developing and under developed countries the safety comes under a big question as manufacturers they give importance to features rather than safety, whether it may be count of air bags or the crumple zone, even the consumers also play an important role by choosing this type of vehicle due to their financial limitations as well as the fact that the maintenance cost is very less in this vehicle. The EBS system which we tend to introduce generally can come in

*Corresponding author: rittumon.yeldo@gmail.com

this manual version in which. Project mainly concentrates on the unpredicted malfunctioning of the brakes which when the vehicle is in motion at normal or high speeds this System helps to apply emergency brake. The system which we are about to produce will be basically focusing on the front wheel drive vehicle and this model will be placed on both left and right side of the drive shaft. Even via providing an indication via the existing indicators available in the market, via a blinking method or some other hazard showing indicators in order to alert the vehicles that the brakes are failed so move on other side as the emergency brake is going to be applied.

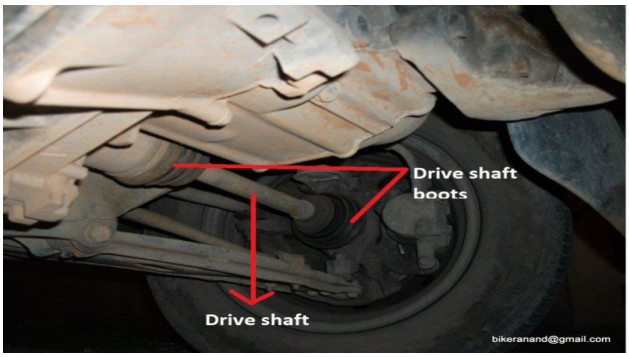



Fig. 1. Drive shaft and boot's location


Fig. 2. Different types of indicator options for alertness

## 4. Research Objective

*Aim:* To design & develop system on brake fail indication and emergency braking system and compare the previous work done related according to its usage and advancement of its small-scale model using solid works and then running a simulation using ANSYS or in solid works

*Objective 1:* Execution of program experimentally on the miniature of working model and performing the analysis based on the real-life working application on an Automobile with implication of this system.

*Objective 2:* Calculation of wear and tear and overall pressure difference acting on the body before the system is applied and after its activation.

## 5. Methodology

1) Literature review has to be done for couple of more papers and the said plan has to be analyzed theoretically, after identifying the pros and cons of the system.
2) Design of the setup and analysis has to be taken care of by using different methods available such as AutoCAD, solid works for designing aspect and ansys for computational analysis. Then based on that the calculation will be carried out.
3) After approving the actual experiment can be carried out on the test rig or miniature setup from which we get to know the actual requirement and its efficiency by which we can perform calculations and compare both the data then change according to the required availability.
4) Topic Selection has been chosen in order to solve the overgoing problems related to these issues.
5) Formulating Research Aim
6) Data Collection by referring to different data from the different authors has to be achieved by overgoing the process of collection so that it can be overlooked in vast matters.
7) Data Analysis now using different analysis methods such as ANSYS, solid works simulation or fusion 360 software's has to be set.
8) Reaching Conclusion with the best output possible to define the paper and its content showing that changes procured has to be set to the given model so that it can be made using different methods

## 6. Virtual Built 3D Model on Solidworks Software

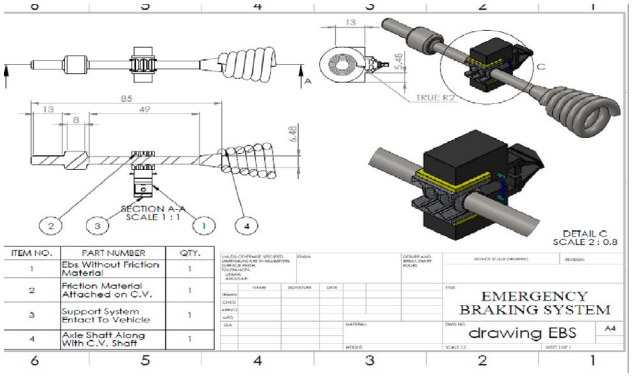



Fig. 3. Drawing chart of the model with specs

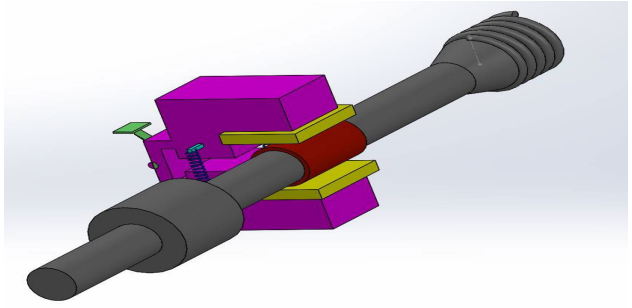
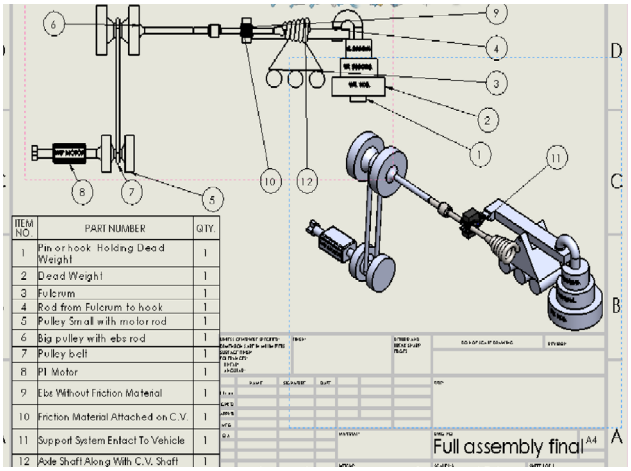


Fig. 4. Solidworks built snapshot (First model)




| ITEM NO | PART NUMBER | QTY. |
|---|---|---|
| 1 | Pin or hook Holding Dead Weight | 1 |
| 2 | Dead Weight | 1 |
| 3 | Fulcrum | 1 |
| 4 | Rod from Fulcrum to hook | 1 |
| 5 | Pulley Small with motor rod | 1 |
| 6 | Big pulley with ebs rod | 1 |
| 7 | Pulley belt | 1 |
| 8 | PI Motor | 1 |
| 9 | Ebs Without Friction Material | 1 |
| 10 | Friction Material Attached on C.V. | 1 |
| 11 | Support System Entact To Vehicle | 1 |
| 12 | Axle Shaft Along With C.V. Shaft | 1 |

Fig. 5. Drawing with specification of full assembly

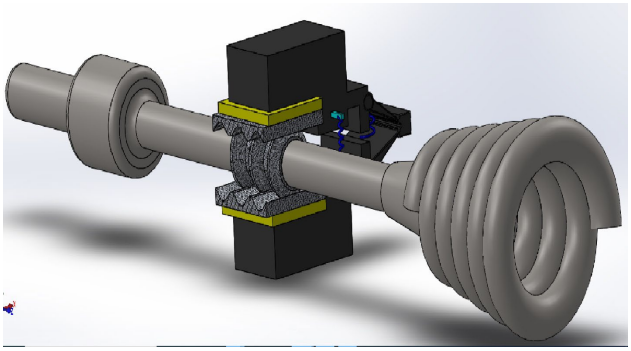


Fig. 6. Front view of EBS with latest modification

## 7. Brief on Actual Setup Placed in Normal Vehicles and that on a Model in Solidworks

### *A. Actual Setup on Front Axle Vehicle*

The following system will be installed between the constant velocity joints and the power transmitting differential rod in a manual or automatic vehicle before the system is enabled. If the system is not activated, the vehicle must be in neutral. The drive shaft of the car is depicted in the above diagram; on the extreme left are the drive shaft boots, which are used to transfer power from the engine to the shaft, and on the extreme left are the constant velocity joints, which are used to transfer rotary power to the wheel using a different shaft. The red centre component of this disc ring, which is typically comprised of cast iron but may also contain composite materials like reinforced carbon or ceramic matrix composites, serves as the braking medium. In this, ceramic or organic (which contain asbestos) brake pads are employed, and the yellow colour serves as the brake pads. The pink object is the holder that it attaches to, which may be controlled by the springs and piston cylinder arrangement that must be given so that, when used, the anti-lock braking system and chain pulling system principles can be used. The circulation rod in the green section will be connected to the car's body but will move freely vertically when the vehicle hits a speed breaker, protecting it from damage.

### *B. Material Specs on Small Scale Model*

Part 1: Motor
Part 2: Small pulley attached to motor rod
Part 3: Belt or rope or chain used in pulley
Part 4: Pulley connected with EBS rod
Part 5: EBS Actual Setup
Part 6: Rod joining EBS, fulcrum & hook
Part 7: Fulcrum
Part 8: Pin or hook holding counter weight
Part 9: Counter Weight

### *C. Using the Above Material Hands on Small Scale Model*

A 1 HP motor. The little pulley that is attached to the motor rod and transfers power to the large pulley by a transmission belt, or more to be utilised with this arrangement, The power obtained from the motor or, in the real-world scenario, a car tyre is then transmitted to a constant velocity shaft and then to a gear box by a second pulley that is connected to the EBS via a rod. A friction material will be present in the axle and will be attached to the EBS, a support rod, or a foundation that is intact to the car body so that the entire system is stable. The C.V. will be maintained open here, or if the vehicle is a real car, the gearbox, and at the end there will be counter weight linked using the pin & hook mechanism so that it can brake the motor or lessen the speed as we keep adding more weight to it, such as starting from 250GMs. 500Gms. 1KG or possibly more depending on the needs

## 8. Simulation Data

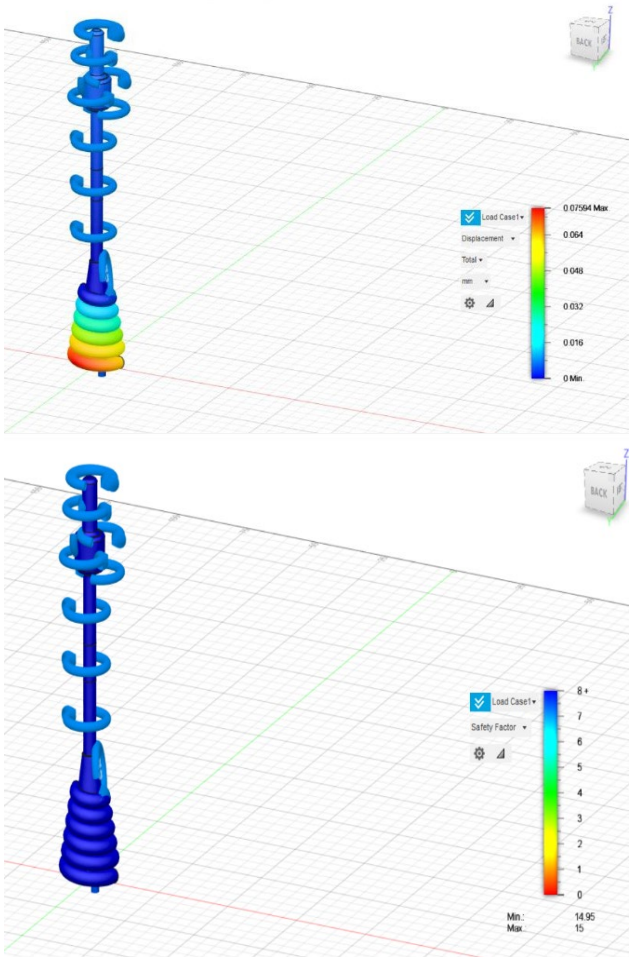



Fig. 7. Axle and constant velocity shaft

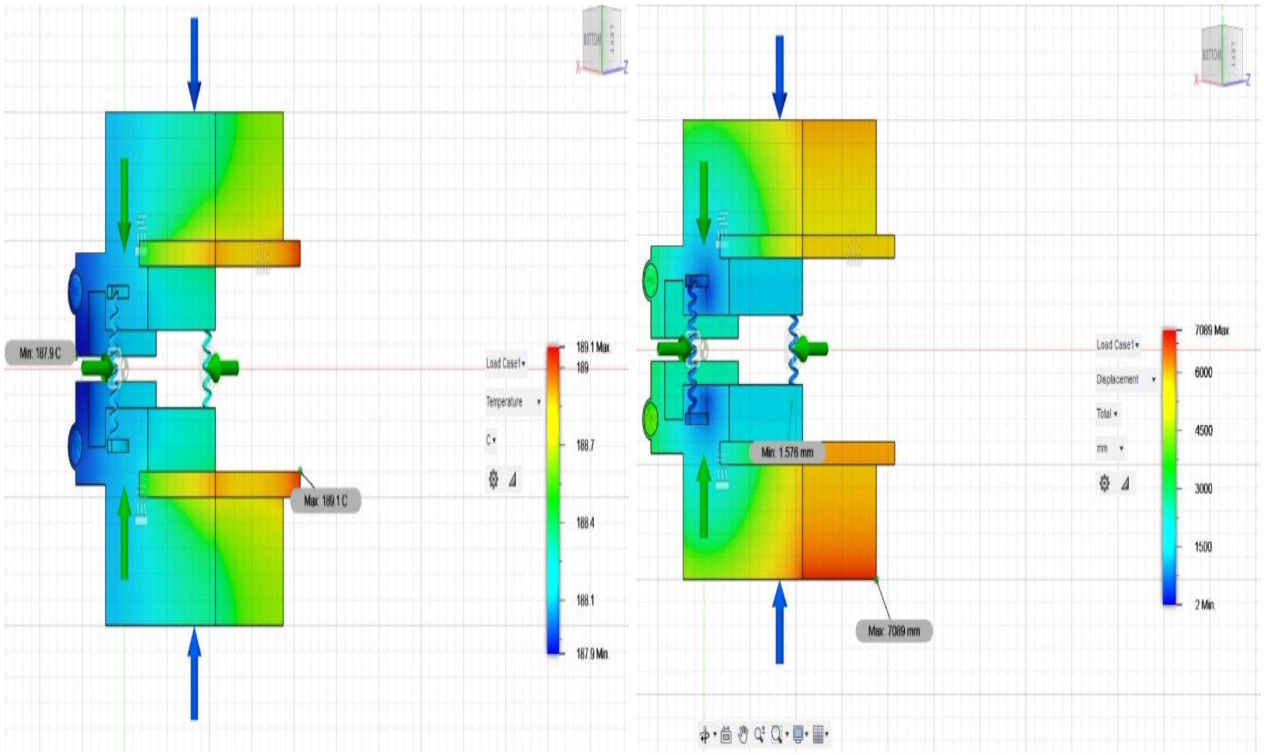



Fig. 8. Emergency braking system without friction material

Table 1
Dimension of model of each part

| Model Name | Specifications | Dimensions (in millimeters, mm & Degree) |
|---|---|---|
| Pin or Hook Holding Dead Weight | Base plate L*B | 15*8 |
| | U-rod L, D, L | 55, R10, 8.95 |
| | Rod Plate L*B | 9*2 |
| | Sweep Command D | R10 |
| Dead Weight | 1Kg Wt. D, dpt | R25, 15 |
| | Wrap Command (in all) dpt | 1 |
| | 500 Gms Wt D, dpt | 35, 15 |
| | 250 Gms.Wt D, dpt | 25, 15 |
| Fulcrum | Roller *3 D, dpt | 14, 30 |
| | Triangle B*H, dpt | 50, 33.75, 30 |
| | Small triangle H | 13.13 |
| | Holes *2 D | 3 |
| Rod from Fulcrum to hook | Main Rod L*H | 100*8 |
| | Cut extrude D | 8 |
| | Boss Extrude *2 D, dpt | 3,8 |
| | Small box L*H, dpt | 9.1,8,5 |
| | Tip connecting the ebs L*H, dpt | 4.40, 5.26, 9.1 |
| Pulley Small with Motor Rod | Roller Revolve Command H, B, H, A (single side) | 15,8,6,120° |
| | Single Rod D, dpt | 7, 60 |
| | Blockage Clip H, L | 12,3 |
| Big Pulley with Ebs rod | Roller Revolve Coomand H, B, H, A (single side) | 40, 10, 9, 140.20° |
| | Connecting Rod D, dpt | 5, 50 |
| Pulley Belt | Sweep Command D | R3.5 |
| | Total length D, L | 14, 100 |
| Motor | Main Head L, H | 30,15 |
| | Cut extrude hole D, dpt | 7, 15 |
| Ebs without Friction Material | Main Block L, H | 20, 13 |
| | Helical Spiring P, Rev | 0.75, 8 |
| | Friction plate resistor *2 L*B, dpt | 10*6, 1 |
| Friction Material Attached on EBS with EBS road | Base Plate *2 L, H, L, A | 10, 1.45, 0.6, 140.35 |
| | Friction Material (Shpherical) L, H, L, A | 10, 1.18, .34, 140.10° |
| Support System Entact to Vehicle | Box Connector L*B | 2.5*2.5 |
| | Spring & Sweep Command P, Rev, D | 1, 3.4, .25 |
| | Connect Rod *2 D, L | 1.5, 4.85 |
| Axle Shaft Along with C.V. Shaft | Rod connecting friction material D, dpt | 4.23, 50 |
| | Buldge part D, dpt | |
| | Rod connecting tire D, dpt | 10, 10 |
| | Loft Coomand D, dpt, D | 5, 15 |
| | C.V shaft spiral P, Rev, Sweep | 5,10,8 |

## 9. Result

After providing the result we have got that a model had been prepared in solid works and simulation is been done using the ANSYS and Fusion 360 simulation process, after that the results we got were really good, and this result will be giving better output compared to the previous work, The small-scale components used in the solid works with specified dimensions are as follows.

## 10. Conclusion

1) Auto accidents can be fatal and have a significant financial impact. Research advises that there should be requirements to maintain the vehicle notably the brakes.
2) Correct signaling of the brake's operational state can help minimize accidents brought on by brake failure. The brake wire's condition is continuously monitored by the system, which warns the rider in the event that it is about to be severed.
3) A good braking system ensures user comfort and safety, but as temperatures rise, brake performance is negatively impacted. This can be avoided by installing an adequate cooling system, which can be done externally by installing holes and fins or cooling fluid.
4) System, which offers a safe and effective emergency stopping process, contains peripherals and an android application. having better control in times of crisis. implementation in the areas with the highest incidence of chain pulling incidents.
5) A specialized rig was used to load the solid braking disc. Compressive and shear stresses caused by clamping load and applied braking torque were used to describe the mechanical stresses brought on by applied brakes.

### *A. Suggestion for Future Work*

The present work which is portrayed in this has been the classic work related to the modelling and simulation and further more details need to be covered.

1) To utilize the energy produced during friction & heat generation in for future prospect.
2) Till now the work has been done for small scale level but thinking to do for large level, in the future.
3) In order to get the optimal result more experimental data will be done in future.
4) We will concern the automobile authorities in order to indulge the same in their vehicle so that we will get to know the future work feasibility of the product of the prepared model.

## References

[1] Seth Daniel Oduro, “Brake Failure and its Impact on Road Traffic Accident in Kumasi Metropolis, Ghana,” International Journal of Science and Technology, vol. 1, no. 9, September 2012.

[2] Dhanamjayulu C., Chalamalasetti Guna Sai, Bharath Srinivas G., Hussain Basha D., Arunkumar G., and Venugopal P., “Brake Failure Detection and Emergency Braking System,” International Journal of Innovative Technology and Exploring Engineering, vol. 9, no. 2, December 2019.

[3] Mufti Reza Aulia Putra, Pandu Sandi Pratama, Aditya Rio Prabowo, “Failure of Friction Brake Components against Rapid Braking Process: A Review on Potential Challenges and Development,” Transportation Research Procedia, vol. 55, pp. 653-660, 2021.

[4] Alan Chen, Frank Kienhofer, “The failure prediction of a brake disk due to nonthermal or mechanical stresses,” Engineering Failure analysis, 124, (2021) 105319

[5] Budaraju Sri Datta, Rama Ganapathy, Sini Raj P., Shriram K. Vasudevan, Abhishek S.N., “An Inventive and Innovative Alternate for Legacy Chain Pulling System through Internet of Things,” Indonesian Journal of Electrical Engineering and Computer Science, vol. 6, no. 3, pp. 688-694, June 2017.

[6] Soumen Pal, D. Mallikarjuna Reddy, S Saha, A Sharma, “Design and Develop a Novel Brake lighting Mechanism for Intensity of Braking: Automobile Applications,” Materials Today: Proceedings, vol. 5, no. 5 Part 2, pp. 13069-13078, 2018.

[7] Michal Vojtíšek-Lom, Miroslav Vaculík, Martin Pechout, František Hopan, Alden Fred Arul Raj, Srinath Penumarti, Jiří Smokeman Horák, Olga Popovicheva, Jakub Ondráček, Barbora Doušová, “Effects of braking conditions on nanoparticle emissions from passenger car friction brakes,” Science of The Total Environment, vol. 788, 147779, 2021.

[8] Hyungjo Seo, Jongsung Park, Yun Cheol Kim, Jung Ju Lee, Ho Jang, “Effect of disc materials on brake emission during moderate-temperature braking,” Tribology International, vol. 163, 107185, 2021.

[9] C. Elanchezhian, B. Vijaya Ramnath, K.N. Sripada Raghavendra, Mithun Muralidharan, G. Rekha, “Design and Comparison of the Strength and Efficiency of Drive Shaft made of Steel and Composite Materials,” Materials Today: Proceedings, vol. 5, no. 1, Part 1, pp. 1000-1007, 2018.