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International Journal for Scientific Research in Modern Engineering and Science

International Journal for Scientific Research in Modern Engineering and Science, 1(1): 8-14 (2020)

MODELING SIMULATION AND TOPOLOGICAL OPTIMIZATION OF FRONT LOWER CONTROL ARM

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Abstract

The lower control arm (LCA) is a component used in light vehicle suspension systems. It plays a small role in armling wheel speed during punching, turning and braking. The scope in this present work is to optimize the front lower control arm with respect to weight with four different materials. A new design concept of the current work, the Frontal LCA, is presented. CATIA software has been used for modeling, the design concept of LCA. After that, ANSYS software is used to analyze the structural strength and optimize the part using topology optimization technique to obtain accurate dimensions with low mass. To verify the initial work, the existing model is taken from the literature as the basis and verified. The task also determines the natural frequency before and after adaptation. The new design aims at a twenty percent reduction in the total mass of frontal LCAs made of suitable materials. Finally, it has been observed that the use of topology optimization technique reduces the mass of LCA due to its reactions.

Keywords: *Front Lower Control Arm; ANSYS; FEA; Topology; Optimization*

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1. Introduction

The lower wishbone is also called an arm. Wishbone can be used as part of a suspension configuration without wheels. Read progressively to find that a fuse has two mounts on the car's skeleton and to find a wheel with which it is attached. Since two mounting bulbs are used twice, this is known as the double fork configuration. Dual forks give greater strength to the development of wheels at high speeds, which reduces the point of curvature as the wheel moves up and down by irregular finished surfaces. Fuses can be effectively balanced as each wheel can be swapped for an ideal wheel development. In cars, a double fuse suspension (or upper and lower arm) is a free suspension configuration that uses two (sometimes parallel) molded fuse arms to find the wheel.

During the actual working condition, the maximum load is transferred from the upper fork arm to the lower arm, which is the probability of failure and lightening of the lower fork arm in place of the ball joint, as well as the arm produced by the road. Control conditions are not desirable due to impact load. Therefore, to improve and modify the existing design it is necessary to focus on the study of stress-strain analysis of the lower arm of the fuses. In addition, current conventional materials (mild steel) are replaced with composite materials (carbon fiber polymer). The current car used a double fork suspension arm made of mild steel and could affect the weight of the vehicle. Therefore, to further improve and overcome this problem, a study has been done on the car suspension and is a composite material. Carbon fiber has proven its strength beyond polymer steel and provides less weight.

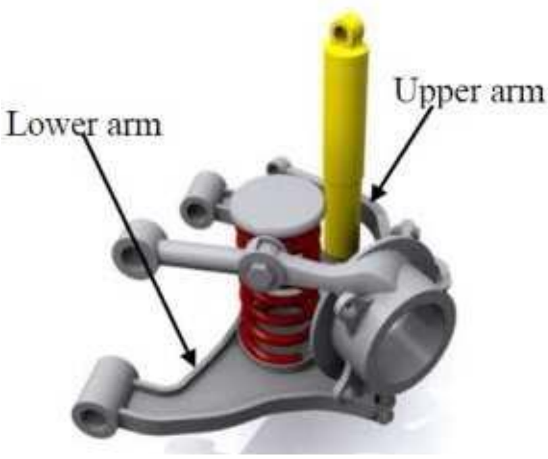


Figure 1. Multi link suspension arm

Topology improvement (TO) is a scientific strategy that advances the format of content within a certain planning space, to provide weights, boundary conditions, and limits to extend the execution of the framework. Rationalization of the two form and measurement is not the same as an improvement, since the scheme can achieve any form within the contour space rather than managing predefined arrangements.

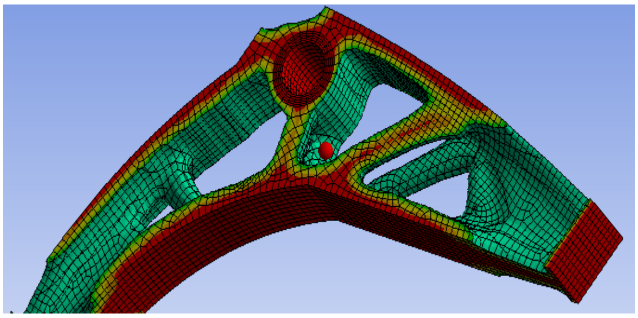


Figure 2. Topology shape optimization using ANSYS software (www.finiteelementanalysis.com)

2. Modeling and Meshing of Suspension Arm Design

The LSA design is the initial step to design the suspension system. Initially, the material is selected for optimization. Based on the properties of the selected material, allowable stresses are calculated using shear stress failure theory. LSAs designed in solid works are formulated with ANSYS analysis software to detect maximum effort and maximum deflection.

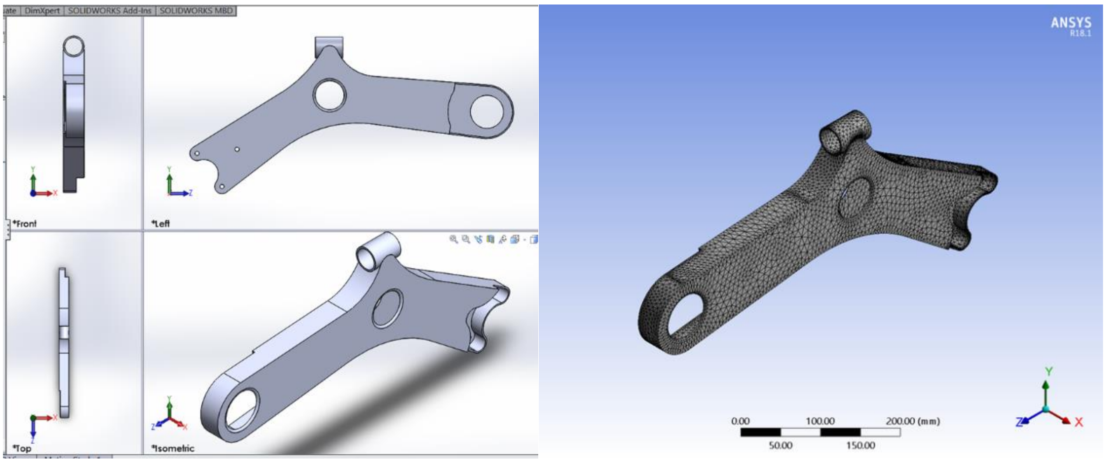
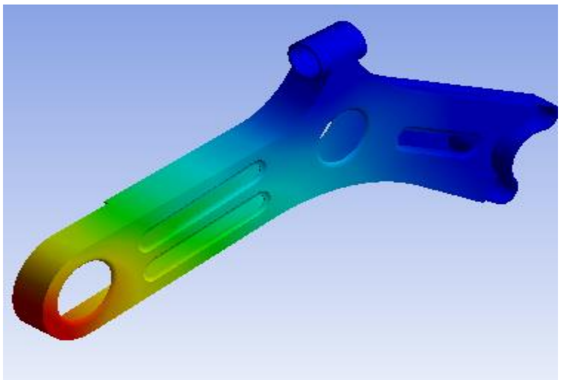


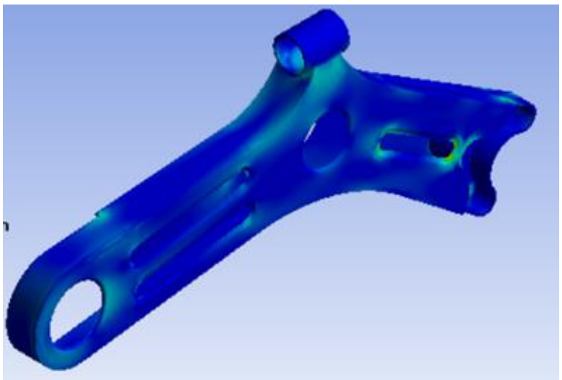
Figure 2. 3D model (left) and meshed views of front lower suspension arm (right)

3. Results & Discussions

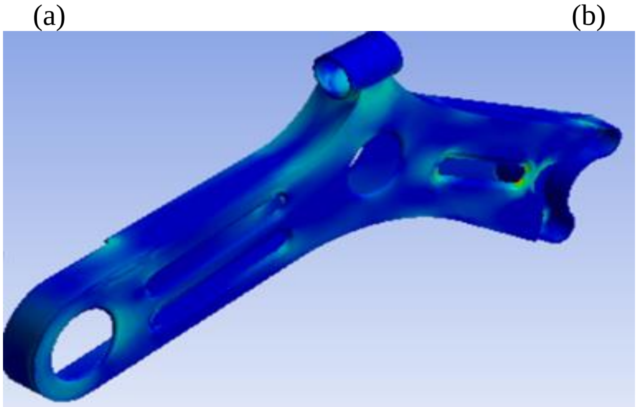
After done the topology optimization the results are obtained. This all results are discussed in this chapter with comparing and improvement with a good literature [9].



(a)



(b)



(c)

Figure 3. Result of deformation, von-mises and maximum shear stress obtained

Above Figure 3 shows for EN24 material, for other material same procedure can be done.

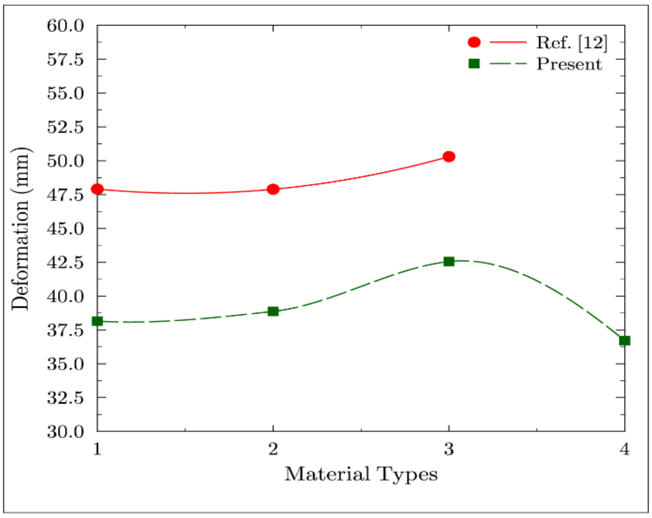


Figure 4. Graph of comparison of total deformation to different materials

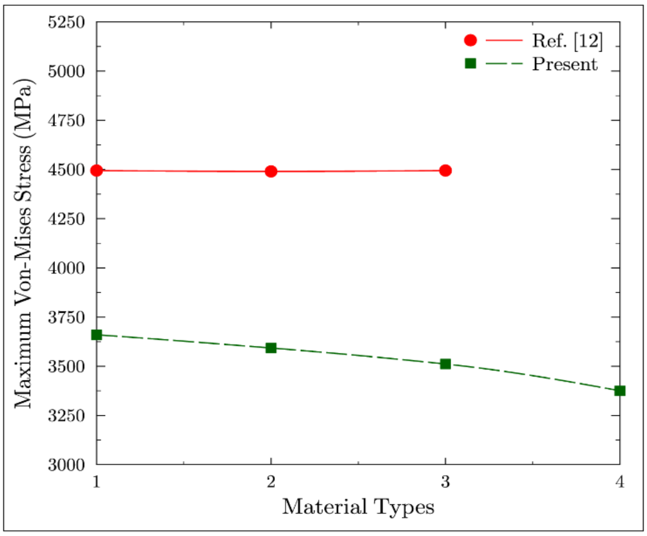


Figure 5. Graph of comparison of Von-Mises stress to different materials

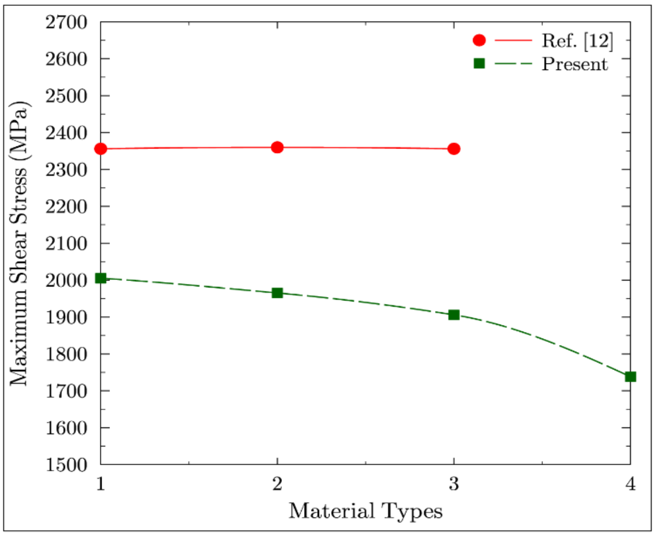


Figure 6. Graph of comparison of maximum shear stress to different materials

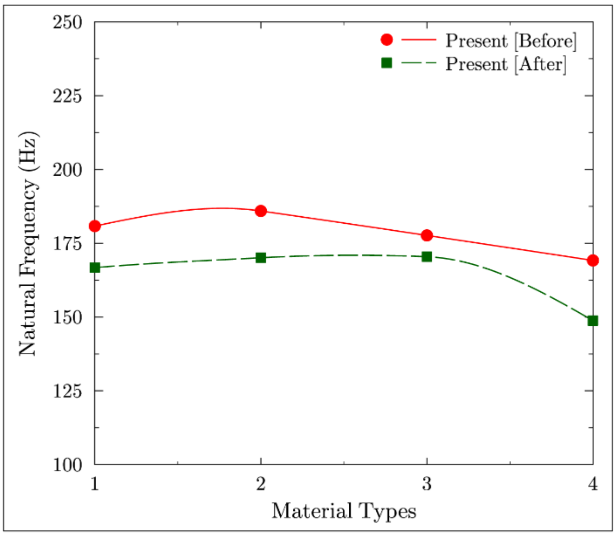


Figure 7. Graphical comparison of natural frequency to different materials

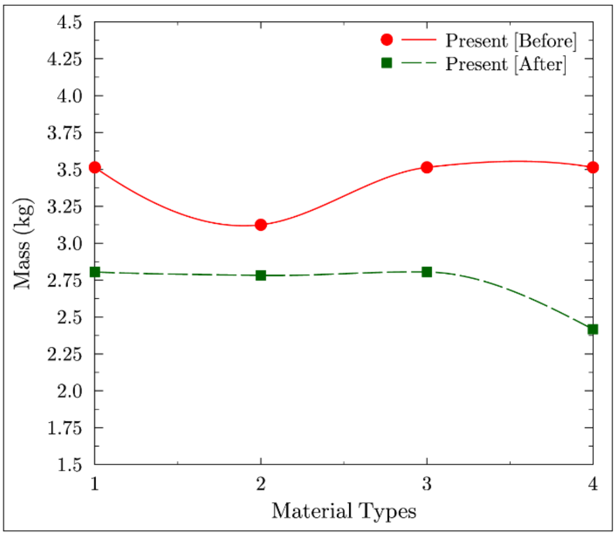


Figure 8. Graph of mass before and after optimization different materials

4. Conclusions

- The front lower control arm is one of the most widely used in independent suspension systems. It transfers maximum load from upper hand to lower hand during hand movement. So, the main objective of the job is to improve the performance of the hand.
- The main objective of this work is to investigate and investigate a new light weight of FCAA using topical optimization and introduced the effective material (C70 steel) used in the FCAA.
- It is observed in the present work that the use of optimized or modified design reduces the total deformation, von-mi effort and shear stress in the design, as well as the minimum natural frequency.
- Using topology optimization technology, a large-scale reduction of up to about 31% can be achieved compared to the current or existing FLCA design concept.

- From the current investigation, it is concluded that the unique and robust design provides better performance than the current commercial FLCA.
- Furthermore, from this existing work which has been concluded using topology optimization technique, the design mass is being reduced with a slight effect on the output response.
- Topology optimization tools have made a good compromise between traditional design and non-traditional optimization techniques.
- This technique is signed into the design from concept to final model in a short period of time.

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