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ANALYSIS AND OPTIMIZATION OF LOWER CONTROL ARM IN FRONT SUSPENSION SYSTEM

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ABSTRACT

The main objective of this paper is project is to model and to perform structural analysis of a lower control arm used in the front suspension system, which is a sheet metal component. Lower control arm allows the up and down motion of the wheel. It is usually a steel bracket that pivots on rubber bushings mounted to the chassis. The existing method in lower control arm

Key words: Structural analysis, Control arm, Chassis

INTRODUCTION

Proposal method in lca is using high carbon steel. To analyze the LCA, CAE software is used. The load acting on the control arm are dynamic in nature, structural load analysis is essential. First finite element analysis is performed to calculate the buckling strength, of a control arm. The FEA is carried out using ANSYS package. The design modification has been done and FEA results are compared. The influencing parameters, which are affecting the response are identified. After getting the final result of finite element analysis optimization has been done using design of experiment method. This leads to cost saving and by modifying material strengthen the product. The final result will be compared with the existing component design to the new design.

EXPERIMENTAL

Literature review

Kumar, Nithin, R. K. Veersha[1] by following design of experiments our team came up with nine possible case models to present to Hwashin. We utilized ABAQUS software to

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run a Finite Element Analysis for each case, of which we selected the best two examples that met Hwashin's criteria of minimizing stress while being lightweight. Our team was notified that the Front Lower Armexperienced the highest levels of stress when the automobile abruptly stops or accelerates. By utilizing CATIA for CAD surface modeling and ABAQUS as the program to run Finite Element.Analyses, we hoped to optimize the Front Lower Arm to the best of our ability.

Lihui Zhao, Songlin Zheng[2], In the paper "Stress Analysis of Lower arm and Validation by Photo-Elasticity" states that "Lower arms are highly liable components and are always subjected to failure due to accumulation of large amount of stresses, which can eventually lead to its failure, by predicting the stress concentration area, the shape of the lower is modified to increase its working life and reduce the failure rates**.**

Santosh Shaun[3]: FEM concept is used in the locking system of the lower arm stress factor is distributed uniformly, damage factor. The database is used to identify the load conditions that were Fatal to those damaged lower-arms. Some of the feature points are selected on the lower-arm design; the deformation of a damaged lower-arm can be then obtained based on the feature points detected by means of the image processing. The critical load condition of the damaged lower-arm is calculated by comparing the obtained actual deformation and the simulated deformation values in the database. On the basis of these calculated load conditions, the critical load condition for the lower-arm is estimated as a statistical distribution based on the bayesian approach. Takuma Nishimura, Takao Muromaki, KazuyukiHanahara, Yukio Tada, Shigeyuki Kuroda and Tadahisa Fukui; "Damage factor estimation of lower-arm in this section, contribution of various researchers is described.

E. Narvydaset et al.[4] investigated circumferential stress concentration factors with shallow notches of the lifting arms of trapezoidal cross-section employing finite element analysis (FEA). The stress concentration factors were widely used in strength and durability evaluation of structures and machine elements. The FEA results were used and fitted with selected generic equation. This yields formulas for the fast engineering evaluation of stress concentration factors without the usage of finite element models. The design rules of the lifting arms require using ductile materials to avoid brittle failure; in this respect they investigated the strain based criteria for failure, accounting the stress triaxiality.

Problem definition

Design calculation

Length of the lower control arm = 212 mm

Breadth of the lower control arm = 19.08 mm

Centre distance of the lower arm = 179.7 mm

Material of lower arm = High carbon steel

Young’s modulus = 2e + 1L

Poisson’s ratio = 0.3

Reaction force

R_A = wl (l-2c)/h …(1)

= 1000 X (6512.64-2 X 179.7) /16

= 384.571 N

R_B = wl(1-2a)/2b …(2)

= 1000 X (6512.64-2 X 4044.96) /19.08

= 322.496 N

Calculation for shear force and bending moment

V_1 = wa …(3)

= 1000 X 4044.96

= 4044.96 N

V_2 = V_1 -R_A …(4)

= 4044.96 -384.517

= 318.835 N

V_4 = wc …(5)

= 1000 X 179.7

= 179,700 N

V_3 = R_B –V2 …(6)

= 322, 496-3660.443

= 267, 234 N

Bending moment

$$M1 = -wa_2/2 \quad \ldots(7)$$

$$= -2.929 \text{ X } 914.4^2/2$$

$$= -1224508.519 \text{ N-mm}$$

$$M2 = -\ wc^2/2 \quad \ldots(8)$$

$$= -2.929 \text{ X } 670.56^2/2$$

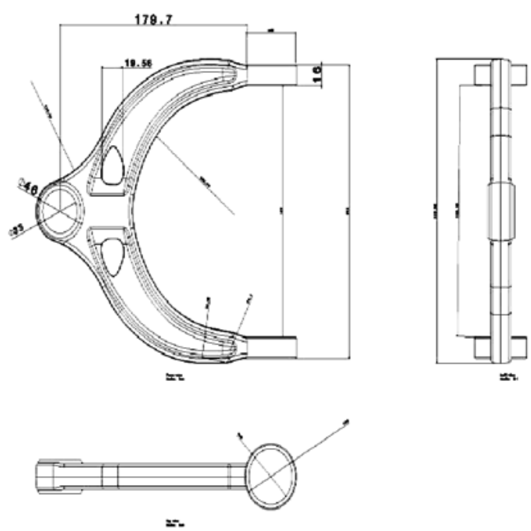
$$= -658513.4701 \text{ N-mm}$$

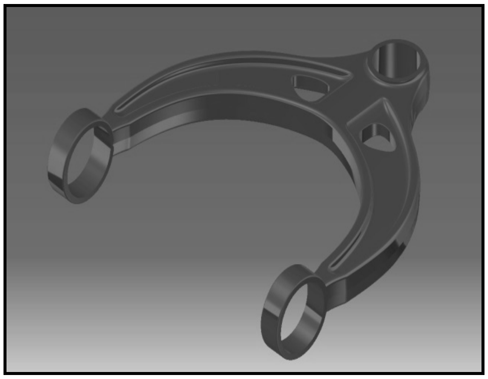
$$M3 = R_A\,(R_A/2w \_\ a) \quad \ldots(9)$$

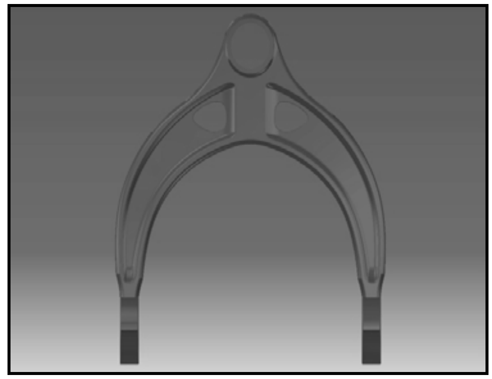
$$= 558566.0757 \text{ N-mm}$$

Design details

Chassis parts are a critical part of a vehicle, leaving no room for error in the design and quality the present process relates to a computer-aided structure analysis and design graphic display device and method, and more particularly, to a computer-aided structure analysis of lower control arm, and which is analyzed and design deemed the customer requirements of LCA. Our project is to optimize the lower control arm by DOE (design of experiments) by suggesting suitable material, and reducing sheet metal thickness. To reduce the batch production cost and to increase the strength of LCA.



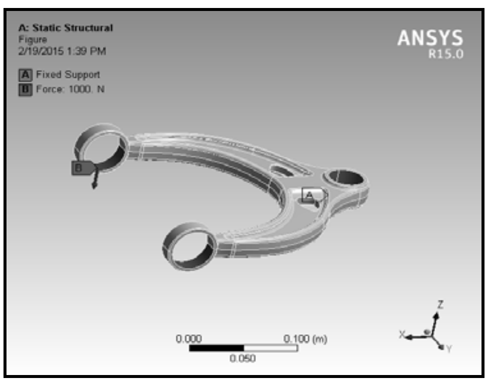


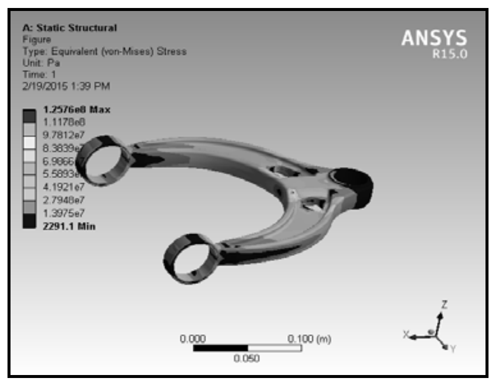


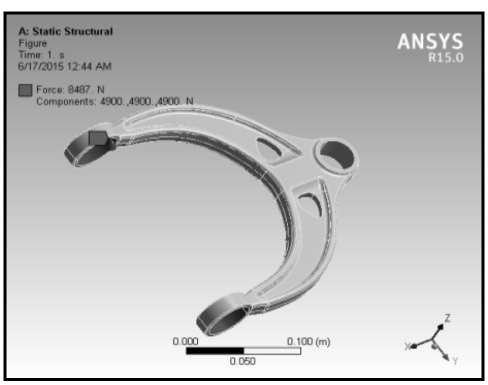
Lower arm

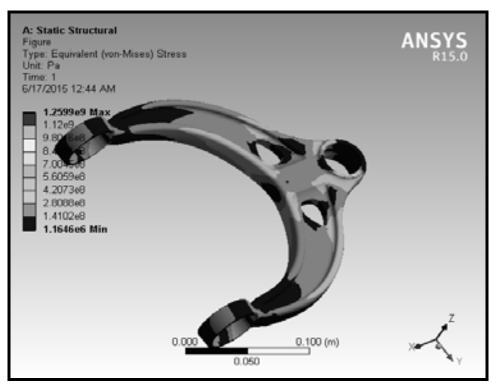
The lower control arm is the most vital component in a suspension system. There are two control arms, lower control arm and upper control arm. Lower control arm allows the up and down motion of the wheel. It is usually a steel bracket that pivots on rubber bushings mounted to the chassis. The other end supports the lower ball joint.

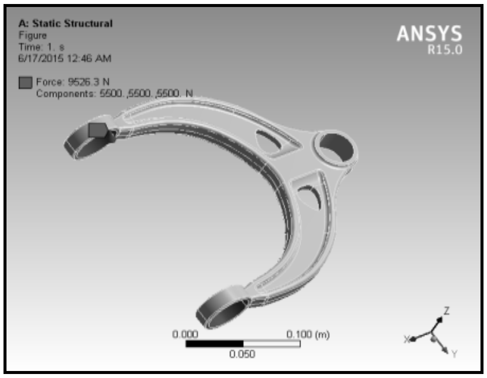
Structural analysis by various loads

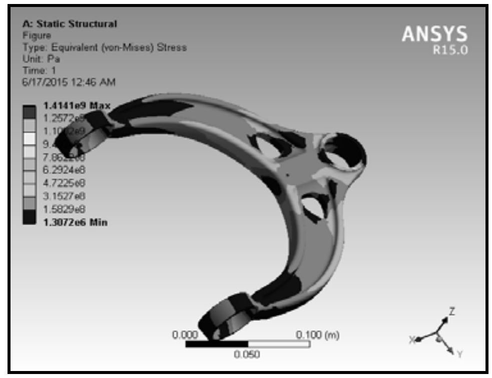




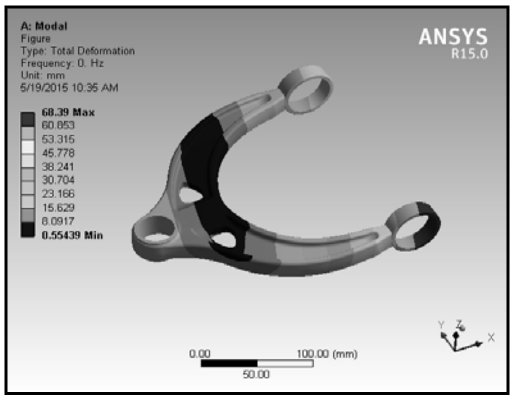








Model analysis



Graphical representation

Loads	Structural steel	Composite matreial	High carbon steel
1000N	1.173e8	1.1563e8	1.2576e8
4900N	5.1421e8	6.1231e8	1.126e9
5500N	5.717e8	7.1522e8	1.149e9

CONCLUSION

The existing design will be modified, by reducing the thickness of the existing profile and the reinforcement of the plate. The optimization of lower control arm will be done by applying the DOE method. The parameters are identified. The sheet metal thickness of the design will be reduced from 3.6 mm to 3 mm and material will be modified from high carbon steel of IS513 to SA1020. Finally mass of the control arm has been expected reduce to 13.8% from existing model.

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