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Design Modification and Improvement on Automobile Suspension System

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***Abstract:** Now days the air suspension system is used in all commercial vehicles like buses and trucks. In the recent era the peoples are looking for Air suspension in Light Commercial Vehicles. The Air suspension system comprises of many brackets, from them we selected the parallel link bracket. The existing Parallel link bracket is consists of more number of supporting plates, tubes, welding and also it having more weight. This type of brackets ate mounted in vehicle chassis with the help of bolted joints. The weight of the Air Suspension System is more important in the aspect of vehicle mileage. All the major OEM's are pressurising for reducing the weight of the air suspension system. By assimilate the optimized process or process route, removing the unfavourable materials or processes and decreasing the number of parts in mandatory area, mean while without affecting the requirement of the component and also reducing the weight of the components or assembly.*

I. INTRODUCTION

The main purpose of a suspension is to separate the body and occupants from the asymmetry of the road. Another major feature of suspension is to maintain the tires on the ground in all the way. If there is no suspension on the tires would lead to lift off from the ground surface every time when they passed over a bump at the same time, the shock on the wheels lift from the ground and came down. Maintain the wheels in the proper steer and camber attitude to the road surface, Resist roll of the chassis. There are two types of suspension system are available namely mechanical suspension and pneumatic system [2]. The mechanical suspension systems are designed for constant sprung mass of the vehicle. Hence required the spring stiffness and frequency will be achieved only where the vehicle is in fully laden condition. But in the other conditions of vehicle like Unlade and varies load condition the stiffness and frequency level will be very high. The other one is air suspension system designed for different load conditions of the vehicle. Hence the spring stiffness and frequency are need to maintain within the limit in all the vehicle conditions like, full laden, Unladen and various load condition. Based on the vehicle load, the pressure inside of the air spring will vary automatically to maintain the spring stiffness and frequency of the vehicle [1].

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The safety concern is important for any vehicle. This paper deals the safety about children and pets left in the vehicle when a car is parked in direct solar radiation [4]. The small modification leads major changes in performance of vehicle [6]. The modification on the components towards safety concern is a major area for resaech. carried out for automobile radiators [7]. Suitable modifications are to be done on braking system to improve the safety concern [5]. Nowadays all passengers prefer to travel Air-Suspension buses/cars for better comfort and tied fewer journeys [3]. It gives better comfort than the conventional mechanical spring suspension systems. The maintenance and replacement cost of the Air-Suspension components are also comparatively low. The parallel link bracket consists of many components as shown in Fig. 1.

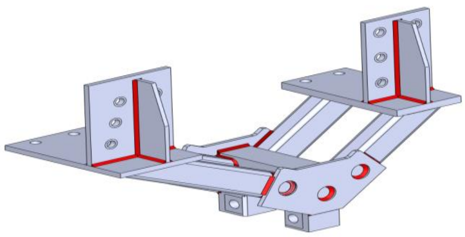

Fig. 1 Parallel link bracket

1.1 Finite Element Analysis

Structural analysis is probably the preferable application method in finite element method. The finite element method is a mathematical procedure that can be involved to obtain solutions of a major class of engineering problems involving stress analysis, heat transfer, electromagnetism, and fluid flow. The basic concept of the Finite Element Method, when applied to problems of structural analysis, is that a continuum can be modelled analytically. It is subdivision into regions considered interconnected at joints called nodes or nodal joints. In each of elements, the behaviour is described by a separate set of assumed functions representing the displacements or stresses in that region. By means of variation principle, a set of equations is used for each element to be assembled to represent the equilibrium or compatibility of the entire body. Finite Element Analysis is the simulation of a physical system by a mathematical approximation of the real system. Using simple, interrelated building blocks called elements; a real system with infinite unknowns is approximated with a finite number of unknowns. A Finite Element Analysis Model is the mathematical idealization of the real system is shown in the Fig.2

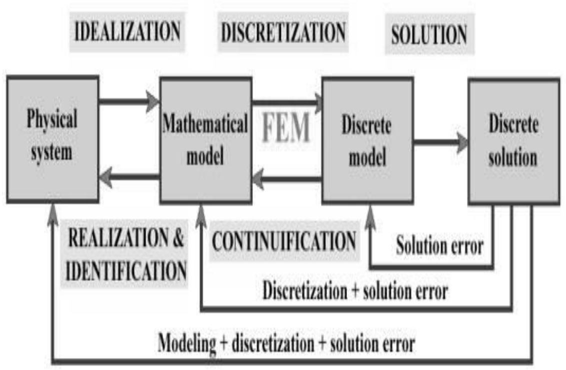

Fig. 2 Finite element Analysis

II. METHODOLOGY

The work flow included CAD modelling, Finite Element modelling, application of material properties, boundary conditions, loads, analysis for various load combinations, post processing and result validation. The Parallel link Bracket assembly is meshed with 10-noded second order tetrahedral elements. Mesh controls with fine element size are applied at the critical locations for better convergence and the analysis is run for the various load combinations as shown in Fig. 3 and Fig.4 and the free body diagram force considerations are show in Fig.5.

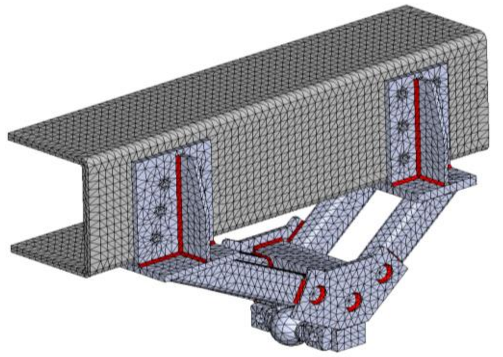

Fig. 3 Meshed model of Existing Parallel link bracket assembly

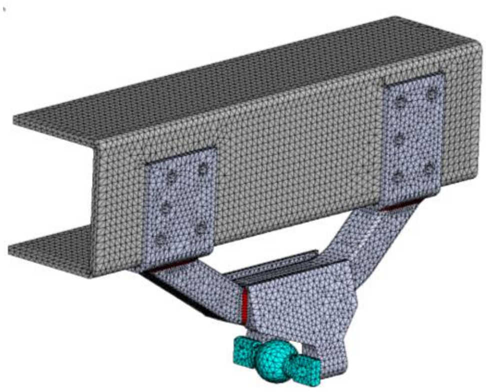

Fig. 4 Meshed model of Proposed Parallel link bracket assembly

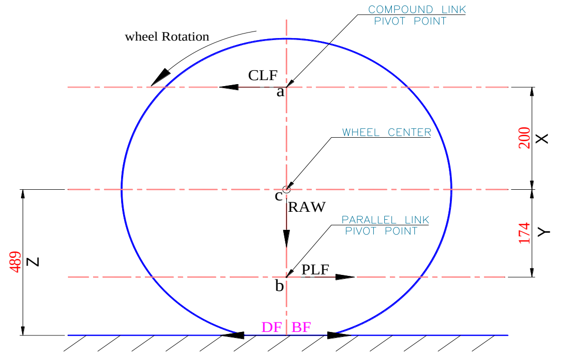

Fig.5 Link Force calculation free body diagram

III. RESULTS AND DISCUSSIONS

The parallel link bracket subjected to above loading conditions and found that the directional stresses are within the yield strength limit of the material. To check the normal stress (X, Y and Z direction) and resultant displacement of new parallel link bracket compared with the existing parallel link bracket.

3.1 Normal stress along X direction

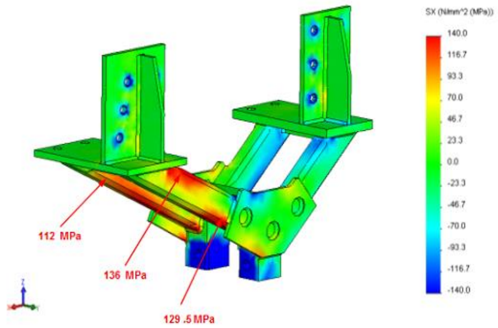

Fig. 6 Normal stress along X direction in existing parallel link bracket

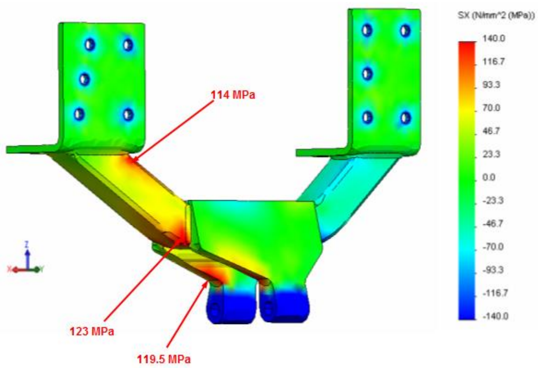

Fig. 7 Normal stress along X direction in proposed parallel bracket

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Comparing the induced stresses along X Direction in both existing and proposed parallel link bracket is lesser than the material Yield Strength of 260 MPa. Whereas in the existing bracket the stress observed is 136 MPa and the proposed bracket is 123 MPa which is lower than the existing bracket as shown in Fig.6 and Fig.7

3.2 Normal stress along Y direction.

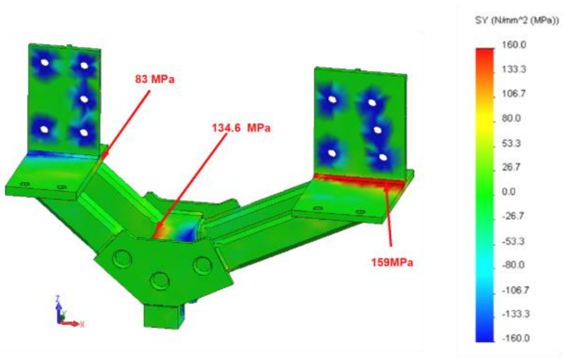

Fig.8 Normal stress along Y direction in existing parallel link bracket

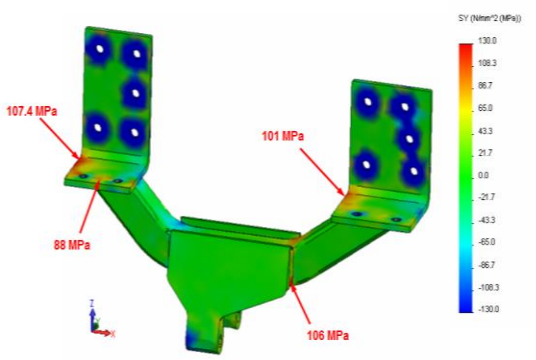

Fig. 9 Normal stress along Y direction in proposed parallel link bracket

Comparing the induced stresses along Y Direction in both existing and proposed parallel link bracket are lesser than the material Yield Strength of 260MPa.Whereas in the existing bracket the stress observed is 159 MPa and in the proposed bracket is 108 MPa which is lower than the existing bracket as shown in Fig.8 and Fig.9.

3.3 Normal stress along Z direction.

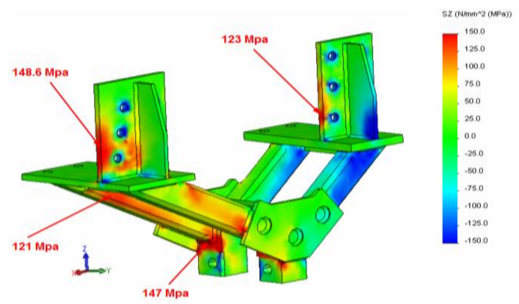

Fig.10 Normal stress along Z direction in existing parallel link bracket

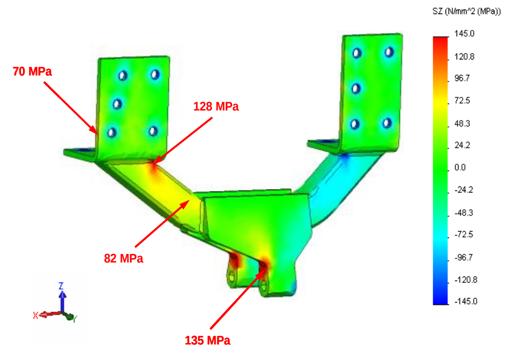

Fig. 11 Normal stress along Z direction in proposed parallel link bracket

Comparing the induced stresses along Z Direction in both existing and proposed parallel link bracket are lesser than the material Yield Strength of 260MPa.Whereas in the existing bracket the stress observed is 149 MPa and in the proposed bracket is 135 MPa which is lower than the existing bracket as shown in Fig.10 and Fig.11

3.4 von Misses stress

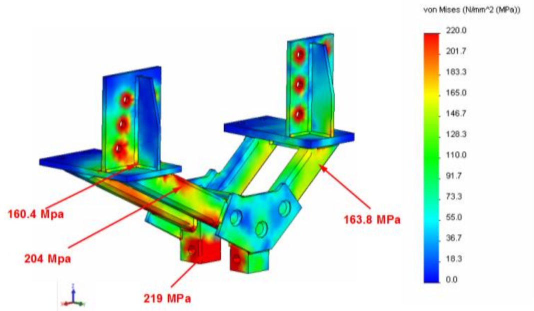

Fig. 12 von Misses stress in existing parallel link bracket

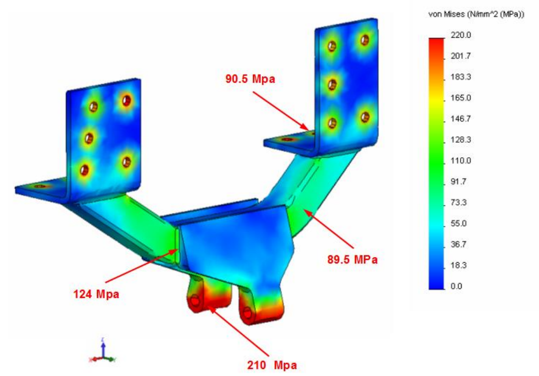

Fig. 13 von Misses stress in proposed Parallel link bracket

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The induced von Misses stresses in both existing and proposed parallel link bracket are lesser than the material Yield Strength of 260MPa. Whereas in the existing bracket the stress observed is 219 MPa and in the proposed bracket is 210 MPa which is lower than the existing bracket. Refer the Fig.12 and Fig.13

3.5 Resultant Displacement

The displacement between the existing and proposed parallel link bracket, the existing bracket found minimum as 0.001 and maximum as 0.303 and the proposed bracket it found minimum as 0.008 and maximum as 0.286 as shown in Fig.14 and Fig.15 respectively and the comparison results are presented in table 1.

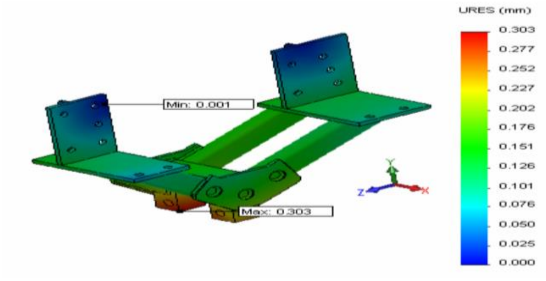

Fig. 14 Resultant displacement in existing parallel link bracket

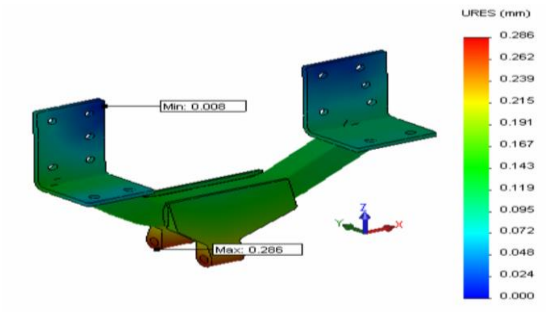

Fig. 15 Resultant displacement in proposed parallel link bracket

Table 1 Component life comparison

S.No	Description	Existing Bracket	Proposed Bracket
1.	Amplitude stress	79.5 MPa	67.5 MPa
2.	Mean stress	79.5 MPa	67.5 MPa
4.	Surface finish factor	0.7677	0.7677
5.	Size factor	0.7993	0.7993
6.	Load factor	0.75	0.75
7.	Temperature factor	1.0	1.0
8.	Reliability factor	0.897	0.897
9.	Expected Life	1.35 * 10^6 Cycles	2.95 * 10^6 Cycles
10.	Factor of safety	1.635	1.925

IV. CONCLUSIONS

The detailed analysis is being carried out for the modified suspension system for automobiles. The analysis concludes the following point which could be incorporated in the real time product. Fatigue failure of the component is happening due to under repeated loading and also fatigue is an interdisciplinary problem which occurs due to combined interaction of loads, materials, manufacturing, environment, probability, crack initiation, detection and growth. About 50-60% of mechanical failures are due to fatigue. In the modified suspension system saves cost about 1600 rupees per component through value engineering and value analysis.

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