Weight and Shape Reduction of Vehicle Chassis Joints Using FEM

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***Abstract*: The suspension is a significant part in a vehicle framework. This work included Strength, load and weight examination, to decide key attributes of a truck skeleton. The static qualities incorporate recognizing area of high strength region and deciding the twist solidness of the skeleton for optimum weight. The unique attributes of truck suspension, for example, weight, stress, the normal recurrence and mode shape were can be calculated. Test modular examination was done by Finite Element method. Modular refreshing of truck frame with joints on body model was finished by changing the specific properties like mass thickness and Poisson's proportion. The different materials are considered during analysis to know the overall stress, deformation and weight variation.**

***Keywords*: Truck chassis joints, bumper bracket, FEA, Chassis frame.**

I. INTRODUCTION

Each vehicle has a body, which needs to pull both the heaps and its fair share. Vehicle body comprises of two sections; skeleton and bodywork or superstructure. Test modular examination was completed to approve the FE models. Modular refreshing of truck body model was finished by changing the specific properties like mass thickness and Poisson's proportion. Anticipated normal recurrence and mode shape were approved against exploratory outcomes.

At long last, the alterations of the refreshed Finite Element truck skeleton model was proposed to diminish the weight, work on the strength, and enhance the soundness of the frame.

The significant spaces of worry in the truck body were observed to be incident of an underlying reverberation at 52 Hz, encountered the torsional and twisting mode. Adjustments to move normal frequencies were proposed by expanding thickness of the body at joints focus segment by 2 mm and extra of stiffeners part situated at joints side space of the base plate. Furthermore, the general changes will be completed from pressure investigation were effectively accomplished with the regular Frequency had moved by 13 % higher than the first worth, expanded the twist solidness by 25 % and decreased the all-out diversion.

II Literature Review

Transportation industry assumes a significant part in the economy of current industrialized and agricultural nations. The aggregate and relative volume of merchandise continued hefty trucks is significantly expanding. The case structure should securely uphold the heaviness of the vehicle parts and communicate loads that outcome from longitudinal, sidelong, and vertical speed increases that are knowledgeable about a dashing climate without disappointment. There are numerous angles to think about when planning a suspension, including segment bundling, material choice, strength, solidness and weight. The essential goal of the frame is to give a design that associates the front and back suspension without inordinate redirection.

The plan of a vehicle structure is of key significance to the general vehicle execution. The vehicle structure assumes a significant part in the usefulness of the vehicle. For the most part, truck is any of different weighty engine vehicles intended for conveying the joined burdens, like the motor, transmission and suspension just as the travelers and payload. The significant concentration in the truck producing businesses is plan of vehicles with more compensation load. Utilizing higher strength prepares than the regular ones are conceivable with relating salary raise load limit. The undercarriage of trucks which is the foundation of vehicles that coordinates the primary truck part frameworks like the axles, suspension, power train, taxi and trailer and so on, as displayed in Figure1, is one of the potential possibility for significant weight decrease [1].

Alongside strength, a significant thought in frame configuration is to have sufficient bowing and torsional solidness for better taking care of qualities. Thus, strength and firmness are two significant rules for the plan of the skeleton [2,3]. Stress-strain relations used to portray distortion of a material are diverse for the versatile and plastic space. Subsequently, know whether the pressure state is in the versatile or plastic space. For this reason a yield rule is utilized to propose the breaking point

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Alongside strength, a significant thought in frame configuration is to have sufficient bowing and torsional solidness for better taking care of qualities. Thus, strength and firmness are two significant rules for the plan of the skeleton [5]. Stress-strain relations used to portray distortion of a material are diverse for the versatile and plastic space. Subsequently, know whether the pressure state is in the versatile or plastic space. For this reason a yield rule is utilized to propose the breaking point
Some of these are: the maximum shear stress criterion, the maximum principal stress criterion and the von Mises stress criterion. These criteria could be expressed in terms of material constants obtained from different physical tests e.g. a shear or a uniaxial tensile test. Investigation of differing cross areas demonstrates that the case waterway segment is best in power with less misshaping, yet weight of skeleton is high contrasted with different cross segments.

III Chassis Side- and Cross-member Joints
Cross-and side-individuals are combined to shape a rectangular one-piece outline. Open-channel areas are usually utilized for cross individuals, yet for uncommon applications some of the time tube segments are likewise utilized. The individual channel individuals don't have satisfactory firmness against curve, yet when combined they structure a moderately inflexible construction equipped for withstanding both bowing the torsional stacking. The connection of the cross-individuals to the side channels needs extraordinary consideration, on the grounds that the intersection focuses are exposed to most extreme twisting just as torsional stresses.

Business vehicle side-individuals are for the most part produced using level strip squeezed into C-channel of fitting area. The web part of C-channel opposes any upward twisting [9]and the top and base spines keep the web from clasping along its length and give extra protection from both bowing and torsional stresses. Since the spines or the external districts of the web are the most extreme focused on pieces of the channel, any connection ought to, in this way, ideally be in the web segment. In real practice, joints are made between ribs or a mix of both web and spine joints for comfort.
Fig 1 and 2 shows a cross-part of' top-cap' area joined between the web and the two ribs. Here and there the web alone is joined, or then again the upper and lower spines from the connections. These joints are generally utilized for light and medium-obligation work. Unadulterated channel-area rib joint and the cross-part spines have been enlarged to give support to the joint[10]. This joint is utilized uniquely for medium obligation work. IOC shows side-and cross-part joint where the cross-part has a lap-welded end gusset (three-sided) section, joined to the side channel web as it were. This technique for joint support permits the rib to be out of openings, which by and large fill in as a point for pressure of the Jonits.

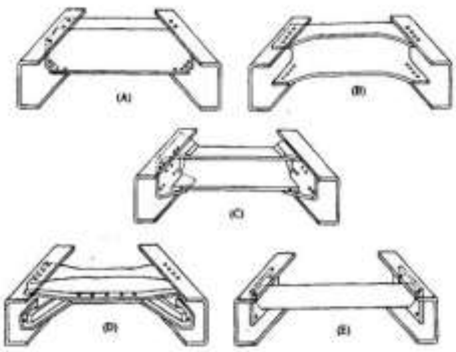

Fig 1. Chassis side- and cross-member reinforcement joints.

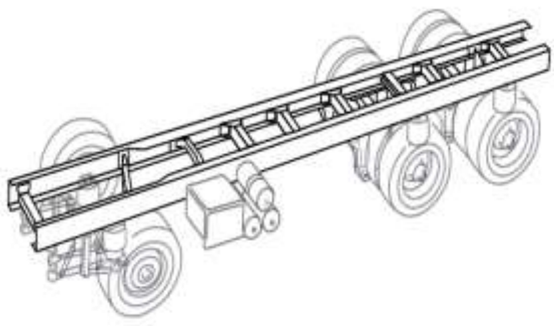

Figure 2. Heavy duty Vehical chassis

A. Top-hat-section cross-member joined to side-member flanges and web.
B. C-section cross-member with extended flanges joined to side-member flanges.
C. C-section cross-member with reinforcement gussets joined to side-member web.
D. 'Top-hat'-section cross-member with alligator-jawed enforcement joined to both.

Figure 2, shows most common type of chassis consists of two chassis rails which run the full length of the vehicle. The chassis rails are made of high tensile pressed steel channels. In a ladder type of chassis, the chassis rails carry all the main components of the vehicle, such as the engine, gearbox, front and rear axle suspensions. Also adding to the burden of the chassis are components such as fuel tanks and air tanks.

IV.CAD Model of Chassis Joints

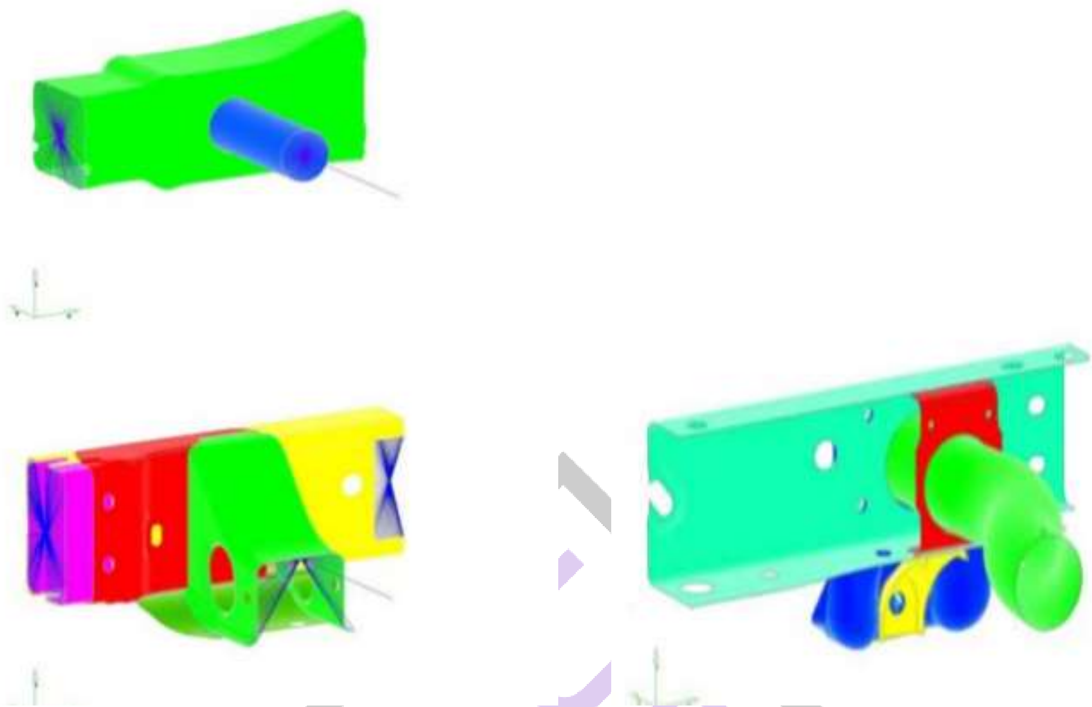

Figure 3, Joints in chassis with Finite Element-model

VI. FEM results of front bracket.

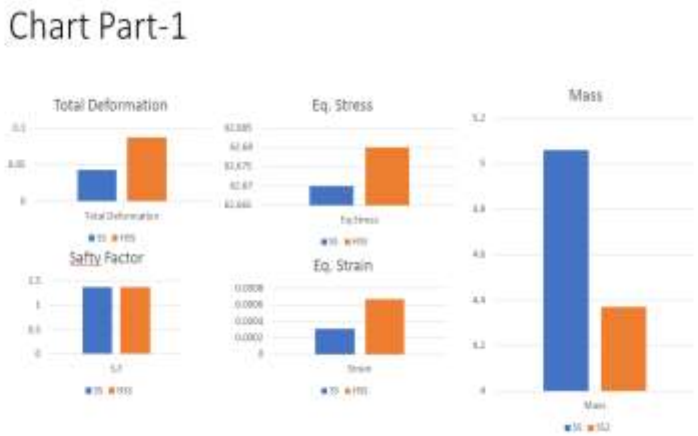

Figure 4. Chart plots part 1

Total deformation of structural steel material is 0.043 mm and of high strength steel material with titanium doped material is 0.087 mm so the difference is 0.4 mm. Equivalent stress of SS material is 62.67 MPa and of high strength steel with titanium doped material is 62.82 MPa, so the difference is 0.15 MPa. . Equivalent strain of SS material is 0.00031 and of high strength steel with titanium doped material is 0.00065, so the difference is 0.00034. The safety factor of structural steel material is 1.07 and the safety factor of high strength steel material material is 1.0608, So the difference is negligible. Weight of structural steel material is 5.016 Kg. and Weight of high strength steel material with titanium doped material is 4.37 kg. So the difference is 0.691 kg.

VI CONCLUSION

This paper explains the heavy duty chassis frame and its elements to reduce the overall weight with optimum strength. The frame can have different reinforcements with the joint areas which may result into high strength and weight, but it is important to realize that the overall weight of the chassis frame should be minimum. Using local plates only in the joint area can also increase side member thickness. Therefore, excessive weight of the chassis frame has to be prevented with suitable stiffeners and light weight reinforcements and other joints. In this work the Weight of structural steel material is 5.016 Kg. and Weight of high strength steel material with titanium doped material is 4.37 kg. So the difference is 0.691 kg. This shows with different material with we can reduce the weight of Joints associated with chassis for weight reduction and thus fuel consumption.

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