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Study On Stress Analysis and Structural Deformation of C-Type Heavy Duty Chassis with Different Materials - A Review

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ABSTRACT: There are several studies and research available based on the examination of heavy duty chassis. Few of them are based on virtual methods and experimentation. FEA methods are mostly used for this purpose. As this part of automobile always undergoes the large number of forces, torque and tension there are always chances of failure of chassis. Also the accidental situation makes chassis unbalanced and deformed in nature. Sometimes bend chassis problem will affect the vehicle performance. The strength and dynamic balancing are affected due to the large number of loading and vibration. Researcher has focused on these issues of chassis from its development. The strength of chassis is increased with considerable range. But still lots of research are needed to improve the performance and lifespan of heavy duty vehicle chassis. This paper review focuses on the studies done before on the structural behavior of chassis and its performance. The important and peered studies are taken into consideration for the topic review and the conclusion. This study will help to understand the various issues, problems and difficulties in the chassis. Also the researchers proposed solutions are noted down to carry forward the further research.

KEYWORDS: Heavy duty chassis, FEA of Chassis, Structural behavior of Chassis, Design of Chassis , Chassis Analysis , Deformation analysis of Chassis.

I. INTRODUCTION TO HEAVY DUTY VEHICLE CHASSIS

Chassis is important part that used in automotive industry. The Chassis is main component of vehicle. The chassis supports all the part of vehicle attached to it like suspension system , transmission system, steering , engine etc. The chassis carry all stationary load attached to it and passenger load and payload. Chassis has to withstand centrifugal force while cornering and bending stresses due to rise and fall of front and rear axles. While designing a chassis these components need to focus like material selection , chassis frame sections and weight.

II. PROJECT METHODOLOGY

Catia Software using for modelling of Heavy Duty Chassis and then for analysis we are using ANSYS workbench . Chassis physical dimensions measured by reverse-engineering process and then reconstructing 3D model in CATIA software in that creating parts of chassis in CATIA part module and make it assembly in CATIA Assembly module. After that in ANSYS workbenchanalysis done by applying material Properties for chassis material and applying Boundary Conditions on chassis.

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Fig.2.1 Project methodology chart/ flow chart

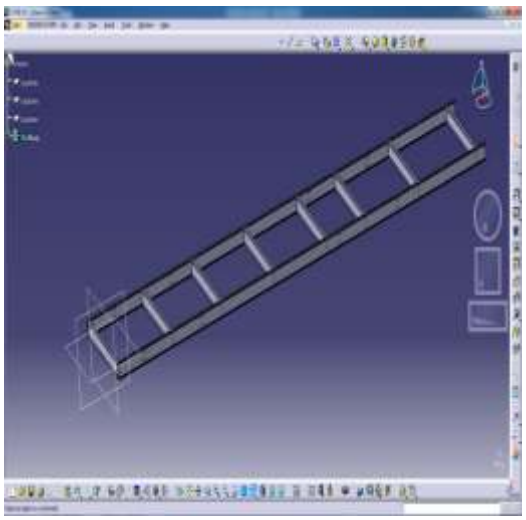


Fig.2.2 Design of Heavy Duty Vehicle Chassis in CATIA Software**.**

III. STRUCTURAL ANALYSIS - C TYPE CHASSIS

3.1ASTM A710 Material results.

Figure 3.1 to Figure 3.5 shows the analysis results for **ASTM A710** in case of **C Type Chassi**s. By observing results, it is found that maximum stresses will not exceed more than 453.6 MPA (Normal Stresses). Deformation is only up to 12.25 mm.

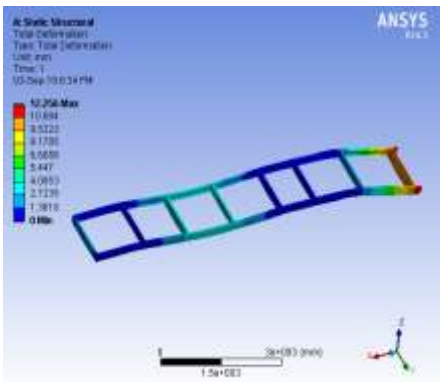
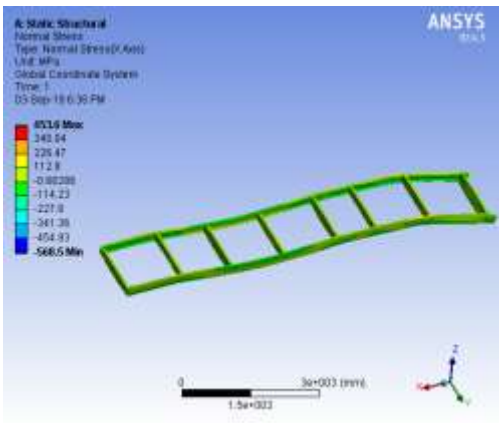


Fig.3.1: Total Deformation in Structural Analysis

Figure 3.1 shows the deformation obtained in case of structural analysis of C-sectioned chassis with ASTM A710 material. As per the material properties and boundary conditions applied on a chassis 12.25 mm deformation is obtained. The color scale shows the deformation range for each color. Here the red color indicates the maximum deformation which is obtained at the back-end of chassis. But the total deformation is up to 13 mm which is acceptable for maximum loading. Remaining chassis body is in light blue and dark blue color which shows the minimum deformation. Hence for this deformation chassis is safe. Appeared deformation in chassis is 8 times more than actual deformation.



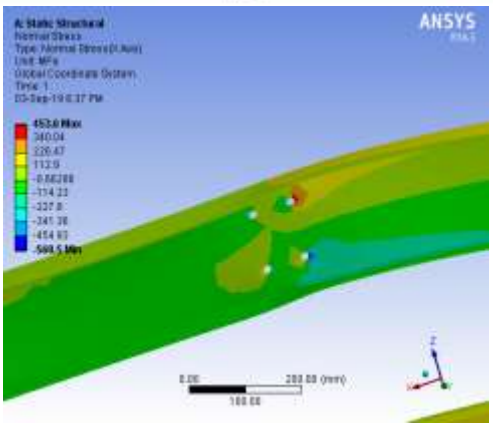


Fig.3.2: Normal Stressesobtained. **Fig.3.3:** Normal Stressesobtained on holes.

Figure 3.2 shows the Normal stresses obtained for this case. 453.6 MPA is the maximum stress value obtained for this case. But this stresses are maximum at the holes and remaining body is in green color which has the stress value range up to 112.9 MPA. Hence chances of failure due to normal stresses are rejected. To study these stresses in detail, let us consider Fig. 3.3 which shows the maximum stress value at the shackle holes. It means that after some time period and running, hole may be enlarged due to wear. But chances of failure are highly rejected.

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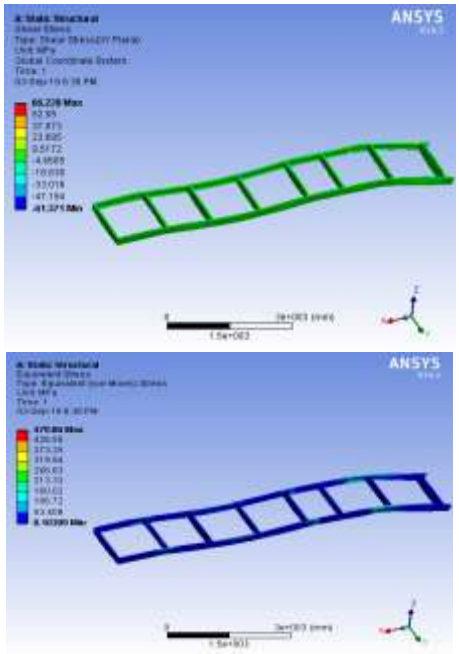

Fig. 3.4: Shear Stressesobtained.**Fig.3.5:** Equivalent StressesObtained

By observing Fig. 3.4 which has shear stress result with 66.22 MPA maximum value. Obtained range of shear stress is very less and entire chassis is appearing into green color. It has up to 23.69 MPA value. This range stress will not even affect the repetitive loading. Hence the found shear stress value is in considerable range.

Equivalent stresses are also very important in case of structural loading. In this case the value of equivalent stress is found 479.86 MPA. But if we look entire chassis frame, then we found that total chassis is obtained in blue color. At the shackle holes only the value is maximum. Obtained value is very large but entire chassis has only 53.40 MPA value. Hence at the shackle hole, strength improvement is needed.

3.2HSS 550 Material results

Figure 3.6 to Figure 3.10 shows the analysis results for **HSS 550** in case of **C type chassis**. By observing that results, it is found that maximum stresses will not exceed more than 472.05 MPA (Normal Stresses). Deformation is only up to 3.6 mm. Stresses and deformation obtained is acceptable range.

Figure 3.6 shows the deformation obtained in case of structural analysis of C-sectioned chassis with HSS 550 material. As per the material properties and boundary conditions applied on a chassis 3.64 mm deformation is obtained. The color scale shows the deformation range for each color. Here the red color indicates the maximum deformation which is obtained at the back-end of chassis. But the total deformation is up to 4 mm which is acceptable for maximum loading. Remaining chassis body is in light blue and dark blue color which shows the minimum deformation. Hence for this deformation chassis is safe.

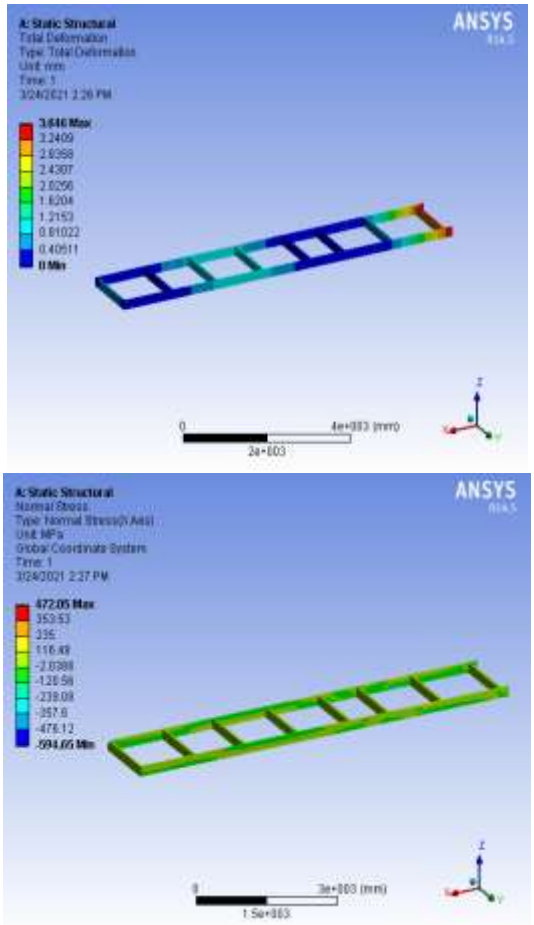

Fig. 3.6: Total Deformation in case of**Fig.3.7:** Normal Stressesobtained.

HSS 550 material

Figure 3.7 shows the Normal stresses obtained for this case. 472.05 MPA is the maximum stress value obtained for this case. But this stresses are maximum at the holes and remaining body is in green color which has the stress value range up to 116.48 MPA. Hence chances of failure due to normal stresses are rejected. To study these stresses in detail, let us consider Fig. 3.8 which shows the maximum stress value at the shackle holes. It means that after some time period and running, hole may be enlarged due to wear. But chances of failure are highly rejected.

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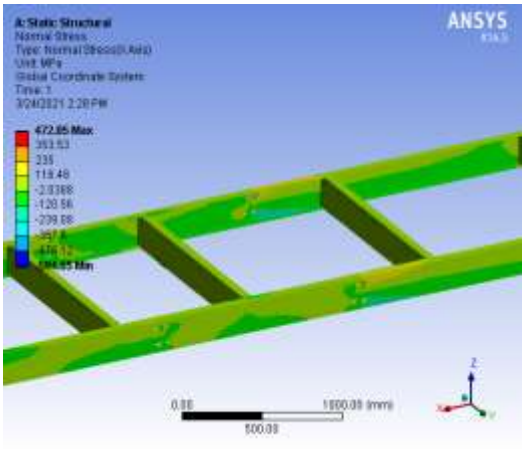

Fig.3.8: Normal Stresseson holes.

By observing Fig. 3.9 which has shear stress result with 65.24 MPA maximum value. Obtained range of shear stress is very less and entire chassis is appearing into green color. It has up to 23.58 MPA value. This range stress will not even affect the repetitive loading. Hence the found shear stress value is in considerable range.

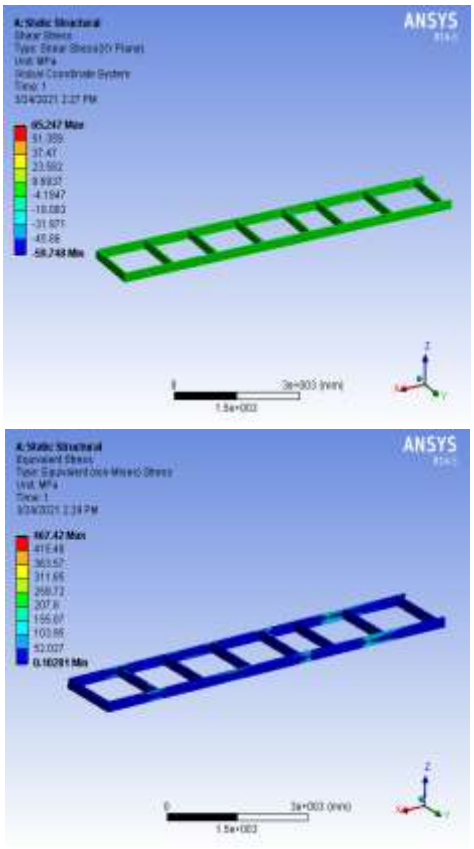

Fig.3.9: Shear Stressesobtained.**Fig.3.10:** Equivalent StressesObtained

Equivalent stresses are also very important in case of structural loading. In this case the value of equivalent stress is found 467.42 MPA. But if we look entire chassis frame, then we found that total chassis is obtained in blue color.

Sr. No.	Result	C Type Chassis	
		ASTM A710	HSS 550
1	Total Deformation (mm)	12.25	3.64
2	Equivalent Stresses (MPA)	479.86	467.42
3	Shear Stress (MPA)	66.22	65.24
4	Normal Stress (MPA)	453.6	472

Table 3.1: Tabulated Results Generated from all Analysis Results

IV. CONCLUSION

By observing the results, it is found that the HSS 550 material gives the better results than ASTM A710 materials. ASTM A710 shear stress value and total deformation value is greater than HSS 550 material value. Total deformation value proves the better option for C-type chassis is HSS 550 material.

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