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Research Paper

Design and Vibration Analysis of Partner 2670wb Chassis

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ABSTRACT—*Chassis is the structural back bone of any vehicle. The main function of chassis is to support the component and withstand the loads applied on it. while applying the load on chassis, it may undergo stress and deformation and it should be within a limit otherwise it leads to failure of the chassis.The objective of this paper is to find out a most suitable joint and a suitable material onC-section with the constraints of stress, frequency and deflection of chassis. chassis modeling is done using CATIA and analysis is done using ANSYS. The overhangs of the chassis are obtained for the stresses,vibrations and deflections with the help of analysis software***.**

KEYWORDS*-Automobile chassis, chassis loads, modeling, structural analysis*.

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I INTRODUCTION

The Main objective is to reducethe weightwhile satisfying performance requirement regarding handling and safety standards, specifically Global bending (stress analysis), vibrations and torsional stiffness's. . Truck chassis is a major component in a vehicle system. This work involved static and dynamics analysis to determine a key characteristics of a truck chassis. One of the most effective shapes for supporting point loads, fixed at two ends is an C-beam The components of the vehicle like engine transmission system, axles, wheels suspension and tires controlling systems and also electrical system parts are mounted on the chassis. The Static characteristics include identifying location of High Stress Area and determining the Torsion Stiffness of the chassis. The Dynamic characteristics of truck chassis such as the Natural Frequency and Mode shape were determined by using Finite Element Method in this paper.

Chassis should be rigid enough to withstand the shock, twist, vibration and other stresses and it ensures low levels of noise, vibrations and harshness throughout the automobile.

II PROBLEM IDENTIFICATION

Vehicle weight and engine power are two of the most important parameters that influence a vehicle's fuel consumption. Thevehicle weight increases lead to more accelerationand increase in fuel consumption. On a developing nation the transportation will play a significant role. So, this industry expect a less fuel consumption by a vehicle. Therefore, Chassis with high strength cross section is needed to minimize the failures including factor of safety in design and to make at less weight. Material having low density value with higher compressive and bending stress reduces the weight of the engine with safe transmission.

III METHODOLOGY

A Three Dimensional solid model of Ladder chassis is created on the computer using CATIA, Dassault Systems. This 3D Model is exported to Ansys for performing Finite Element Analysis.

There are three main steps carried in Finite Element Analysis, namely: pre-processing, solution and post processing. In pre-processing (model definition) includes: define the geometric domain of the problem, the element type(s) to be used, the material properties of the elements, the geometric properties of the elements (length, area, and the like), the element connectivity (mesh the model), the physical constraints (boundary conditions) and the loadings. In solution phase, the governing algebraic equations in matrix form are assembled and the unknown values of the primary field variable(s) are computed. The computed results are then used by back substitution to determine additional, derived variables, such as reaction forces, element stresses and frequencies. Actually, the features in this step such as matrix manipulation, numerical integration and equation solving are carried out automatically by commercial software. In post processing, the analysis and evaluation of the result is conducted in this step.

IV MATERIAL SELECTION

The material for C-section is composites are being used at present. The composites are needed high to withstand a load. As a result of this thickness of the material should increases and it lead to increase in weight. The material to be selected should have high strength and density should be low. The material chosen for chassis is structural steel with the constraints. This was chosen keeping in mind the load it has to withstand, also it hasless wear, produce a uniform harder case, good balance of toughness and ductility.

TABLE 1 SPECIFICATION OF MATERIAL

PROPERTIES	METRIC	IMPERIAL
Tensile Strength	440 MPa	63800 psi
Yield Strength	370 MPa	53700 psi
Modulus of elasticity	205 GPa	29700 ksi
Shear modulus	80 GPa	11600 ksi
Poisson's ratio	0.29	0.29

V DESIGN CALCULATION

TABLE 2 SPECIFICATION

CHASSIS DESIGN	DIEMENSION
Length	5000mm
Width	600
Height	170
Rivit diameter	20
Flitch	Balance

YOUNGS MODULUS (E) = $2x10^5$

POISION RATIO = 0.31

I – MOMENT OF INTERTIA

$I_{A1} = BD^3/12$

$= 100 \text{ x } 5^3/12$

$= 1041.66 \text{ mm}^4$

$I_{A2} = BD^3/12$

$=5 \text{ x}160^3/12$

$=1.766 \text{ x}10^6 \text{ mm}^4$

$I_{A3} = BD^3/12$

$=100 \text{ x}5^3/12$

$=1041.66\text{mm}^4$

$A = 1041.66 +1.708 \text{ x}10^6+1041.66$

$IA = 1.708 \text{ x}10^6\text{mm}^4$

$Y=5WL^4/384EI$

$Y=5x1.6x5000^4/384x2x10^5x1.70x10^6$

$=5x10^{15}/1.31x10^{14}$

=28.117 mm

=0.02816mm

A.Static Load

σ = P/A

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OVER LENGTH = 4920 mm
OVER HEIGHT = 2170 mm
OVER WIDTH = 1850 mm
WHEEL BASE = 2670 mm
Min GROUND CLEARANCE = 218 mm
ENGINE CAPACITY = 2953CC
VEHICLE WEIGHT = 4720 KG
KERB WEIGHT = 2685 KG
VEHICLE WEIGHT = 4720 KG
= 4720x9.81
= 46303.2 N
KERB WEIGHT = 2035 KG
= 2035x9.81
= 19963.35 N
AREA = 550+800+550
= 1900
$\sigma = P/A$
= 66266.55/1900
= 34.87 N/mm^2

VI DESIGN OF CHASSIS FRAME USING CATIA

The geometric modeling of Ladder chassis with C- type cross section is done using CATIA with rivet joints. The three-dimensional model of the ladder chassis of C type cross-section is shown in the Fig. 1

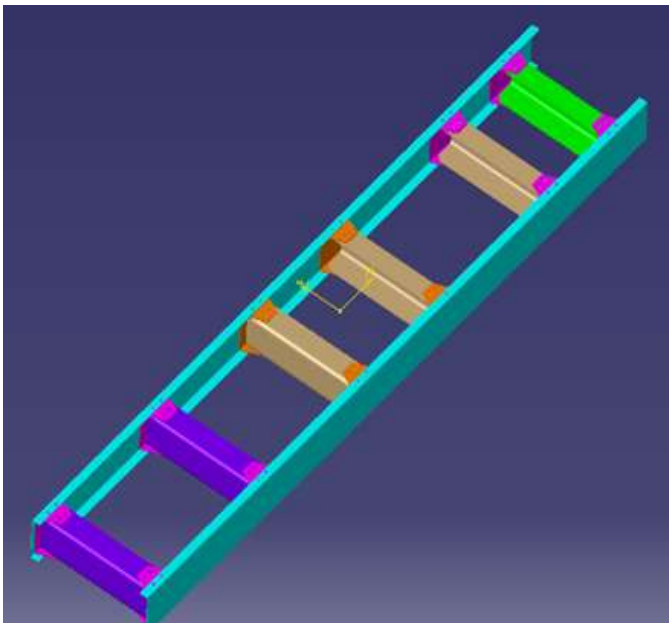

Fig. 1design

VII ANALYSIS

The design thus made was imported from CATIA in to the ANSYS workbench for static analysis of the whole material under different loading conditions. Initially the material and the property of the material was created in the library for the analysis process.

A.Meshing

Then the chassis was finely meshed by giving sizing so that they are divided into fine particles. the finely meshed particles is shown below:

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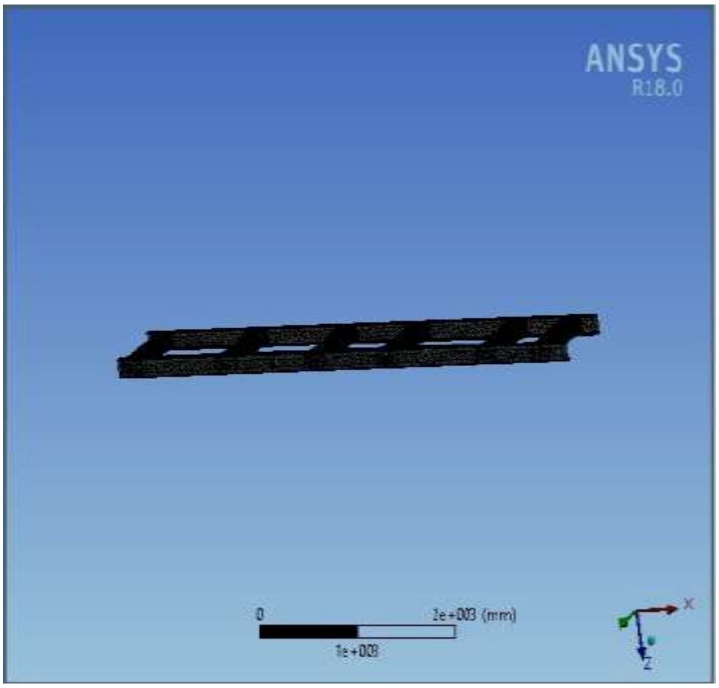

Fig.2 Meshed parts

B.Static Analysis

The meshed parts were then finally analyzed in static condition. Then the condition for fixed supports was given and a load for varying conditions were applied on the surface and the stress and deformation are obtained
The variation of the deformation along the whole part is as shown below

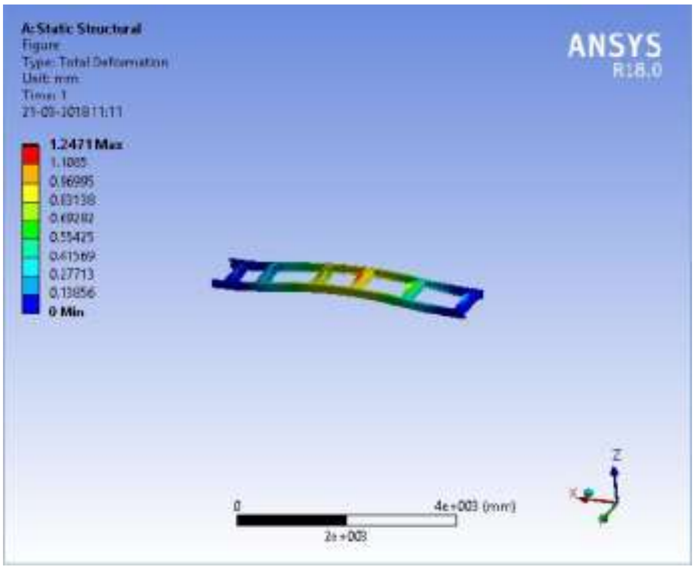

Fig.3total deformation

The variation of the stress and strain along the directon is as shown below and was found to be in the safer side

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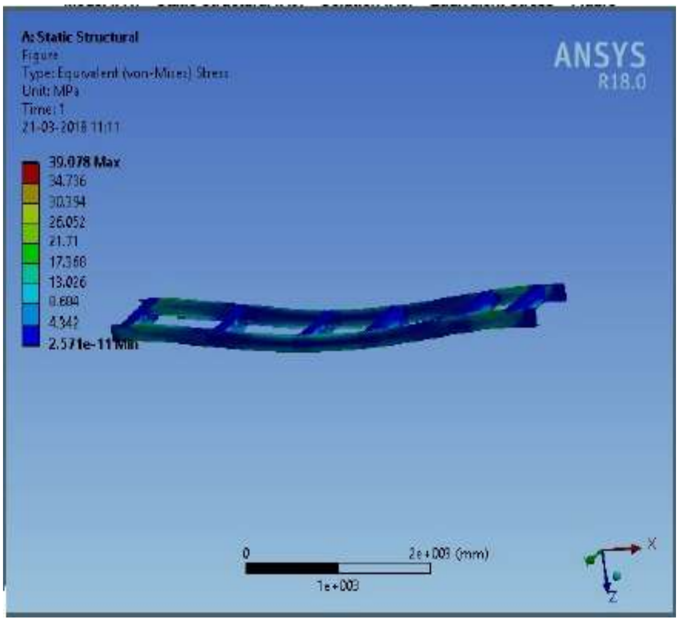

Fig. 4:stress deformation

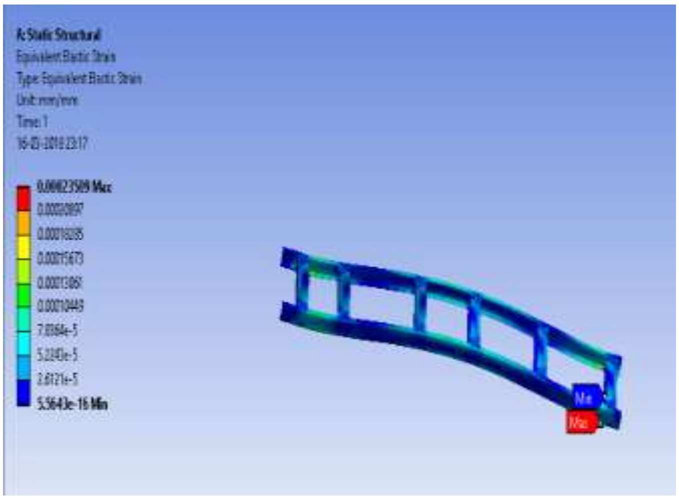

Fig. 5:strain deformation

Stress is defined as the pressure or force which is applied on the material body.A stress member engine is a vehicle engine used as an active structural element of the chassis to transmit forces and torques rather than being passively contained by the chassis with anti-vibrationmounds.Strain is defined as the force acted internally by the help of an external force.We know that,hookes law states that,stress is directly proportional to the strain.

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B.FEA(ansys) results of stress and deformation

LOAD (N)	STRESS (N/MM^2)		DEFORMATION (MM)	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
8000	4.342	34..17	0.13856	1.2471

C.FEA(ansys) results of strain and deformation

LOAD N	STRAIN	DEFORMATION Mm
7000	0.0002204	0.893
8000	0.001625	1.247

D.FEA(ansys) results of Frequency and deformation

Load (N)	Frequency (Hz)	Deformation(mm)	
		MINIMUM	MAXIMUM
8000	5.524	0.3379	3.4061

E.FEA results for different Time Period

TIME PERIOD	FREQUENCY 7000 (HZ)	FREQUENCY 8000 (HZ)
1	21.317	28.887
2	33.134	40.708
3	55.815	61.488
4	60.751	63.503
5	92.732	103.60
6	99.876	106.67

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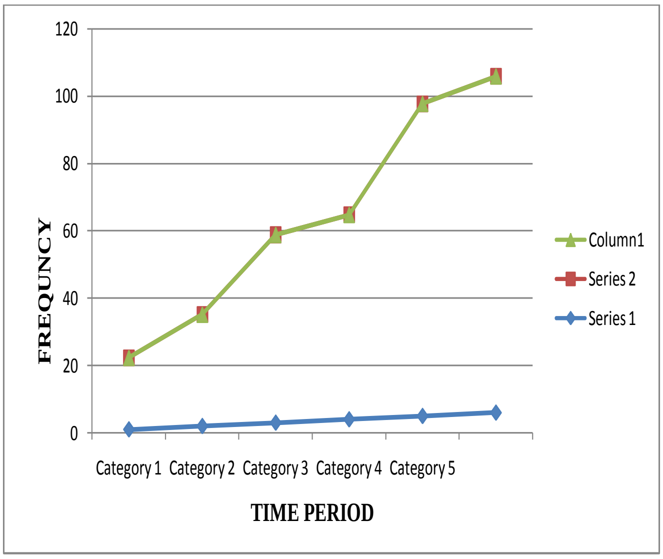

Fig. 6 TIMEPERIOD Vs FREQUENCY for a load of 7000N

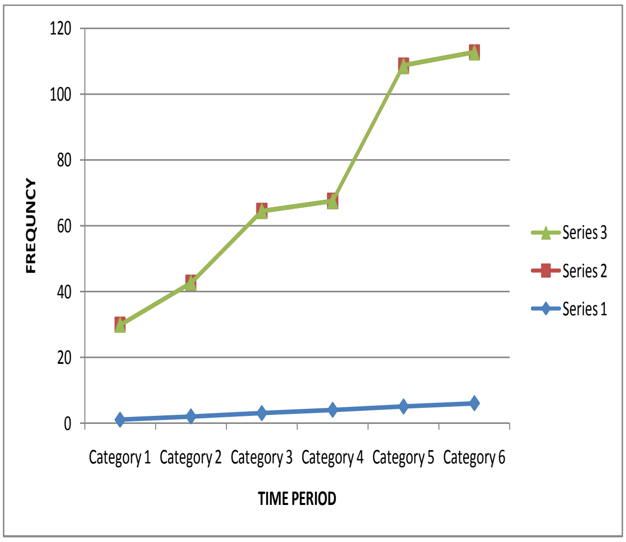

Fig. 7 TIMEPERIOD Vs FREQUENCY for a load of 8000N

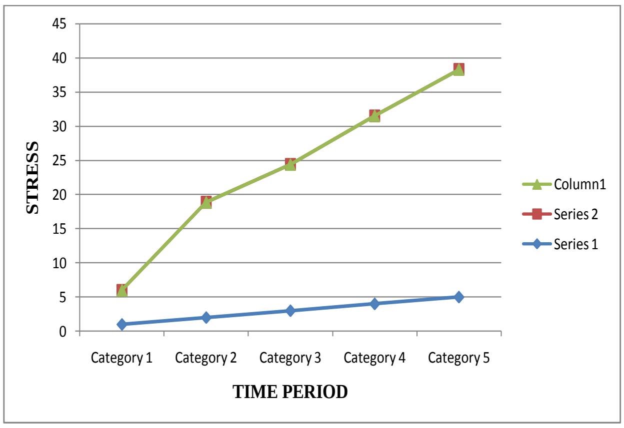

Fig. 8 TIMEPERIOD Vs STRESS.

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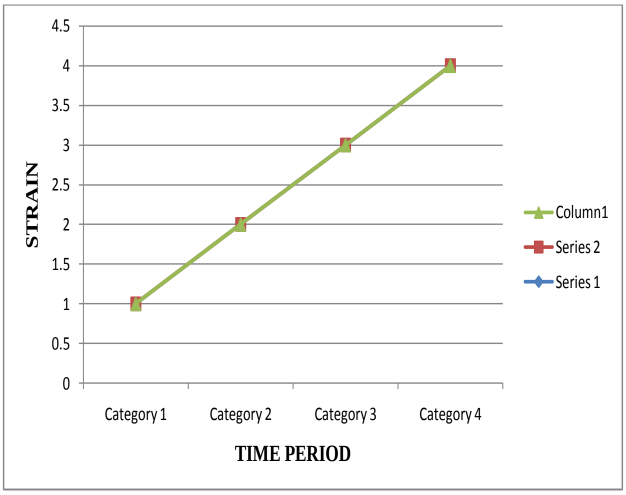

Fig.9 TIMEPERIOD V s STRAIN

VIII CONCLUSION

In the present work, ladder type chassis frame was analyzed using ANSYS 1 software. From the results, it is observed that C Cross-section type of Ladder Chassis would able to withstand a load for rivet joints. The C- Cross-section Ladder Chassis with rivet joints is having deflection i.e., 1.24 mm and Von Mises stress and Maximum Shear stress i.e., 34.17MPa &4.342MPa respectively for Structural steelS235 with rivet joint on C-section. Finite element analysis is effectively utilized for addressing the conceptualization and formulation for the design stages. Based on the analysis results of the present work, the following conclusions can be drawn. 1) Part is safe under the given loading condition. 2) The generated Von Mises Stress & Maximum Shear Stress is less than the permissible value so the design is safe for the structural steel s235. 3)The weight is reduced

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