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DESIGN AND ANALYSIS OF LADDER CHASSIS

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Abstract: In present the Ladder chassis which are uses for making buses and trucks are C and Hollow Rectangular cross section type, which are made of Steel alloy. There are always possibilities of being failure/fracture in the chassis/frame. Therefore Chassis with high strength cross section is needed to minimize the failures including factor of safety in design. Basically C cross section type of chassis is used in buses and Rectangular cross section type moderate load vehicle where high strength is required. So we have taken Rectangular Box type cross section as well as c type cross section for making ladder chassis.

***Index Terms* – HEV**

I. INTRODUCTION

In this work, Stress analysis is a key characteristics of a chassis. The design and analysis of chassis is done by identifying the location of high stress areas. The chassis design used in this project is the ladder frame chassis. The reason for ladder frame type of chassis is that here it is easier to change the design without having to change the chassis thereby saving overall design time. It also provides a good beam resistance because of its continuous rail from front to rear. The disadvantage with using this type of chassis is that it has poor torsion stiffness, higher fuel consumption and also heavier than a unibody.

II. OBJECTIVE

To design and analysis of ladder frame chassis for moderate load vehicle as per following given condition:

1. Load on chassis is 910kg 2.Weight of chassis should be minimum 3.High Strength 4.Use suitable low cost Material

As per above condition design ladder type chassis design and analysis in two cross section type chassis

1. Square hollow section Chassis
2. C channel section Chassis

III. SELECTION OF CHASSIS TYPE

Other shape sections that are also used as steel member are Pipe section, Plate section, and Bar sections. Based on above discussion we can now understand the differences between different shape sections, their relative benefits, their structural strengths etc. An optimum structural design includes all the above individual shape sections to be correctly chosen, designed to support and transmit loads properly throughout the structure. The next time we see various steel sections in construction, we now know why a specific shape is used as a structural member. We can also comprehend the importance of shape profile of the section in the structural design and construction.

Result	I Shape	C Shape	L Shape	T Shape	HSS
Axial	Good	Moderate	Moderate	Moderate	Good
Flexure X-X	Poor	Poor	Moderate	Poor	Good
Flexure Y-Y	Good	Moderate	Poor	Moderate	Good
Buckling	Poor	Poor	Poor	Poor	Moderate
Torsion	Poor	Poor	Poor	Poor	Good
Shear	Good	Moderate	Moderate	Moderate	Good
Example	Steel Girders / Floor Beams /Colum ns	Joists in roof framing system	Truss bracing member s	Truss chord memb ers	Column

IV. DESIGN CALCULATIONS FOR CHASSIS FRAME

In working chassis two rectangular beam are available for loading. As per above calculations on loading condition maximum loading are calculated is 910 kg. In that load weight of chassis is also added for more safety purpose so we have total load in this work is 1025 kg as mention above in calculation part. This total load is equally divided for two rectangular beam therefore so 6144 N is applied on beam as shown in fig. Red color code shown the applied load in following figure. Blue color code shown a fixed support of Chassis.

Side bar of the chassis are made from "C" Channels with mm x mm x mm Material of the chassis is ASTM A710 Steel

Front Overhang (a)	= 900 mm
Rear Overhang (c)	= 1000 mm
Wheel Base (b)	= 3900 mm
Front track	= 1700mm
Modulus of Elasticity, E	= 2.10 x 105 N / mm2
Poisson Ratio	= 0.303
Capacity of MPV	= 910 kg = 8927.1 N
Capacity of MPV with 1.25%	= 11158.875 N
Weight of the body and engine	= 115kg = 1128.15 N

Total load acting on chassis = Capacity of the Chassis + Weight of body and engine

= 11158.875 + 1128.15 = 12287.025N

Chassis has two beams. So load acting on each beam is half of the Total load acting on the chassis.

Load acting on the single frame = 12287.025/2 = 6143.5125 N / Beam

4.1 Calculation for Reaction

Beam is simply clamp with shock absorber and leaf spring. So, beam is considered as a simply supported beam supported at C and D with uniform distributed load.

Load acting on the entire span of the beam = 6143.5125 N Length of the beam = 5800 mm

Uniformly Distributed Load = 6143.5125/ 5800 = 1.06 N/mm

For getting the load at reaction C and D, taking the moment about C and we get the reaction load generate at the support **4.2 Calculation of the moment are as under.**

Moment about C.

$1.06\times900\times900/2 = (1.06\times3900\times3900/2) - (Rd\times3900) + (1.06\times1000\times4400)\ 0$

Rd = 3152.8205 N

Total load acting on the beam = 1.06 × 3900 = 6148N

Rc + Rd = 6148 Rc= 2995.1795 N

4.3 Calculation of shear force and bending moment:

Shear force calculations:

Fa = 0 N Fc = (-1.06×900) + 2995.1795 = 2041.17595 N

Fd = (-1.06×4800) + 3152.8205 + 2995.1795 = 1059.99645 N

Fb = 0 N

Bending moment calculations:

Ma = 0 Nmm Mc= (-1.06×900×900)/2 = -429300 Nmm

Md = [(-1.06×4800×4800)/2] + (2995.1795×3900) = - 529999.95Nmm

Mb = 0 Nmm

4.4 CAD Model of Chassis

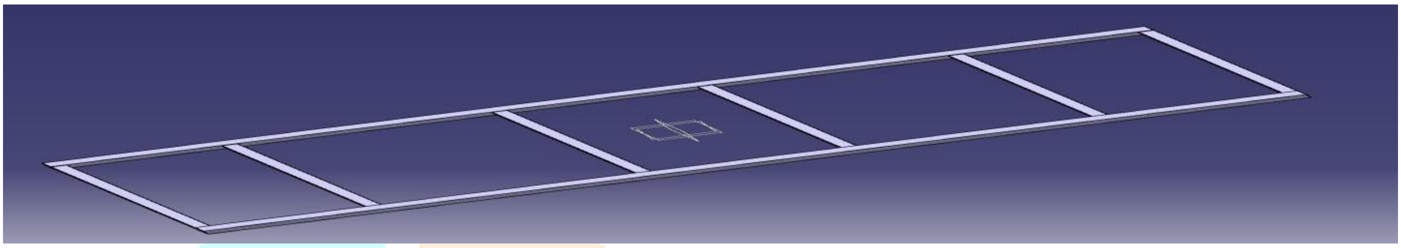


Figure 5.2: CAD model of Rectangular Section Ladder Chassis

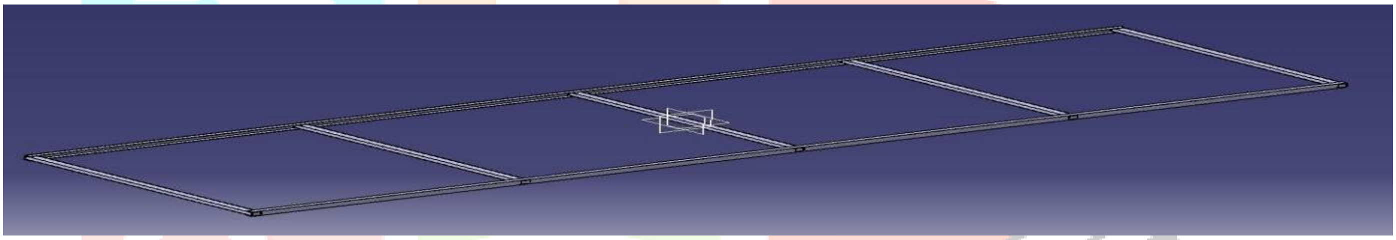
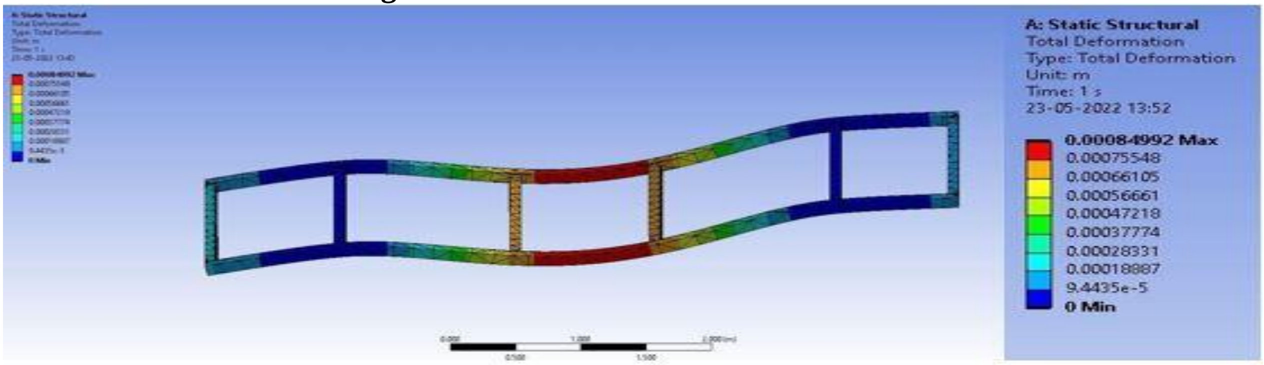


Figure 5.3: CAD model of C section Chassis

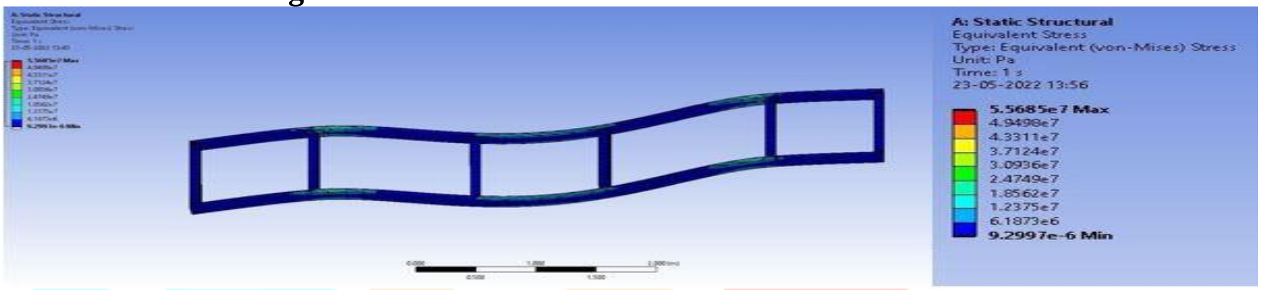
V FEA Analysis for Chassis

5.1 For Rectangular Chassis

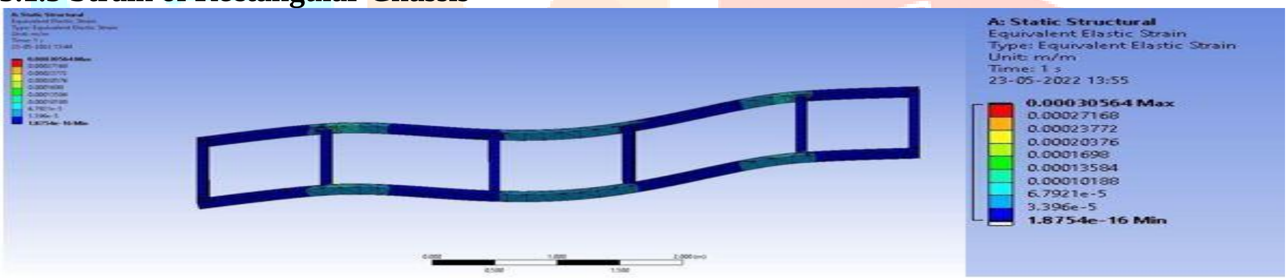
5.1.1 Deformation of Rectangular Chassis



5.1.2 Stress of Rectangular Chassis

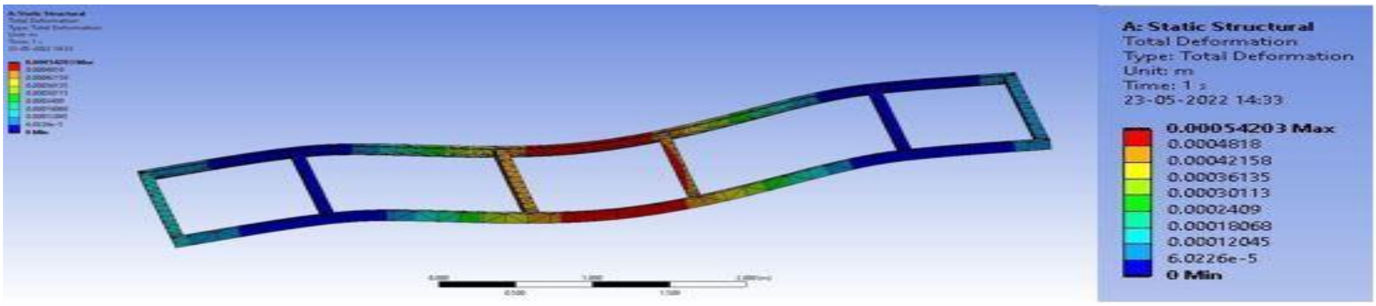


5.1.3 Strain of Rectangular Chassis

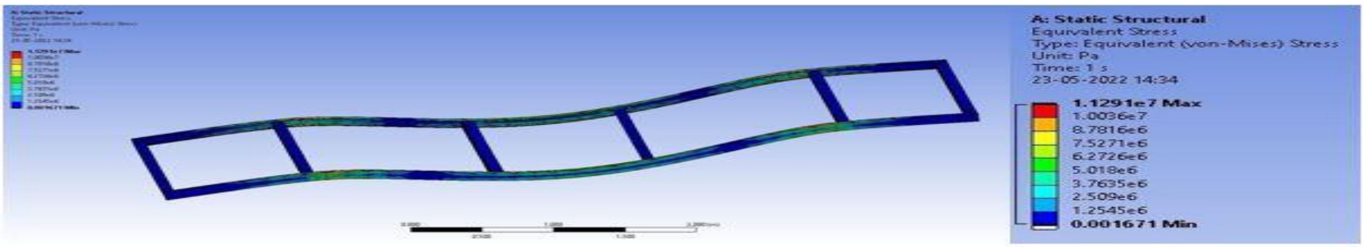


5.2 For C Channel Chassis

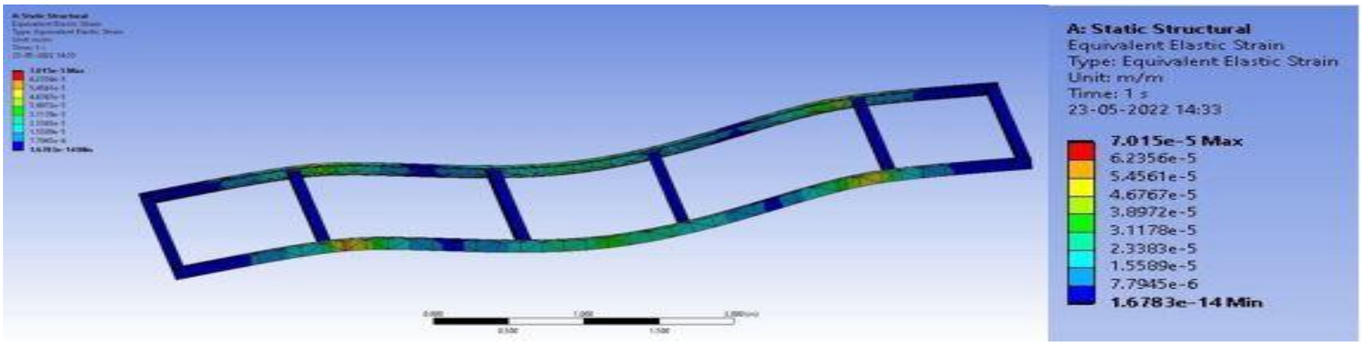
5.1.1 Deformation of C Channel Chassis



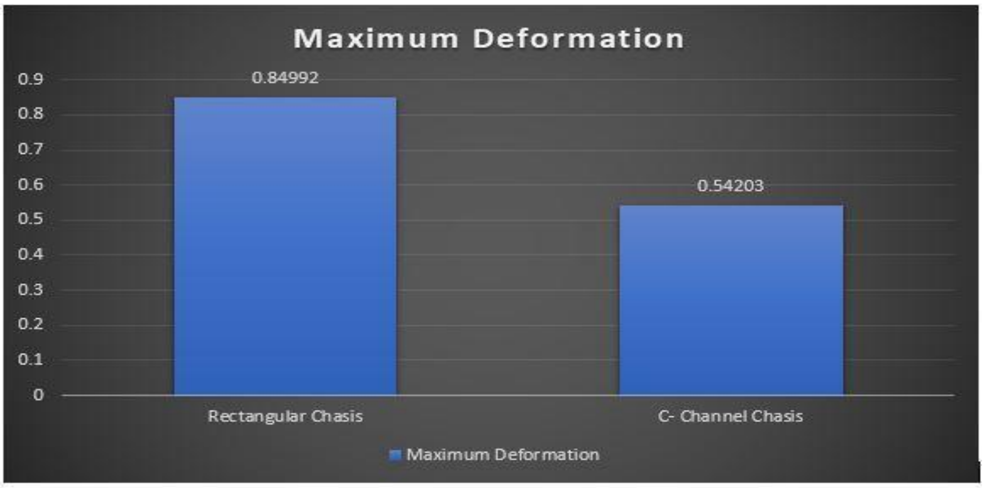
5.1.2 Stress of C Channel Chassis



5.1.3 Strain of C Channel Chassis



VI COMPARATIVE RESULT OF CHASSIS



Maximum Deformation in both chassis

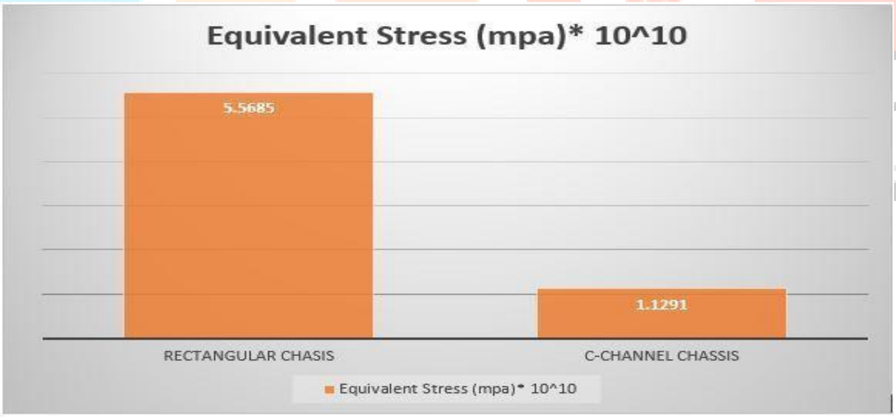
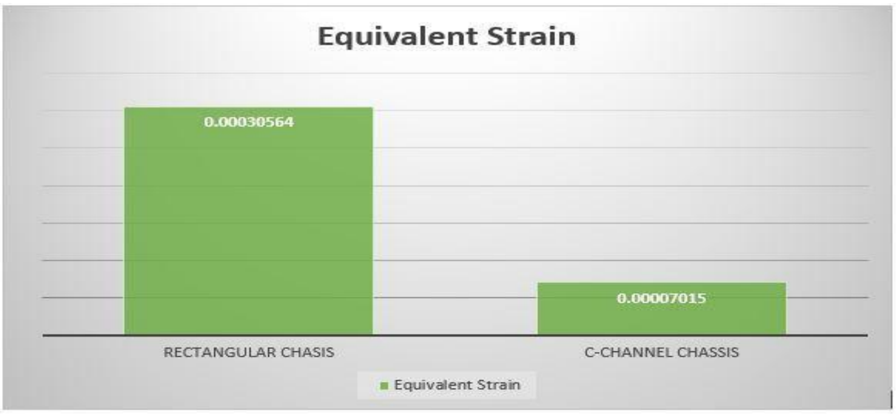


Figure 7.2: Equivalent Stress in chassis



Equivalent Strain in chassis

VII CONCLUSION

In the present work, the ladder type chassis rectangular and C-channel Chassis are designed in CATIA V5.

In the present work, the ladder type chassis frame was analyzed using ANSYS workbench software.

From the result it is observed that C- type Cross section has more Strength than the Rectangular Cross section Ladder frame. Finite element analysis is effectively utilized for addressing the concept in structural analysis and formulation of the design stages. Based on the analysis results of the present work.

1. The deformation in C-Channel chassis is minimum as Compared to rectangular Chassis and it acceptable for safe design.
2. The Equivalent stress in C-Channel chassis is minimum as Compared to rectangular Chassis and it acceptable for safe design.
3. The Equivalent Strain in C-Channel chassis is minimum as Compared to rectangular Chassis and it acceptable for safe design.

VIII ACKNOWLEDGMENT

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