International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 09 | Sep 2023 www.irjet.net p-ISSN: 2395-0072

Design Chassis For Onion Harvesters

Vaibhav Dhikale[1], Rushikash Dhikale [2], Rahul Ghuge[3]

[1]Trainee Engineer, Mechanical Engineering Department, MCOEARC Odha Nashik ,Maharashtra, India
[2]Trainee Engineer, Mechanical Engineering Department, MCOEARC Odha Nashik ,Maharashtra, India
[3]Trainee Engineer, Mechanical Engineering Department ,MCOEARC Odha Nashik ,Maharashtra, India

---***---

Abstract - *The chassis for any vehicle is the most important part as it becomes a structural backbone for the support of different systems attached to it and carries out the load of and also loads experienced by the chassis is also an important aspect. Produce vehicle chassis to mount all the systems required for harvesting and propelling the harvester. Produce chassis to sustain in all conditions. It should sustain all forces generated during the harvesting of the farm which is due to soil resistance. Making a lightweight chassis to reduce dead weight on the vehicles without any compromise for the safety of the driver. Making a lightweight chassis by considering various rules and regulations given in the SAE TIFAN rulebook while designing the chassis and also understanding various specific cross sections for the chassis fabrication is very important. In this various software like Creo, Catia, and ANSYS have been used for the process of doing modeling and Analysis of the chassis frame.*

***Key Words*: Chassis, TIFAN, Creo, Catia, ANSYS**

1. INTRODUCTION

TIFAN is a national-level event that is held under the banner of SAE International All undergraduate students from all around the nation participate in making the aesthetic, ergonomic, and safe chassis, for the purpose of the competition. For this competition, the teams strive to make the most well-designed Harvester frame with all parameters considered. Designing the chassis is the most important part for any team, due to the fact that it supports all the various departments of the whole vehicle. The design should be made in such a way that it should not compromise the driver's safety in any condition. The design should not fail at any cost, it should have the minimum required stiffness, strength, and torsional rigidity, and it should be highly reliable and safe.

2. Analyses of Chassis and Calculation

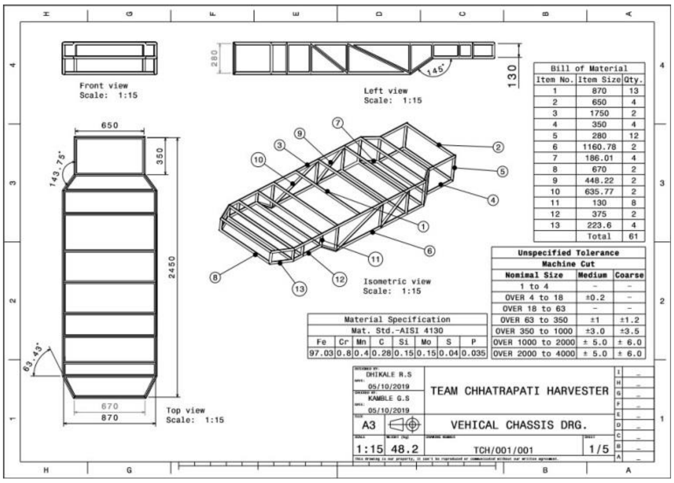


Fig chassis sheet

3. Calculation of Chassis

Material of chassis selection = AISI 4130

- **Chemical composition**

Element	Content
Iron	97.03-98.22%
Chromium	0.80-1.10%
Manganese	0.40-0.60%
Carbon	0.28-0.33%
Silicon	0.15-0.33%
Molybdenum	0.15-0.25%
Sulfur	0.04%
Phosphorous	0.035 %

- **Mechanical properties**

Properties	Metric
Tensile strength, ultimate	560 MPa
Tensile strength, yield	460 MPa
Modulus of elasticity	190-210 GPa
Bulk modulus	140 GPa
Shear modulus	80 GPa
Passions ratio	0.27-0.30
Elongation at break	59.6
Hardness, Brinell	217
Hardness. Knoop	240
Hardness, Rockwell	95
Hardness. Vickers	228
Machinability	70

- **Vehicle Dimensions**

Parameter	value
Length	2450 mm
Width	870 mm
Height	1500 mm
Ground clearance	270 mm

- **Cross section of chassis Hollow**

Diameter of chassis (D) = 25mm
Thickness of chassis (t) = 3mm

1. **Calculations of Bending Strength for The Chassis Cross Section Formula for bending**

Bending strength = Sy*I/C
Where
Syt = Yield Strength
I = Moment of Inertia
C = Extreme Fiber Distance
Given: Syt = 460 MPa = 460*106 N/m^2 ,
C = D/2 = 0.025/2 = 0.0125 m
D = 0.025 m, d = 0.019 m
I = л/64 (D^4-d^4)
= л/64 (0.0125^4- 0.019^4)
= 1.277*10-8 mm4
Bending strength = Syt*I/C
= (460*106) (1.277*10-8)/(0.0125)

Bending strength = 469.936 N-m

2. **Loading Diagram**

2.1 Load at point P1=10Kg
2.2 Load at point P2=10Kg
2.3 Load at point P3=23Kg
2.4 Load at point P4=26Kg
2.5 Load at point P5=40Kg
2.6 Load at point P6=23Kg
2.7 Load at point P7=63kg
2.8 Load at point P8=25Kg
2.9 Load at point P9=105Kg
2.10 Load at point P10=25Kg
2.11 Load at point P11=35Kg
2.12 Load at point P12=4.5Kg
2.13 Load at point P13=4.5Kg

System	Point load
Steering system	P1,P2
Setting arrangement	P3,P6
Digging system	P4
Transmission system	P5,P7
Conveyer system	P9,P10
Hydraulic system	P4,P9
Separating system	P11,P12,P13

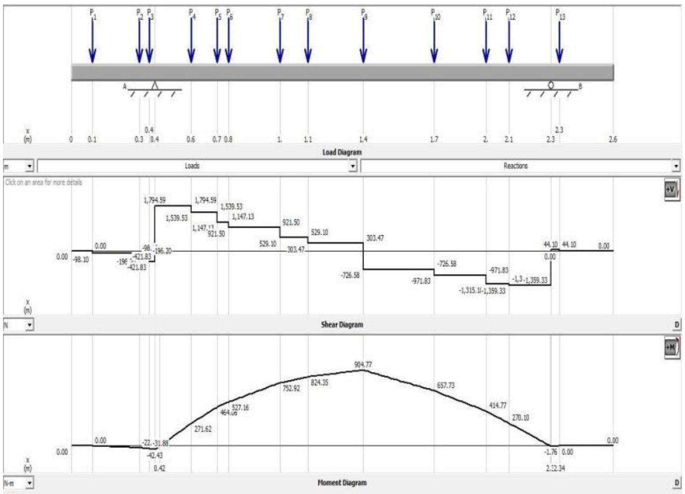


Fig. Loading Diagram

3. **G force calculation**

Given:

Assumptions,

Front impact time taken = 0.15

Rear impact time taken = 0.3

Side impact time taken = 0.3

3.1Calculating G force for front impact

Velocity of vehicle = 5.27 m/s

Mass of vehicle = 394 kg

By using formula

V = U+A*T

=5.27+a*(0.15)

= 35.133 m/s^2

We, know

Force = mass*acceleration

= 394*35.133

= 13842.53 N

G Force = force / (mass of vehicle*9.8)

= 13842.53/(394*9.8)

G Force = 3.71

FEA Analysis of frame (front impact) Load = 3.71 G

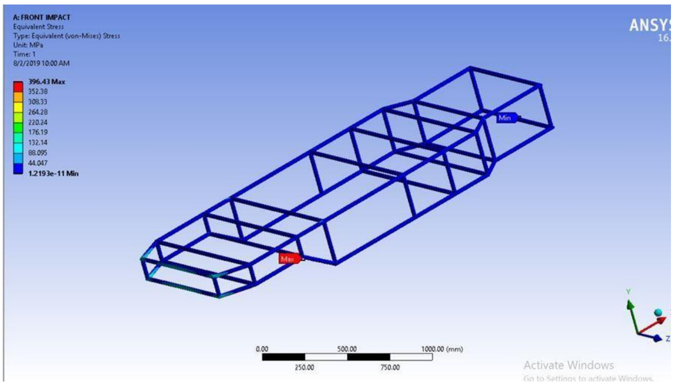


Fig. Front Impact Diagram

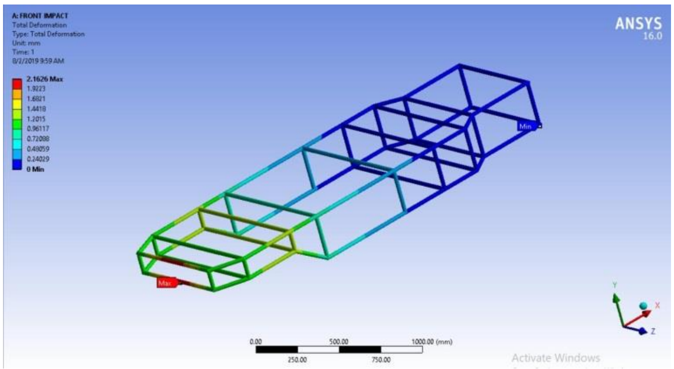


Fig. Front Impact Stress Diagram

3.2 Calculating G force for side impact

Velocity of vehicle = 5.27 m/s

Mass of vehicle = 394 kg By using formula

V = U+A*T

V = 5.27+A(0.3)

= 17.566 m/s2

We, know

Force = mass*acceleration

= 394*17.566

=6921.004 N

G Force = force / (mass of vehicle*9.8)

= 6921.004/(394*9.8)

G Force = 1.85

FEA Analysis of frame (side impact) Load = 1.85 G

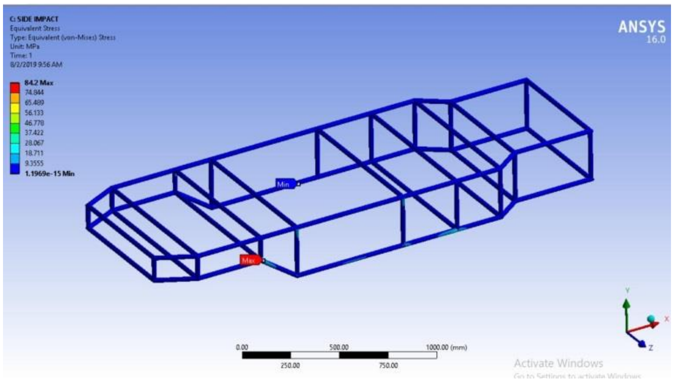


Fig. Side Impact Diagram

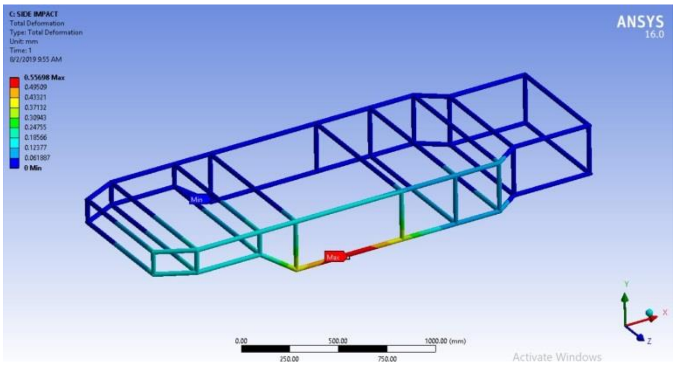


Fig. Side Impact Stress Diagram

3.3 Calculating G force for rear impact

Velocity of vehicle = 5.27 m/s

Mass of vehicle = 394 kg By using formula

V = U+A*T

= 5.27+A*(0.3)

= 17.566 m/s2

We, know

Force = mass*acceleration

= 394*17.566

=6921.004 N

G Force = force / (mass of vehicle*9.8)

= 6921.004/ (394*9.8)

G Force = 1.85

FEA Analysis of frame (rear impact) Load = 1.85 G

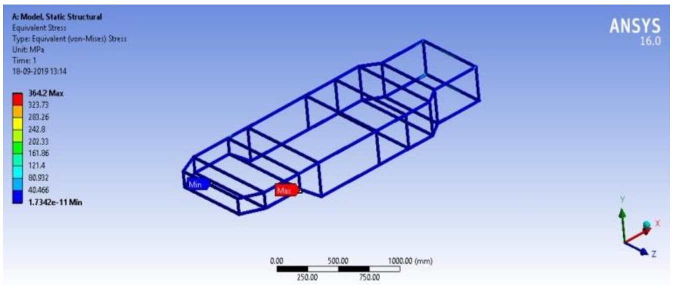


Fig. Rear Impact Diagram

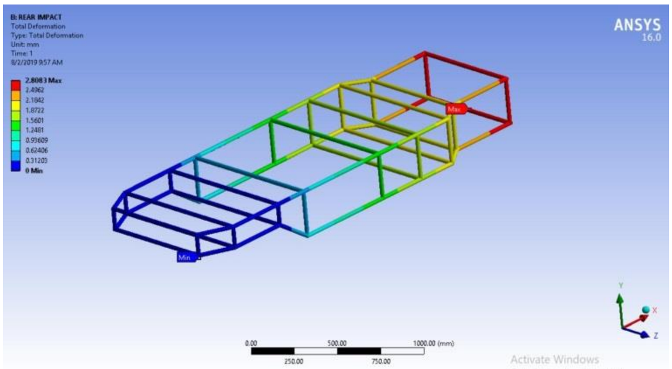


Fig. Rear Impact Stress Diagram

3.4Factor of safety calculation

1) Factor of safety front impact
   Maximum stress induces at front section = 396.6 MPa
   Yield strength of material = 460 MPa
   F.O.S =460/396.63 = 1.1
2) Factor of safety side impact
   Maximum stress induces at side section = 269.2MPa
   Yield strength of material = 460 MPa
   F.O.S =460/269.27 = 1.17
3) Factor of safety rear impact
   Maximum stress induces at rear section = 84.2 MPa
   Yield strength of material = 460 MPa
   F.O.S = 460/84.2 = 5.46

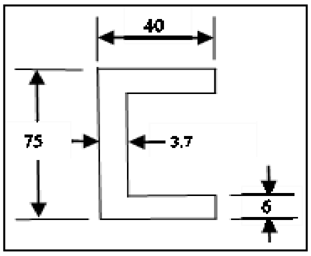
3.5 Mounting Calculation

Properties table

Property's	Metric
Yield strength	250Mpa
Tensile strength	410 Mpa
% Elongation (At gauge length @ 5.65)	23 %

Chemical properties

Element	Content `
Carbon	0.23% max
Silicon	0.40% max
Manganese	1.50
Phosphorous	0.045
Sulfur	0.045



Cross section = C - Cross section

Width =40 mm

Height =75 mm

Thickness of web = 3.7 mm

Thickness of flange = 6 mm

Total length = 650 mm

Bending strength = Sy*I/C

Moment of Inertia = I_{xx}=76 cm^4, Iyy = 12.6 cm^4

I = Ixx+Iyy = 76 +12.6 = 88.6 *$10^{-8}$$mm^4$

Bending strength = 250*(88.6*10^{-8})/ (0.0375)

= 5906 Nm

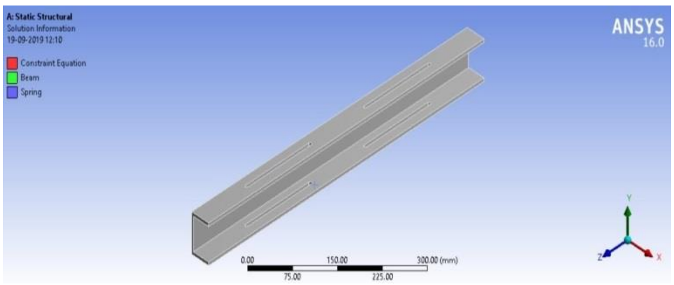


Fig. C Section Plate Diagram

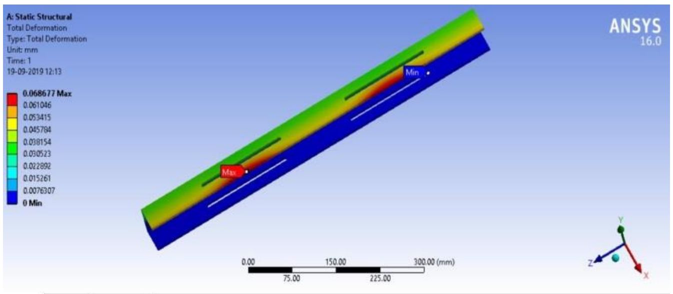


Fig. C Section Plate Impact Diagram

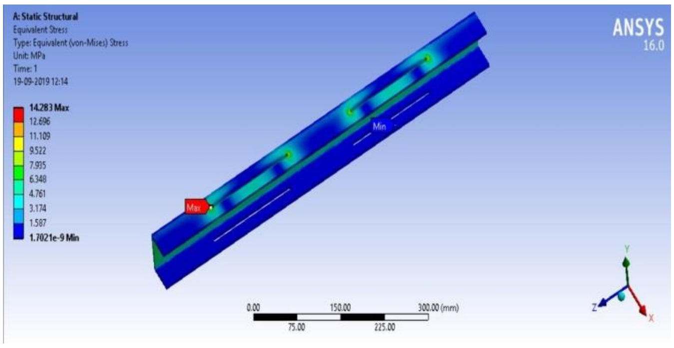


Fig. C Section Plate Stress Diagram Max

Deformation = 0.068 mm

Max Stress = 14.283 MPa

FOS = Yield Strength / Max Stress

= 250/14.283 = 17.50

4. Case study

Over all view of analysis

Analysis	Load	Stress	F.O.S
Front Impact	3.71G	396.63 Mpa	1.1
Side Impact	1.85G	269.27 Mpa	1.17
Rear Impact	1.85G	84.2 Mpa	5.46

5. Conclusion

To study chassis design and analysis of chassis for requires machine. Different machine have different chassis criteria has per change its formula for design. We study the how to chassis design and manufacturing the chassis for onion harvester

Fig. CHHATRAPATI HARVESTER

We have created the final product after completing the chassis, mounting manufacturing, and all system fittings. As a Mechanical Engineer, I am proud that the final product looks great and fully functional.

REFERENCES

[1] Smita, C. Saddu, Modeling and analysis of composite as an alternative material for leaf spring, volume 11, Issue IV (Mayjune 2014) , PP 39-44..

[2] J. William Fitch, "Motor Truck Engineering HandbookFourth edition" SAE Inc, Warrendale, U.S.A, 1993.

[3] AutarK.Kaw. Mechanics of Composite Materials. 2e. Taylor and Francis Group, LLc , 2006..

[4] N V Dhandapani, G Mohan kumar, K K Debnath, "Static analysis of Off-High way vehicle Chassis structure for the effect of various stress distributions", Journal of Mechanical Science and Technology, Vol.1, No 6, 2012.

[5] Ojo Kurdi, Roslan Abdul Rahman, "Finite Element Analysis of Road Roughness Effect on Stress Distribution of Heavy Duty TruckChassis", International Journal of Technology, Vol.1, PP 57-64, 2010.

[6] Cicek Karaoglu, N. Sefa Kuralay, "Stress analysis of a truck chassis with riveted joints", Finite Elements in Analysis and Design, Vol.38, PP 1115–1130, 2002.

[7]]. Haval Kamal Asker1 and Arkan Fawzi, "Stress Analysis of Standard Truck Chassis During Ramping On Block Using Finite Element Method", JUNE 2012.

[8] B. Subhramanyam, Mahesh Kolati, Vishal, K Praveen Kumar, "Analysis of Formula Student Race Car", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, Vol. 5 Issue 10, October-2016

[9] Surve Aditya, Naik Vishal, Naikar Aditya, Mohd. Raees, "ANALYSIS OF FSAE CHASSIS", International Journal of Scientific & Engineering Research Volume 9, Issue 3, March-2018 40 ISSN 2229-5518.

BIOGRAPHIES

Mr. Dhikale Vaibhav B.
Mechanical Engineer
Mathoshri College Of Engineering
Nashik, Maharashtra

Mr. Dhikale Rushikash
Mechanical Engineer
Mathoshri College Of Engineering
Nashik, Maharashtra

Mr. Ghuge Rahul
Mechanical Engineer
Mathoshri College Of Engineering
Nashik, Maharashtra