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Design and Analysis of FSAE Chassis for Safe Conditions

P. N. V Bala Subramanyam, B Nageswara Rao, Y. Yashwanth Sai, K. Chandra Mouli, CH. Sreenivasa Pavansai

Abstract: ***This article focuses on the "DESIGN OF CHASSIS AND STATIC ANALYSIS OF A FORMULA SAE CAR" for the ride comfort. Basically a chassis is a bracket holds the components, transfers load and also plays a very important role in design of a formula race car but can be called as the back bone support of a good race car. Perfect design allows a light in weight with higher stiffness and it is a safe chassis to be produced at a reasonable manufacturing cost. The projects wholly focus in the design and analysis of a fsae chassis which can sustain to the racing world. Introduction to the various types of analysis which can be performed on the formula student race car, based on the concepts of space frame's load distributions like lateral, longitudinal vertical and horizontal torsion and consequent deformation modes in order to ensure the safety of the driver and the various ways by which the results obtained after the analysis can be optimized for the safety of the driver has been discussed, one can easily get an idea about how to perform different types of analysis by applying what amount of loads on a student formula race car. The project work has the loading conditions & boundary conditions for different type of analysis like stress, deformation analysis of chassis.***

Keywords: ***Chassis design, Deformation analysis of chassis, Stress analysis, tubular space frame chassis.***

I. INTRODUCTION

In this paper, the complete prototype of chassis and its design is done in catia v5. To get that enhancement on safety considerations we majorly concentrated on type of material, weight of the material, perfect triangulation to the node points in the chassis which is a primary consideration of a vehicle, based on it the behavior. We are designing the chassis for formula cars and the chassis of the vehicle should be enoughh strengthen to absorb the energy when front, back, side, torsion-al loading conditions which may happen during the impact test should be distributed throughout the chassis according to the load path. The chassis is nothing but a carrying unit which connects every other parts in the car like steering, suspension, braking, transmission etc. We are designing in away to sustain in every case which can effect the chassis. A Space frame chassis were chosen over various types of chassis.

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*Correspondence Author(s)
P. N. V Bala Subramanyam, Department of Mechanical Engineering, Koneru Lakshmaiah Educational Foundation, Guntur (A.P), India.
Dr. B. Nageswararao, Department of Mechanical Engineering, Koneru Lakshmaiah Educational Foundation, Guntur (A.P), India.
Y.Yashwanthsai, Department of Mechanical Engineering, Koneru Lakshmaiah Educational Foundation, Guntur (A.P), India.
K.Chandramouli, Department of Mechanical Engineering, Koneru Lakshmaiah Educational Foundation, Guntur (A.P), India.
CH. Sreenivasa Pavansai, Department of Mechanical Engineering, Koneru Lakshmaiah Educational Foundation, Guntur (A.P), India.

The judges are not only looking for a good design but for a lot of testing as well. The basic and fundamental principle to build a chassis design states that a chassis is to be designed to sustain and achieve the torsion-al rigidity and light in weight in order to achieve good handling and control over a race car. Torsion-al rigidity refers to the amount of torque required to twist the frame by one degree or in the other words capability of chassis to resist twisting force or torque. While the vehicle is at the corner entry, the torsion-al rigidity is too small then the chassis will be thrown off also called over steer. If the torsion-al rigidity is too large, then the corner entry is difficult and leads to the under steering tendency. These parameters conjointly applied to space frame chassis. Generally, the result of the torsion-al rigidity on space frame is totally different to the monocoque. Space frame chassis is light in weight because it take less space, as its manufacturing is cost-effective, requires simple tools and damages to the chassis can be easily rectified.

II. CONTEXT

1.1 Formula SAE

Formula SAE is a student design competition where the students have to design, build and test a Formula-style car to compete with it later. The competition started in 1978 in USA but now it is present in many countries in Europe as well. As the time goes on, the level present in the competition has increased greatly, in fact, the world record of acceleration of an electric car is hold by a Swiss team (from 0 to 62 mph in 1.5sec).

III. EVENT PLAN

2.1 Static Events

2.1.1 Design Event

The students have to justify their designs to a group of judges who usually are people closely related to Formula student car. The maximum points that a team can achieved in this event are 150.

2.1.2 Cost Event

It would be easy for a team with a budget of millions to develop a much better car than one who has a tight budget. For this reason, this event consists in defending in front of the judges the Bill of Materials of the car.

2.1.3 Business Case Event

Finally, to complete the statics events it has to be some marketing. In the Business Case Event one team member has to try to sell the car as the team was a fictional company and the judges were investors.

2.2 Dynamic Events

2.2.1 Acceleration Event

The opening of the dynamic event's, is the one which is less related with the driver's skills. It is 75 meters long straight and the car has to do it as fast as it can.

2.2.2 Skid Pad Event

This event is meant to test the cornering behaviour of the car. First it has to do two laps in the right circle and then other two laps in the left one. The time in this event is the average time of the four laps.

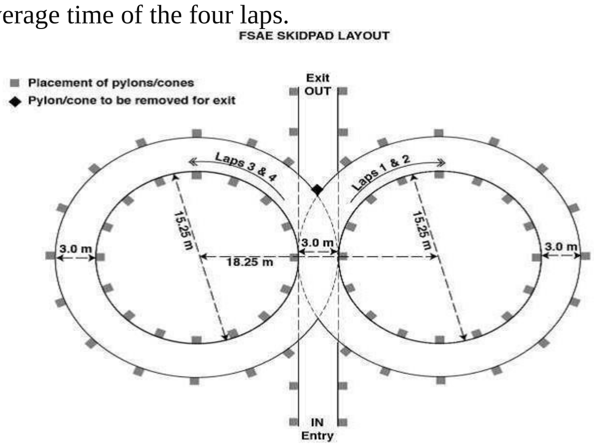

Fig1: Skid Pad Layout

2.2.3 Autocross Event

The Autocross event consists in a race circuit with many closed curves which gives more importance to acceleration than to top speed. Each driver has to chances and the fastest time is the one counted towards the classification.

2.2.4 Endurance Event

This is the greatest event and the hardest one. Each year few cars are able to finish it. The Endurance event consists of running in the same circuit of the Autocross event but this time it is about laps which makes a total distance of 22 km.

2.2.5 Fuel Economy Event

During the Endurance event the fuel consumption is recorded. At the end of the event the consumption of all cars that managed to finish the Endurance are ranked.

Event	Points
Design Event	150
Cost Event	100
Business Case Event	75
Acceleration Event	75
Skid Pad Event	50
Autocross Event	150
Endurance Event	100
Fuel Economy Event	150

Table 1. Competition Point

IV. RULES

3.1 Chassis Design configuration

The 2012 FSAE rules and regulations state that the vehicle has to comprise of open-wheel and open-cockpit. The minimum wheelbase allowed is 1525 mm (60 inches). This is measured from the centre of ground contact of the front and rear tires with the wheels pointed straight ahead. Also, the smaller track of the vehicle (front or rear) must be at least 75% of the larger track. The Chassis structure components are described as follow.

3.2 Main hoop

The Main hoop is a roll bar just behind or alongside the "driver's torso" . Its function is to protect the driver's upper body from injury should roll over occur. The rules state that the construction should be made from a single piece of uncut tube and be supported by bracing to protect the driver. It is also required that in the event of roll over, the driver's head and hands must not contact the ground. There is strict restriction regarding the material used for the design of the main hoop. The following materials are not allowed aluminum alloys, titanium alloys and composite materials.

3.3 Front hoop

The Front hoop is roll bar located above the driver's legs, close to the steering wheel. In the regulation, it is stated that when the driver is seated and restraint normally, the helmet of a 95th percentile male (See fig), as measurement from anthropomorphic dummies must be at least 50.8mm from the straight line drawn from the top of the main hoop to the top of the front hoop as shown in fig. .

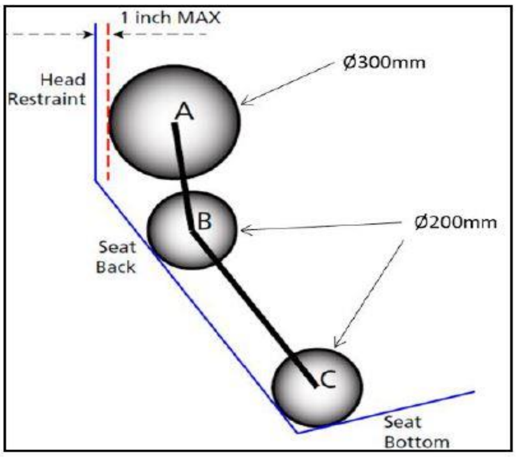

Fig. 2: 95th percentile male with helmet

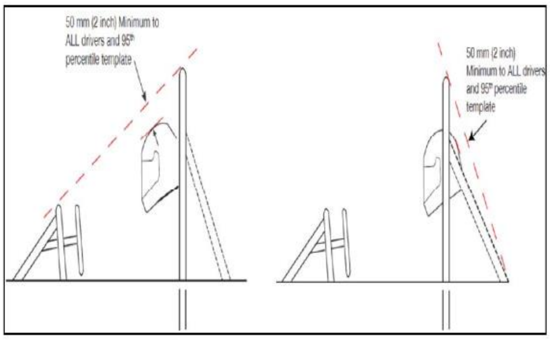

Fig 3: 95th Requirements for minimum helmet clearance

The rule states that the Side Impact Structure for tube frame cars should consist of at least three tubular members located on each side of the driver while seated in the normal driving position.

3.4 Side impact structure

As shown in fig, the side impact zone is the area of the side of the car which extends from the top of the floor to 350mm above the ground and from the Front hoop back to the Main hoop

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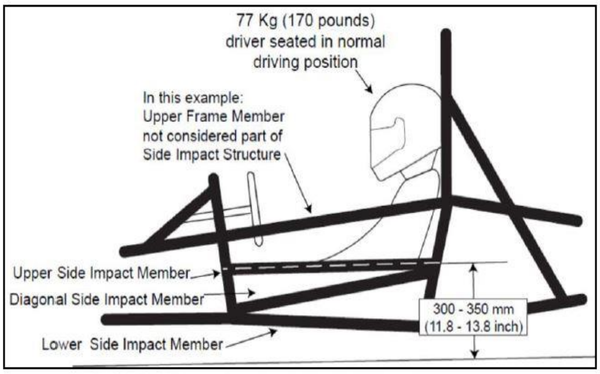

Fig 4: Side impact rules

The rule states that the Side Impact Structure for tube frame cars should consist of at least three tubular members located on each side of the driver while seated in the normal driving position.

3.5 Templates

Specific templates must be used to ensure the comfort of the driver they are

3.5.1 Cockpit template

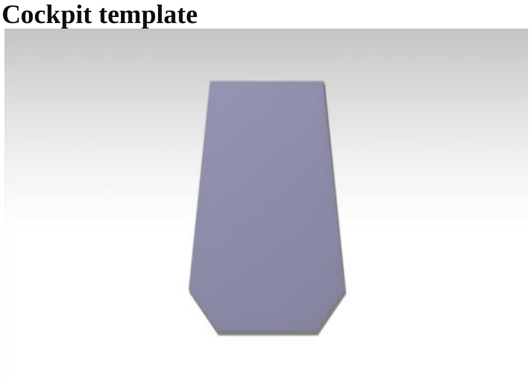

Fig 5: Cockpit template

3.5.2 Foot well template

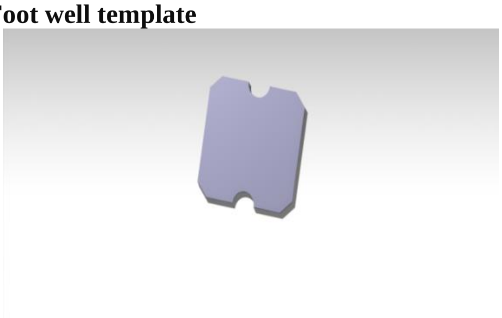

Fig 6: Foot well template

V. LITERATURE SURVEY

The formula student vehicle is considered to be one of the important structures of an automobile. It is the structure which holds both the car body and the drive train, power train. Many mechanical parts like the, the axle assemblies including the vehicle wheels, suspension parts, engine and the drive train the brakes, steering components etc, are bolted onto the chassis. The vehicle chassis provides the strength to withstand the loads for supporting the different vehicular components and also the payload and helps to keep the automobile enough rigid and stiff. Therefore, the chassis is also an important component of the overall safety system. Furthermore, it ensures low level of noise, vibrations and harshness throughout the automobile. A chassis should be rigid enough to sustain or hold the sudden shocks, twists or roll over conditions, vibration and other stresses. Apart from the strength considerations, we have an important design consideration is that chassis design is to have acceptable bending and torsion-al stiffness are two primitive factors for the design of chassis.

The skeletal frame is the most element in strength and stability to the vehicle under different conditions. Formula vehicles provide strength and flexibility to the vehicle. The backbone structure of the automobile, which holds the frame to increase the strength. If the vehicle frame is designed in a way that kind of rectangular format, it will be easily distorted under loads as shown in figure.

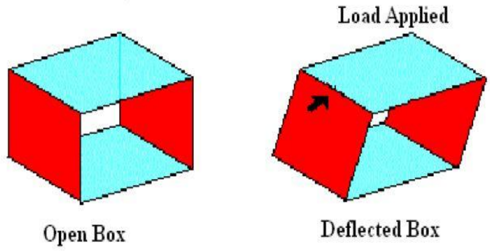

Fig7: Part with no triangulation

Triangulation the square shaped part is included by a diagonal member braced with the vehicle, greatly reducing the amount of deflection.

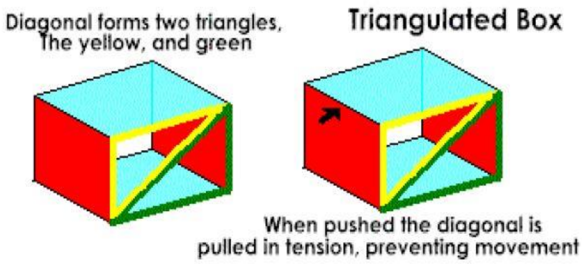

Fig 8: Part with triangulation

As shown in Figure, Decrease in deflection and increase in the strength is gained when the part is loaded. The diagonal triangulated member is stressed in tension and the end members are stressed in compression. The force is achieved in the opposite direction, the diagonal member would be placed under compression and the ends will be placed in tension. This triangulated diagonal member is higher in length and under greater loads member is more capable of buckling if compression loads are applied. This is principle behind the triangulation and it is very crucial to know the load paths. So that the diagonal members will be in under tension

VI. CLASSIFICATION OF CHASSIS

This skeleton structure is the basic primary factor and consideration of the vehicle, all components, like transmission system, bodywork for aerodynamics, driver cabin, fuel tank, guiding, suspension framework and steering system are rigidly mounted on the chassis there are different materials which are manufactured for the assembling these systems. The material is selected by their availability and properties required for the vehicle, the vehicle weight should not be compromised in design of a vehicle, for example carbon fiber which is light in weight.

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6.1: Classification of chassis as follows

(I) Conventional control chassis: In these types of chassis where the components are connected to the base structure like a ladder chassis.

(ii) Semi-forward control chassis: In this type of chassis the half of the powered engine is mounted inside the driver's cabin and other half outside driver's cabin most commonly seen in trucks.

(iii) Full forward control chassis: In this type of chassis the driver's position is right on the top of the front axle and cabin downwards engine mounted totally inside driver's cabin like modern trucks and buses.

Following primary elements of the Chassis are

1. Frame: It is assembly of long two members joined by welding called side members and primary structures like main hoop, front hoop, front bulkhead joined together with the help of number of cross members.
2. Single cylinder engine: Provides the power as a source to drive the wheels.
3. Clutch: It is an intermediate connects and disconnects the power from the engine to the transmission framework.
4. Transmission system
5. Universal Joints
6. Shafts that transfers the power

VII. CHASSIS TYPES

1. Ladder chassis:

It is comprise in the shape of the ladder it is comprise of the two parallel rails and different cross part are available in the middle of the two rails. these are accommodated the torsion-al firmness. these case was utilized around mid-1940 in the dashing case now these are found in truck .

Fig 9: Ladder Chassis

2. Twin tube chassis:

It is advance of the ladder chassis in these types of the chassis the large tube are replaced by the similar tube and the bulkhead. These sort of the can stent the extensive measure of the heap. These were utilized after the 1971 it were the boundless game vehicle recorded multi year after its presentation.

3. Space frame chassis:

In these sorts the chassis is secured with the four cylinders along the length of the chassis. the body give the solid torsion-al firmness yet it need in the supporting. The space outline is the following consistent advance of the multi tube suspension in these it is comprise of the chassis which are of uniform size and they are join at their hub .these decrease their capability of twisting pressure ,a strategy for development of the pressure spans was create which was the most headway in the game vehicle .these acquired the unrest the game vehicle, these vehicle give better dealing with execution and it increment its firmness property and it brought perfection. Regardless of the reality the most well similar and known chassis structure in Formula one race vehicles is space frame, the cylindrical space outline are likewise utilized particularly in Formula understudy race vehicles. These edges contain arrangement of cylinders that are consolidated to frame a structure which interfaces all the critical segments together. The members are "triangulated" to enable them a proper load path in impacts and pressure just and don't twist because of torsion to any high degree.

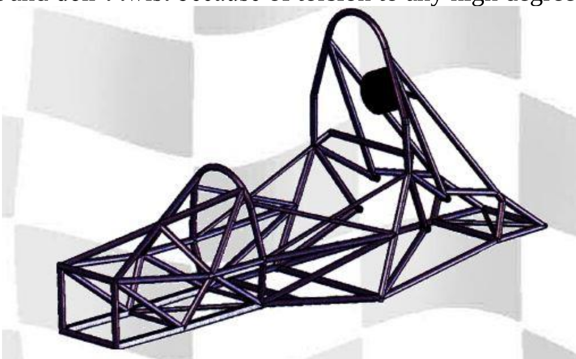

Fig10: Space frame Chassis

4. Monocoque Chassis:

Most of the commercial cars produced entire the world are made of steel. This total steel structure is a one single-piece which defines the entire shape of the vehicle. The other components are just joined to it and made by welding a several pieces joined together:

• The floor pan is which the bottom of the chassis is the biggest piece in the vehicle, and different pieces are press made by huge stepping machines.

• These joints are spot welded jointly by robot arms (some even utilize laser welding) in a stream generation line.

• After that, a few adornments like entryways, cap, boot top, side boards and rooftop are included.

The Ford Consul presented an advancement of monocoque chassis, called unit body or uni body.

Fig11: Monocoque Chassis

5. X-Frame:

It was presented by the American engine in 1960's, in these there is the x part in the middle of the edge which help in oppose the contorting power. there is no expected of the sub edge and it guarantee the even appropriation of the heap .The rounded individuals are "triangulated" to enable them to support stacks in strain and pressure just and don't distort because of twisting or torsion to any high degree.

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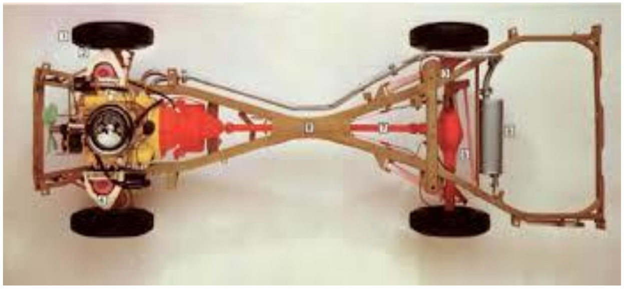

Fig12: X- Frame Chassis

7.1 ROLES OF A CHASSIS FRAME

1. To carry the amount of weight that goods or passengers carried in the vehicle.
2. To carry the self-weight of the vehicle like frame, chassis, engine, transmission etc.
3. The chassis should be able sustain sudden powers or jerks caused because of the sudden braking or speeding up.
4. To chassis should be able to the stresses caused due to the bad road condition.
5. To withstand diffusive power while cornering.

7.2REQUIERMENTS OF BODIES FOR VARIOUS TYPES OF VECHILE

The body of the most vehicle should to satisfy the accompanying necessities:

1. The body should to be light.
2. It should to have least number of components.
3. It should to give adequate space to travelers and luggage.
4. It should to withstand vibrations while in movement.
5. It should offer least protection from air.
6. It should to be cost effective and should not be much complex while manufacturing.
7. It should to be appealing fit as a fiddle and shading.
8. It should have uniformly distributed load
9. It should to have long exhaustion life
10. It should to give great vision and ventilation.

VIII. DESIGN PARAMETERS AND CALCULATIONS

Design parameters for a Formula SAE chassis depends upon the FSAE rules so here are some important rules which highly effect the material dimension for chassis.

- The vehicle must have a wheelbase of at least 1525 mm.
- The smaller track of the vehicle must be no less than 75 % of the larger track.
- Steel properties used must be (in case of non-welded structure)

Young's Modulus= 200 Gpa
Yield Strength = 305Gpa
Ultimate Strength = 365 Gpa
Coming to the moment of inertia for the material dimensions

Application of the material	Minimum Wall thickness	Minimum area moment of inertia
Roll hoops	2.0mm	11320 mm^4
Side impact, front bulkhead, roll hoop bracing, harness attachment	1.2mm	8509 mm^4
Front bulk head supports, triangulation members	1.2	6695 mm^4

Another important rule for a safe chassis would be on side impact zone Upper member of side impact zone must connect roll hoops node-to-node and must lie between 240mm to 320mm above the upper surface of lowest side impact zone member

So these parameters helps to design chassis to satisfy the rules and to obtain material and its dimensions. So to obtain the dimensions we have constrains based upon rules as

D_o-D_i = 4mm for roll hoop and

Moment of inertia (I) = $((D_o^4 - D_i^4)*\pi)/64$

So $D_o = D_i + 4$-----------------------------(2)

And $11320 = \pi*((D_i + 4)^4 - D_i^4)/64$

Finally by solving we get D_i = 17.24 mm and D_o = 21.24 mm (based on Eq 1)

But coming to availability there will be ready availability of material with outer diameter of 25.4mm. So to find the material which will be highly available outer diameter of 25.4mm was selected.

So now Eq1 becomes as

$11320 = \pi*(25.4^4 - D_i^4)/64$

Now we can obtain D_i as 20.75 mm

And thickness as $(D_o\text{-}D)/2_i$ = (25.4-20.75)/2 = 2.3 mm for roll hoops

By repeating the same methodology for the other two types of materials we has

- For side impacts and bulk heads we obtained material thickness as 1.6mm
- For bulk head supports and triangulation members we obtain thickness as 1.2 mm
- To design a chassis, we have consider the factors. So here are the factors that we should consider for designing a good chassis.

8.1 Weight Distribution

Distribution of loads in the chassis should be equally distributed to the four wheels. We have to consider the weights in the chassis like driver, engine, mounting members, steering components, braking components etc. Making the "CG" point in the chassis as grounded as possible by changing the distribution ratio's and components re-location . Such that, weight transfer is factor for a vehicle while cornering more load is on the outer wheels.

A formula student vehicle that has a certain weight distribution ratio based towards the rear of the vehicle (40/60) can brake later and harder into corners. This happens because when the vehicle brakes, the weight moves towards the front of the vehicle and the vehicle gets closer to a 50/50 weight distribution.

8.2 Wheel Base and Track width

The wheel base and track width also a factor that should be considered for a race car. According to the vehicle loads acts on the chassis should be considered and should design a chassis. Proper balance of the vehicle is achieved through the accurate wheel base and track width according to the load acting on it.

8.3 Wheel Loads

Wheel loads are of three different types they are

- Vertical loads
- Lateral loads
- Longitudinal loads

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8.3.1 Vertical loads

Vertical loads are the loads directly acting upon the vehicle wheels in static conditions when the vehicle is in static conditions, these vertical loads depends upon the distance from front and rear axles to the center of gravity. So here is the process to calculate the vertical load on the vehicle. But before moving into the calculations there are some assumptions they are.

- Vehicle is completely in static conditions that is only self weight is the only force acting on the vehicle.
- Vehicle is in the horizontal plane with zero inclination.
- Vehicle weight division for left and right in an axle will be in the same ratio i.e.. weight on one wheel will be the half of the weight of that axle.
- Finally weight on the wheel is equally distributed to its respective pickup points equally.

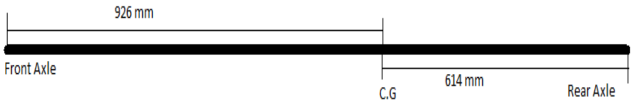

Fig 13: Vehicle C.G location

Mass of the vehicle (M) = 280 Kg

Total wheel base of the vehicle will be

(L) = 926+614 = 1540 mm

Now weight acting on front axle will be as

F x = (M*y)/L ------(3) Where X= Distance from C.G to Front axle, Y = Distance from C.G to Rear axle.

From Eq(3) we can obtain that load on front axle as 112 Kg

Load from the axle will be equally distributed for the front wheels. This distribution depends upon the arrangements of components in the vehicle. So, let us assume that loads are equally distributed to both the wheels. Finally load acting on each front wheel will be as

M(front wheels) = 56 Kg

A wheel will be connected to the chassis by the means of four suspension pickup points So wheel loads will be transferred to the chassis by those four points in a double wishbone suspension system. So load on each front suspension pickup points will be as

M(front pickup point) = 14 Kg

These wheel loads helps to perform the torsional analysis on chassis. But these loads are not constant with the time these keep changing during breaking and cornering. So provide minimum comfort drive chassis must withstand to these loading conditions.

8.3.2 Lateral loads

Lateral loads are observed when the car is under cornering. In cornering the load will be transferred from inner wheel to the outer wheel so in this the chassis must be able to resist this load travel so that driver can experience good turning experience.

Lateral loads depends upon the roll center and C.G of the vehicle.

From the text book of Race car dynamics by Milliken-Milliken in chapter 16 we have a formula to calculate weight transfer Before going into calculations here are some assumptions

- Vehicle is having roll rate in front axis and rear axis as 70,000 and 50,000 lb-ft/rad.
- Track banking angle as 10 deg.
- Radius of vehicle path as 600ft horizontally
- Vehicle speed is about 60 Kmph
- This is calculated for front axle as it is the part which has more contact with driver. Weight transfer during lateral acceleration on front wheel will be given by

W f = A ϒ * (W/t f) * (((H*k ɸf)/(k ɸf * k ɸr))+((b/l)* Z rf))

Where

A ϒ = Lateral acceleration of the vehicle

W = total weight of the vehicle

t f = Front track width

H = distance between roll center and C.G (244mm)

K ɸf ,Kɸr = Frontal and rear roll rates respectively

l = Wheel base

Z rf = Front roll axis height from ground (70mm)

b = distance from C.G to rear axle

when we substitute these parameters in the above formulae there will be a load transfer of 20 Kg in the front axle.

So load acting on outer front wheel while cornering will be about

W tf = w f + W f

= 20+56 =76 Kg

8.3.3 Longitudinal loads

Longitudinal loads are observed when the vehicle is under accelerating or in breaking conditions. In such cases the vehicle weight will be transferred from front axle to rear and from rear axle to rear respectively.

Before going into calculations there are some assumptions

- Rate of deceleration will be about 1.5 g's

Longitudinal Load transfer will be given by the formulae

∆W = M ϒ h / L

Where

M = mass of vehicle

ϒ = rate of deceleration during breaking

h = height of C.G

L = length of wheel base.

Basing on the above formulae we has a weight distribution of 87 Kg on front axle

So total weight on the front axle will be about

W F = ∆W + W f (vertical weight on front axle)

W F = 87 + 112 = 199 kg

so this is how weight is distributed to the wheels in static and dynamic conditions. Chassis should withstand these loadings and provide maximum safety to the driver.

8.4 TURNING RADIUS

By changing the Ackermann settings of the car the overall turning radius of the car can be adjusted. The turning radius of the vehicle was calculated based on the ideal Ackermann position to maximum turning angles of the wheels. Since the two front wheels turn at different angles based on the Ackermann setting on the uprights the average steering angle first needed to be determined for the Ackermann setting. The average steering angle was calculated using wheelbase, distance of CG from the rear axle and the required turning radius. The car had a wheelbase of 1540mm and the distance from the CG location to the rear axle was 616 mm. The required turning is 2.501 m which is reasonable for the expected hairpin turns of the formula autocross racetrack.

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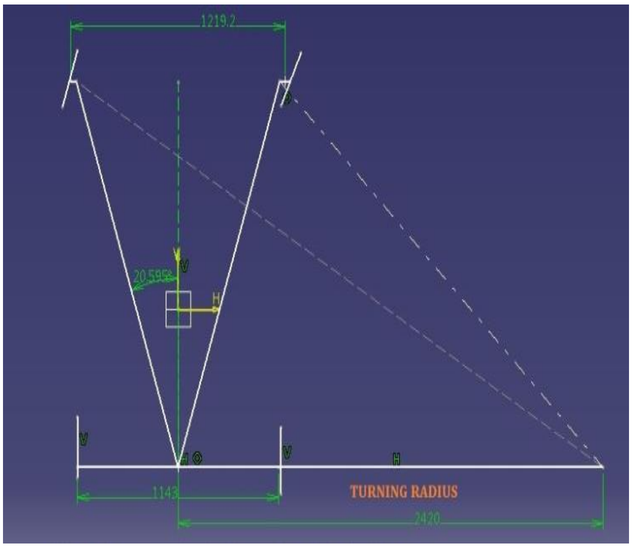


Fig14: Turning Radius

8.5 Material selection

- Machining process: The material is selected based on effective enough to sustain welding, cutting, grinding, drilling.
- Welding equipment: Selected MIG welding process, so the material should be weld-ability should be high.
- Strength considerations: Yield strength, ultimate strength, Breaking point, elongation ratio for tensile loads.
- Availability: The selected material should be available in the market as per the dimensions.
- Other considerations: Low density, High strength, torsion-al rigidity, Sustainable to bending loads and impact loads.

Based on these factors, we selected "AiSi-1018" for designing the chassis.

8.6 DATA SHEET

Physical Properties	Metric	Imperial
Density	7.87 g/cc	0.284 lb/in^3

Mechanical Properties

Mechanical Properties	Metric	Imperial
Hardness, Brinell	126	126
Hardness, Knoop (Converted from Brinell hardness)	145	145
Hardness, Rockwell B (Converted from Brinell hardness)	71	71
Hardness, Vickers (Converted from Brinell hardness)	131	131
Tensile Strength, Ultimate	440 MPa	63800 psi
Tensile Strength, Yield	370 MPa	53700 psi
Elongation at Break (In 50 mm)	15.0 %	15.0 %
Reduction of Area	40.0 %	40.0 %
Modulus of Elasticity (Typical for steel)	205 GPa	29700 ksi
Bulk Modulus (Typical for steel)	140 GPa	20300 ksi
Poissons Ratio (Typical For Steel)	0.290	0.290
Machinability (Based on AISI 1212 steel. as 100% machinability)	70 %	70 %
Shear Modulus (Typical for steel)	80.0 GPa	11600 ksi

Fig 15: Material Data sheet

8.7 Loads acting on chassis

- In this analysis we are considering the wheel loads
- Wheels are connected to the chassis at suspension pickup points.
- So forces acting on pickup points are calculated.
- For analysis we are giving fixed support at the 2 rare set of pickup points.
- Lateral load is given at the one set of front pickup points and other set left free.

8.8 CAD Design and Analysis of Space Frame Chassis

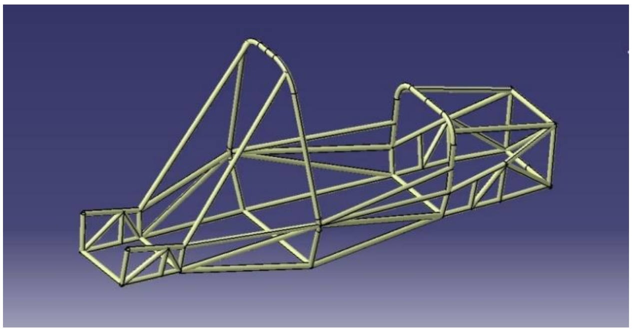


Fig16: Chassis model designed in Catia V5

8.9 LOADS ACTING ON THE CHASSIS WRT TO STEERING

When the wheel has to turn, the driver has to turn the steering wheel with certain torque Such, that the wheel will to turned. The amount of steering torque required to turn the steering wheel by the driver is called Steering Wheel Torque (W T).

Calculations for steering wheel toque is as follows,
W=Front axle weight=116kg
U=Coefficient of friction=0.7
E=kingpin offset=30mm
B=Width of tire=6.89 inch
T=54.6100 N-M
Steering wheel torque=kingpin torque/gear ratio
Then the output torque is dividing by steering ratio which is 4.25 degree. Final steering wheel torque=14.191 N-M.

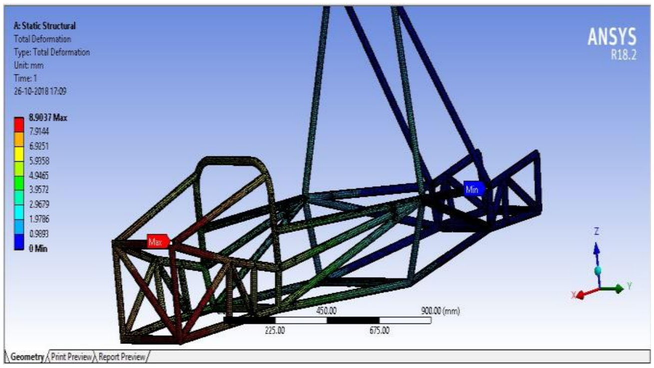
FORCE applied on steering wheel is 55.87N.

We have, force to turn the steering and we have know about the amount of load transferred to the chassis by the steering wheel turn.
F1/ F2= R1/R2
F1= Amount of force required to turn the steering wheels=55.87 N
F2= Amount of force transferred to chassis or a tie rod
R1= Radius of steering wheel= 127mm
R2= Radius of the wheel rim=177.8 mm
Therefore by substituting the values, we got F2=229 N

9. Results:

9.1 Static analysis for vertical loads under 3g bump conditions.

9.1.1 Deformation:



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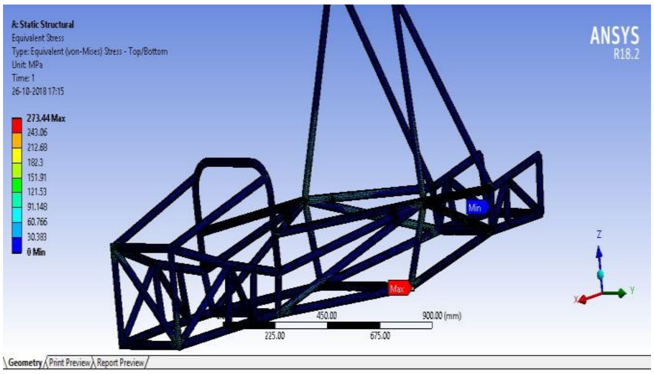
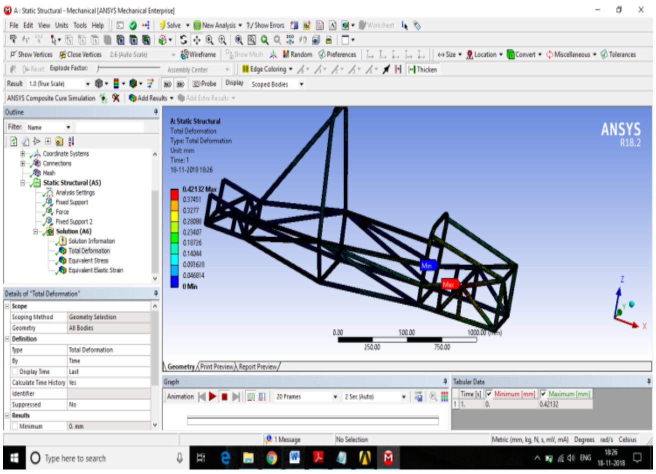
9.1.2 Vonmises stress

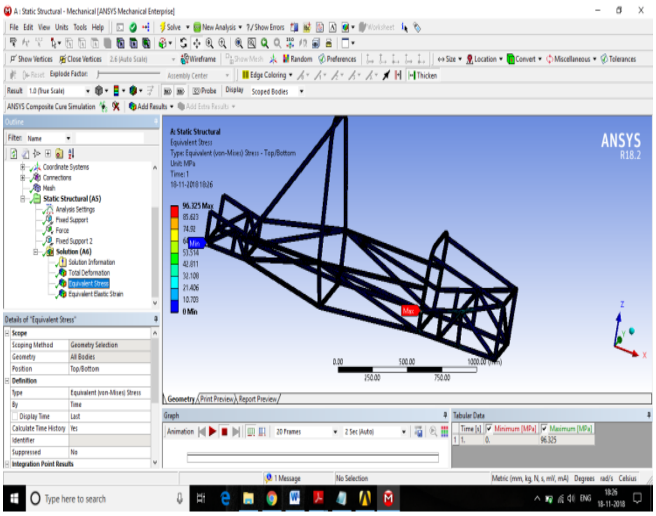


9.2 Lateral loading conditions

9.2.1 Deformation

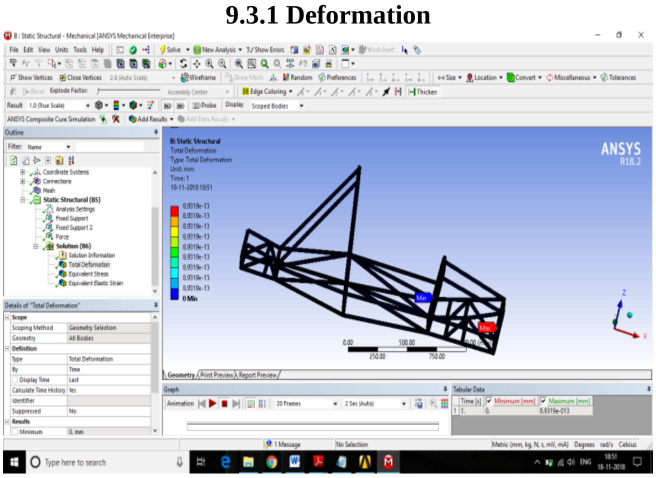


9.2.2 Vonmises stress

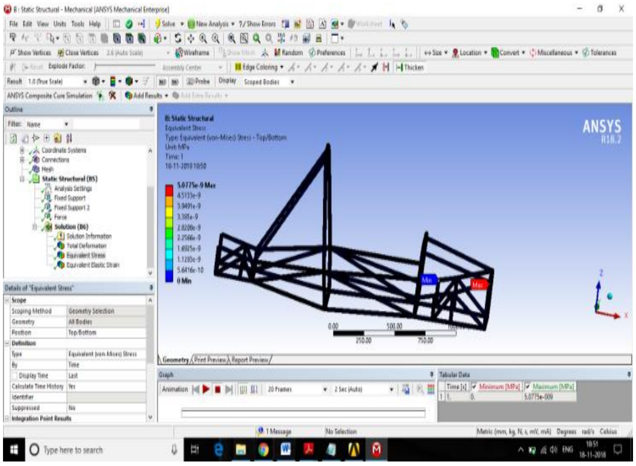


9.3 Longitudinal loading condition

9.3.1 Deformation



9.3.2 Vonmises stress



In the above results we can observe that the maximum stress developed in the chassis is 273.44 Mpa under 3g loading conditions but the material used to chassis has maximum yield strength as 370 Mpa so the designed chassis can with stand these loading conditions with 1.3 factor of satefy.

IX. CONCLUSION

The designing process for static conditions is completed. The numerical solution is approximate to the simulated solution hence our design procedure is correct for such kind of vehicle design. This paper includes static and dynamic parameters according to the formula student race. The work successfully achieved the objective. Result shows that designing of car and its components using Catiav5 has very good extent for enhancement of vehicle geometry, behavior and performance of the vehicle. The overall analysis satisfies the constraints and of Formula SAE International rulebook, so the vehicle modeling under the dynamic analysis is considerable.

FUTURE SCOPE

In the above the thesis was developed to provide good safety and ride comfort for the driver not only in load transferring conditions. But analysis was performed on static conditions assuming maximum loading conditions, but in driving conditions we can experience combined loading conditions along with the engine vibrations. So analyze these conditions chassis can developed in with mathematical solutions using Matlab so based upon it chassis can be analyzed for maximum loading conditions under crash situation also which is not mentioned in above cases.

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AUTHORS PROFILE

P. N. V Bala Subramanyam, Department of Mechanical Engineering, Koneru Lakshmaiah Educational Foundation, Guntur (A.P), India.

Dr. B. Nageswararao, Department of Mechanical Engineering, Koneru Lakshmaiah Educational Foundation, Guntur (A.P), India.

Y.Yashwanthsai, Department of Mechanical Engineering, Koneru Lakshmaiah Educational Foundation, Guntur (A.P), India.

K.Chandramouli, Department of Mechanical Engineering, Koneru Lakshmaiah Educational Foundation, Guntur (A.P), India.

CH. Sreenivasa Pavansai, Department of Mechanical Engineering, Koneru Lakshmaiah Educational Foundation, Guntur (A.P), India.

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