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Study of Impact Analysis on ATV

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Abstract – *The main function of the Rollcage is to protect the driver and support all control system like suspension, steering, engine. The design factor contains durability and maintenance of the frame. Car accidents are happening every day. Most drivers are convinced that they can avoid such troublesome situations. However the statistic shows that ten thousand dead and hundreds of thousands to million wounded every year. Hence, improvement in the safety of automobiles is prerequisite to decrease the harm due of accidents. In order to reduce injuries from accidents and to make the vehicle safe the impact analysis of the car should be done which will help us to know the behavior of vehicle in static and dynamic conditions.*

Key Words: Impact Analysis, Hypermesh Software.

1. INTRODUCTION

The definition of rollcage is "a structural frame work designed to prevent serious body shell deformation in the case of a collision or roll-over". But a rollcage is better described as a Rollover Protection Structure (or system). It must be able to understand the weight of the car landing on the proof providing protection to riders of such vehicle from road hazard, debris and the elements. It comprises a framework of a circular or hollow steel tubing welded together to form a cage having a front portion and overhead protection over which a weather proof fabric cover having at least a front mounted window is place able to form an enclosed cab. The framework is easily attachable to existing front and rear structures of an all-terrain vehicle so as to cover and enclose the rider's area. The frame work is use able with or without the cover for roll over protection and also provides a means to deflect branches and similar hazards away from the rider.

1. G – Force:-

A physical force equivalent to one unit of gravity that is multiplied during rapid changes of direction or velocity. Driver experience sever G-force as they corner, accelerate and brake. G-force depends on mass, greater the mass greater the G-force. Inertia is resistance to an objects changing its motion and G-force is an objects acceleration. Impact time is the time when two bodies collides, i.e. an impact of high force or shock applied over short time period when two bodies collide.

2. G – Force Calculation for Various Impact Forces.

2.1 Front Impact:-

Condition-Rear portion of the buggy is resting against the wall and another vehicle is supposed to collide against it at front side.
Constraints- Rear part of the Engine compartment is fixed.
Force- Force is applied at the nose of the buggy.
Calculations- Assuming max. Velocity as 60 Kmph and impact time as 0.24s.
By Law of conversation of energy:-
Change in Kinetic energy = Work Done

$$0.5mv^2 = F.s$$

And
S = Vmax × Impact Time.

Where, m = Gross weight of the vehicle. (Kg)
F = Force. (N)
V = Maximum velocity of vehicle. (M/s)
s = Displacement of vehicle. (m)
t = Impact time. (s)

Mass of Vehicle (m) = 190kg
V = 16.67m/s

s = 16.67 × 0.24
s = 4.00 m
Thus,
$0.5 \times 190 \times (16.67)^2 = F \times 4.00$
F = 6599.86 N

2.1.1 Result of front Impact in Hypermesh :-

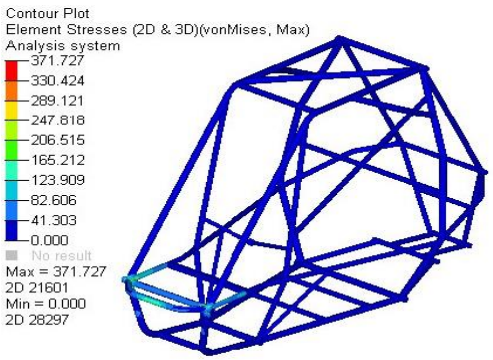

Fig 1 – Element Stresses

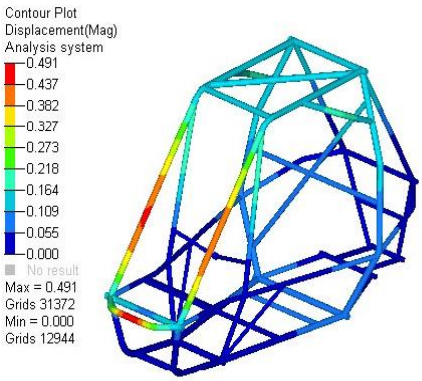

Fig 2 - Displacement

2.2 Rear Impact :-

Condition – Front Portion of the Buggy is resting aganinst the wall and another Vehicle is supposed to collide against it at rear side.
Constraint – Front Part of the Buggy is fixed.
Force – Force is applied at rear part of the engine compartment of buggy.
Calculations – Assuming max. Velocity of vehicle as 60 Kmph and impact time as 0.42 sec.

Thus,
s = Vmax × impact time

s = 16.66 × 0.42
= 6.997 m

$0.5mv^2 = F.s$
$0.5 \times 190 \times (16.66)^2 = F \times 6.997$
F = 3768.44 N

2.2.1 Result of Rear Impact in Hypermesh:-

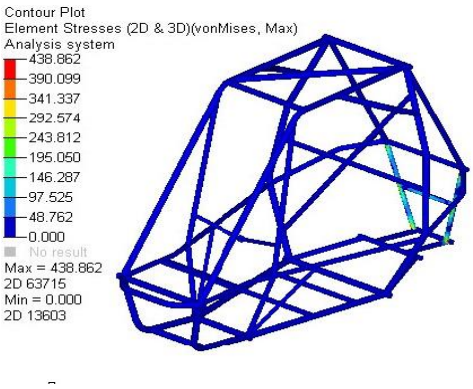

Fig 3 - Element Stresses

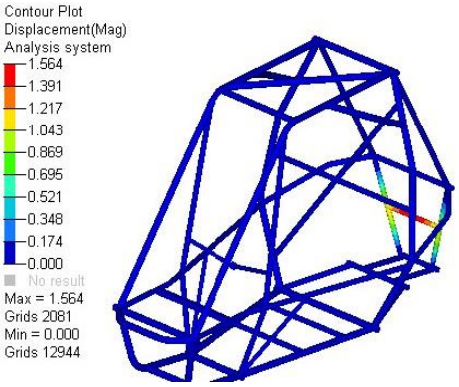

Fig 4 - Displacement

2.3 Side Impact :-

Condition – Side wall of the Buggy is resting against the wall and another vehicle is supposed to collide against it from opposite side over same portion.
Constraints – Side Impact Member upto A-arm is fixed.
Force – Force is applied at side impact member upto A-arm of opposite side.
Calculation – The imapct time for side impact is consider as 0.84 sec
Thus we get after doing similar calculation as shown above :-
F = 1884.22 N.

2.3.1 Result of Side Impact in Hypermesh:-

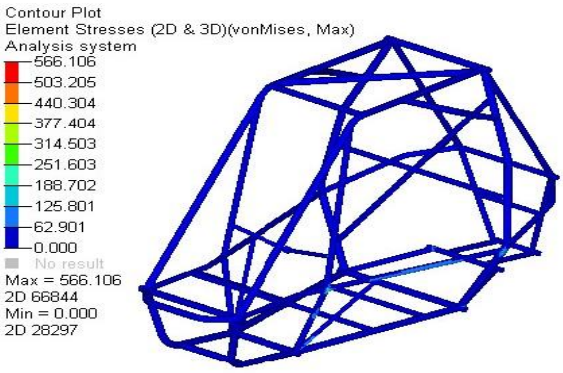

Fig 5 – Element Stresses

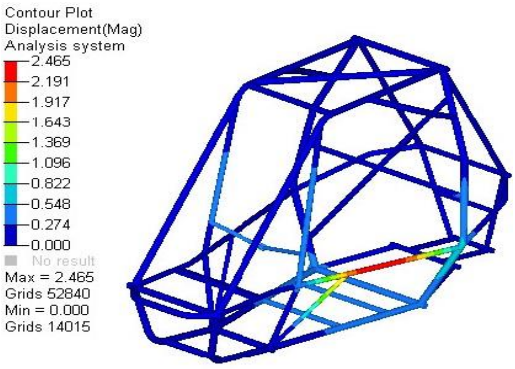

Fig 6 – Displacement

2.4 Rollover:-

Condition – When Buggy is taking a turn, centrifugal force tends to roll the buggy.
Constraints – Lower Frame side member of one side of the Buggy is fixed.
Force – Force is applied on upper side of buggy.

Calcul;ations :-
Velocity taken = 30 km/hr
μ = 0.65

Cornering force = Frictional force between the tire and road

$$\frac{mv^2}{r} = \mu mg$$

$$\frac{v^2}{r} = \mu g$$

Table 1 - Force calculated at different velocity

Velocity(m/s)(kmph)	r(m)	Force
8.33(30)	18.88	2805N
16.66(60)	18.88	2793N
12.5(45)	18.88	1572N

2.4.1 Results in Hypermesh :-

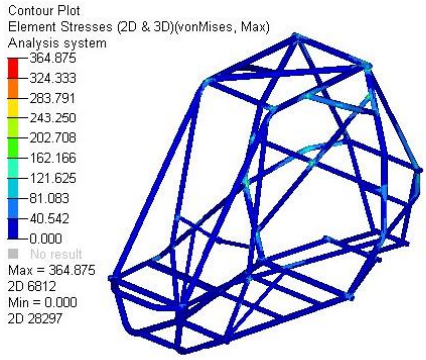

Fig 7 – Element Stresses

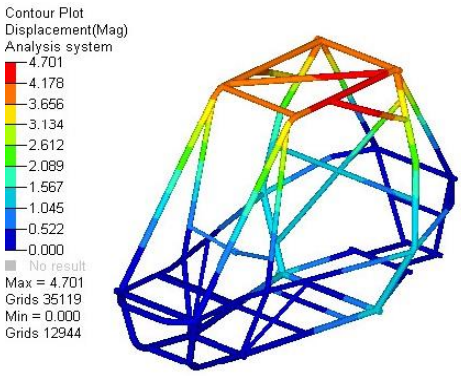

Fig 8 – Displacement

2.5 Torsional Rigidity :-

Torsional rigidity is defined as the amount of torque required to produce unit deflection. Twisting of chassis is caused due to transfer of forces by suspension mounting points on the chassis.

- Force= 2G
- Torque= Total Force Applied*Average of all Perpendicular distance between the nodes of applied forces.
- T=3727.8*336.36=1253Nm
- Deflection= Displacement between any two nodes/Distance between two nodes
- Deflection= 1.631-(-1.140)/279.4=0.56degree
- Thus,
- Torsional Rigidity= Torque/Deflection
  - =1253/0.56
  - =2237.5Nm/deg

2.5.1 Result in Hypermesh: -

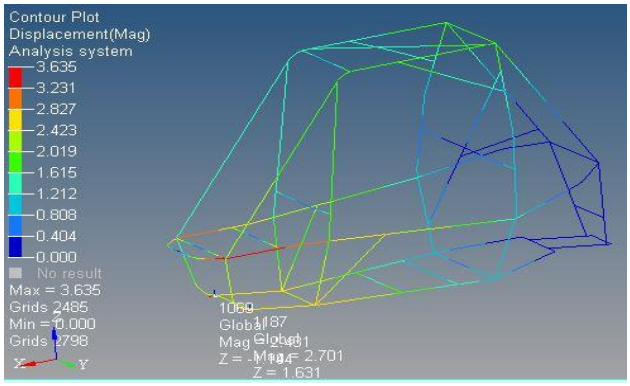

Fig 9 – Torsional Rigidity by CAE Beam method

3. Conclusion:-

4. Type of test	Force	Deformation (mm)	Factor of Safety(FOS)	Stress (Mpa)
Front Impact	5g	0.491	1.67	357.72
Rear Impact	4g	1.564	1.36	438.86
Side Impact	3g	2.465	1.05	566.16
Rollover	1.5g	4.701	1.64	364.87

Table 2 – Conclusion of all the analysis.

By analysing the results and by making suitable changes we can make proper and safe vehicle. The cage is particularly design for the automobile, for rough road drive. This design is beneficial for un-even road in urban and undeveloped areas. This design will have positive affect on transportation and provide luxurious drives in all areas. Thus by some modification it will play a great deal in automobiles industry.

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