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Design and Impact Analysis of Go-Kart Vehicle

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***Abstract:*-- Design of component for automobile consists of three main principles:**
1. Optimization
2. Safety
3. Comfort

The primary objective of the chassis and frame is to provide a 3-dimensional protected space around the driver that will keep the driver safe. The primary objective of the roll cage is to provide a 3-dimensional protected space around the driver that will keep the driver safe. These objectives were met by roll cage material that has more strength and less in weight giving us an advantage in reduction of weight. The strength of roll cage and chassis is increased by almost eliminating the bends and joints during the welding. The modeling of structure and design of roll cage and chassis is done by the software SOLIDWORKS.
To start with the initial design of the frame and chassis , some design guidelines are to be set .They include intended transmission, steering and the most important part is placing and fixing them in the correct placement , mounting of seat , design features and manufacturing methods .

CAE ANALYSIS

FRONT IMPACT ANALYSIS

2.1.1 Impact load calculation:

Using the projected vehicle/driver mass of 175 kg, the impact force was calculated based on a G-load of **3**.

F = ma …. (2.1)

Where,
F = Total force.
m = Total mass of the vehicle.
a =acceleration due to gravity
=> 190*3*10 = ***5700N***

Impulse time = weight*(velocity/load) … (2.2)

=> 190*(16.67/5700) = 0.55 **seconds**

We apply 5250 N from the front for the test of front impact of the roll cage structure of the vehicle for determining strength at the time of front collision

2.1.2 RESULTS

Maximum deformation= 0.590 mm.

Maximum deformation for the front impact is under the safe limit and does not affect the safety of the driver.

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 8	0.590847 mm Node: 142

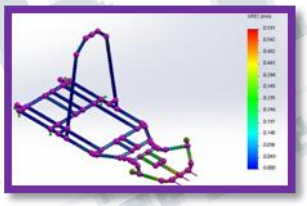

Fig. 2.1 Maximum Deformation

Maximum Von Misses Stress= 128.481 N/mm$^{2.}$

Name	Type	Min	Max
Stress1	TXY: Shear in Y Dir. on YZ Plane	0 N/mm^2 (MPa) Element: 7	128.481 N/mm^2 (MPa) Element: 261

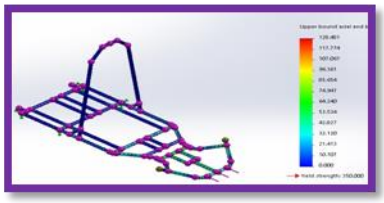

Fig. 2.2 Maximum Von Misses Stress

Incorporated Factor of Safety= σ_{yt}/σ_{max}
Where,
σ_{yt}- Tensile strength, Yield
σ_{max} - Maximum working stress
FOS = σ_{yt} / σ_{max}
= 350/128.481
= 2.72

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As factor of Safety for automobiles goes up to 8, hence design is safe against specified stress.

Name	Type	Min	Max
Factor of Safety1	Automatic	2.72414 Node: 131	10 Node: 1

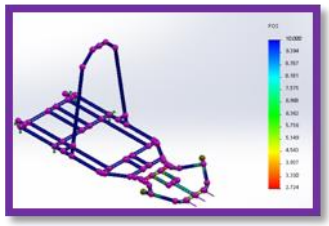

Fig. 2.3 Factor of safety

2.2 Side impact analysis

2.2.1 Impact load calculation:

Using the projected vehicle/driver mass of 190 kg, the impact force was calculated based on a G-load of 3.

F = ma

Where, F = Total force.

m = Total mass of the vehicle.

a =acceleration due to gravity.

Impulse time = weight*(velocity/load)

=> 190*(16.67/5700) = **0.55 seconds**

We apply 5700N from the side for the test of side impact of the roll cage structure of the vehicle for determining strength at the time of side collision.

2.2.2 Results

Maximum deformation= 0.718mm.

Maximum deformation for the side impact is under the safe limit and does not affect the safety of the driver.

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 8	0.718117 mm Node: 30

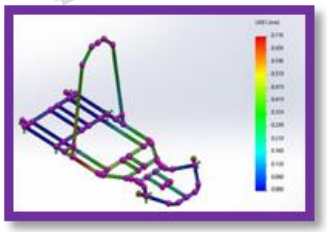

Fig. 2.4 Maximum Deformation

Maximum Von Misses Stress= 187.866 N/mm^2

Name	Type	Min	Max
Stress1	TXY: Shear in Y Dir. on YZ Plane	0 N/mm^2 (MPa) Element: 7	187.866 N/mm^2 (MPa) Element: 20

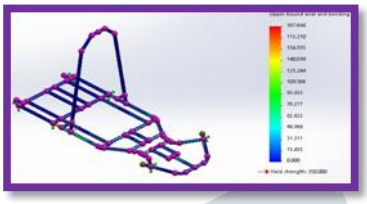

Fig. 2.5 Maximum Von Misses Stress

Incorporated Factor of Safety= σ_{yt} / σ_{max}

Where,

σ_{yt}-Tensile strength, Yield

σ_{max} - Maximum working stress

FOS = σ_{yt}/ σ_{max}

=350 /187.866

= 1.86

Name	Type	Min	Max
Factor of Safety1	Automatic	1.86303 Node: 21	10 Node: 1

Fig. 2.6 Factor of safety

2.3 Rear impact analysis

2.3.1 Impact load calculation:

Using the projected vehicle/driver mass of 190 kg, the impact force was calculated based on a G-load of 3.

F = ma

Where,

F = Total force.

m = Total mass of the vehicle.

a =acceleration due to gravity

190*3*10 = **5700 N**

Impulse time = weight*(velocity/load)

=> 190*(16.67/5700) = **0.55 seconds**

We apply 5700 N from the rear for the test of rear impact of the roll cage structure of the vehicle for determining strength at the time of front collision.

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2.3.2 Results

Maximum deformation= 0.0376685 mm

Maximum deformation for the side impact is under the safe limit and does not affect the safety of the driver.

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 8	0.0376685 mm Node: 127

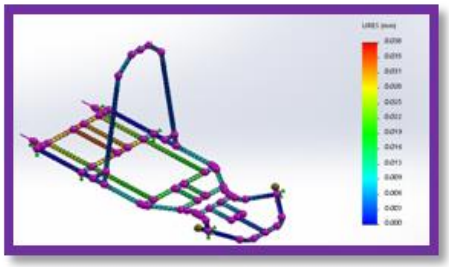

Fig. 2.7 Maximum Deformation

Maximum Von Misses Stress= 68.2442 N/mm^2

Name	Type	Min	Max
Stress1	TXY: Shear in Y Dir. on YZ Plane	0 N/mm^2 (MPa) Element: 7	68.2442 N/mm^2 (MPa) Element: 347

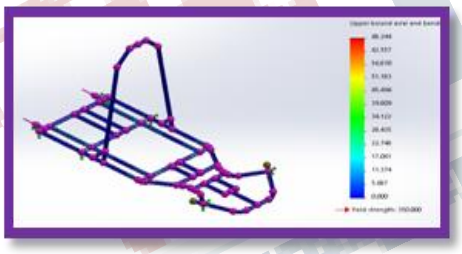

Fig. 2.8 Maximum Von Misses Stress

Incorporated Factor of Safety= σyt / σmax

Where,

σ_{yt}- Tensile strength, Yield

σ_{max} - Maximum working stress

FOS = σ_{yt} / σ_{max}

= 350/68.244

= 5.12

Name	Type	Min	Max
Factor of Safety1	Automatic	5.12864 Node: 129	10 Node: 1

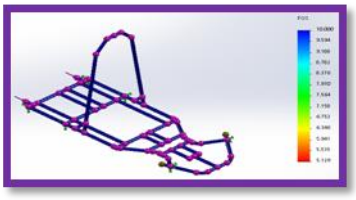

Fig. 2.9 Factor of safety

2.4 Torsional analysis

2.4.1 Impact load calculation:

Using the projected vehicle/driver mass of 190 kg, the impact force was calculated based on a G-load of **3**.

F = ma

Where,

F = Total force.

m = Total mass of the vehicle.

a =acceleration due to gravity

=> 190*3*10 = **5700 N**

Impulse time = weight*(velocity/load)

=> 190*(16.67/5700) = **0.55 seconds**

We apply 57000 N at the front suspension pickup points in opposite directional for the test of torsional analysis of the roll cage structure of the vehicle for determining strength at the time of side collision

2.4.2 Results

Maximum deformation= 25.369 mm.

Maximum deformation for the side impact is under the safe limit and does not affect the safety of the driver.

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 8	25.369 mm Node: 69

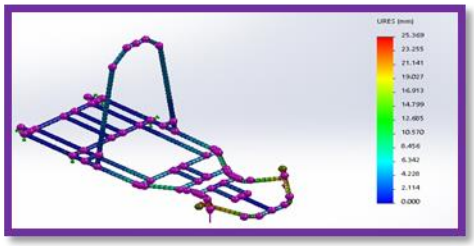

Fig. 2.10 Maximum Deformation

Maximum Von Misses Stress= 205.494 N/mm^2

Name	Type	Min	Max
Stress1	TXY: Shear in Y Dir. on YZ Plane	0 N/mm^2 (MPa) Element: 7	308.113 N/mm^2 (MPa) Element: 20

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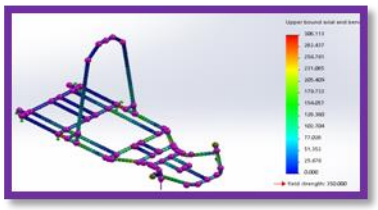

Fig. 2.11 Maximum Von Misses Stress

Incorporated Factor of Safety= σ_{yt} / σ_{max}

Where,

σ_{yt}- Tensile strength, Yield

σ_{max} - Maximum working stress

FOS = σ_{yt} / σ_{max}

= 350/308.113

= 1.1359

Name	Type	Min	Max
Factor of Safety1	Automatic	1.13595 Node: 21	10 Node: 5

Fig .2.12 Factor of safety

REFERENCES

[1] **Arnaud Sivert**[1] made the electric go-karts have the same dynamics as competition petrol go-karts, with an honorable autonomy of 20-30 minutes.

[2] **Prof. Alpesh V. Mehta** [2] Tested the kart for its fuel economy under three conditions running fully on IC engine, running fully on electric motor, & running on combination of both electric and IC-engine (hybrid).

[3] **HemankDabhade** [3]designed and fabricated competition go kart is as per the World Karting Association Standards.

[4] **Lim Wai Tuck** [5]made the design and fabrication of UMP Go-Kart Chassis and analyze the Go-Kart chassis structure.