“GO KART”
A Major Project Report

Submitted in Partial Fulfillment of requirements for the Award of Degree of Bachelor of Engineering in Mechanical Engineering
Submitted to

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Submitted By
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Under the guidance of
Prof.Arham JavedAs per Allotted by College.

DEPARTMENT OF MECHANICAL ENGINEERING
RADHA RAMAN INSTITUTE OF TECHNOLOGY & SCIENCE, BHOPAL (M.P.)

Session: 2017-2021

RADHARAMAN INSTITUTE OF TECHNOLOGY & SCIENCE BHOPAL (M.P.)

Department of Mechanical Engineering

APPROVAL CERTIFICATE

This Major project work entitled **Go Kart** being submitted by **"Himanshu Morya" (Roll No.:0808ME171029.)** is/are approved for the award of degree of **Bachelor of Engineering** in **Mechanical Engineering**.

Internal Examiner **External Examiner**

Date: **Date:**

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CANDIDATE DECLARATION

We/I **Himanshu Morya (Roll No.:0808ME171029)** students of **Bachelor of Engineering** in Mechanical **Engineering, Radharaman Institute Of Technology & Science**, **Bhopal (M.P.),** hereby declare that the work presented in this Major project Go-Kart is the outcome of our own work, is bonafide and correct to the best of our knowledge and this work has been carried out taking care of Engineering Ethics. The work presented does not infringe any patented work and has not been submitted to any other university or anywhere else for the award of any degree or any professional diploma.

Date:

“Team Member I” (Enrollment No)
“Team Member II” (Enrollment No)
“Team Member III” (Enrollment No)
“Team Member IV” (Enrollment No)

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This project work is the result of guidance and support of various people at RITS without whom all our effort would have been directionless and fruitless. We sincerely thank all of them, for assisting us in completing the dissertation.

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Finally, we would like to say that we are indebted to my parents for everything that they have done for us. All of this would have been impossible without their constant support. And we also thanks to God for being kind to me and driving me through this journey.

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"Team Member II" (Enrollment No)
"Team Member III" (Enrollment No)
"Team Member IV" (Enrollment No)

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ABSTRACT

The report as presented by the team Elites documents the process and methodology of producing a go-kart which can be operated on petrol by the modelling it with CAD software with the material, AISI 1080 steel. The feasibility of the go-kart design was examined by CATIA or ANSYS software. The basic characteristic of go-kart is discussed by composite materials by FMEA package in design has also been look into. Some fundamental of FMEA is also briefly discussed and its application on the analysis of go-kart chassis, especially bending deflection is also been discussed. Analytical evaluations of different preliminary go–kart designs were then performed by FMEA package in effort to determine the best possible design. After the best possible design, is determined, the chassis is been built and an experimental testing is conducting to validate the numerical analysis. The behaviour of bending deflection has also been looked of in the go-kart chassis and is calculated from the data obtained from FEA package

After making of the design and implementing it in manufacturing our go – kart we did testing in our college RITS , Bhopal . It was done to test what things worked in our favour.

Chapter 1

Introduction

OVERVIEW

Go-kart is a four-wheeled, small engine, single sealed racing car used mainly in United States , India. They were initially created in the 1950s. Sir Art Ingles is considered as the the father of karting. He built the first go-kart in Southern California in 1956.

A go-kart, is a type of open wheeled car or racing quadracycle. Go-karts can be of various shapes and forms, from less power models to high powered racing models. Some Super karts, are able to beat racing cars or motorcycles on long circuits. These also contain same engine as that of a bike.

Many recreational karts can be powered by four stroke engines or electric motors while racing go karts may use a two stroke and also , higher powered four-stroke engines. Most of the go karts are single seater but some recreational models can accommodate even a passenger.

There are several countries where , go-karts can be licensed for use in public roads. Typically, there are some restrictions , in the European Union, a go-kart should change for use on the road must be outfitted with luminating headlights (high/low beam), tail lights, a horn, even indicators, and an engine not exceeding 20 hp.

Here we are first making a normal a go kart which is having a chassis which is design in such a manner that it will have a impact force distribution in order to make sure that the minimum amount of impact force is transfer to driver on which the seat of driver is place during head on collision, sideways collision or rear collision.

For the beginning we started our design by considering all possible alternatives for a system and modeling them in CAD software CATIA V5 and analyzing using ANSYS FEA. Based on the analysis result , model was modified and finalized and retested and a final design was fixed. The designing of the vehicle is done by considering these aspects.

Safety and ergonomics
Cost
Market availability
Safe Engineering practices
Strength of the chassis
Aesthetics

Our Team Elites design objectives was to be achieved in three simple goals applied to every component of the go-kart: durable, light weight and high performance, to optimize the design in reducing the cost and the well uniform impact force distribution throughout the chassis.

By keeping these aspects, we categorized our team team Elites
Into following groups.

Design & simulation
Steering

Engine and transmission
Brakes and wheel
Manufacturing

We already set a budget for the project. Throughout the design process we distributed the budget in such a way that if we assign more money to one system, we reduce that amount from some other system. Like we could never compromise with safety .

* OBJECTIVE

The main objective of making the vehicle is to participate in major go-kart events and also to drive which is having more power, efficiency, better handling, good dynamic than a traditional or a regular go kart.

DESIGN, ANALYSIS AND FABRICATION OF GO-KART

Abstract

Team Elites Go-kart is a simple looking but powerful four wheeled kart. Go-kart, by definition, has no suspension and no differential. They are usually raced on scaled down tracks, but are sometimes driven as entertainment or as a hobby by non-professionals. Kart racing is generally accepted as the most economic form of motor sport available. As a free-time activity, it can be performed by almost anybody and permitting licensed racing for anyone from the age above 8 onwards. Kart racing is usually used as a low-cost and relatively safe way to introduce drivers to motor racing.Their is no limit of who should or can drive a go-kart , from a kid to an young to an adult anyone can drive it . Go-Karting is considered as the first step in any serious racer's career. It can prepare the driver for highs-speed wheel-to-wheel racing by helping develop guide reflexes, Precision car control and decision- making skills . It is also useful when someone is tensed and for a recreation go kart can be used. Also, it brings an awareness of the various parameters that can be altered to try to improve the competitiveness of the kart that also exist in other forms of racing.

Index Terms

Go-kart
Racing
Design
Frame
Analysis
Steering System

Braking System
Engine
Transmission and Innovation.

Chapter 2

INTRODUCTION

Go-kart is a four-wheeled, small engine, single sealed racing car used mainly in United States , India. They were initially created in the 1950s. Sir Art Ingles is considered as the the father of karting. He built the first go-kart in Southern California in 1956.

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There are several countries where , go-karts can be licensed for use in public roads. Typically, there are some restrictions , in the European Union, a go-kart should change for use on the road must be outfitted with luminating headlights (high/low beam), tail lights, a horn, even indicators, and an engine not exceeding 20 hp.

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2 FRAME DESIGN

Frame Material

The material which we used for the frame is AISI 1080 LOW CARBON STEEL as it has reasonable price and provide enough safety to the driver which we ordered from a reputed firm in Mumbai. The pipe is of 1 inch diameter having 1mm thickness. The physical properties of the pipe are as follows.

.

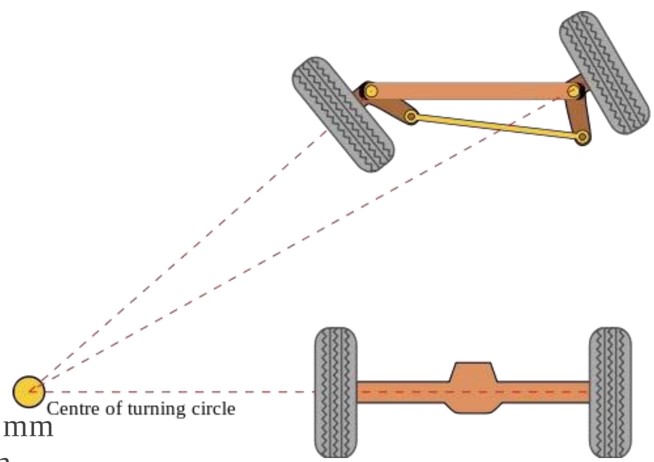
The chemical composition of the our ordered frame pipe is as follows.

S.no	PROPERTIES	VALUES AS PROVIDED BY FIRM
1.	Tensile strength of pipe	440 MPa
2.	Yield strength of pipe	379 MPa
3.	Bulk Modulus of pipe	141 GPa
4.	Shear modulus of pipe	79 GPa
5.	Young's Modulus of pipe	205 GPa
6.	Poisson's ratio of pipe	0.291

MATERIALS	PERCENTAGE OF EACH ELEMENT %
Low grade Carbon	0.14-.0.25
Manganese	0.60-0.92
Phosphorous	≤ 0.040
Sulphur	≤ 0.050
Iron	98.8 - 99.26

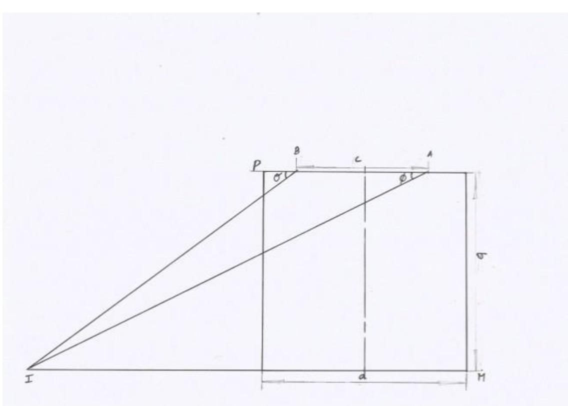
3. STEERING SYSTEM

Team Elites Used Ackermann steering system and steering in common is the key interface between the driver and the vehicle. The main objective of our steering system is to provide directional control to the vehicle. It will be smooth, compact and light. it must also be precise and must also provide the driver a perfect control of the vehicle. We will make such a steering system such that the driver can take a quick turn or curve with minimum discomfort.
Our steering system is designed to provide easy turning with quick response and it follows Ackermann Design.



CALCULATION

Track Width (a) = 1666.76 mm
Wheel Base (b) = 1778 mm
Pivot to pivot point (c) = 710 mm
Let outer turning radius Ro = 2600 mm



Where ,

α = Ackermann angle

$TT - (2 \times AAAAAAAA\ AAA) = \sin\beta$
$AAAAAAAAA\ AAA = 494.8363\ AA$
The value of turning radius of our kart is assumed to be 2.6m.

$AAa\ A\ \alpha 1 = 39.047°$

$AiAAA$
Consider a Δ ABP,
cotθ = BP/IP
= 1667/1020
$\boldsymbol{\theta}$ = 35.42º
Consider Δ IAP,
cotØ – cot$\boldsymbol{\theta}$ = c/b
cotØ = 2.86y
Ø = 25.61º

Inner turning radius Ri = (b/sin$\boldsymbol{\theta}$)/((a-c)/2)
= (1778/sin35.2)/((1666.78-694)/2)
=
Ackermann angle = tanα =(c/2)/b
= (1778/2)/694
α = 18.7º
The turning radius and turning angles are calculated graphically. We calculated that the Graphical values and arithmetical values of our team are approximately equal.

4. BRAKING SYSTEM

For Our kart , team Elites used disc brake . Disc brake is a wheel brake which helps to slow down the speed of the vehicle by the friction caused by pushing brake pad is against the disc with a set of calliper. Discs are mostly made from cast iron. They are fixed on the axle. When brake calliper is forced mechanically, pneumatically or hydraulically against the both sides of the disc, friction occurs and thus the vehicle can be stopped.
The main objective of the brakes is to stop the car safely and At the time of braking, kinetic energy is converted into heat energy due to the friction between calliper pad and rotor disc.
Kinetic Energy = ½ Mv2
Where M is mass
v is velocity

2
= 180 x 11.112 /2
= 11108.889

Deceleration of the vehicle should not exceed 1.3G. μ = 0.6 Stopping distance of the vehicle is calculated by Newton Law's of motion.

v2 = u2 + 2aS
where,
v is the final velocity of the vehicle u is the initial velocity of the vehicle S is the stopping distance

S = v2-u2/ 2a
= 11.112/2x1.3x9.8
= 4.84 m
Breaking force = K.E/S

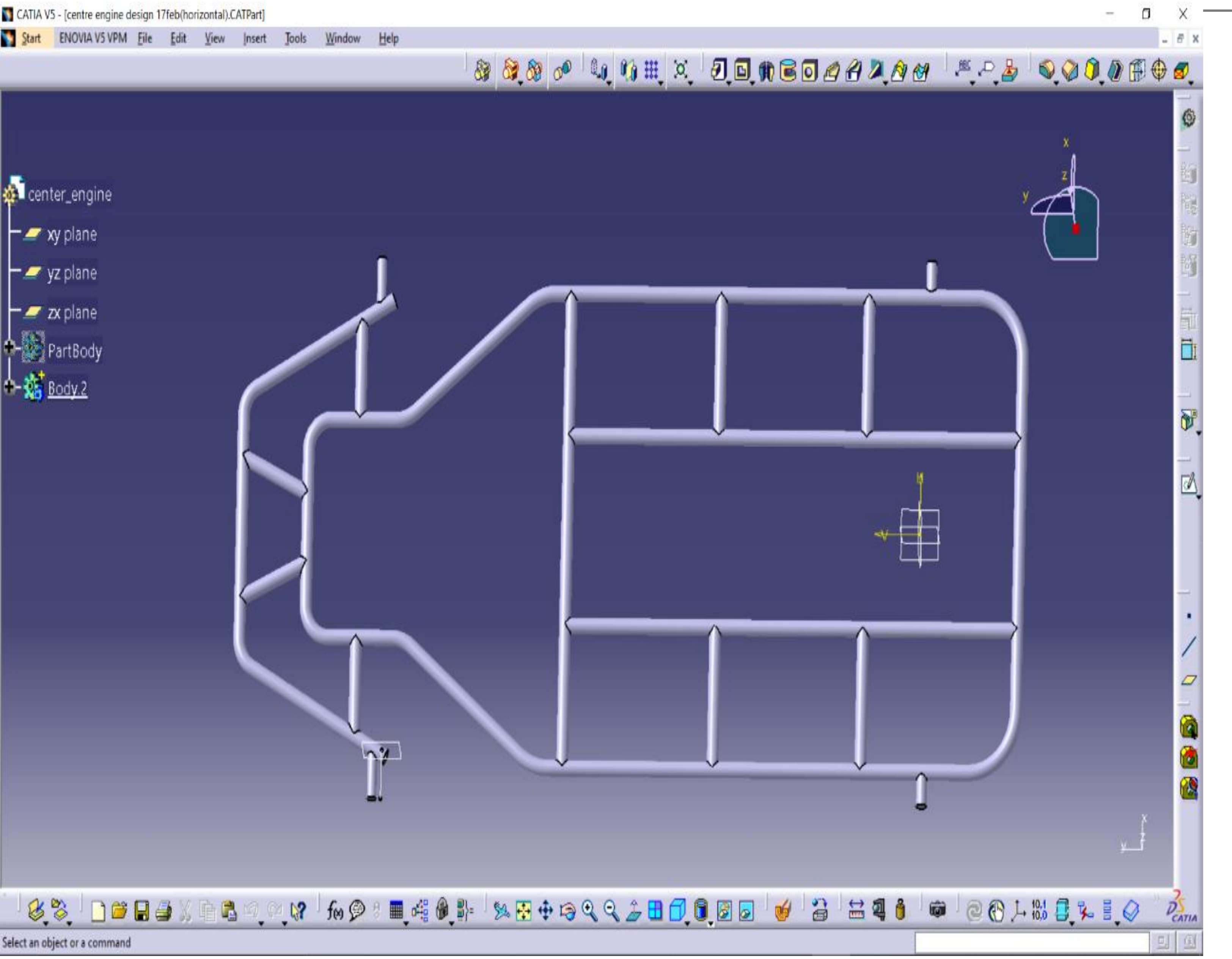
= 10491.73/4.84
= 2295.225 N

5. Overview

CHASSIS	Seamless tube (AISI 1080)	
WHEELBASE	738.6 mm	
OVERALL LENGTH OF VEHICLE	1778 mm	
TRACK WIDTH	1666.76 mm	
TYPE OF ENGINE	Apache 160	
STEERING	Mechanical linkage	
WHEELS AND TYRES		
BRAKES	Hydraulic disc brake	
TRANSMISSION	Manual 5 speed gear transmission	
MASS OF THE CHASSIS	11.416kg	
GROUND CLEARANCE	2 inch	from bottom most part

6. CAD Model

22)


CATIA V5 - [centre engine design 17feb(horizontal).CATPart]
Start
ENOVIA V5 VPM
File
Edit
View
Insert
Tools
Window
Help
center_engine
xy plane
yz plane
zx plane
PartBody
Body.2
Select an object or a command

7. Engines

Displacement:	**160**
Engine:	**Oil cooled , OHC , 4 Valve**
Maximum Power:	**15.53 bhp@8400 rpm**
Maximum Torque:	**13.9 Nm @ 7000 rpm**
Gears:	**5 Speed**
Clutch:	**Wet Multiplate Clutch**
Bore:	**58mm**
Stroke:	**47.2mm**
No. of Cylinders:	**1**

For our go-kart we used apache rtr 160 engine . The reason for using this engine is that is it is powerful in this segment and has a good initial pickup and also it fits in our budget . This engine uses 4 valves , two for inlet and two for outlet . Also it uses overhead camshaft .

8. Transmission system

We used the same transmission system as that of apache rtr 160 engine .Similar to any other transmission systems, by using gear ratios, it is important in order the conversion of power from engine to prop shaft. The reason for using this is that it is convenient and also it fits with our design .It also consists of drive train, prop shaft, final drive shafts and with or without gearbox and clutch . The clutch which we press with our hand its wire goes down to this part where the pressure plates press against each other to free the gears and drive shaft and we can easily change the gears .

9. Tyres

The tyres of a go kart differ from that of a commercial or passianger car . These are small thick . For go-kart Team Elites used BKT tyres .Unlike normal vehicles tyres use on normal road to cater for different road conditions, go-kart has very specific type of tyres for two major purposes i.e. dry or wet track so that drivers can have maximum performances and grips from the tyres. Dry and wet tyres are two main types of tyre used in karting. A dry tyre does not have grooves on the tyre , but our BKT tyres had grooves for better gripping . These tyres had a longer life as compared to other.

On the other hand, wet tyres which are grooved are used in order to have more grips when the track is slippery. Hence, for track conditions that are in wet conditions, wet tyre . We used the wet tyre i.e BKT tyres.

10. KILL SWITCH

Kill Switch is one of the major component of a go-kart. In our kart we used 3 Kill switch are provided so to provide safety to the driver. In case of any emergency the driver can push the kill switch so that the engine would stop functioning. The kill switch and its related electronics and wiring are designed such that when the kill switch is pressed, power is stopped on primary ignition coil of the engine. Hence making the kart stop .

11. BODY WORKS AND SEAT

We used Bucket seat in order to provide comfort and also it is very strong and rigid. Go kart seats are adjusted to give extra safety and comfort to the driver as per the heights and position of the driver when compared to the normal seats. We used the seat such that it was partially heat resistant .
We used side bumpers in order to provide safety to the driver in case of collision . We also used front bumper for the same safety reason in case if the vehicle gets front collision .

12. Frame FEA Safety Analysis

When we design a kart we need to check whether the chassis design we made is strong or not. Also it assures us that a type of engine and driver can be mounted on it . For our kart we used CATIA software to design the frame . We then used this design in ANSYS for analysis in static structural to find out front and rear impact . It took several attempt for us to reach the final design .

12.1 Front Impact Analysis

The front impact test is carried out as
Mass of the vehicle (Driver + vehicle estimated) M = 160 Kg
From mass moment of inertia equation,
Frontal impact Force F = P x ΔT

Where,
P = momentum
ΔT = duration of time = 1.1 seconds
P = M x V
= 160 x 17.8
= 2848 Kg m/s
F = P x ΔT
= 2848 x 1.1
= 3132.8.4 N

For our front impact analysis we imported the design from CATIA to ANSYS in static structural .Then we did the meshing . Then we fixed All four points and apply load from frontwards . We will then determine total deformation and Factor of safety .

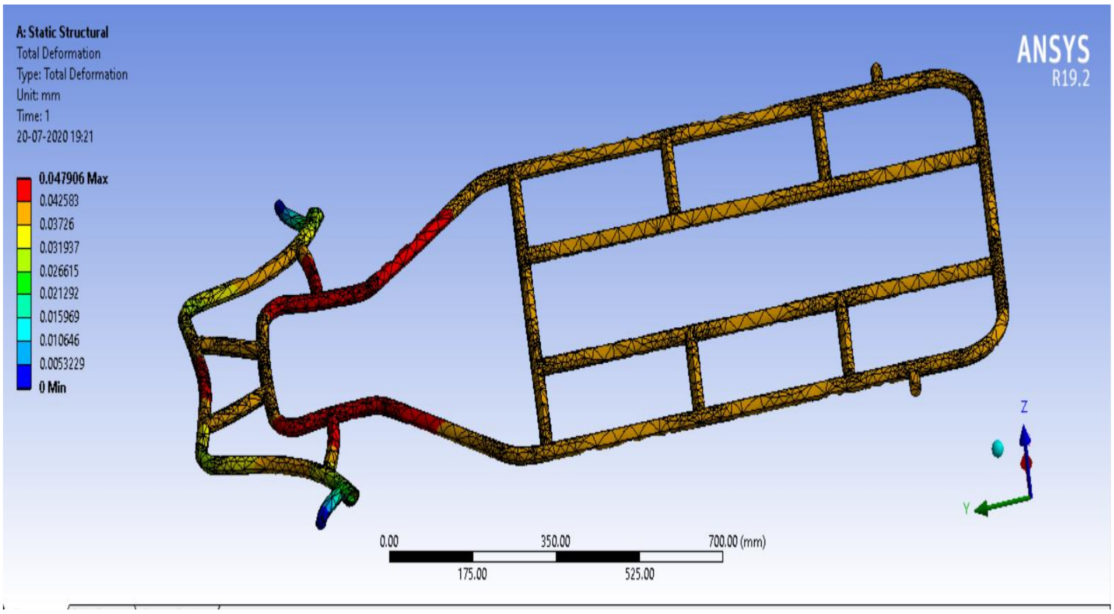
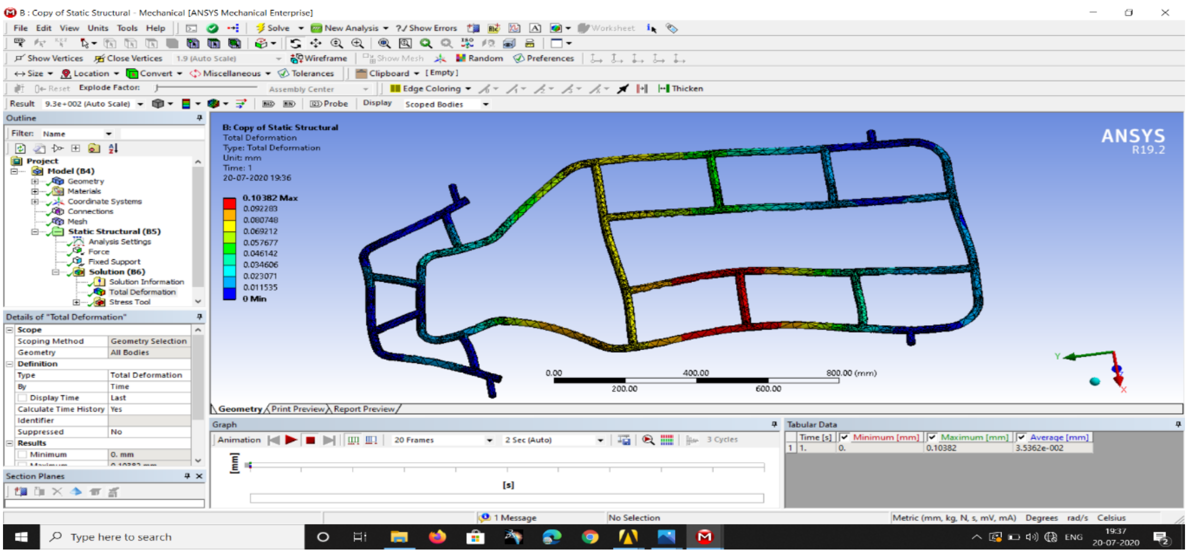


Fig. Deformation

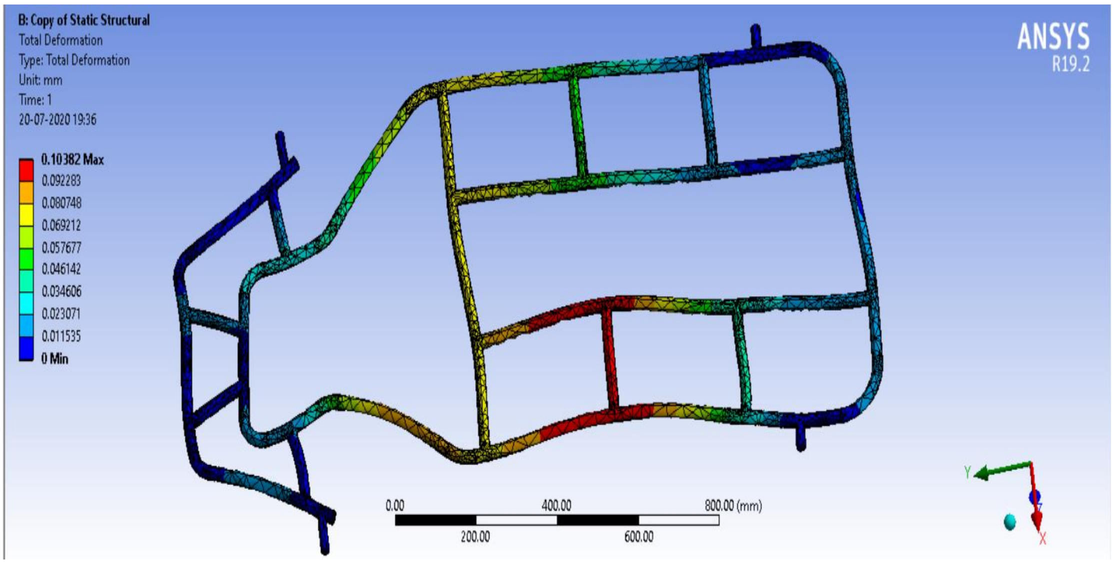
From the design and its analysis we found that The maximum deformation is found to be 0.104 mm which is very small and it is safer to use



12.2 Side Impact Analysis Side

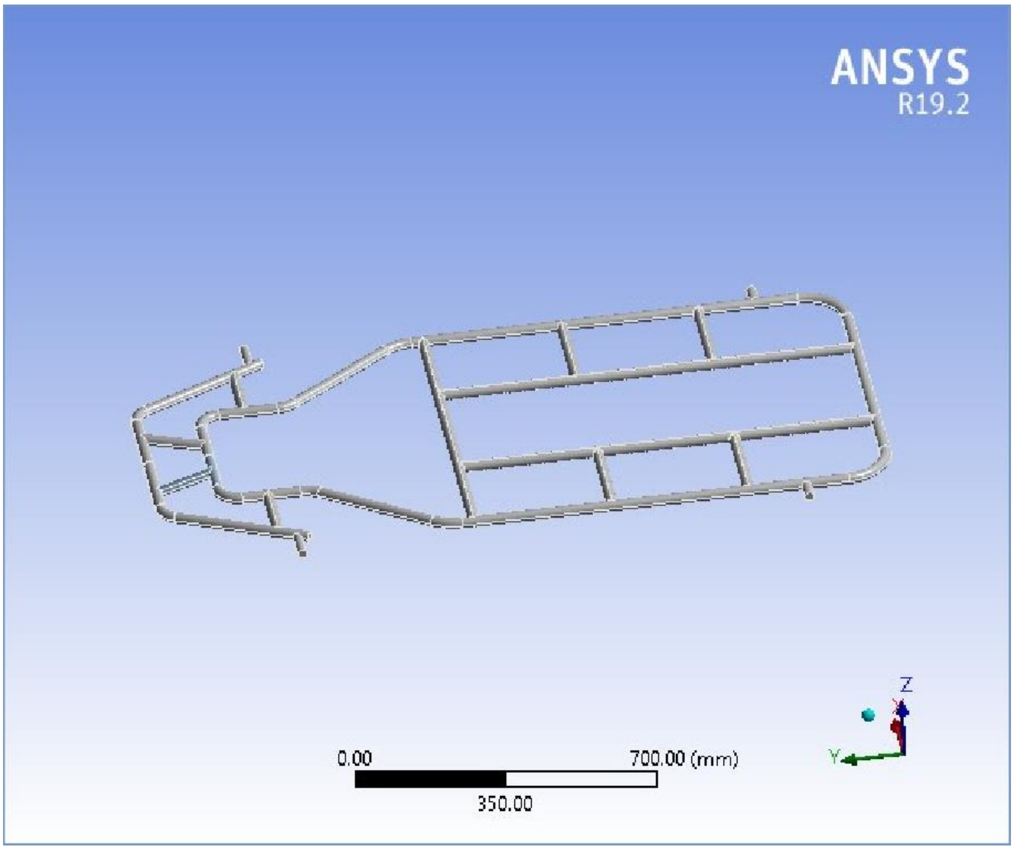
impact Force F = P x ΔT where P = M x V
M = 160 Kg
V = 48 kmph = 13.3 m/s
P = M x V
= 160 x 13.3
= 2128 Kg m/s F = P x ΔT
= 2128 x 1.1
= 2340.8 N

For our front impact analysis we imported the design from CATIA to ANSYS in static structural .Then we did the meshing . Then we fixed All four points and apply load from sidewards . We will then determine total deformation and Factor of safety .



12.1.1 Side Impact Analysis : (1000N)

Project



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	E:\ansys analysis practice\Go kart design rear engine side impact.JPG_files\dp0\SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	872. mm
Length Y	1704.9 mm

Length Z	25.4 mm
Properties	
Volume	4.4502e+006 mm³
Mass	34.934 kg
Scale Factor Value	1.
Statistics	
Bodies	13
Active Bodies	13
Nodes	72846
Elements	46173
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Clean Bodies On Import	No
Stitch Surfaces On Import	No
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Body Groups

Object Name	*Part*
State	Meshed
Graphics Properties	
Visible	Yes
Definition	
Suppressed	No
Assignment	Structural Steel
Coordinate System	Default Coordinate System
Bounding Box	
Length X	872. mm
Length Y	1704.9 mm
Length Z	25.4 mm
Properties	
Volume	4.4502e+006 mm³
Mass	34.934 kg
Centroid X	-0.95554 mm
Centroid Y	533.66 mm
Centroid Z	2.3787e-002 mm
Moment of Inertia Ip1	8.5531e+006 kg·mm²
Moment of Inertia Ip2	2.3863e+006 kg·mm²
Moment of Inertia Ip3	1.0937e+007 kg·mm²
Statistics	
Nodes	72846
Elements	46173
Mesh Metric	None
CAD Attributes	
Color:143.143.175	
Color:143.159.175	
Color:143.175.143	
Color:143.175.159	
Color:143.175.175	
Color:159.143.175	
Color:159.175.143	
Color:175.143.143	
Color:175.143.159	
Color:175.143.175	
Color:175.159.143	
Color:175.175.143	

TABLE 4
Model (A4) > Geometry > Part > Parts

Object Name	*Component1\Brep With Voids*	*Component2\Brep With Voids*	*Component3\Brep With Voids*	*Component4\Brep With Voids*	*Component5\Brep With Voids*	*Component6\Brep With Voids*	*Component7\Brep With Voids*	*Component8\Brep With Voids*	*Component9\Brep With Voids*	*C*
State	Meshed									
Graphics Properties										
Visible	Yes									
Transparency	1									
Definition										
Suppressed	No									
Stiffness Behavior	Flexible									
Coordinate System	Default Coordinate System									
Reference Temperature	By Environment									
Behavior	None									
Material										
Assignment	Structural Steel									
Nonlinear Effects	Yes									
Thermal Strain Effects	Yes									
Bounding Box										
Length X	872. mm	783.4 mm	21.4 mm		748.32 mm	214.92 mm				
Length Y	1704.9 mm	1559.1 mm	963.32 mm		21.4 mm					
Length Z	25.4 mm	21.4 mm								
Properties										
Volume	1.5204e+006 mm^3	1.4981e+006 mm^3	3.4179e+005 mm^3		2.6479e+005 mm^3	73717 mm^3	73715 mm^3	73717 mm^3	73724 mm^3	
Mass	11.935 kg	11.76 kg	2.683 kg		2.0786 kg	0.57868 kg	0.57867 kg	0.57868 kg	0.57873 kg	
Centroid X	-2.799 mm	-5.4498e-005 Mm	-152.4 mm	152.4 mm	-2.018e-005 mm	-266.7 mm	266.7 mm	-266.7 mm	266.7 mm	-
Centroid Y	599.76 mm	498.7 mm	273.5 mm		762. mm	118.24 mm		437.39 mm		
Centroid Z	7.0435e-002 Mm	-1.3564e-003 mm	4.1606e-004 mm	1.0456e-003 Mm	-6.1554e-005 mm	1.3686e-003 mm	1.4647e-003 mm	2.0075e-003 mm	1.338e-003 mm	-4
Moment of Inertia Ip1	3.1545e+006 kg·mm^2	3.3576e+006 kg·mm^2	2.037e+005 kg·mm^2		118.65 kg·mm^2	33.142 kg·mm^2	33.141 kg·mm^2	33.143 kg·mm^2	33.148 kg·mm^2	
Moment of Inertia Ip2	8.231e+005 kg·mm^2	1.1156e+006 kg·mm^2	153.11 kg·mm^2		94724 kg·mm^2	2059.5 kg·mm^2			2059.6 kg·mm^2	

Moment of Inertia Ip3	3.9761e+006 kg·mm²	4.4725e+006 kg·mm²	2.037e+005 kg·mm²		94724 kg·mm²	2059.2 kg·mm²			2059.3 kg·mm²
Statistics									
Nodes	60976	15243	2566	2232	3548	762	857	860	347
Elements	31176	7487	1202	1006	1791	356	396	407	120
Mesh Metric	None								

TABLE 5
Model (A4) > Geometry > Part > Parts

Object Name	*Component12\Brep With Voids*	*Component13\Brep With Voids*
State	Meshed	
Graphics Properties		
Visible	Yes	
Transparency	1	
Definition		
Suppressed	No	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Behavior	None	
Material		
Assignment	Structural Steel	
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	
Bounding Box		
Length X	144.58 mm	
Length Y	23.4 mm	
Length Z	21.4 mm	
Properties		
Volume	48065 mm³	48074 mm³
Mass	0.37731 kg	0.37738 kg
Centroid X	-253.53 mm	253.53 mm
Centroid Y	1212.6 mm	
Centroid Z	-1.3836e-003 mm	-3.8252e-004 mm
Moment of Inertia Ip1	21.654 kg·mm²	21.662 kg·mm²
Moment of Inertia Ip2	579.05 kg·mm²	579.09 kg·mm²
Moment of Inertia Ip3	578.74 kg·mm²	578.78 kg·mm²
Statistics		
Nodes	482	379
Elements	192	138
Mesh Metric	None	

Coordinate Systems

TABLE 6
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

Connections

TABLE 7
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

Mesh

TABLE 8
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default
Sizing	
Use Adaptive Sizing	Yes
Resolution	Default (2)
Mesh Defeaturing	Yes
Defeature Size	Default
Transition	Fast
Span Angle Center	Coarse
Initial Size Seed	Assembly
Bounding Box Diagonal	1915.1 mm
Average Surface Area	6203.5 mm²
Minimum Edge Length	1.3851e-003 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Standard Mechanical

Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Statistics	
Nodes	72846
Elements	46173

Static Structural (A5)

TABLE 9
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 10
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	

Solver Files Directory	E:\ansys analysis practice\Go kart design rear engine side impact.JPG_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No

Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	Nmm

TABLE 11
Model (A4) > Static Structural (A5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	12 Faces	2 Faces
Definition		
Type	Force	Fixed Support
Define By	Vector	
Magnitude	1000. N (ramped)	
Direction	Defined	
Suppressed	No	

FIGURE 1
Model (A4) > Static Structural (A5) > Force

Solution
(A6)

TABLE 12
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
MAPDL Elapsed Time	20. s
MAPDL Memory Used	1.0137 GB
MAPDL Result File Size	35.438 MB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Total Deformation*	*Maximum Principal Elastic Strain*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Total Deformation	Maximum Principal Elastic Strain
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Results		
Minimum	0. mm	-8.2212e-007 mm/mm
Maximum	4.7906e-002 mm	2.6839e-004 mm/mm
Average	3.9724e-002 mm	1.7913e-006 mm/mm
Minimum Occurs On	Component1\Brep With Voids	
Maximum Occurs On	Component1\Brep With Voids	
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1.	0.	4.7906e-002	3.9724e-002

FIGURE 3
Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Principal Elastic Strain

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Principal Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
1.	-8.2212e-007	2.6839e-004	1.7913e-006

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	4.1236
Minimum Occurs On	Component1\Brep With Voids
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
1.	4.1236	15.	14.999

Material Data
Structural Steel

TABLE 20
Structural Steel > Constants

Density	7.85e-006 kg mm^-3
Isotropic Secant Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat Constant Pressure	4.34e+005 mJ kg^-1 C^-1
Isotropic Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Isotropic Resistivity	1.7e-004 ohm mm

TABLE 21
Structural Steel > Color

Red	Green	Blue
132	139	179

TABLE 22
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0

TABLE 23
Structural Steel > Compressive Yield Strength

Compressive Yield Strength MPa
250

TABLE 24
Structural Steel > Tensile Yield Strength

Tensile Yield Strength
250

TABLE 25
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength
460

TABLE 27
Structural Steel > S-N Curve

Alternating Stress MPa	Cycles	Mean Stress MPa
3999	10	0
2827	20	0
1896	50	0
1413	100	0
1069	200	0
441	2000	0
262	10000	0
214	20000	0
138	1.e+005	0
114	2.e+005	0
86.2	1.e+006	0

TABLE 28
Structural Steel > Strain-Life Parameters

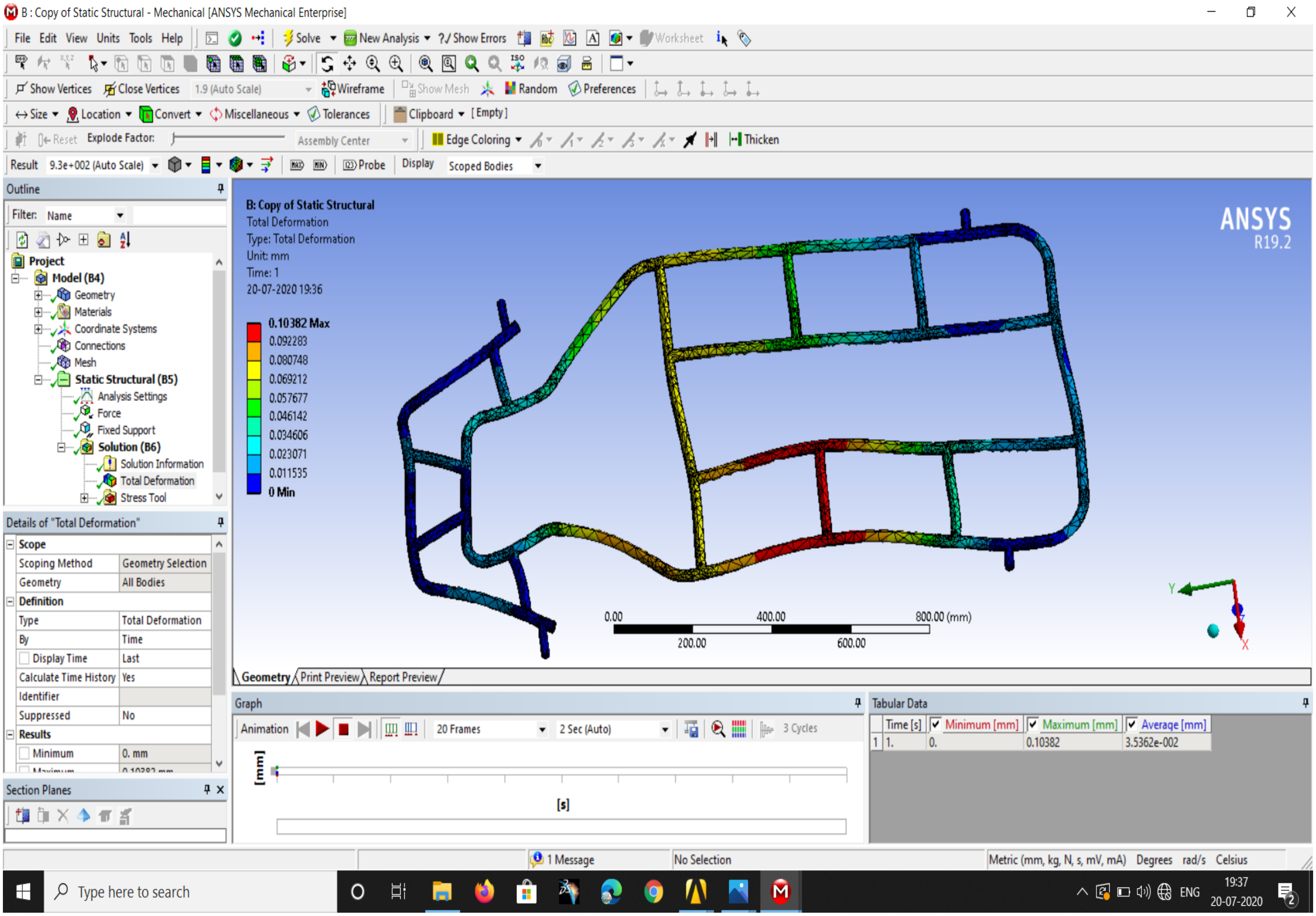
Strength Coefficient MPa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient MPa	Cyclic Strain Hardening Exponent
920	-0.106	0.213	-0.47	1000	0.2

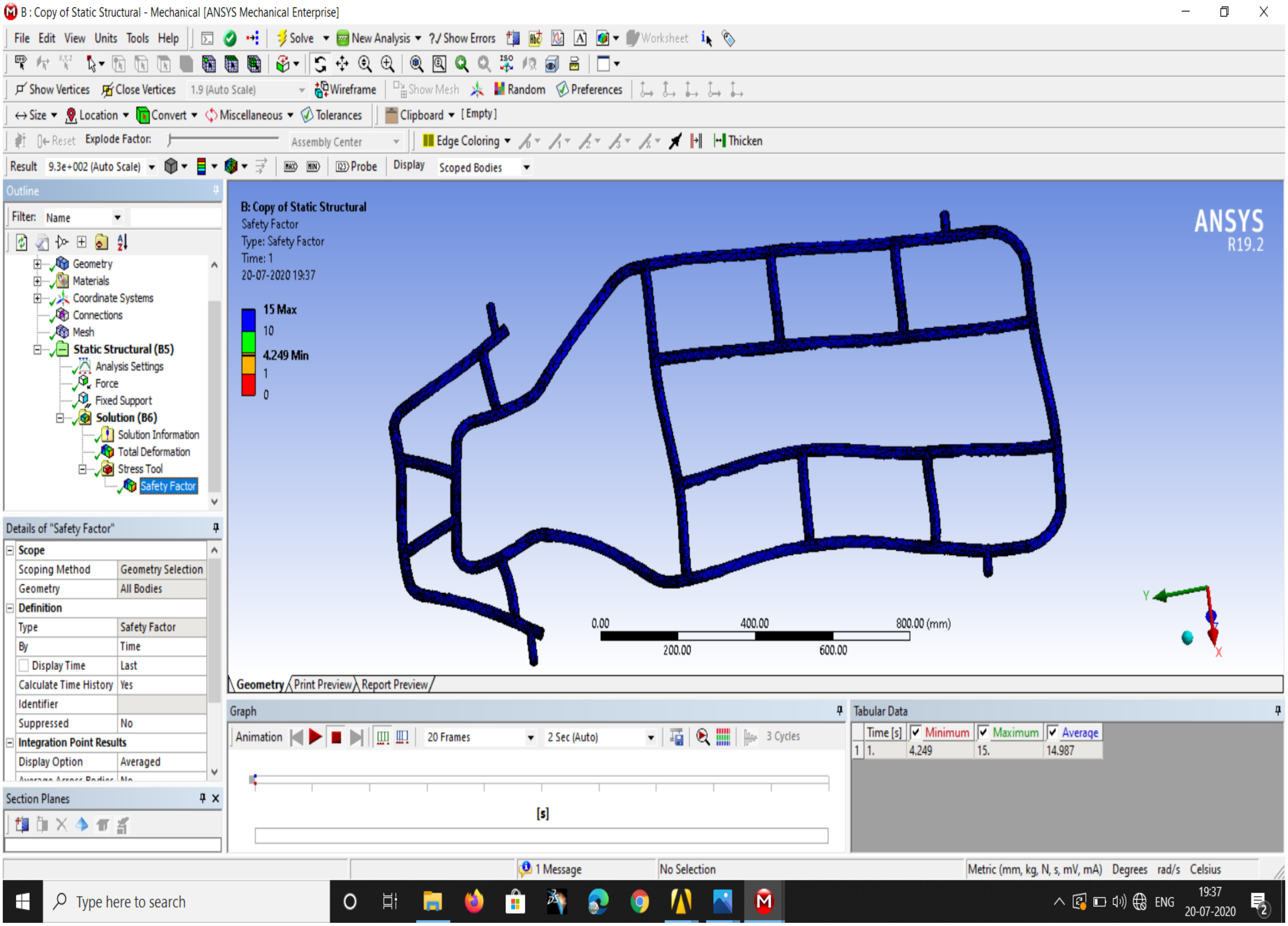
TABLE 29
Structural Steel > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
2.e+005	0.3	1.6667e+005	76923	

TABLE 30
Structural Steel > Isotropic Relative Permeability

Relative
10000

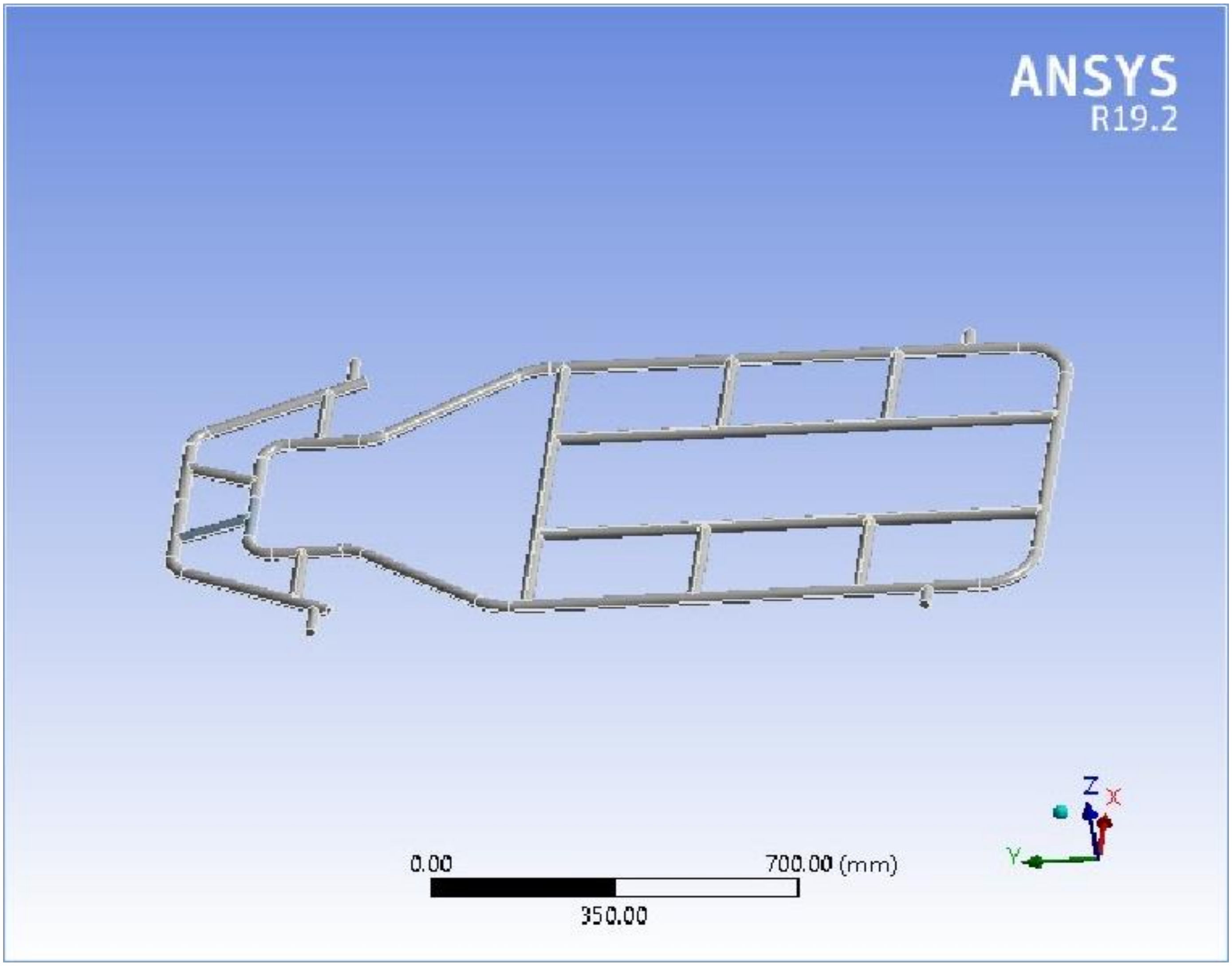

B : Copy of Static Structural - Mechanical [ANSYS Mechanical Enterprise]
File Edit View Units Tools Help
Solve
New Analysis
Show Errors
Worksheet
Show Vertices
Close Vertices
1.9 (Auto Scale)
Wireframe
Show Mesh
Random
Preferences
Size
Location
Convert
Miscellaneous
Tolerances
Clipboard
[Empty]
Reset
Explode Factor:
Assembly Center
Edge Coloring
Thicken
Result
9.3e+002 (Auto Scale)
Probe
Display
Scoped Bodies
Outline
Filter:
Name
Project
Model (B4)
Geometry
Materials
Coordinate Systems
Connections
Mesh
Static Structural (B5)
Analysis Settings
Force
Fixed Support
Solution (B6)
Solution Information
Total Deformation
Stress Tool
Details of "Total Deformation"
Scope
Scoping Method
Geometry Selection
Geometry
All Bodies
Definition
Type
Total Deformation
By
Time
Display Time
Last
Calculate Time History
Yes
Identifier
Suppressed
No
Results
Minimum
0. mm
Section Planes
B: Copy of Static Structural
Total Deformation
Type: Total Deformation
Unit: mm
Time: 1
20-07-2020 19:36
0.10382 Max
0.092283
0.080748
0.069212
0.057677
0.046142
0.034606
0.023071
0.011535
0 Min
ANSYS
R19.2
0.00
400.00
800.00 (mm)
200.00
600.00
Y
X
Geometry
Print Preview
Report Preview
Graph
Animation
20 Frames
2 Sec (Auto)
3 Cycles
[mm]
[s]
Tabular Data
Time [s]
Minimum [mm]
Maximum [mm]
Average [mm]
1
1.
0.
0.10382
3.5362e-002
1 Message
No Selection
Metric (mm, kg, N, s, mV, mA)
Degrees
rad/s
Celsius
Type here to search
ENG
19:37
20-07-2020


B : Copy of Static Structural - Mechanical [ANSYS Mechanical Enterprise]
B: Copy of Static Structural
Safety Factor
Type: Safety Factor
Time: 1
20-07-2020 19:37
15 Max
10
4.249 Min
1
0
ANSYS
R19.2
0.00
400.00
800.00 (mm)
200.00
600.00
Outline
Geometry
Materials
Coordinate Systems
Connections
Mesh
Static Structural (B5)
Analysis Settings
Force
Fixed Support
Solution (B6)
Solution Information
Total Deformation
Stress Tool
Safety Factor
Details of "Safety Factor"
Scope
Scoping Method Geometry Selection
Geometry All Bodies
Definition
Type Safety Factor
By Time
Display Time Last
Calculate Time History Yes
Identifier
Suppressed No
Integration Point Results
Display Option Averaged
Tabular Data
Time [s] Minimum Maximum Average
1 1. 4.249 15. 14.987
Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius

12.2.1 Front Impact Analysis : (1000N)

Project

First Saved	Sunday, July 19, 2020
Last Saved	Sunday, July 19, 2020
Product Version	19.2 Release
Save Project Before Solution	No
Save Project After Solution	No


ANSYS
R19.2
0.00
700.00 (mm)
350.00
Z
X
Y

Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	E:\ansys analysis practice\Go kart design rear engine_files\dp0\SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	872. mm
Length Y	1704.9 mm
Length Z	25.4 mm
Properties	
Volume	4.4502e+006 mm³
Mass	34.934 kg
Scale Factor Value	1.
Statistics	
Bodies	13
Active Bodies	13
Nodes	72846
Elements	46173
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes

Compare Parts On Update	No
Analysis Type	3-D
Clean Bodies On Import	No
Stitch Surfaces On Import	No
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Body Groups

Object Name	*Part*
State	Meshed
Graphics Properties	
Visible	Yes
Definition	
Suppressed	No
Assignment	Structural Steel
Coordinate System	Default Coordinate System
Bounding Box	
Length X	872. mm
Length Y	1704.9 mm
Length Z	25.4 mm
Properties	
Volume	4.4502e+006 mm³
Mass	34.934 kg
Centroid X	-0.95554 mm
Centroid Y	533.66 mm
Centroid Z	2.3787e-002 mm
Moment of Inertia Ip1	8.5531e+006 kg·mm²
Moment of Inertia Ip2	2.3863e+006 kg·mm²
Moment of Inertia Ip3	1.0937e+007 kg·mm²
Statistics	
Nodes	72846
Elements	46173
Mesh Metric	None
CAD Attributes	
Color:143.143.175	
Color:143.159.175	
Color:143.175.143	
Color:143.175.159	
Color:143.175.175	
Color:159.143.175	
Color:159.175.143	
Color:175.143.143	
Color:175.143.159	
Color:175.143.175	
Color:175.159.143	
Color:175.175.143	

TABLE 4
Model (A4) > Geometry > Part > Parts

Object Name	*Component1 \Brep With Voids*	*Component2 \Brep With Voids*	*Component3 \Brep With Voids*	*Component4 \Brep With Voids*	*Component5 \Brep With Voids*	*Component6 \Brep With Voids*	*Component7 \Brep With Voids*	*Component8 \Brep With Voids*	*Component9 \Brep With Voids*	*Component10 \Brep With Voids*	*Component11 \Brep With Voids*
State	Meshed										
Graphics Properties											
Visible	Yes										
Transparency	1										
Definition											
Suppressed	No										
Stiffness Behavior	Flexible										
Coordinate System	Default Coordinate System										
Reference Temperature	By Environment										
Behavior	None										
Material											
Assignment	Structural Steel										
Nonlinear Effects	Yes										
Thermal Strain Effects	Yes										
Bounding Box											
Length X	872. mm	783.4 mm	21.4 mm		748.32 mm	214.92 mm				71.495 mm	
Length Y	1704.9 mm	1559.1 mm	963.32 mm		21.4 mm					128.14 mm	
Length Z	25.4 mm	21.4 mm									
Properties											
Volume	1.5204e+006 mm³	1.4981e+006 mm³	3.4179e+005 mm³		2.6479e+005 mm³	73717 mm³	73715 mm³	73717 mm³	73724 mm³	46176 mm³	
Mass	11.935 kg	11.76 kg	2.683 kg		2.0786 kg	0.57868 kg	0.57867 kg	0.57868 kg	0.57873 kg	0.36248 kg	
Centroid X	-2.799 mm	-5.4498e-005 mm	-152.4 mm	152.4 mm	-2.018e-005 mm	-266.7 mm	266.7 mm	-266.7 mm	266.7 mm	-84.433 mm	84.433 mm
Centroid Y	599.76 mm	498.7 mm	273.5 mm		762. mm	118.24 mm		437.39 mm		1393.6 mm	
Centroid Z	7.0435e-002 mm	-1.3564e-003 mm	4.1606e-004 mm	1.0456e-003 mm	-6.1554e-005 mm	1.3686e-003 mm	1.4647e-003 mm	2.0075e-003 mm	1.338e-003 mm	-4.7668e-004 mm	-6.5638e-004 mm

Moment of Inertia Ip1	3.1545e+006 kg·mm²	3.3576e+006 kg·mm²	2.037e+005 kg·mm²		118.65 kg·mm²	33.142 kg·mm²	33.141 kg·mm²	33.143 kg·mm²	33.148 kg·mm²	514.61 kg·mm²	514.59 kg·mm²
Moment of Inertia Ip2	8.231e+005 kg·mm²	1.1156e+006 kg·mm²	153.11 kg·mm²		94724 kg·mm²	2059.5 kg·mm²			2059.6 kg·mm²	20.804 kg·mm²	20.803 kg·mm²
Moment of Inertia Ip3	3.9761e+006 kg·mm²	4.4725e+006 kg·mm²	2.037e+005 kg·mm²		94724 kg·mm²	2059.2 kg·mm²			2059.3 kg·mm²	514.28 kg·mm²	514.26 kg·mm²
Statistics											
Nodes	60976	15243	2566	2232	3548	762	857	860	347	2619	1141
Elements	31176	7487	1202	1006	1791	356	396	407	120	1330	572
Mesh Metric	None										

TABLE 5
Model (A4) > Geometry > Part > Parts

Object Name	*Component12\Brep With Voids*	*Component13\Brep With Voids*
State	Meshed	
Graphics Properties		
Visible	Yes	
Transparency	1	
Definition		
Suppressed	No	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Behavior	None	
Material		
Assignment	Structural Steel	
Nonlinear Effects	Yes	
Thermal Strain Effects	Yes	
Bounding Box		
Length X	144.58 mm	
Length Y	23.4 mm	
Length Z	21.4 mm	
Properties		
Volume	48065 mm³	48074 mm³
Mass	0.37731 kg	0.37738 kg
Centroid X	-253.53 mm	253.53 mm
Centroid Y	1212.6 mm	
Centroid Z	-1.3836e-003 mm	-3.8252e-004 mm
Moment of Inertia Ip1	21.654 kg·mm²	21.662 kg·mm²
Moment of Inertia Ip2	579.05 kg·mm²	579.09 kg·mm²
Moment of Inertia Ip3	578.74 kg·mm²	578.78 kg·mm²
Statistics		
Nodes	482	379
Elements	192	138
Mesh Metric	None	

Coordinate Systems

TABLE 6
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

Connections

TABLE 7
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

Mesh

TABLE 8
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	

Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default
Sizing	
Use Adaptive Sizing	Yes
Resolution	Default (2)
Mesh Defeaturing	Yes
Defeature Size	Default
Transition	Fast
Span Angle Center	Coarse
Initial Size Seed	Assembly
Bounding Box Diagonal	1915.1 mm
Average Surface Area	6203.5 mm²
Minimum Edge Length	1.3851e-003 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Standard Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Statistics	
Nodes	72846
Elements	46173

Static Structural (A5)

TABLE 9
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 10
Model (A4) > Static Structural (A5) > Analysis Settings

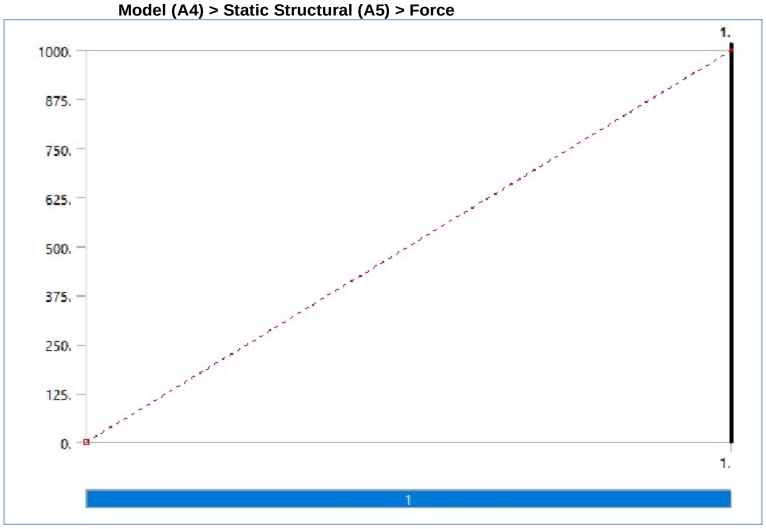
Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled

Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	E:\ansys analysis practice\Go kart design rear engine_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 11
Model (A4) > Static Structural (A5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	12 Faces	2 Faces
Definition		
Type	Force	Fixed Support
Define By	Vector	
Magnitude	1000. N (ramped)	
Direction	Defined	
Suppressed	No	

FIGURE 1
Model (A4) > Static Structural (A5) > Force



Solution (A6)

TABLE 12
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
MAPDL Elapsed Time	20. s
MAPDL Memory Used	1.0137 GB
MAPDL Result File Size	35.438 MB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output

Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Total Deformation*	*Maximum Principal Elastic Strain*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Total Deformation	Maximum Principal Elastic Strain
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Results		
Minimum	0. mm	-8.2212e-007 mm/mm
Maximum	4.7906e-002 mm	2.6839e-004 mm/mm
Average	3.9724e-002 mm	1.7913e-006 mm/mm
Minimum Occurs On	Component1\Brep With Voids	
Maximum Occurs On	Component1\Brep With Voids	
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

FIGURE 2
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

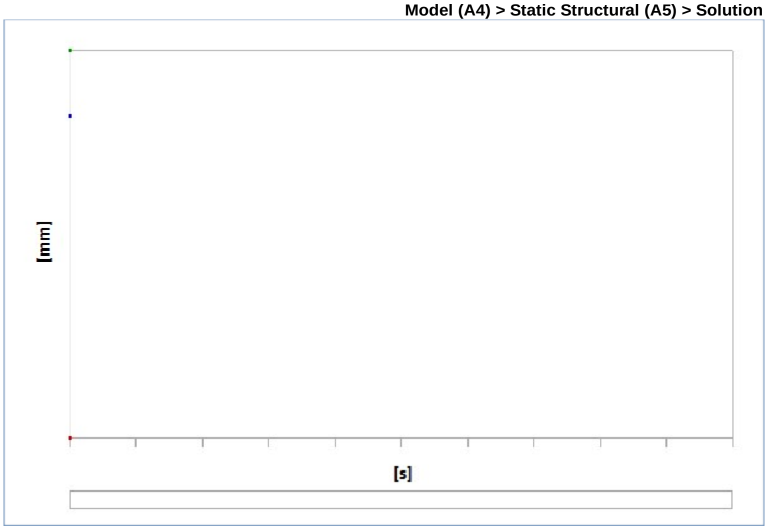


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1.	0.	4.7906e-002	3.9724e-002

FIGURE 3
Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Principal Elastic Strain

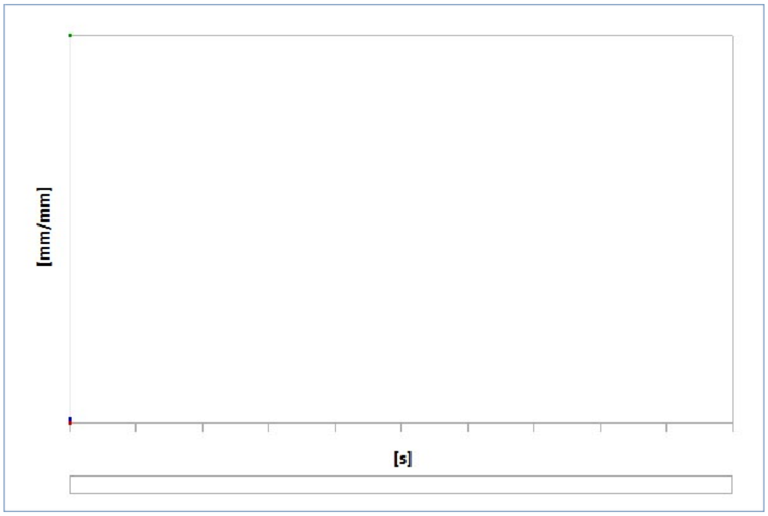


TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Principal Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
1.	-8.2212e-007	2.6839e-004	1.7913e-006

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	4.1236
Minimum Occurs On	Component1\Brep With Voids
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

FIGURE 4
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

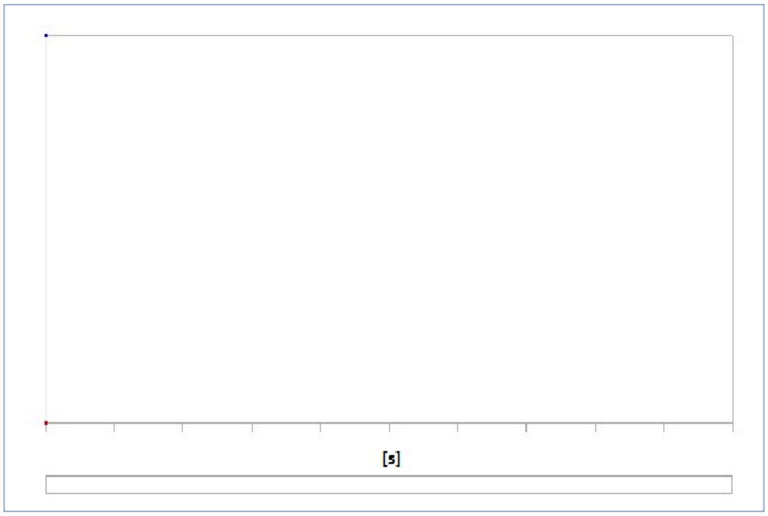


TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
1.	4.1236	15.	14.999

Material Data

Structural Steel

TABLE 20
Structural Steel > Constants

Density	7.85e-006 kg mm^-3
Isotropic Secant Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat Constant Pressure	4.34e+005 mJ kg^-1 C^-1
Isotropic Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Isotropic Resistivity	1.7e-004 ohm mm

TABLE 21
Structural Steel > Color

Red	Green	Blue
132	139	179

TABLE 22
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength
0

TABLE 23
Structural Steel > Compressive Yield Strength

Compressive Yield Strength
250

TABLE 24
Structural Steel > Tensile Yield Strength

Tensile Yield Strength
250

TABLE 25
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength
460

TABLE 26
Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature
22

TABLE 27
Structural Steel > S-N Curve

Alternating Stress MPa	Cycles	Mean Stress MPa
3999	10	0
2827	20	0
1896	50	0
1413	100	0
1069	200	0
441	2000	0
262	10000	0
214	20000	0
138	1.e+005	0

114	2.e+005	0
86.2	1.e+006	0

TABLE 28
Structural Steel > Strain-Life Parameters

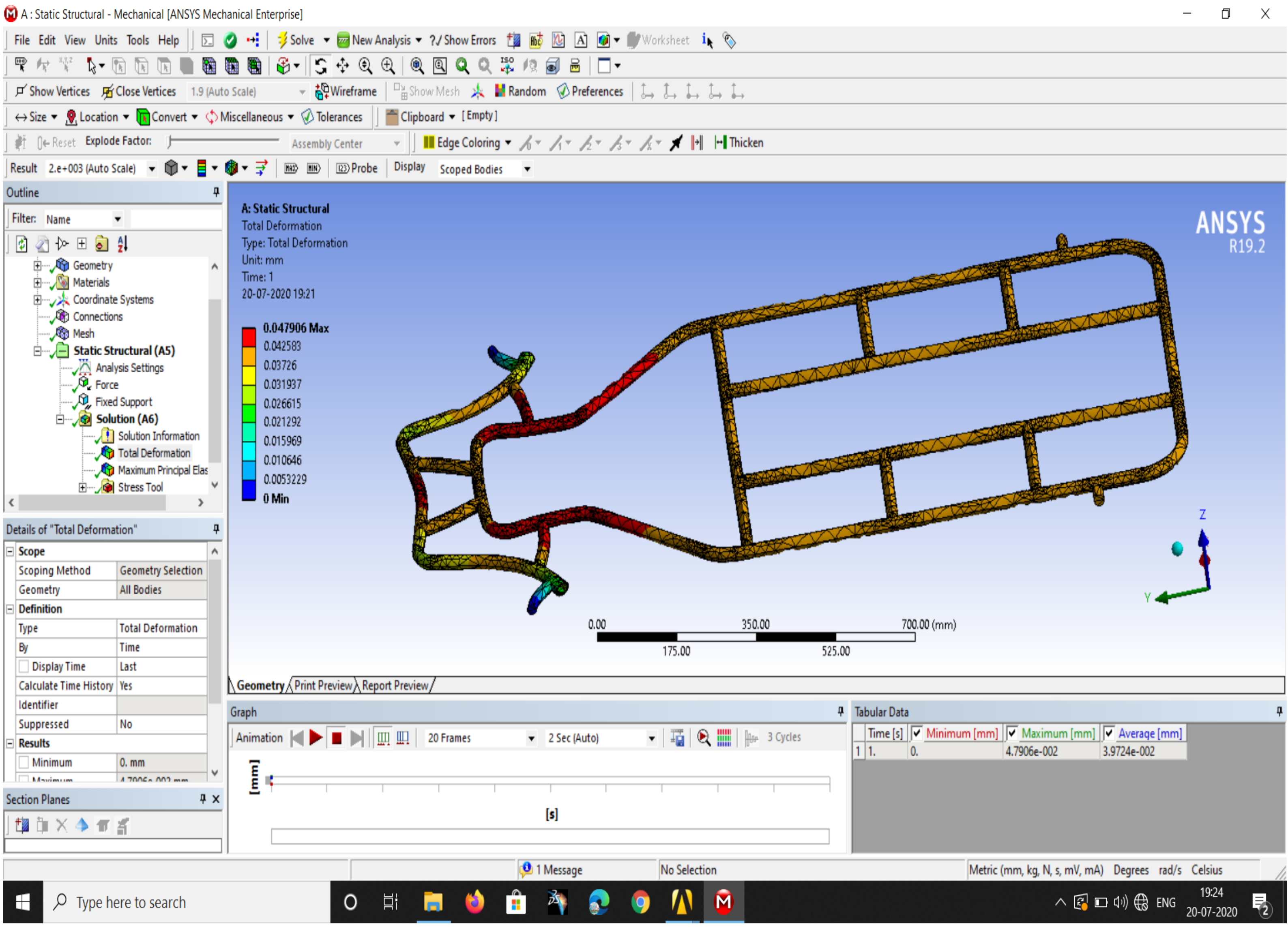
Strength Coefficient MPa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient MPa	Cyclic Strain Hardening Exponent
920	-0.106	0.213	-0.47	1000	0.2

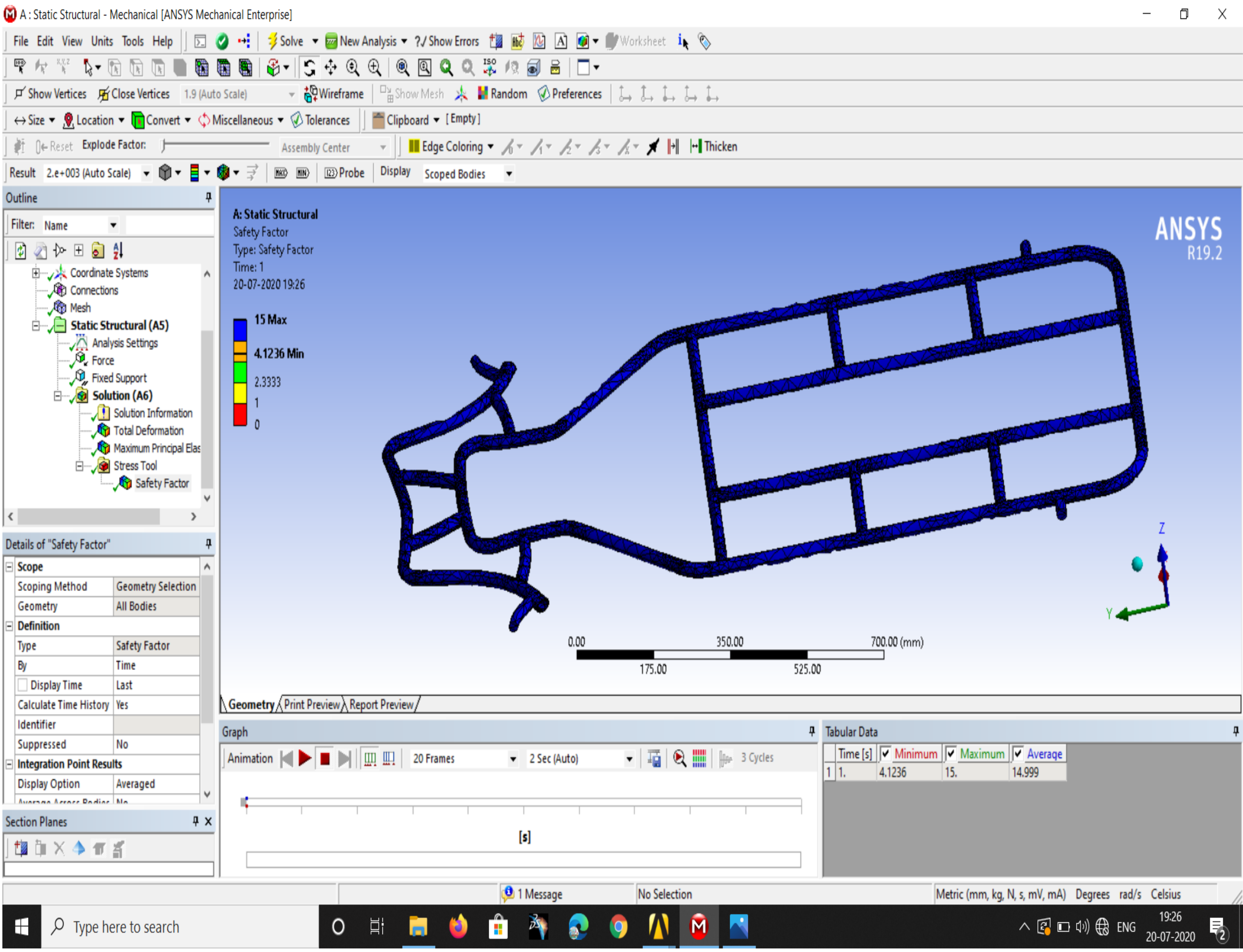
TABLE 29
Structural Steel > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
2.e+005	0.3	1.6667e+005	76923	

TABLE 30
Structural Steel > Isotropic Relative Permeability

Relative
10000




A : Static Structural - Mechanical [ANSYS Mechanical Enterprise]
A: Static Structural
Safety Factor
Type: Safety Factor
Time: 1
20-07-2020 19:26
15 Max
4.1236 Min
2.3333
1
0
ANSYS
R19.2
0.00
350.00
700.00 (mm)
175.00
525.00
Outline
Coordinate Systems
Connections
Mesh
Static Structural (A5)
Analysis Settings
Force
Fixed Support
Solution (A6)
Solution Information
Total Deformation
Stress Tool
Safety Factor
Details of "Safety Factor"
Scope
Scoping Method
Geometry Selection
Geometry
All Bodies
Definition
Type
Safety Factor
By
Time
Display Time
Last
Calculate Time History
Yes
Identifier
Suppressed
No
Integration Point Results
Display Option
Averaged
Tabular Data
Time [s]
Minimum
Maximum
Average
1
1.
4.1236
15.
14.999
Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius

Chapter 3

2.2 CONCLUSION ON LITERATURE REVIEW

- **From our design we found that mass of the chassis is 11.416kg and also our front impact analysis and rear impact analysis also shows us that at 1000N force and 4.2 FOS our vehicle can withstand collision from front and side .**
- **For the braking part we had used Apache rtr160 disc brake from the calculations of total weight and maximum speed at 48km/h .**

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