A REPORT

ON

Making of Solar car

BY

AT

FACULTY OF SCIENCE & TECHNOLOGY

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(April 2016)

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Introduction

A solar cars is a 4 wheeler vehicle which is running on power generated by the solar cells. Solar cars is running on solar power from the sun. They are very stable and uses clean energy. Solar cars which are considered as an upgrade to conventional cars, and economically better than other fuel variants, since these are battery powered have zero emission, and is often argued to be much better than other cars as they are considered almost pollution free Solar cars depend on a solar array that uses photovoltaic cells (pv cells) to convert sunlight into electricity. Unlike solar thermal energy which converts solar energy to heat for either household purposes , industrial purposes or to be convert to electricity. when the PV cells gets heated up due to the sunlight pv cells excite electrons and allow them to flow and thus it create electric current.

Pv cells are made up of semiconductor materials such as silicon and alloys of indium, gallium and nitrogen. Crystalline silicon is the most common material used and has an efficiency rate of 15-20 %.

Components used in solar car-

S.NO.	COMPONENT WITH DESCRIPTIONS	QUANTITY
01	12V, 120ah Battery Lead Acid	04 nos
02	400W Solar Panel	04 nos
03	900W X 48V(input) Motor BLDC	01 nos
04	Charger 30 amp max. Copper	01 nos
05	Brakes, Master Cylinder, Disc Plate With All Accessories (Power Brakes)	01 set
06	Front Axle With Steering Assembly	01 set
07	Leaf Spring	04 nos
08	24 Tube 50 Amp Controller	01 nos
09	Tyres with Rim, Size rear wheel 2.75 14 tyre 2.75 - 14 inner tube 2.75—14	04 nos
10	Electrical Component(Like Head Light, Back Light , Horn , Buzzer And Wiring)	01 set
11	Seat	02 nos
12	Chasis & Body 2870 X 1000 X 2200 mm	01 set
13	Total Weight	350 kg

Procedure-

The following stages of procedure has been followed in the making of the Solar car:

Stage 1 : This is the initial step in the making , From a rectangular tube with 3x2 inches of width , height and 0.25 inches thickness we made an chassis with dimension of 81 x 27 inches . We used arc welding for joining and Gas cutter for removing the unwanted material.

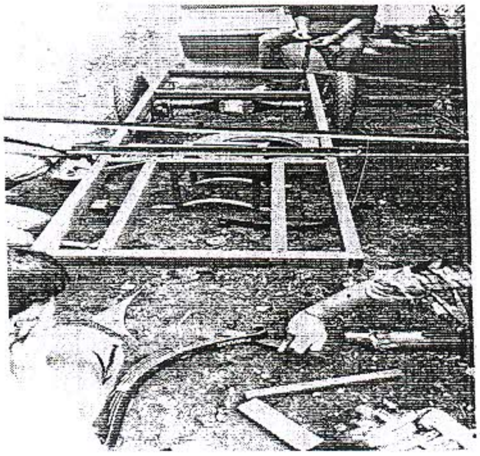


Fig 1

Stage 2 : Fitting the differential in the rear wheel.

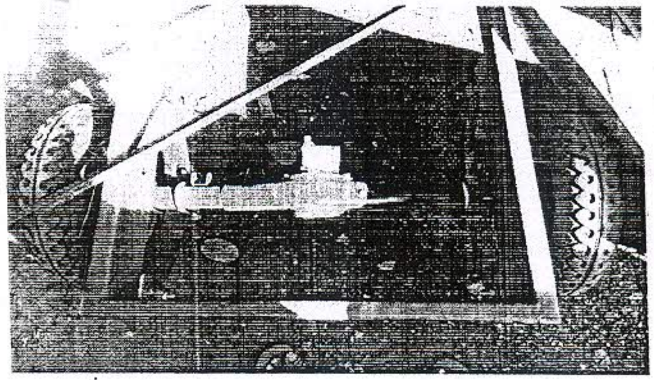


Fig 2

Stage 3: Axle fitting in line with the differential.

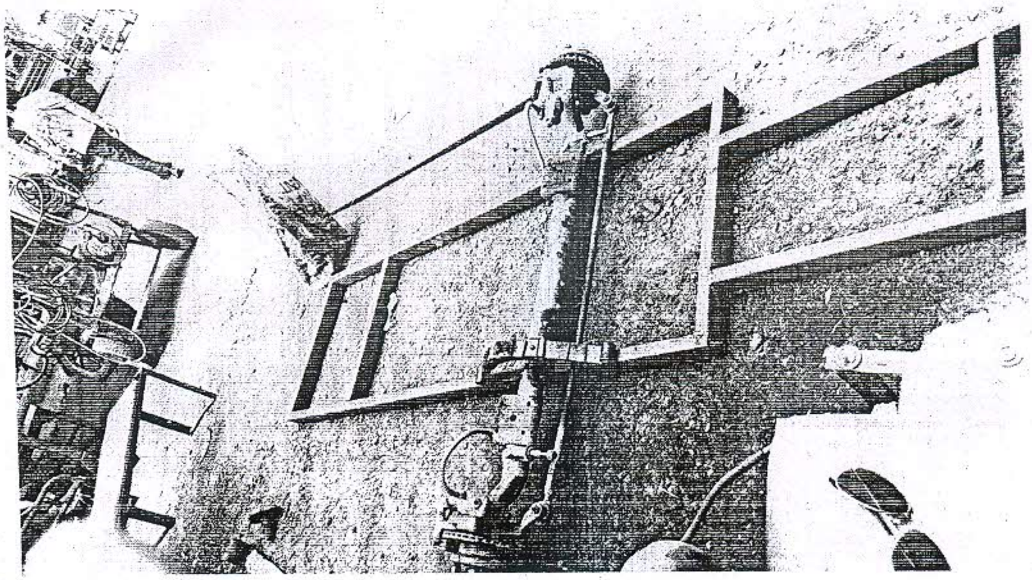


Fig 3

Stage 4 : Next the steering has been setup which is of an rack and pinion type .

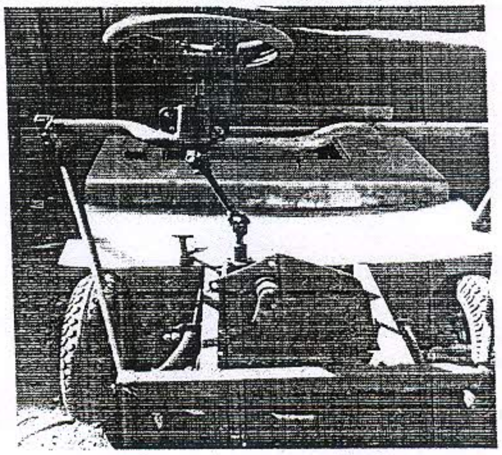


Fig 4

Stage 5 : Fitting of the accessories (refer to page 4) and Fabrication of the body of the solar car.

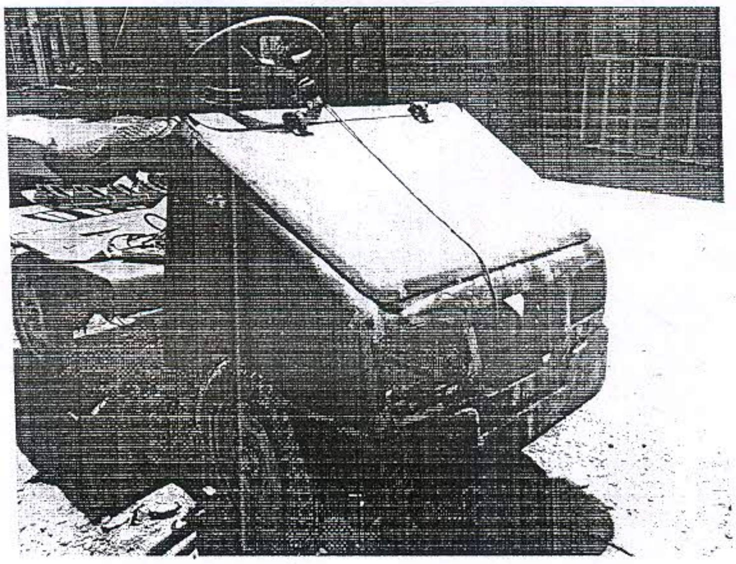


Fig 5

Stage 6: Fitting of the Solar Panel.

Mechanisms used in solar car-

- **Ackermann steering geometry** is a geometric arrangement of linkages in the steering of a car or other vehicle designed to solve the problem of wheels on the inside and outside of a turn needing to trace out circles of different radii. The intention of Ackermann geometry is to avoid the need for tyres to slip sideways when following the path around a curve. The geometrical solution to this is for all wheels to have their axles arranged as radii of circles with a common centre point. As the rear wheels are fixed, this centre point must be on a line extended from the rear axle. Intersecting the axes of the front wheels on this line as well requires that the inside front wheel is turned, when steering, through a greater angle than the outside wheel.

- **Disc brake:**

- A disc brake is a type of brake that uses calipers to squeeze pairs of pads against a disc in order to create friction that retards the rotation of a shaft, such as a vehicle axle, either to reduce its rotational speed or to hold it stationary. The energy of motion is converted into waste heat which must be dispersed.
- Hydraulic disc brakes are the most commonly used form of brake for motor vehicles but the principles of a disc brake are applicable to almost any rotating shaft. Compared to drum brakes, disc brakes offer better stopping performance because the disc is more readily cooled. As a consequence discs are less prone to the brake fade caused when brake components overheat. Disc brakes also recover more quickly from immersion (wet brakes are less effective than dry ones).
- Most drum brake designs have at least one leading shoe, which gives a servo-effect. By contrast, a disc brake has no self-servo effect and its braking force is always proportional to the pressure placed on the brake pad by the braking system via any brake servo, braking pedal, or lever. This tends to give the driver better "feel" and helps to avoid impending lockup. Drums are also prone to "bell mouthing" and trap worn lining material within the assembly, both causes of various braking problems.
- The brake *disc* (or *rotor* in American English) is usually made of cast iron, but may in some cases be made of composites such as reinforced carbon–carbon or ceramic matrix composites. This is connected to the *wheel* and/or the *axle*. To retard the wheel, friction material in the form of brake pads, mounted on the brake caliper, is forced mechanically, hydraulically, pneumatically, or electromagnetically against both sides of the disc. Friction causes the disc and attached wheel to slow or stop.

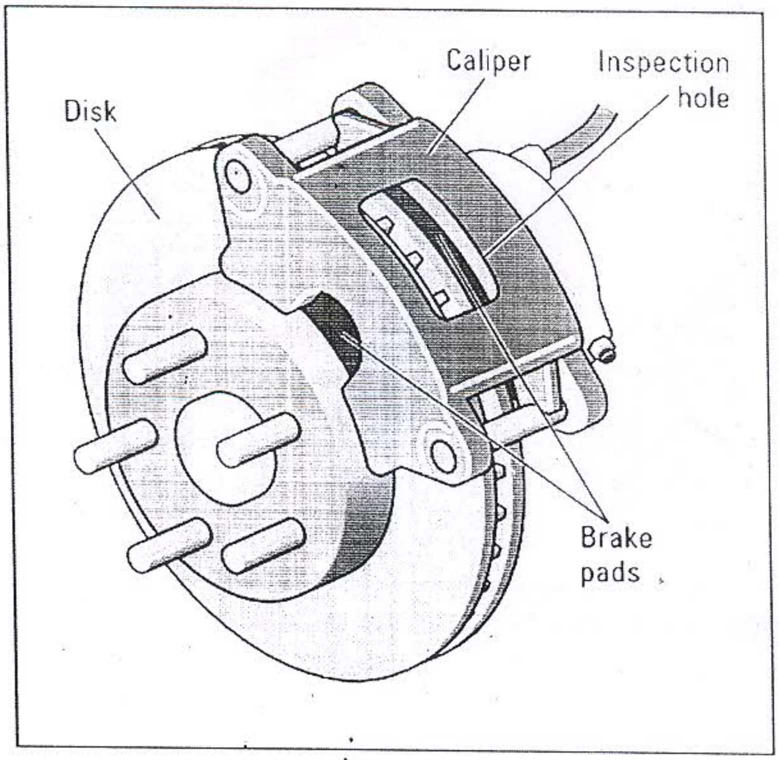


Fig 6

Design of solar car

Vision behind the solar car was to make a car which is using a conventional energy thus the design of this car was kept simple and light weighted. We didn't used car doors just to reduce the weight of the car. The main weight of the car comes from the components of the car like solar panel, battery, axel etc. The chassis of the car is made up of cast square iron pipes to keep it light weighted. Solar panel is tilted slightly downwards towards the back. So that at the time of rain the water will fall backward and water will not disturb the driver. Secondly at the time of parking the car panel well get more exposé to the sunlight.

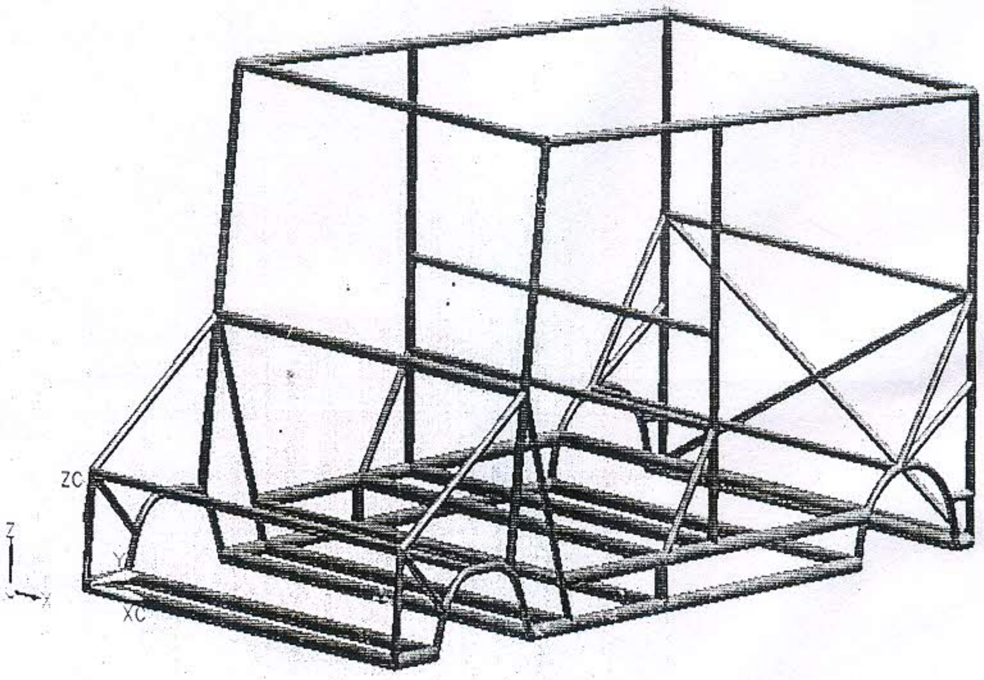


Fig 7

Analysis Report

First Saved	Sunday, April 03, 2016
Last Saved	Sunday, April 03, 2016
Product Version	16.2 Release
Save Project Before Solution	No
Save Project After Solution	No

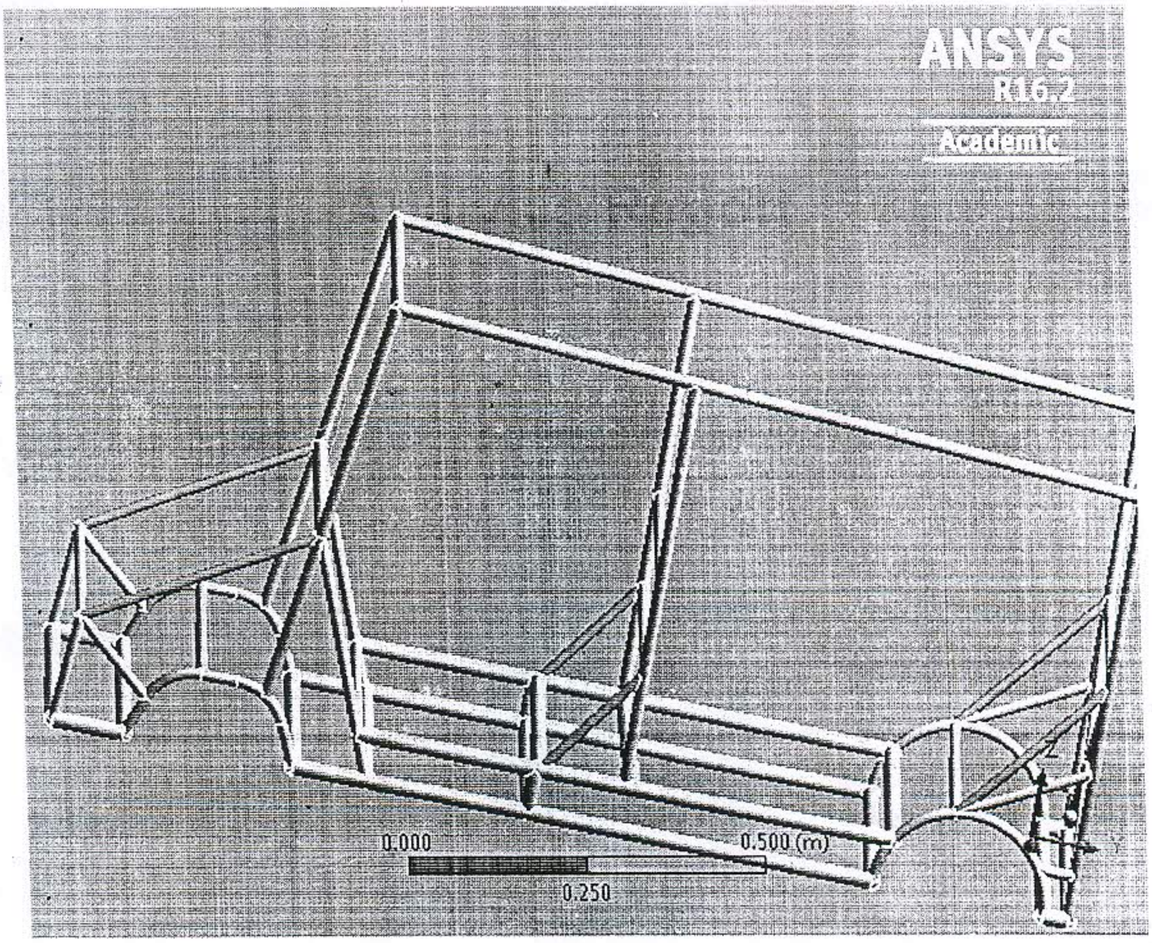


Fig 8.

Contents

Units

TABLE 1

Unit System	Metric (m, kg, N, s, V, A) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\AMIT\Desktop\don' delete\car_files\dp0\SYS-1\DM\SYS-1.agdb
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	0.70866 m
Length Y	1.457 m
Length Z	0.68808 m
Properties	

Volume	8.365e-003 m^3
Mass	65.665 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	25078
Elements	11667
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\AMIT\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*solar_car*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Structural Steel
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	0.70866 m
Length Y	1.457 m
Length Z	0.68808 m

Properties	
Volume	8.365e-003 m^3
Mass	65.665 kg
Centroid X	0.3429 m
Centroid Y	0.76894 m
Centroid Z	0.16102 m
Moment of Inertia Ip1	16.818 kg·m^2
Moment of Inertia Ip2	7.598 kg·m^2
Moment of Inertia Ip3	18.71 kg·m^2
Statistics	
Nodes	25078
Elements	11667
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (B4) > Coordinate Systems > Coordinate System

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

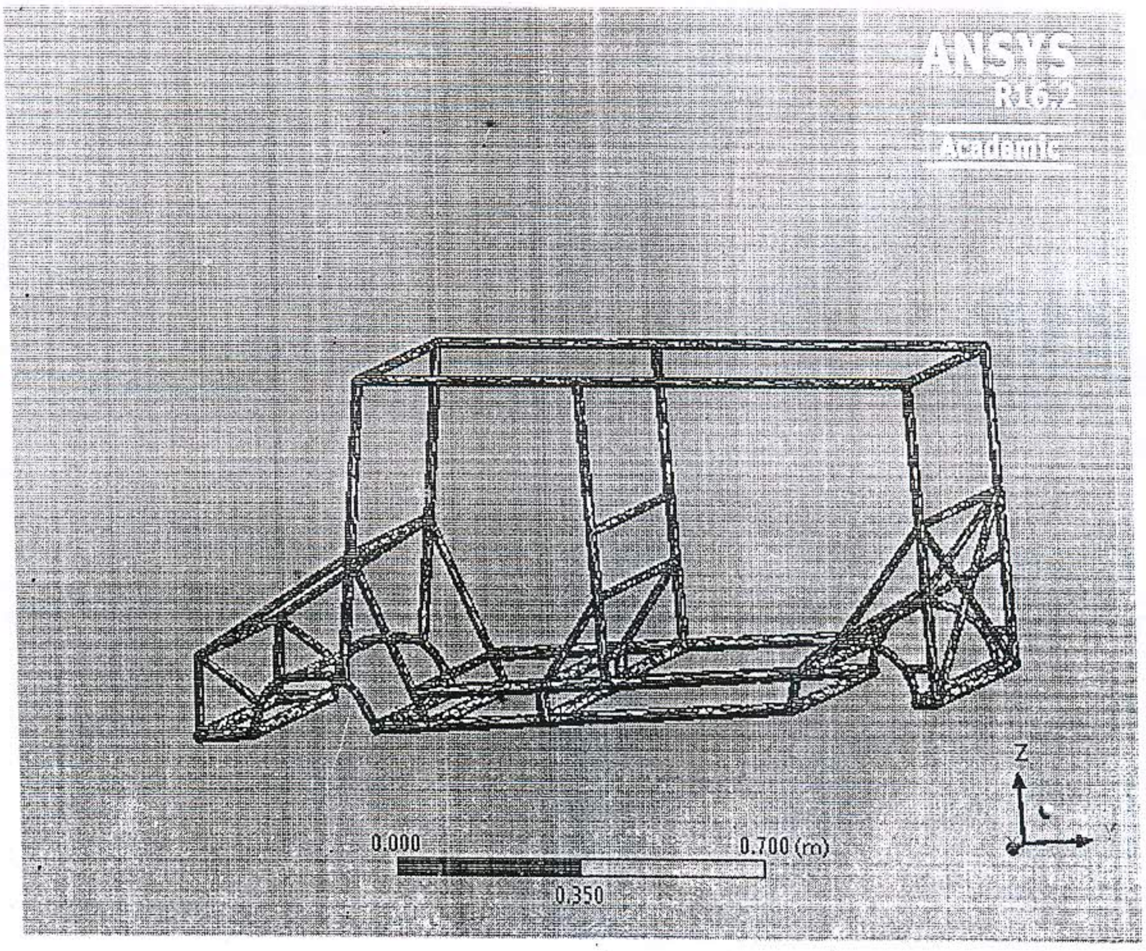
Mesh

TABLE 5
Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	-100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	Default
Initial Size Seed	Active Assembly

Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	1.4737e-004 m
Inflation	
Use Automatic Inflation	Program Controlled
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Advancing Front
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	0
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	25078
Elements	11667
Mesh Metric	None

FIGURE 9
Model (B4) > Mesh > Figure



Static Structural (B5)

TABLE 6
Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (B4) > Static Structural (B5) > 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	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
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	C:\Users\AMIT\Desktop\don' delete\car_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	mks

TABLE 8
Model (B4) > Static Structural (B5) > Loads

Object Name	*Fixed Support*	*Force*	*Force 2*	*Force 3*
State	Fully Defined			
Scope				
Scoping Method	Geometry Selection			
Geometry	10 Faces	4 Faces	6 Faces	5 Faces
Definition				
Type	Fixed Support	Force		
Suppressed	No			
Define By		Components		

Coordinate System	Global Coordinate System		
X Component	0. N (ramped)		
Y Component	0. N (ramped)		
Z Component	-200. N (ramped)	-1178. N (ramped)	-1256. N (ramped)

FIGURE 10
Model (B4) > Static Structural (B5) > Force

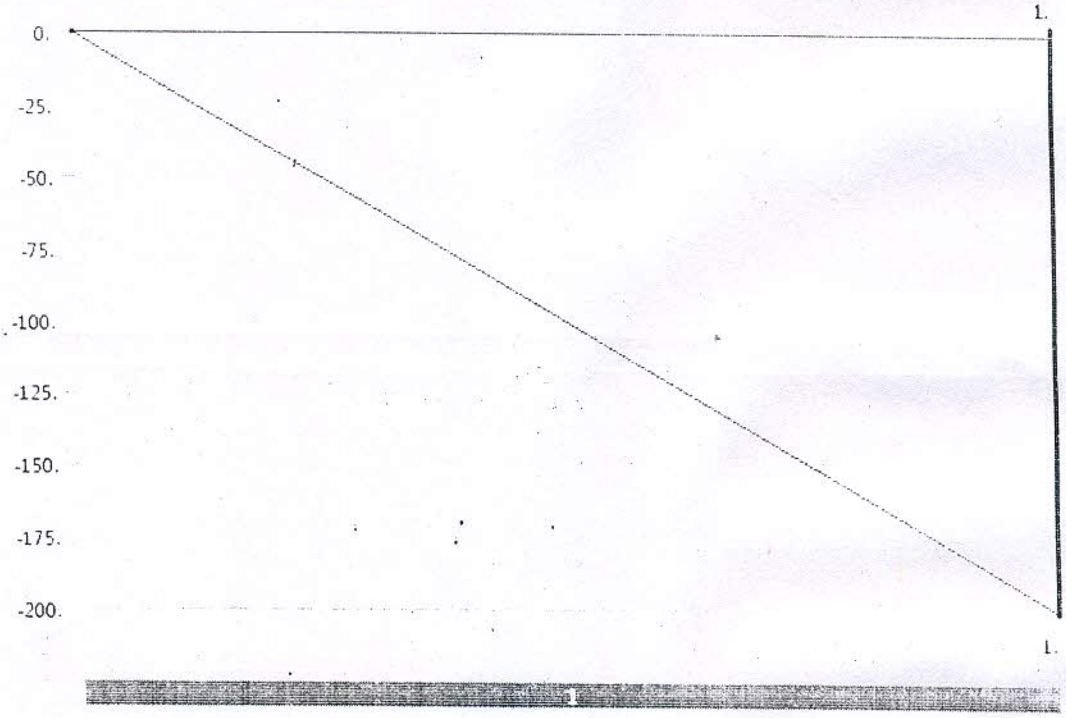


FIGURE 11
Model (B4) > Static Structural (B5) > Force > Figure

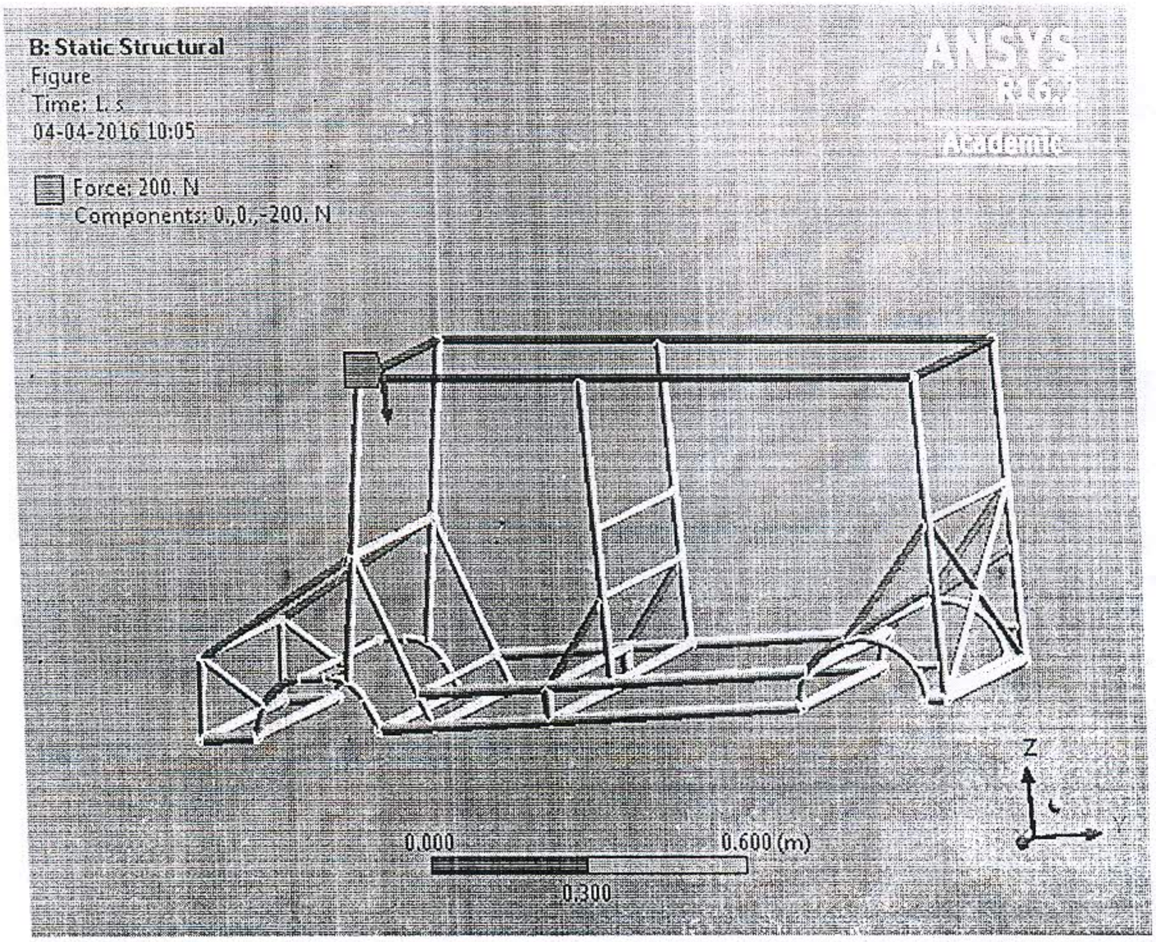


FIGURE 12
Model (B4) > Static Structural (B5) > Force 2

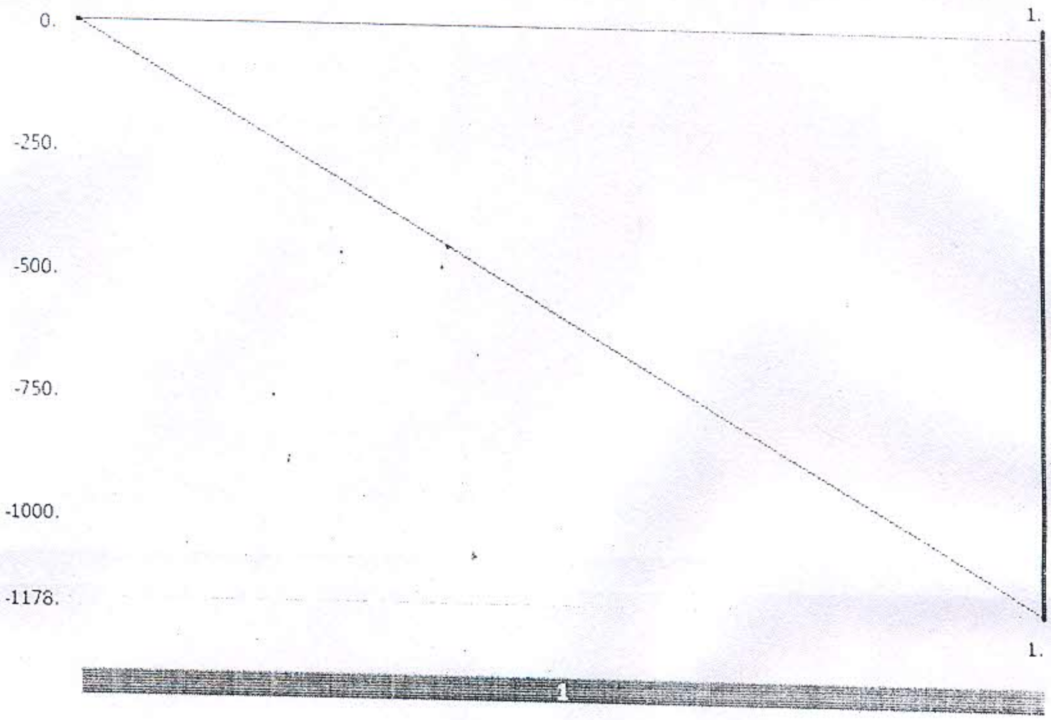


FIGURE 13
Model (B4) > Static Structural (B5) > Force 2 > Figure

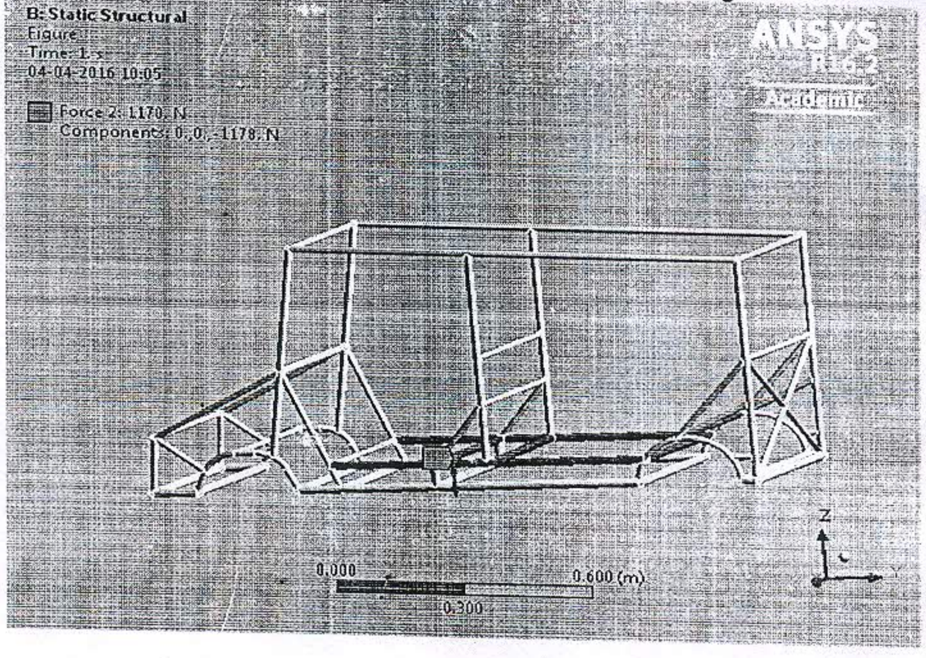
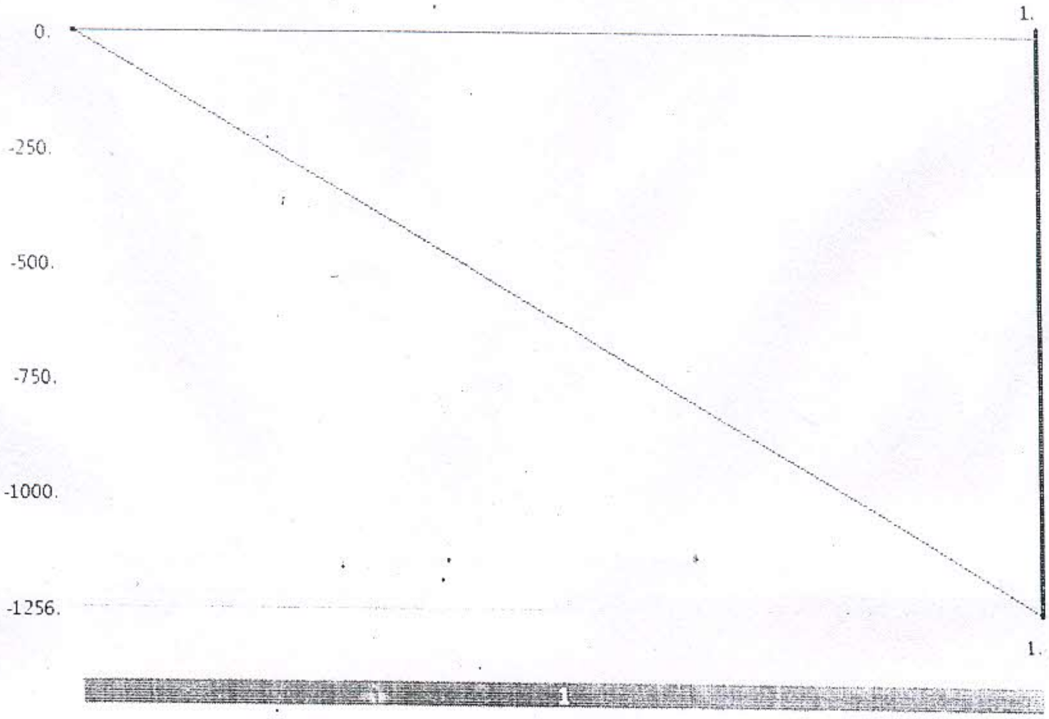


FIGURE 14
Model (B4) > Static Structural (B5) > Force 3



Solution (B6)

TABLE 9
Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	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 11
Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Total Deformation*	*Equivalent Elastic Strain*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Total Deformation	Equivalent Elastic Strain
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Results		
Minimum	0. m	4.3312e-021 m/m
Maximum	1.498e-004 m	9.8277e-005 m/m
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

TABLE 12
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

Time [s]	Minimum [m]	Maximum [m]
1.	0.	1.498e-004

FIGURE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation > Figure

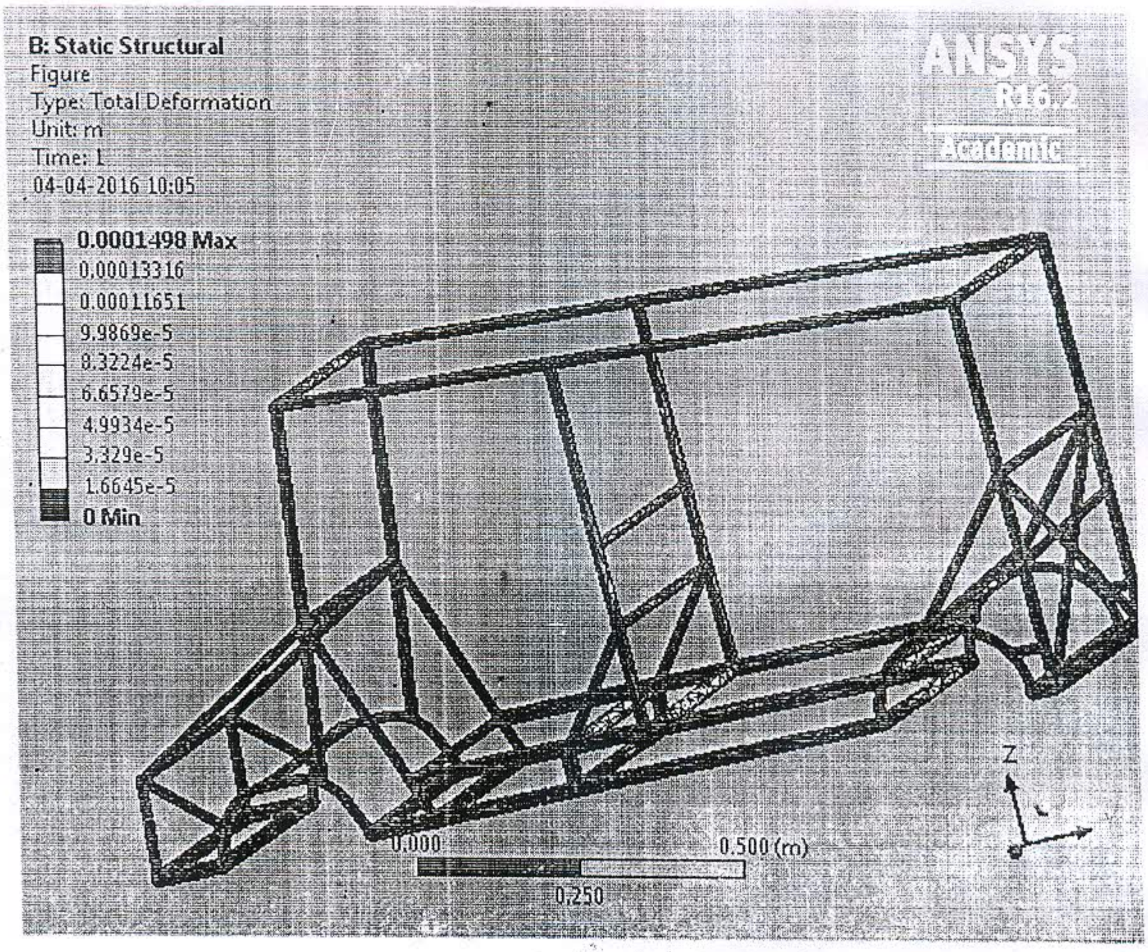


TABLE 13
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [m/m]	Maximum [m/m]
1.	4.3312e-021	9.8277e-005

FIGURE 16

Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain > Figure

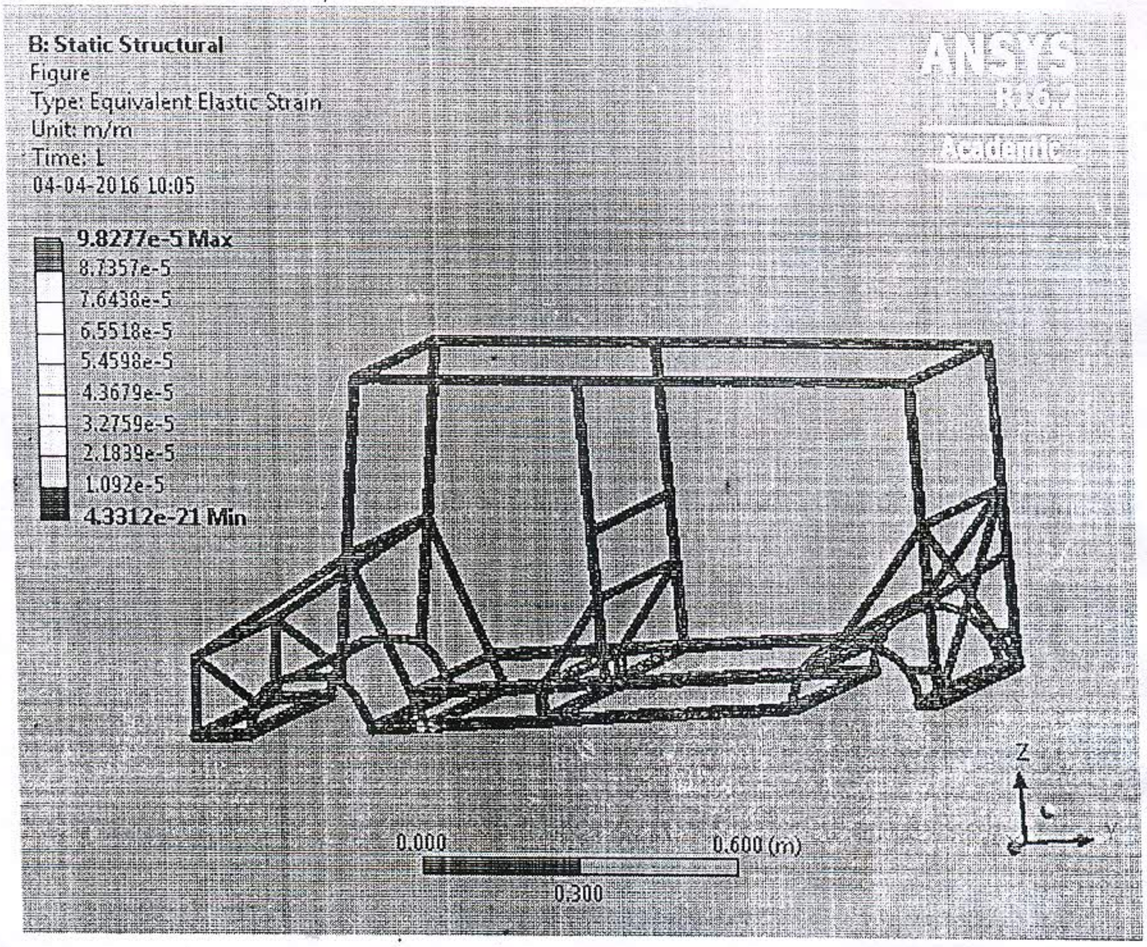


FIGURE 17

Model (B4) > Static Structural (B5) > Solution (B6) > Figure

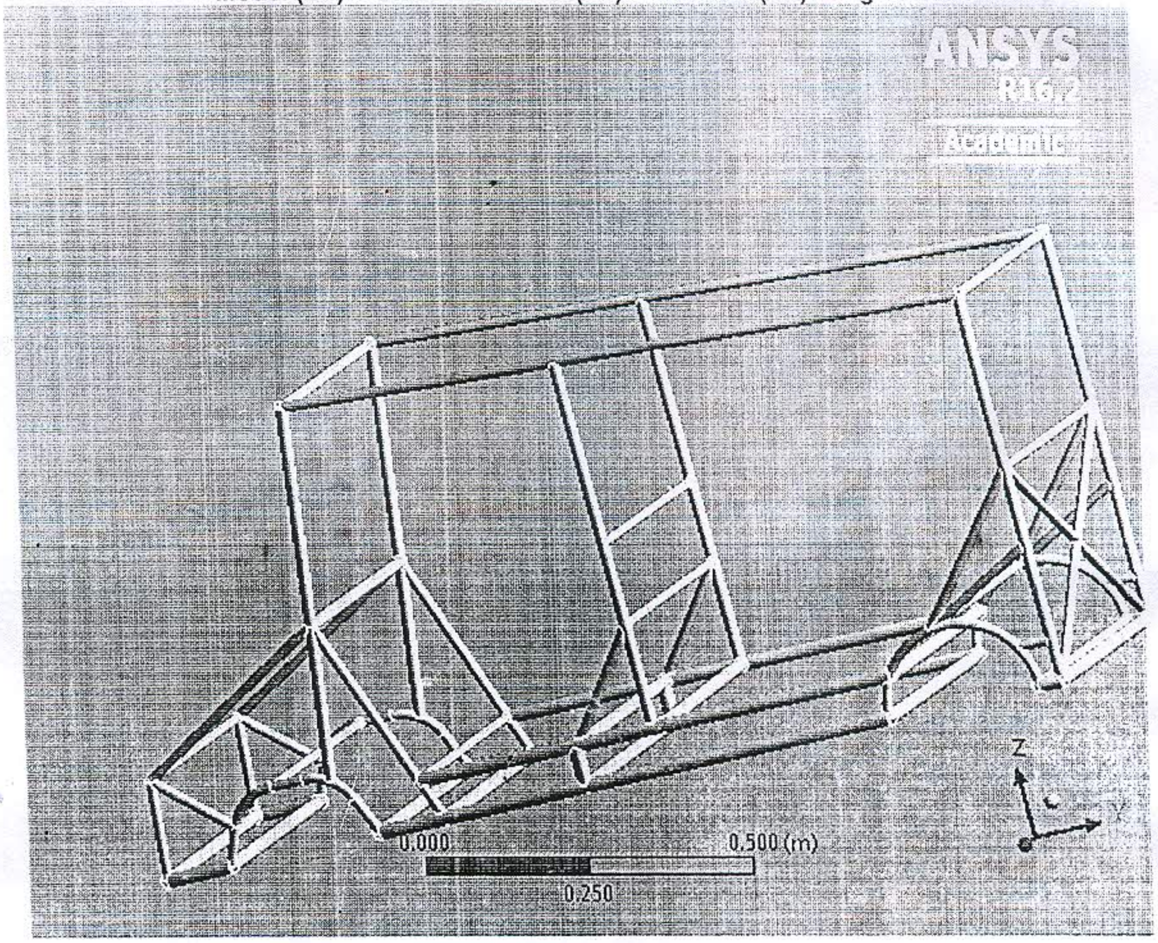


TABLE 14
Model (B4) > Static Structural (B5) > Solution (B6) > Fatigue Tools

Object Name	*Fatigue Tool*
State	Solved
Materials	
Fatigue Strength Factor (Kf)	1.
Loading	
Type	Fully Reversed
Scale Factor	1.
Definition	
Display Time	End Time
Options	
Analysis Type	Stress Life
Mean Stress Theory	None
Stress Component	Equivalent (Von Mises)
Life Units	
Units Name	cycles
1 cycle is equal to	1. cycles

FIGURE 18

Model (B4) > Static Structural (B5) > Solution (B6) > Fatigue Tool

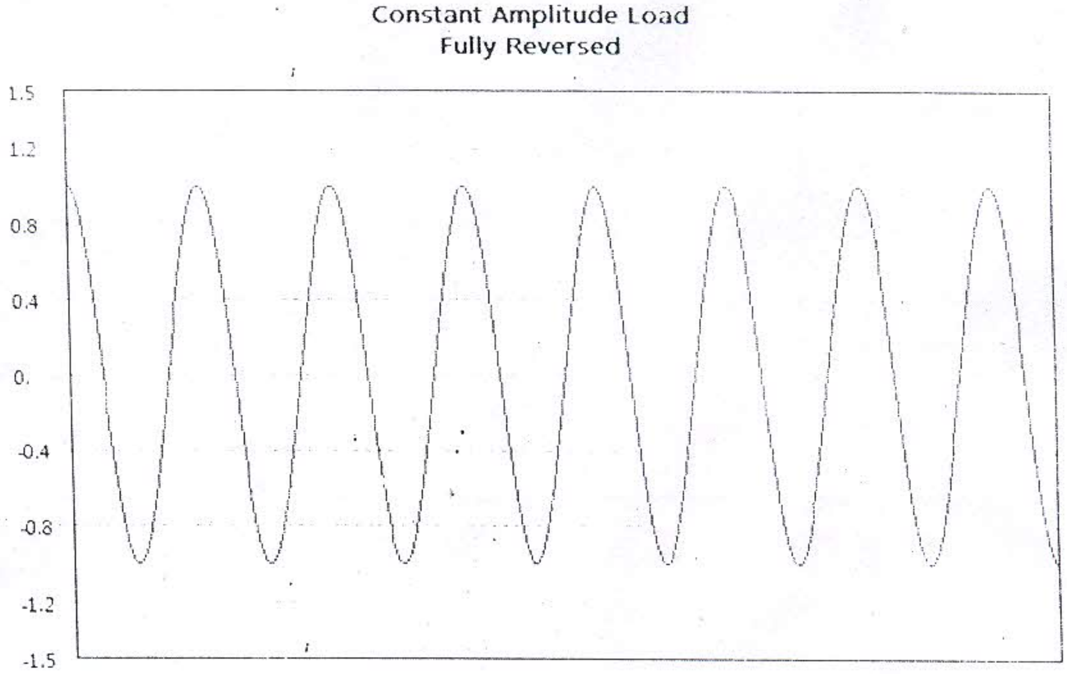


TABLE 15

Model (B4) > Static Structural (B5) > Solution (B6) > Fatigue Tool > Results

Object Name	*Damage*	*Safety Factor*	*Life*
State		Solved	
Scope			
Scoping Method		Geometry Selection	
Geometry		All Bodies	
Definition			
Design Life	1.e+009 cycles		
Type	Damage	Safety Factor	Life
Identifier			
Suppressed		No	
Integration Point Results			
Average Across Bodies		No	
Results			
Maximum	1000.		
Minimum		4.6365	1.e+006 cycles

FIGURE 19

Model (B4) > Static Structural (B5) > Solution (B6) > Fatigue Tool > Damage > Figure

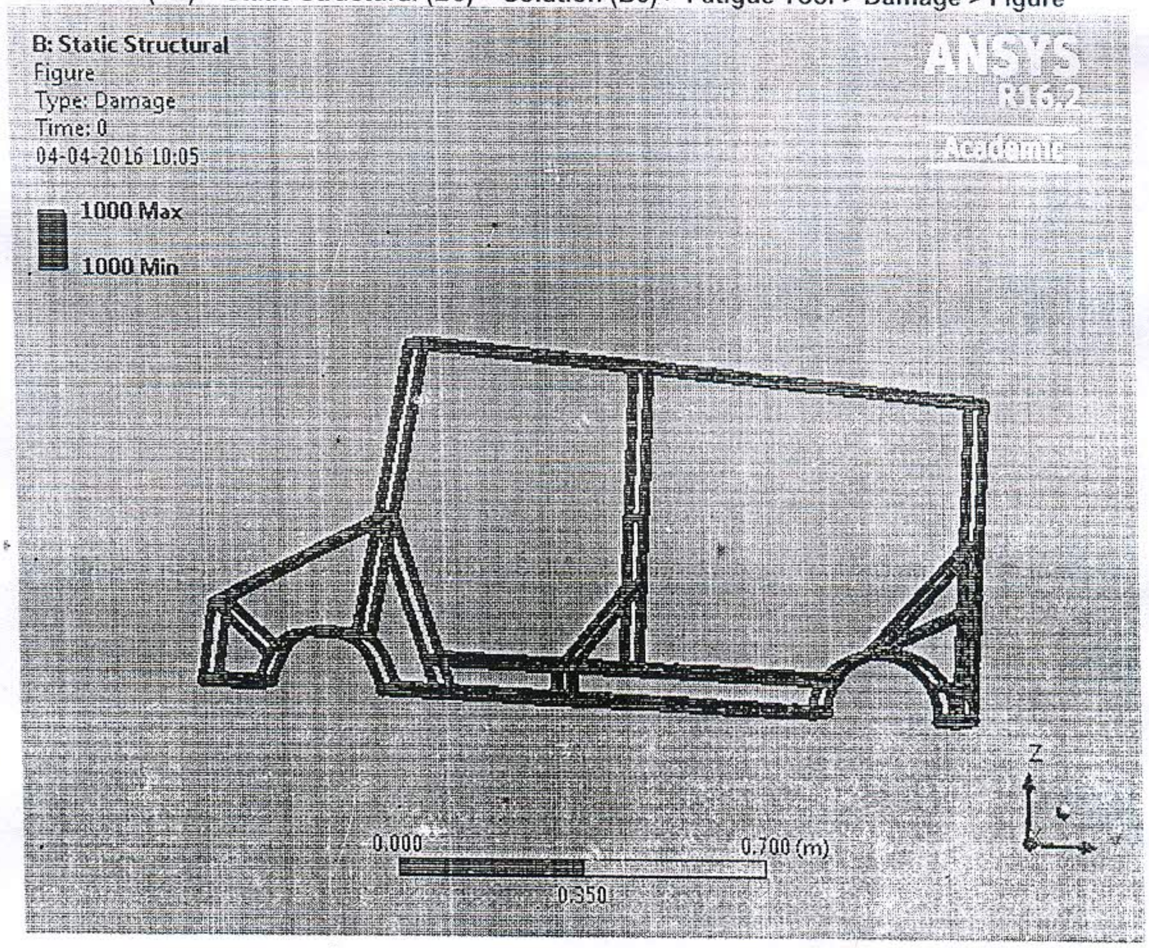


FIGURE 20

Model (B4) > Static Structural (B5) > Solution (B6) > Fatigue Tool > Safety Factor > Figure

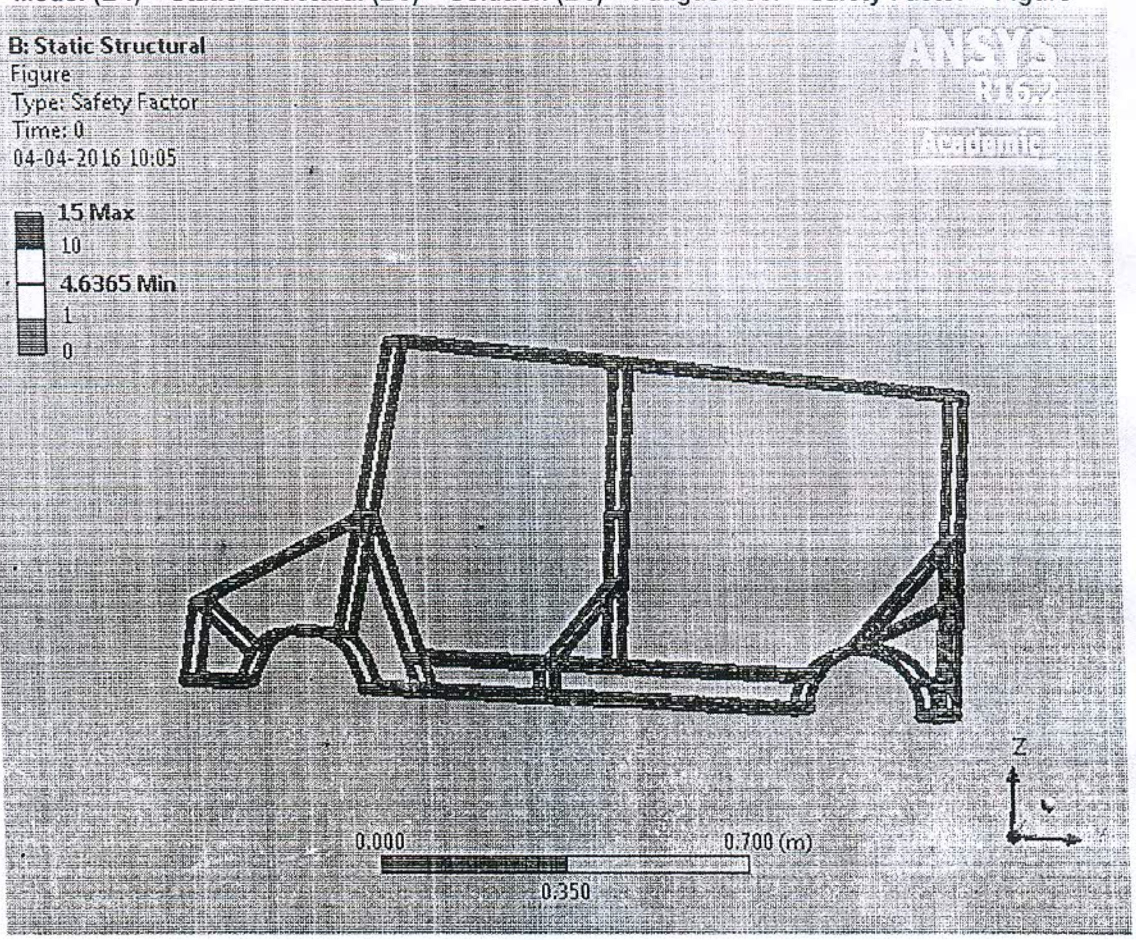
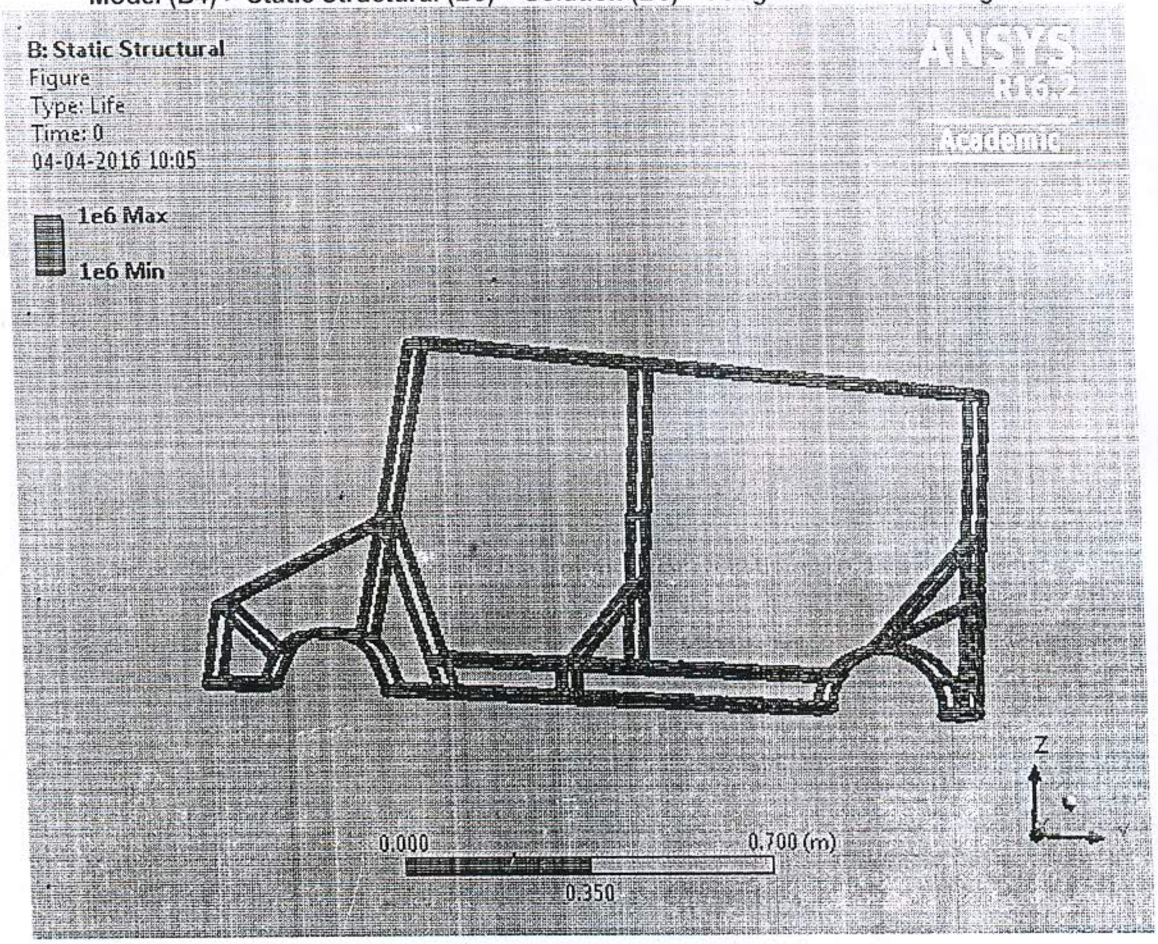


FIGURE 21

Model (B4) > Static Structural (B5) > Solution (B6) > Fatigue Tool > Life > Figure



Material Data

Structural Steel

TABLE 16
Structural Steel > Constants

Density	7850 kg m^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	434 J kg^-1 C^-1
Thermal Conductivity	60.5 W m^-1 C^-1
Resistivity	1.7e-007 ohm m

TABLE 17
Structural Steel > Compressive Yield Strength

Compressive Yield Strength Pa
2.5e+008

TABLE 18

Structural Steel > Tensile Yield Strength

Tensile Yield Strength Pa
2.5e+008

TABLE 19
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength Pa
4.6e+008

TABLE 20
Structural Steel > Alternating Stress Mean Stress

Alternating Stress Pa	Cycles	Mean Stress Pa
3.999e+009	10	0
2.827e+009	20	0
1.896e+009	50	0
1.413e+009	100	0
1.069e+009	200	0
4.41e+008	2000	0
2.62e+008	10000	0
2.14e+008	20000	0
1.38e+008	1.e+005	0
1.14e+008	2.e+005	0
8.62e+007	1.e+006	0

TABLE 21
Structural Steel > Strain-Life Parameters

Strength Coefficient Pa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient Pa	Cyclic Strain Hardening Exponent
9.2e+008	-0.106	0.213	-0.47	1.e+009	0.2

TABLE 22
Structural Steel > Isotropic Elasticity

Temperature C	Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa
22	2.e+011	0.3	1.6667e+011	7.6923e+010

TABLE 23
Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000

The above results gives the analysis of the solar car and accordingly the manufacture of it has been made with the specifications given in this report.