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"Aerodynamics Study of Co_2 Car Design"

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***Abstract*— when objects pass through air, forces are produced by virtual motion between the air and surfaces of the object. Aerodynamics is the education of these forces, generated by means of the motion of air, commonly aerodynamics are taken into consideration rendering to the kind of flow as subsonic, hypersonic, supersonic and so forth. This take a look at is accomplished at the scaled model of the dragster race car, because the dragster wishes extra space & substantial value to construct and test the identical, to reduce the cost and speedup the refinement manner, we have carried out this study on the miniature model of the car and tested with the wind loading of 57MPH to analyse the wind loading and the obstruction in the path of movement.**

The initial study is performed at the primary geometry of the car to test the drift parameters. The second take a look at is finished on the subtle model of the car, ensuring all of the uncovered corners are rounded to avoid obstruction of air and make certain clean waft of the air. Drag and lift parameter is basically reduced in this look at because of the change inside the body layout and addition of curves and drafts on the flow surface of the Co2 car surface.

Key Points*: *Race Car, Dragster, Co2, Solid Works.

1. INTRODUCTION

An essential thought in outlining a car is aeromechanics. The study of air is the effect of wind current and the powers included whilst an article travels thru the air or when air moves past an object. Flight technological know-how has tackled new importance since the requirement for more fuel-productive vehicles. An inadequately composed vehicle makes use of greater fuel. The flow of air shifting round a car is called streamline. A body with a preferred adjusted or rectangular form will bring about air to split a ways from the streamline into whirls of air. This uneven or turbulent air improvement with the intention to ease the vehicle off is known as drag. Vehicles have much less resistance on the off hazard that they are adjusted inside the front and reduced to a degree in the again (teardrop shape). In this motion, you will define, develop, and check an aero robotically stable car. The auto you'll be building is similar to a smaller than expected rocket fuelled hot rod. As you manufacture your warm rod, take as a whole lot time as required. It's going to have an advanced opportunity of looking exceptional and going quick at the off hazard that you assemble it with tolerance and consideration. One noteworthy slip-up can spoil the entire hot rod and forestall you from dashing Take pleasure on your work and attempt to make the fine dragster inside the elegance.

In this section a few fundamental air motion optimized requirements and their applications to aircraft aeromechanics will be mentioned. During the talks in this element the wind circulation might be considered as unfaltering. This means that all flow properties, as an example, weight, speed, temperature and thickness are concept to be free of tome. But in a little district near to the plane surface, in which consistency is imperative, the wind current will likewise be notion to be non-gooey or in viscid.

2. PROBLEM DEFINATION AND SCOPE OF PRESENT WORK.

2.1 Objectives

Analysis will be carried out using solid works software to predict air flow parameters and drag on the component by considering external flow simulation at 57MPH.

2.2 Methodology

- From the literature background the gap in a paper is to design and study of aerodynamics co2 car. This will be considered has the objective of this work.
- Solid works software is used for modelling, meshing and analysis of the co_2car.
- Applying material properties and boundary conditions on a element, as per ASTM standards.
- Analyzing the airflow of car and predicting two parameters, drag and lift.
- Finally predicting reduction in drag component, under different surfaces.
- Correlating both results.

2.3 Scope

Our scope of the project is to study the aerodynamic flow of the air and the drag forces during the travel of the car at high speeds.
Considerations for the study.

1. Speed @ 57MPh
2. Car body is designed to have curvatures and angled surfaces to the direction of travel.
3. Gravity and wind force at normal atmosphere is considered.
4. Self-weight of the car is also considered.
5. The flow characteristic results show the aerodynamic parameters and the drag if any in this study.

3. RESULTS AND DISSUASIONS

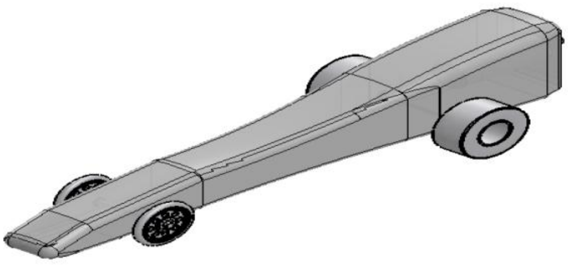

Fig: 3.1 basic model of co_2 car

- Model information - Optimised design
- Current configuration – 57mph

The initial design was having sharp edge faces and faces intersecting into corners, which are aiding the direct obstruction of the air flow during motion.

Model	Co_2 car assy-old SLDASM
Project path	F:\SCCE2016\$CO_2$carproject
Unit system	SI (m-kg-s)
Analysis type	External
Coordinate system	Global Coordinate system
Reference axis	Z

4. MESHING GEOMETRY

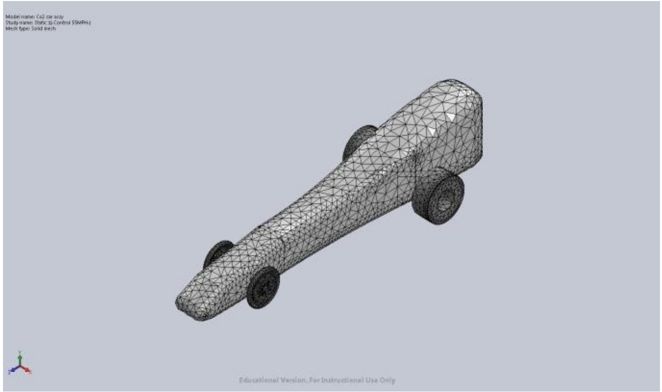

Fig: 4 meshing geometry of ccar model

4.1BOUNDARY CONDITIONS

2D Plane flow	None
At X min	Symmetry
At X max	Default
At Y min	Default
At Y max	Default
At Z min	Default
At Z max	Default

4.1.1Ambient condition

Thermodynamic parameters	Static pressure : 101325pa Temperature 293.26 K
Velocity parameters	Velocity vector Velocity in X direction : 0 mile\h Velocity in Y direction : 0 mile\h Velocity in Z direction : -55.0000000 mile\h
Turbulence parameters	Turbulence intensity and length Intensity : 0.10% Length : $8.337e^{-004}$m

4.2 Input Data

4.2.1 Initial mesh setting

- Automatic initial mesh :on
- Result resolution level : 4
- Advanced narrow channel refinement : off
- Refinement in solid region : off

4.2.2 Geometry resolution

- Evaluation of minimum gap size : automatic
- Evaluation of minimum wall thickness : automatic

4.3 Computational domain

X min	0
X max	0.274 m
Y min	-0.228m
Y max	0.304m
Z min	0.546m
Z max	0.381m

4.4 Calculation control options Finish conditions

Finish conditions	If one is satisfied
Maximum travels	4
Goals convergence	Analysis interval : $5e^{-001}$

4.5 RESULTS

4.5.1 General info

- Iteration: 138
- CPU time: 221s

4.5.2 Calculation mesh

- Basic mesh dimensions-old

Number of cells in X	19
Number of cells in Y	40
Number of cells in Z	74

4.6 Number of cells

Total cells	57227
Fluid cells	56109
Solid cells	309
Partial cells	809
Irregular cells	0
Trimmed cells	0

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4.7 Maximum refinement level: 1

4.7.1 Goals

Name	Value	Progress	Use in convergence	Delta	criteria
Drag	-32.824	100	On	0.14747	3.6120
Lift	12.043	100	On	0.208961	0.2255

4.8 Min /Max Table

Name	Minimum	Maximum
Pressure [pa]	100955.23	101967.23
Temperature [K]	293.07	293.85
Density (fluid) [kg/m^3)	1.20	1.21
Velocity [mile/h]	0	65.5408196
Velocity X [mile/h]	-15.7155005	19.6210812
Velocity Y [mile/h]	-31.6410901	34.9538794
Velocity Z [mile/h]	-65.4000224	6.0181535
Temperature (fluid) [K]	293.07	293.85
Mach number	0	0.09
Vortices [1/s]	0.044	14555.541
Shear stress [pa]	0	4.24
Relative pressure	-369.77	642.23
Heat transfer coefficient [w/m^2/K]	0	0

4.9 Engineering Database

Gases

Air

Path: gases pre-defined

Specific heat ratio (cp/cy): 1.399

Molecular mass: 0.0290kg/mol

Dynamic viscosity

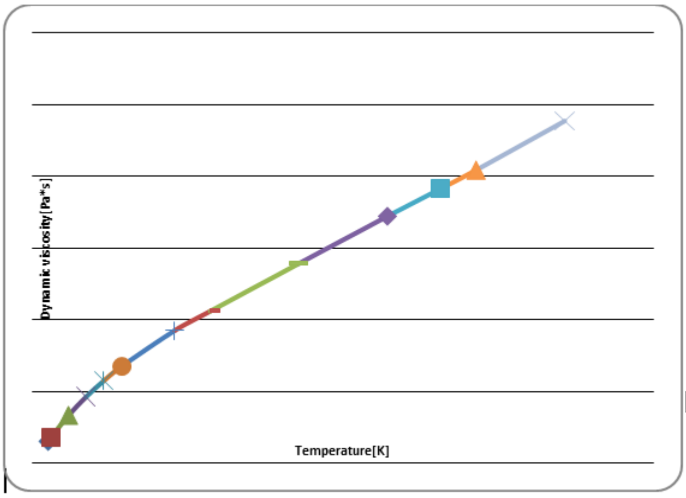

Fig: 4.9 Dynamic viscosity of model

Specific heat (Cp)

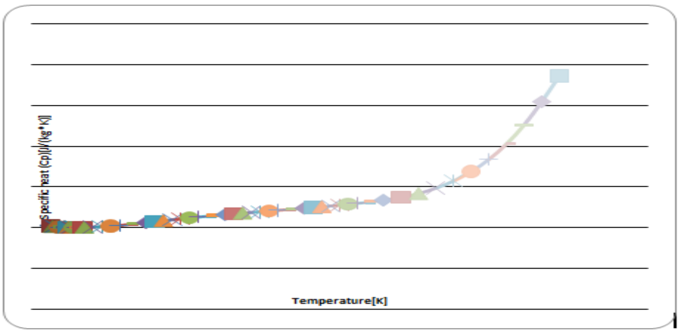

Fig: 4.9 specific heat of the model

Thermal conductivity

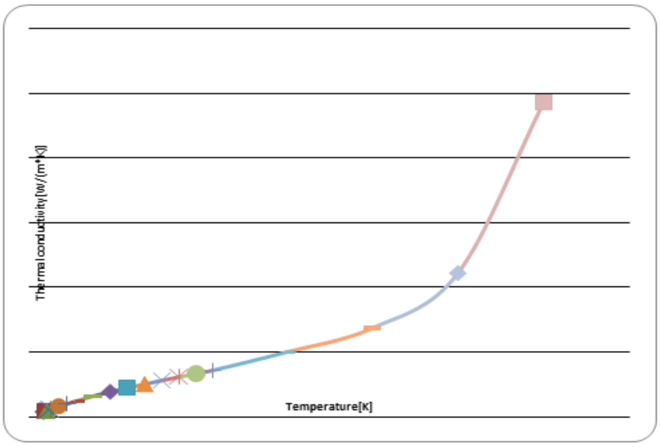

Fig: 4.9 Thermal conductivity of the model

4.10 Wind pressure of geometry

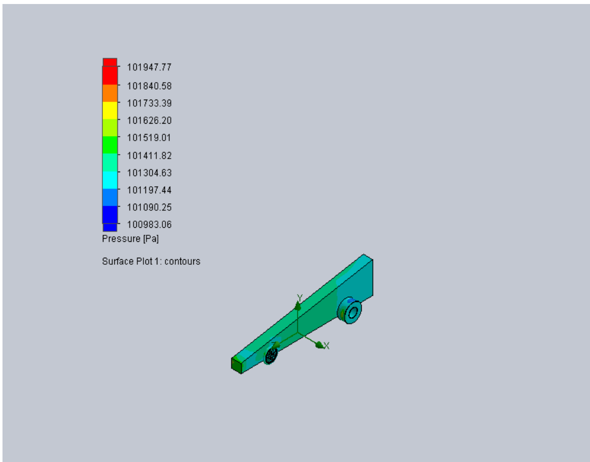

Fig: 4.10.1 wind pressure on the body surface is maximum 101519.01 [pa]

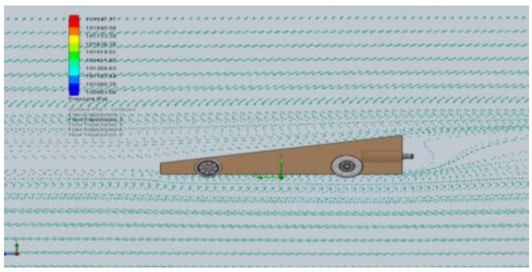

Fig: 4.10.2 this figure shows air is gets deflected because of the slop at the top.

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- Air at bottom is being aspirated by front flat surface as it flows below vehicle and vacuum is created at back because of the flat rear end.
- Back side car is created cavity it will reduce car speed.
- This design of car requires more fuel consumption.
- This type of car design is not safety because haven't stability handling.

5. ASSUMPTIONS ORIGINAL MODELS

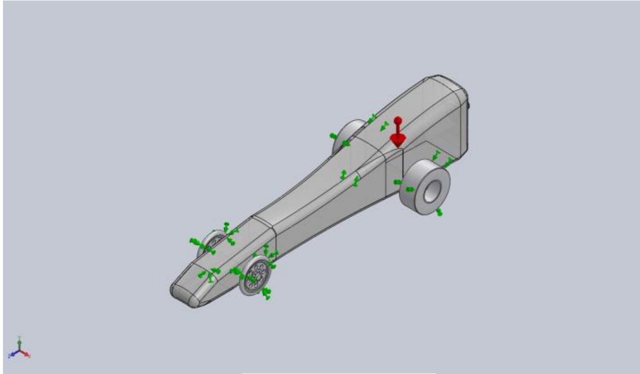

Fig: 5 Original models

- Vehicle running at 57mph
- Check for air flow condition
- External flow parameter study

5.1 Boundary Conditions

2D Plane flow	None
At X min	Symmetry
At X max	Default
At Y min	Default
At Y max	Default
At Z min	Default
At Z max	Default

5.1.1 Ambient condition

Thermodynamic parameters	Static pressure : 101325.00pa Temperature : 293.20 K
Velocity parameters	Velocity vector Velocity in X direction :0 mile /h Velocity in Y direction :0 mile /h Velocity in Z direction : -55.000000mile/h
Turbulence parameters	Turbulence intensity and length Intensity : 0.10% Length :8.337e^{-004}m

5.2 Calculation mesh

5.2.1 Basic mesh dimensions

Number of cells in X	12
Number of cells in Y	18
Number of cells in Z	59

5.3 Number of cells

Total cells	13528
Fluid cells	12691
Solid cells	152
Irregular cells	0
Partial cells	685
Trimmed cells	0

5.4 Maximum refinement level: 1

Name	Unit	Value	Progress	Use in convergence	Delta	Criteria
Drag	p	-26.529	100	On	0.115377466	4.63969
Lift	p	-3.822	100	on	0.702104028	0.76063

5.5 Max/Min Table

Name	Minimum	Maximum
Pressure [pa]	100951.23	103167.23
Temperature [K]	293.09	293.76
Density (fluid) [kg/m^3)	1.20	1.26
Velocity [mile/h]	0	61.5423196
Velocity X [mile/h]	-22.0655005	23.6210812
Velocity Y [mile/h]	-35.0755090	36.0758794
Velocity Z [mile/h]	-61.4800224	5.7181535
Temperature (fluid) [K]	293.09	293.46
Mach number	0	0.08
Vortices [1/s]	0	3308.641
Shear stress [pa]	0	4.27
Relative pressure	-374.91	1798.28
Heat transfer coefficient [w/m^2/K]	0	0
Surface heat flux [W/m^2]	0	0

5.6 Engineering database Air

Path: gases pre-defined

Specific heat ratio (c_p/c_v): 1.399

Molecular mass: 0.0290 kg/mol

Dynamic viscosity

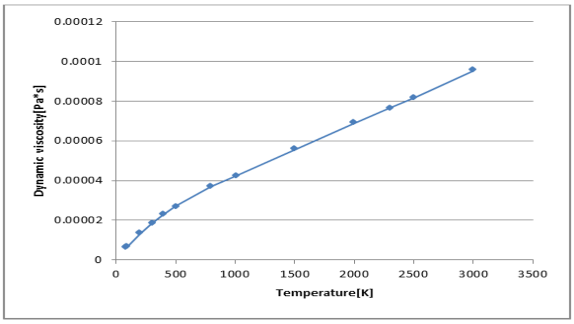

Fig: 5.6.1 dynamic viscosity of the model

Specific heat (Cp)

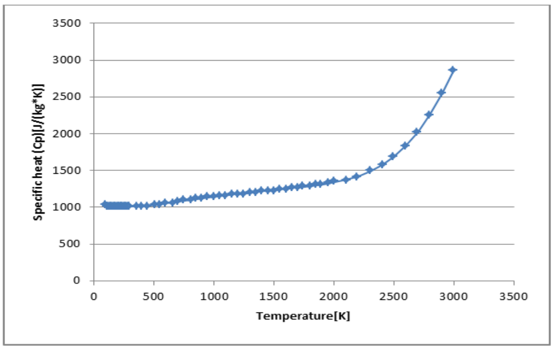

Fig: 5.6.2 specific heat of the model

Thermal conductivity

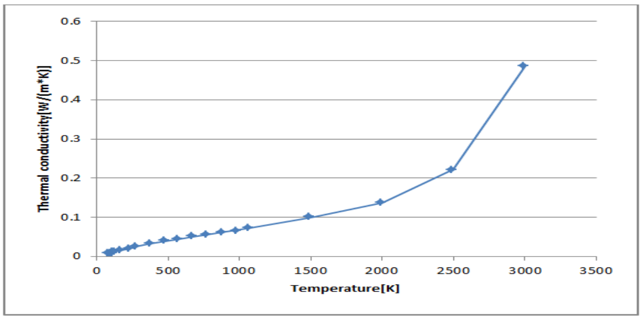

Fig: 5.6.3 Thermal conductivity of the model

5.7 Flow simulation of Co2 car design

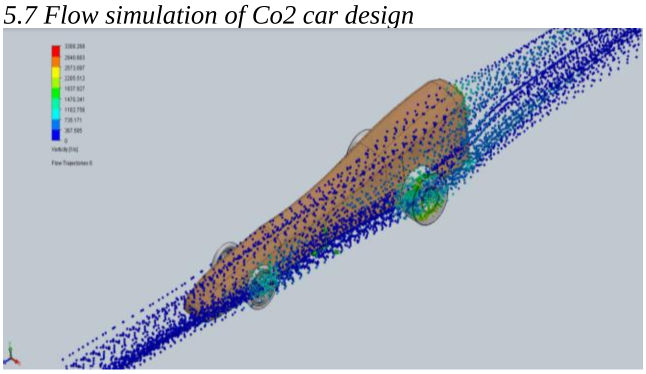

Fig: 4. 7.1 Flow simulation of Co2 car design

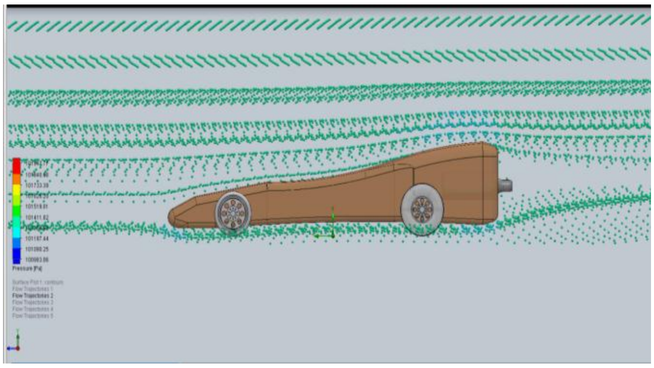

Fig: 4. 7.2 Flow simulation of Co2 car design

- Reduce the fuel consumption.
- Reduce the drag and lift rate.
- Improvement of driving characteristics.
- Increasing speed and efficiency of the car.

5.8 surface pressure [pa]

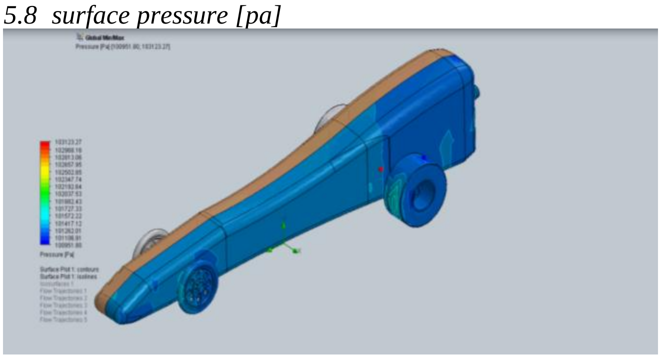

Fig: 5.8.1 3-D view of surface pressure [pa]

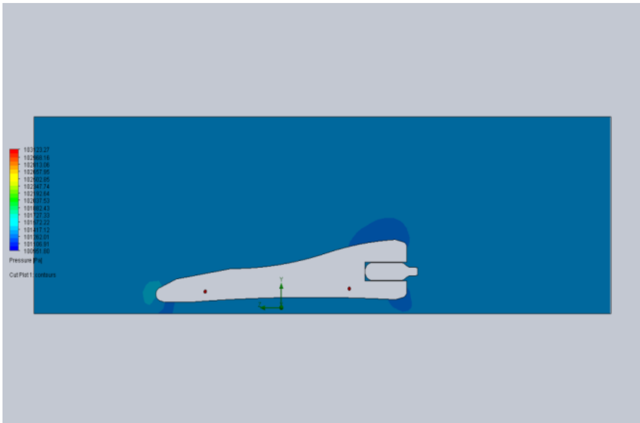

Fig: 5.8.2 Side view of surface pressure [pa]

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6. COMPARISON FOR OLD DESIGN AND NEW DESIGN.

OLD DESIGN Lift & drag is maximum		
Goal name	Unit	Value
Drag	p	-32.8242701
Lift	p	-12.0434561

NEW DESIGN lift & drag is minimum		
Goal name	Unit	Value
Drag	p	-26.59619726
Lift	p	-3.916694302

7. CONCLUSION & FUTURE SCOPE

Drag and lift parameter is largely reduced in this study due to the change in the body design and addition of curves and drafts on the flow surface of the Co2 Car surface.

Further the study can be optimised for better results by further modifying the body and/or adding the aerofoil at the tail end and/or changing the rear end geometry to have a flow directional curved shape.

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BIOGRAPHIES


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