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Design and Finite Element Analysis of Tri Cycle Type Landing Gear

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ABSTRACT
In this thesis, the tricycle type landing gear will be designed and modelled in 3D modeling software Catia
CFD analysis will be done on the landing gear at different velocities to determine pressure drop, drag and lift forces. Static analysis will be performed by applying the forces using different materials and better material will be optimized.
CFD and static analysis will be done in Ansys.

INTRODUCTION
Landing Gear Types Aircraft landing gear supports the entire weight of an aircraft during landing and ground operations. They are attached to primary structural members of the aircraft. The type of gear depends on the aircraft design and its intended use. Most landing gear have wheels to facilitate operation to and from hard surfaces, such as airport runways. Other gear feature skids for this purpose, such as those originate on helicopters, balloon gondolas, and in the tail area of some tail dragger aircraft. Aircraft that operate to and since frozen lakes and snowy areas may be equipped with landing gear that have skis. Aircraft that operate to and from the surface of water have pontoon-type landing gear. Regardless of the type of landing gear utilized, shock absorbing equipment, brakes, retraction mechanisms, controls, warning devices, cowling, fairings, and structural members necessary to attach the gear to the aircraft are considered parts of the landing gear system.

DESIGN OF LANDING GEAR
Computer Aided Design (CAD) is the use of computer software to design a product or an object.
Computer Aided Manufacturing (CAM) is the use of computer software and hardware to plan, manage and control the operations of a manufacturing plant.
Computer Aided Engineering is the use of computer software to solve engineering problems and analyze products created using CAD.
CATIA is an acronym for Computer Aided Three-dimensional Interactive Application. It is one of the leading 3D software used by organizations in multiple industries ranging from aerospace, automobile to consumer products.
CATIA is a multi-platform 3D software suite developed by Dassault Systems, encompassing CAD, CAM as well as CAE. Dassault is a French engineering giant active in the field of aviation, 3D design, 3D digital mock-ups, and product lifecycle management (PLM) software. CATIA is a solid modeling tool that unites the 3D parametric features with 2D tools and also addresses every design-to-manufacturing process. In addition to creating solid models and

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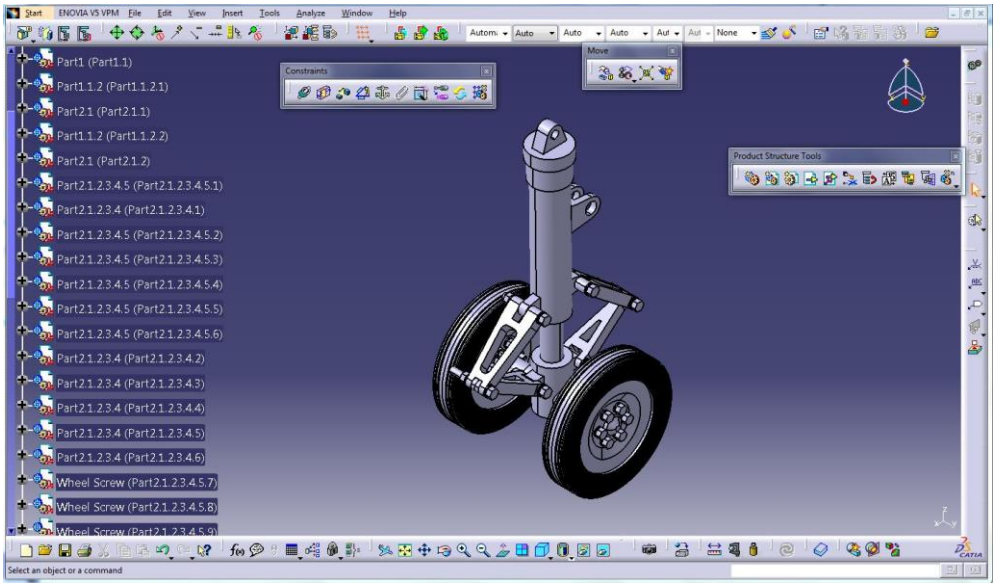
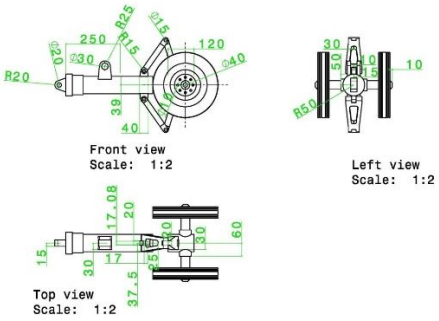
assemblies, CATIA also provides generating orthographic, section, auxiliary, isometric or detailed 2D drawing views. It is also possible to generate model dimensions and create reference dimensions in the drawing views. The bi-directionally associative property of CATIA ensures that the modifications made in the model are reflected in the drawing views and vice-versa.

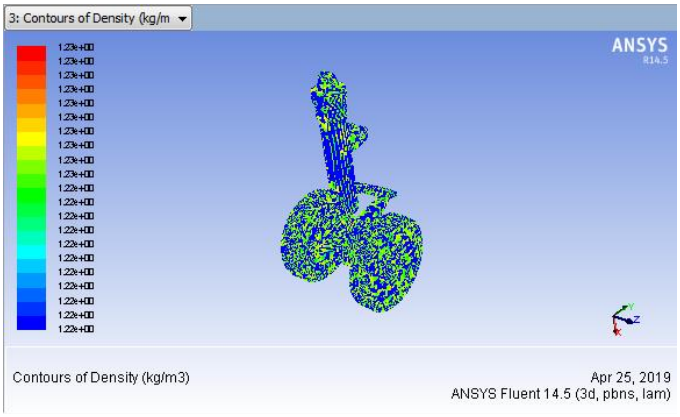


Landing Gear Assemble Isometric View



Draft of landing gear Assemble

CFD ANALYSIS OF LANDIGN GEAR AT 65 m/s SPEED



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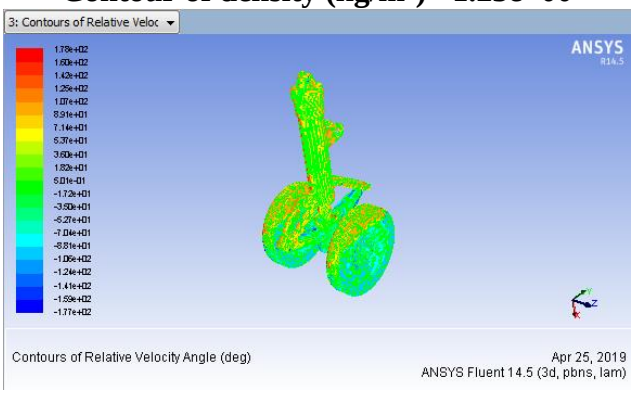
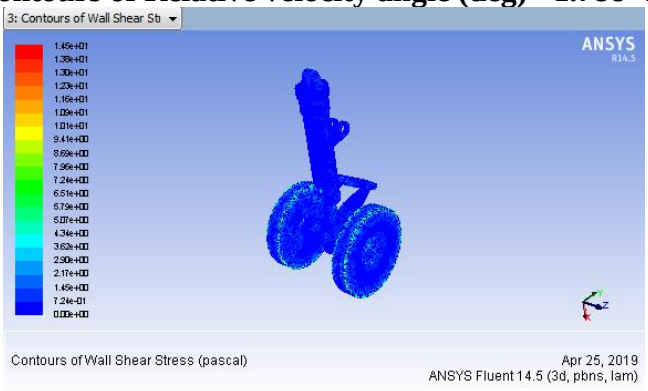
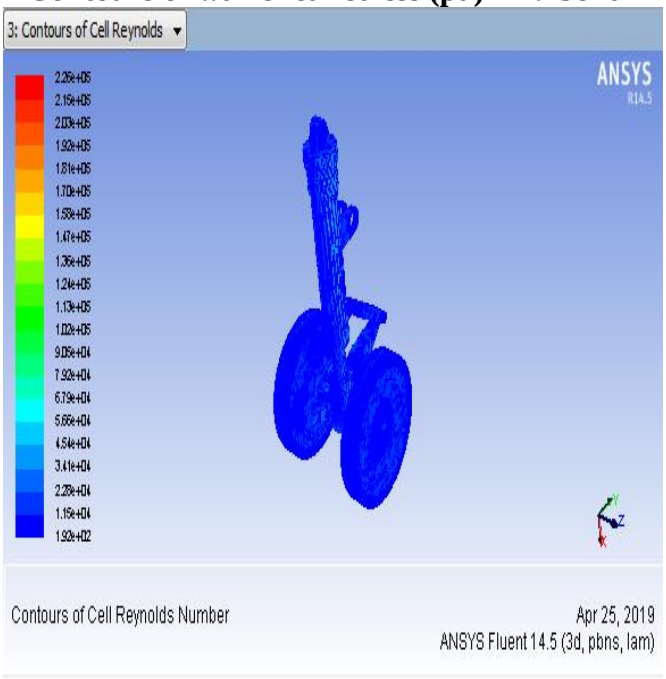
Contour of density (kg/m^3)= 1.23e+00



Contours of Relative velocity angle (deg) =1.78e+02



Contours of wall shear stress (pa) = 1.45e+01



Contours of Cell Reynolds Number= 2.26e+05

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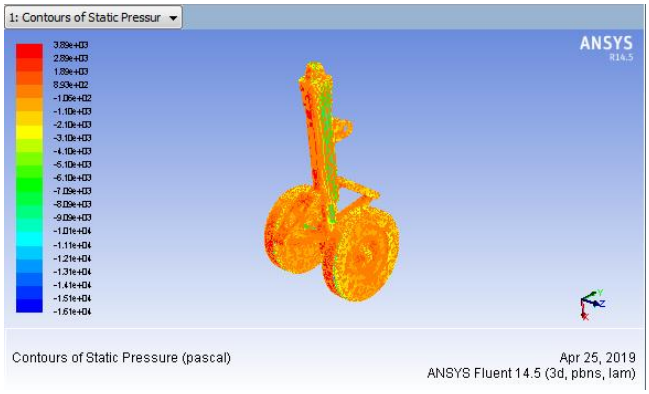
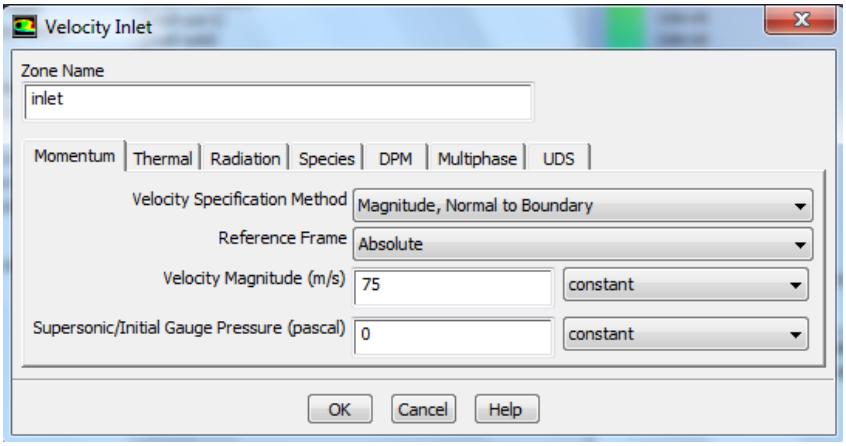
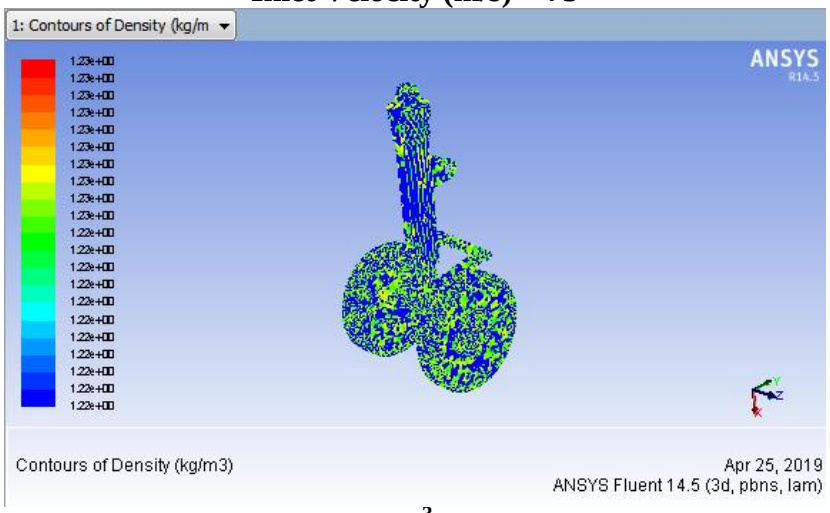


Contours of static Pressure (Pa) = 3.89e+03

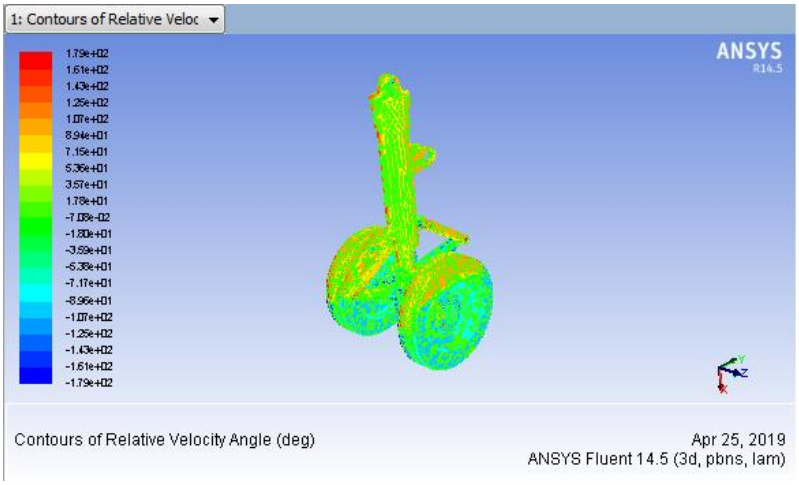
CFD ANALYSIS OF LANDIGN GEAR AT 75 m/s SPEED



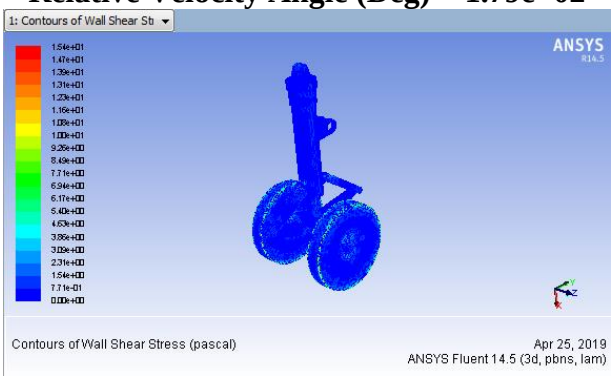
Inlet Velocity (m/s) = 75



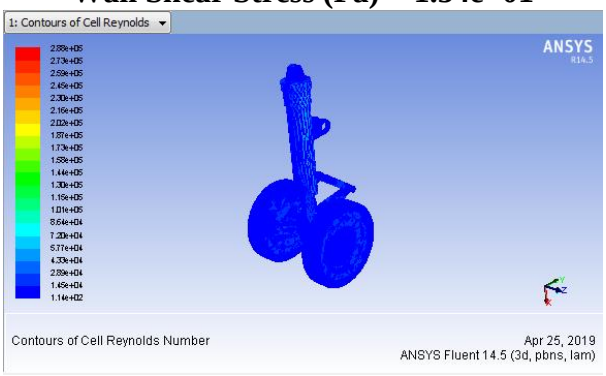
Density (kg/m^3) = 1.23e+03



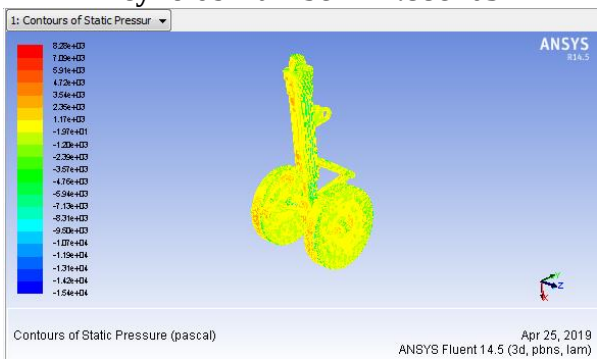
Relative Velocity Angle (Deg) = 1.79e+02



Wall Shear Stress (Pa) = 1.54e+01



Reynolds Number = 2.88e+05



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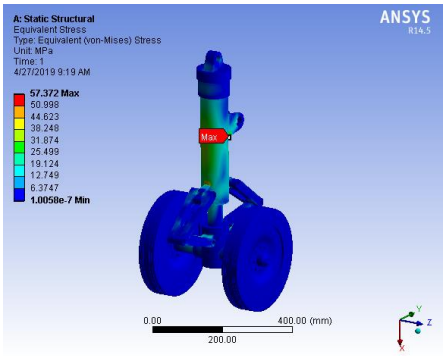
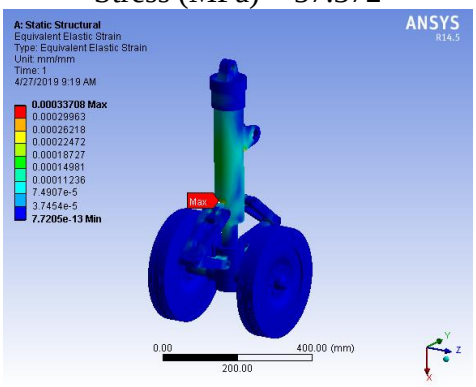
Static Pressure (Pa) = 8.28e+03

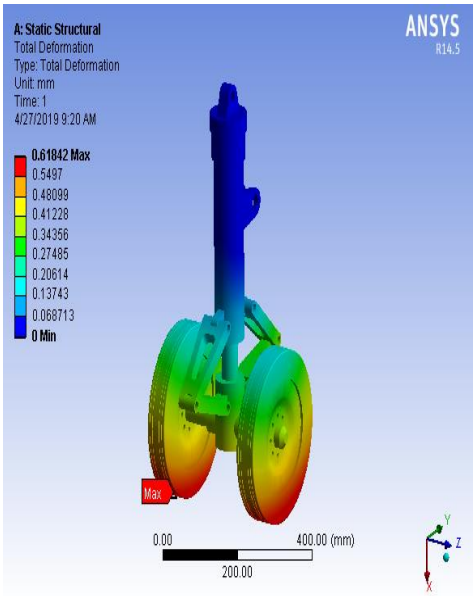
STRUCTURAL ANALYSIS OF LANDING GEAR MATERIAL STEEL 4337 AT 75M/S SPEED.



Stress (MPa) = 57.372



Strain = 0.00033708



Total Deformation (mm) = 0.61842

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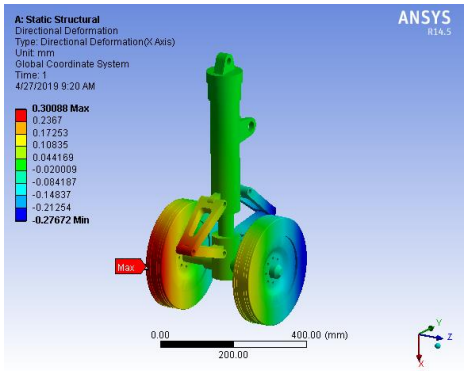
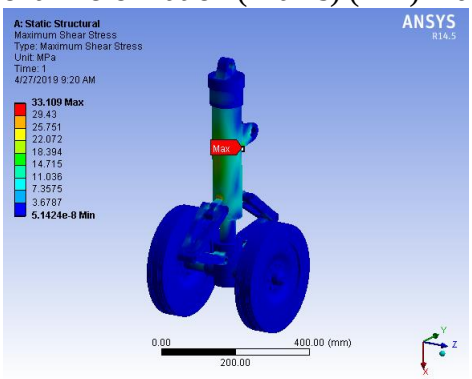
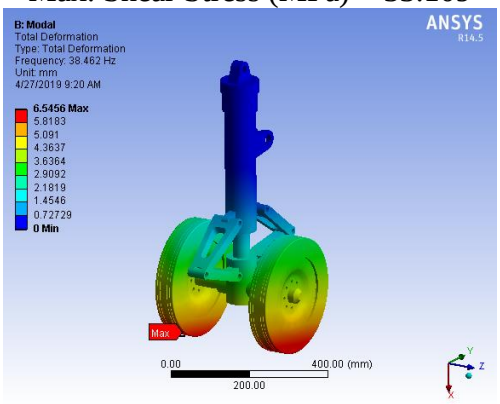


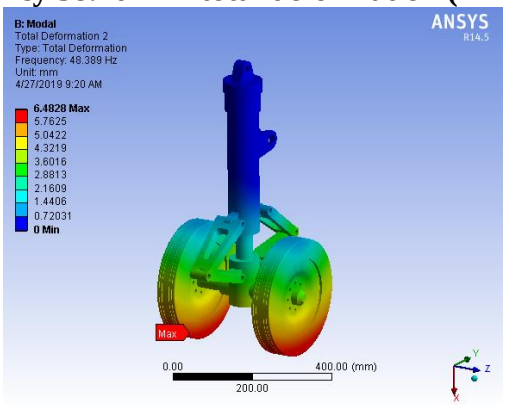
Directional Deformation (X axis) (mm) = 0.30088



Max. Shear Stress (MPa) = 33.109



At Frequency 38.462 Hz total deformation (mm) = 6.5456



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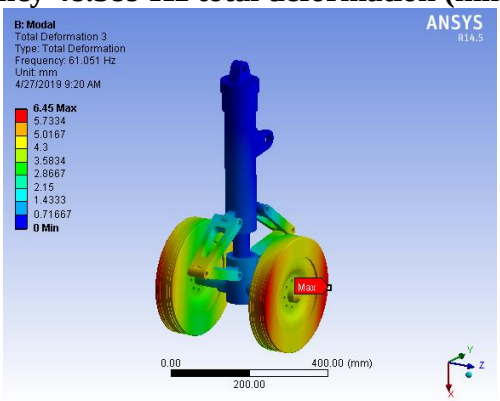
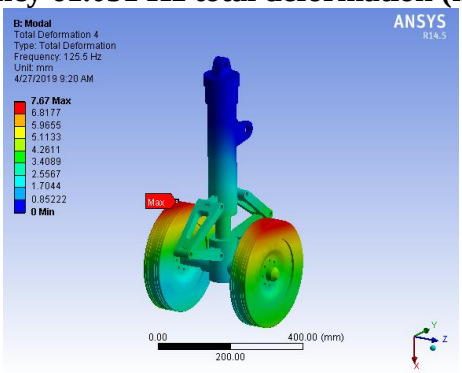
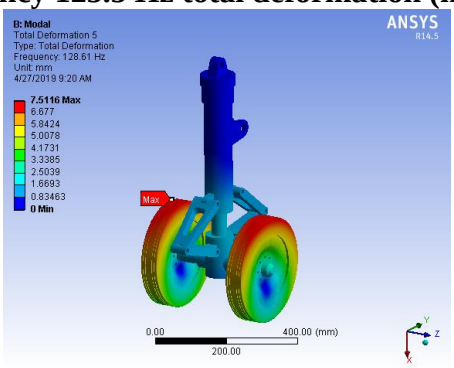
At Frequency 48.389 Hz total deformation (mm) = 6.4828



At Frequency 61.051 Hz total deformation (mm) = 6.45



At Frequency 125.5 Hz total deformation (mm) = 7.67



At Frequency 128.61 Hz total deformation (mm) = 7.5116

TABLE OF ANALYSIS AT 65M/S SPEED.

	Al7075	Steel 4337	Carbon Steel 1095
Stress (MPa)	27.295	27.203	27.295
Strain	0.00045853	0.0001596	0.00023483
Total deformation (mm)	0.85078	0.29282	0.43572
Direction Deformation(X axis) (mm)	0.41488	0.1429	0.21248

Max. Shear Stress (MPa)	15.743	15.699	15.743

Al 7075

Frequency (Hz)	Total Deformation
37.445	10.866
47.142	10.772
59.022	10.716
122.12	12.728
124.2	12.48

Steel 4337

Frequency (Hz)	Total Deformation
38.466	6.5457
48.387	6.4823
61.049	6.4484
125.51	7.6699
128.62	7.5117

Carbon Steel 1095

Frequency (Hz)	Total Deformation
32.032	6.651
40.32	6.5926
50.48	6.5574
104.46	7.791
106.23	7.6389

Table of Analysis result at 75m/s speed.

	Al7075	Steel 4337	Carbon Steel 1095
Stress (MPa)	57.566	57.372	57.566
Strain	0.0009684	0.00033708	0.00049596
Total deformation (mm)	1.797	0.61842	0.92019
Direction Deformation(X axis) (mm)	0.87341	0.30088	0.44731
Max. Shear Stress (MPa)	33.201	33.109	33.201

Al 7075

Frequency (Hz)	Total Deformation
37.434	10.865
47.145	10.775
59.029	10.724
122.09	12.728
124.2	12.48

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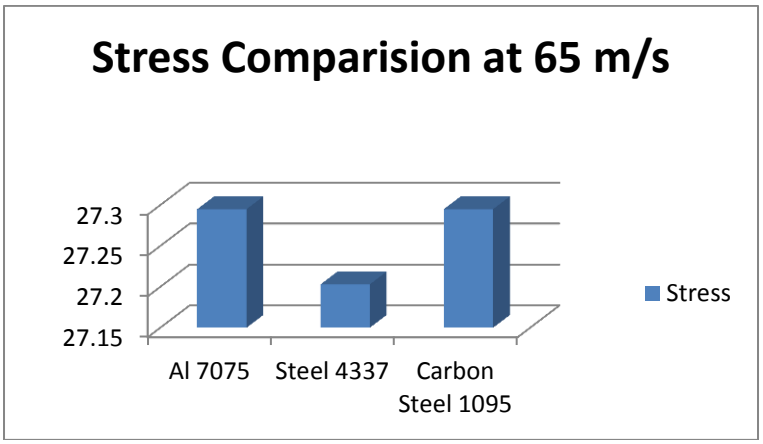
Steel 4337

Frequency (Hz)	Total Deformation
38.462	6.5456
48.389	6.4828
61.051	6.45
125.5	7.67
128.61	7.5116

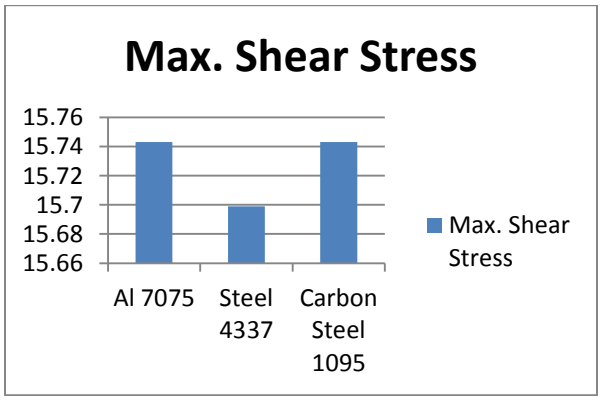
Carbon Steel 1095

Frequency (Hz)	Total Deformation
32.027	6.6508
40.322	6.5935
50.483	6.5598
104.45	7.791
106.23	7.6388

Graphical result at 65 m/s



Stress



Max. Shear stress

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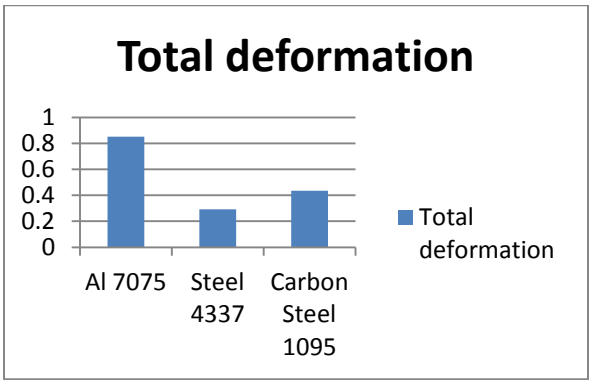
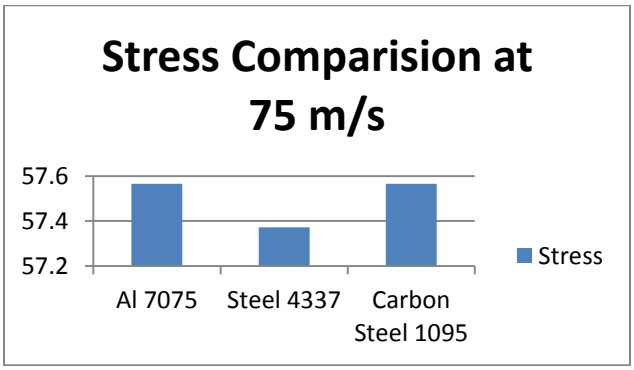
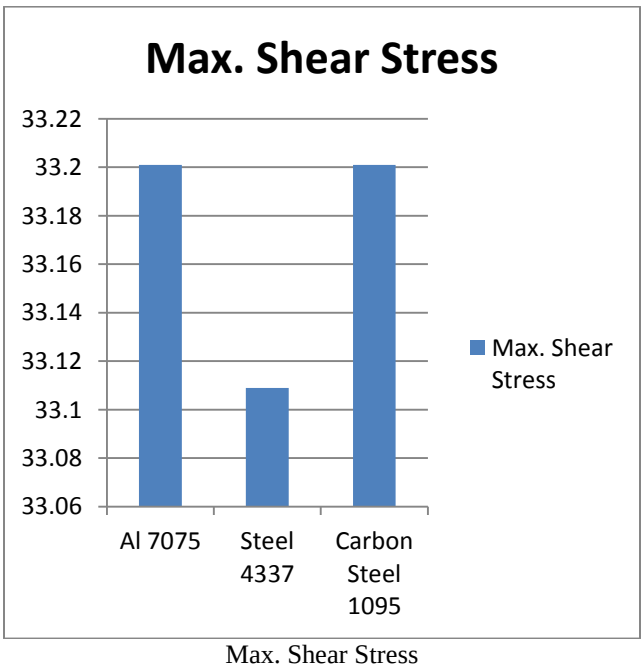


Total Deformation

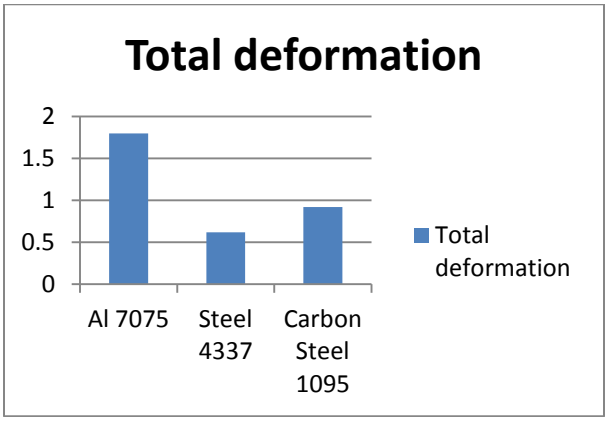
Graphical result at 75 m/s



Stress



Max. Shear Stress



Total deformation

CONCLUSION

In this thesis, the tricycle type landing gear has been designed and modeled in 3D modeling software Catia. CFD analysis is done on the landing gear at different at two velocities i.e at 65 m/s and at 75m/s to determine pressure drop, drag and lift forces. Static analysis will be performed by applying the forces using al 7075, steel 4337 and carbon steel 1095 materials and better material will be optimized.

As if we verify the results obtained here for the ansys 65m/s, the stress, deformation and shear stress are very less for the steel 4337 material when compared with the other two materials.

As in the same process the results obtained here for the ansys 75m/s, the stress, deformation and shear stress are very less for the steel 4337 material when compared with the other two materials.

So as per the resulted graphs we can observe that the material steel 4337 is having the better properties for the landing gear even at higher speeds

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