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Optimization Of Venturi Of Carburettor Using Ansys Software

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ABSTRACT

The venturi of the carburettor is important that provides a necessary pressure drop in the carburettor device. Angle of venturi helps for Pressure drop in carburettor.

The main aim of the project is to determine the optimum pressure of carburettor by optimising the angle of venturi. To optimise the Pressure in the carburettor, CFD analysis is carried out on venturi of the carburettor. In CFD analysis, parameters like velocity, pressure drop and angle of venturi is determined. Optimum pressure observed in CFD analysis is used as static load for structural static analysis. Carburettor is optimised for different materials (i.e., zinc, aluminium and cast iron).3d model of Carburettor is designed in CAD software and flow analysis is done using CFD software and static analysis is carried out by using CAE software. NX-CAD software is used for 3d modelling and ANSYS software is used for flow and static analysis of carburettor.

METHODOLOGY

- 3d model of carburettor will be generated on NX-CAD software.
- The 3d model of carburettor is converted to parasolid file.
- The parasolid file of carburettor is imported to solid works stimulation to perform flow analysis on carburettor.
- Flow analysis will be done on carburettor for different angles of venturi. (i.e.30^0, 45^0, 60^0).
- From analysis, pressure and velocity are observed for three angles of venturi of carburettor.
- Optimum pressure is observed and taken as load input for static analysis of carburettor.
- Static analysis is carried out on carburettor for different materials.(i.e. Zinc, aluminium, cast iron).
- From analysis, displacements, stresses and factor of safety of carburettor for different materials is determined.

3D MODELLING OF CARBURETTOR

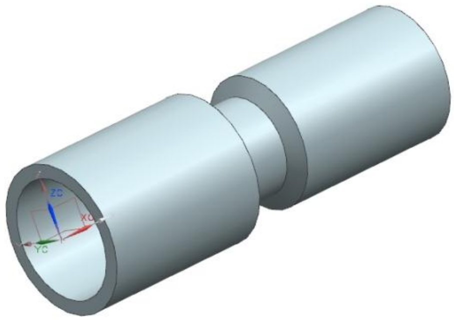

Fig Shows the Isometric view of Carburettor

FLOW ANALYSIS OF CARBURETOR

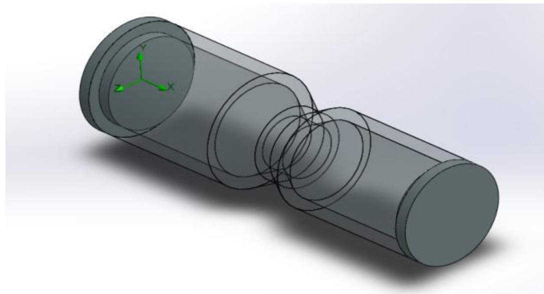

Fig. Shows the Geometry of carburettor

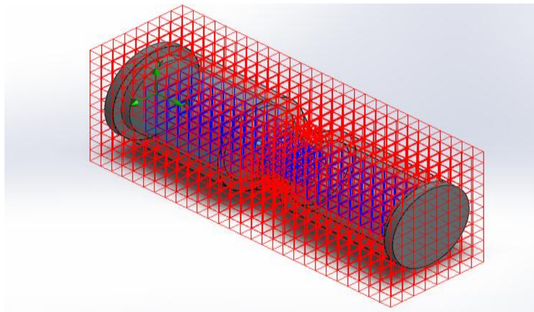

Fig shows fluid domain and solid domain of carburettor

BOUNDARY CONDITIONS:

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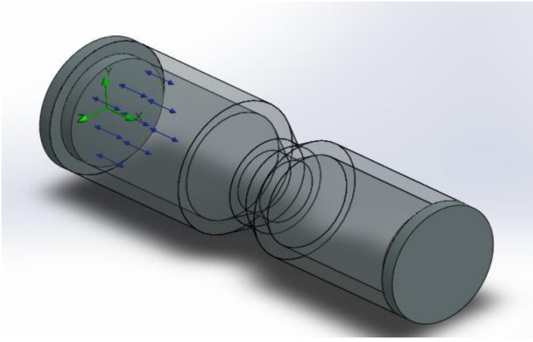

Fig shows boundary conditions of pressure applied on the carburettor

Location	Pressure [Pa]	Velocity [m/s]
Convergent	97729.9	68.6
Open of venturi	95048.5	94.8
End of venturi	89478.1	138.3
Divergent	89825.9	133.8

MATERIAL PROPERTIES:

Material: air (fluid):

PROPERTY	UNITS	VALUES
Density	kg/m3	1.225
Cp (Specific Heat)	j/kg-k	1006.43
Thermal Conductivity	w/m-k	0.0242
Viscosity	kg/m-s	1.79E-05
Molecular Weight	kg/kg mol	28.966
Thermal Expansion Coefficient	1/k	0
Speed of Sound	m/s	340m/s

Results:

<u>Case:1 Carburettor with venturi of 30^0 angle:</u>

Pressure cut plot:

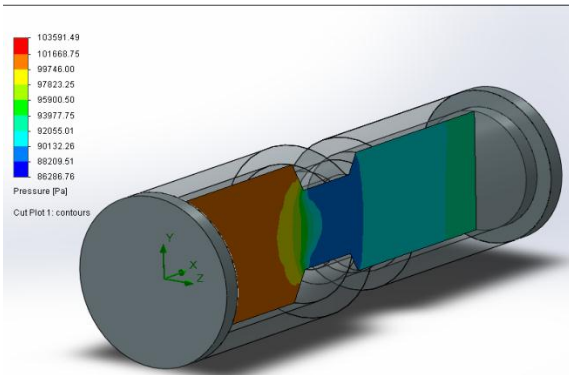

Fig shows variation of pressure in carburettor by cut plot

Velocity cut plot:

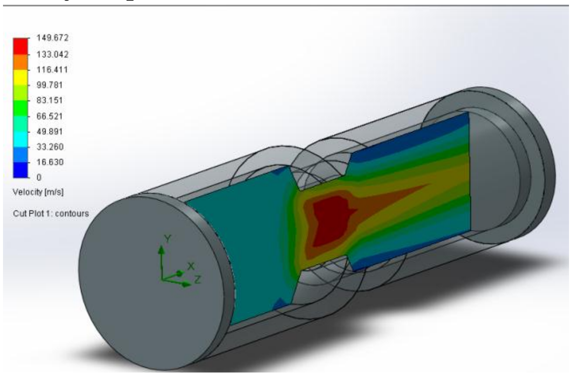

Fig shows variation of velocity in carburettor by cut plot

<u>Case:2 Carburettor with venturi of 45^0 angle:</u>

Pressure cut plot:

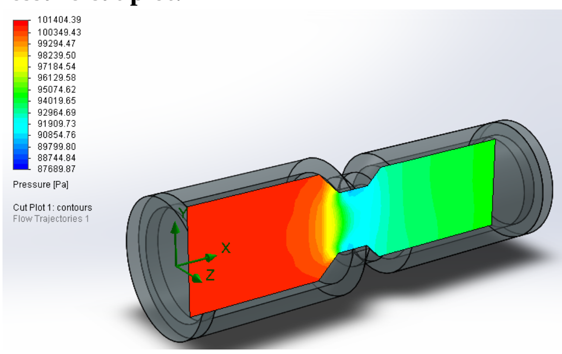

Fig shows variation of pressure in carburettor by cut plot

Velocity cut plot:

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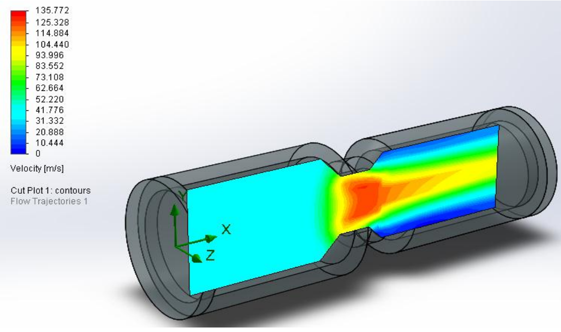

Fig shows variation of velocity in carburettor by cut plot

Case:3 Carburettor with venturi of 60^0 angle:

Pressure cut plot:

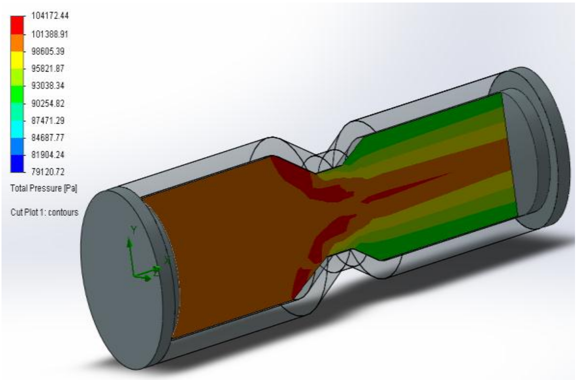

Fig shows variation of pressure in carburettor by cut plot

Velocity cut plot:

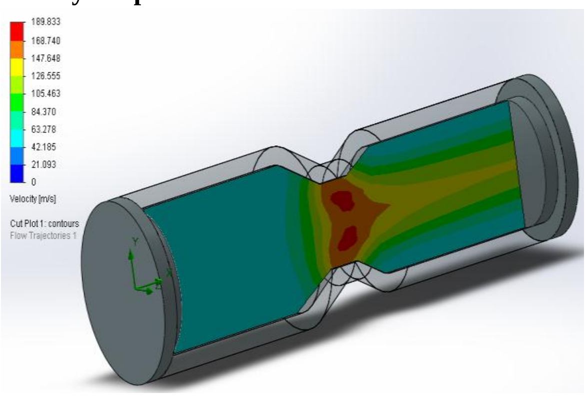

Fig shows variation of velocity in carburettor by cut plot

Table shows pressure and velocity at different locations of carburettor

Location	Pressure [Pa]	Velocity [m/s]
Convergent	98902.09	60.77971
Open of venturi	91577.22	126.5504
End of venturi	87947.87	150.9275
Divergent	90513.7	137.2439

The velocity and pressure in the carburettor changes with respect to change in the angle of venturi of the carburettor. It is also concluded that pressure increases with decrease in velocity. The pressure of carburettor for 60^0 angle of venturi is less compare to 30^0 and 45^0 angles of venturi in all the locations of the carburettor. The velocity at all the locations of carburettor is higher for 60^0 angle of venturi compare to 30^0 and 45^0 angles of venturi. So, the pressure load for static analysis of the carburettor is taken from results of carburettor with 60^0 angle of venturi. The maximum pressure observed from results of carburettor with 60^0 angle of venturi is 98.90 KPa.

Static analysis is done on carburettor with 60^0 angle of venturi. Carburettor is studied for a static load of 98.90 KPa. Static analysis is carried out on carburettor for different materials (i.e. aluminium, zinc and cast iron).

Location	Pressure [Pa]	Velocity [m/s]
Convergent	99266.42988	53.01966
Open of venturi	95684.29718	94.48036
End of venturi	91841.52715	124.4323
Divergent	92371.83801	120.1502

STRUCTURAL ANALYSIS OF CARBURETOR

Element type: Solid92

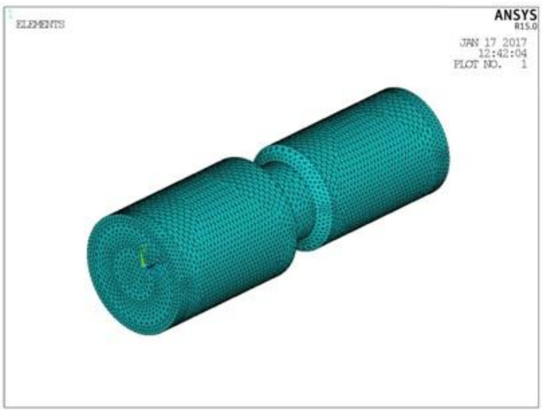

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Fig. shows the Finite element model of the Carburettor

CASE-1: Static analysis of carburettor for aluminium material

Young's modulus = **70GPa**

Density = **2800 kg/m3**

Yield strength = **276 MPa**

Boundary conditions:

Both sides of carburettor are fixed in all DOF and A Pressure load of 0.98 applied on Carburettor.

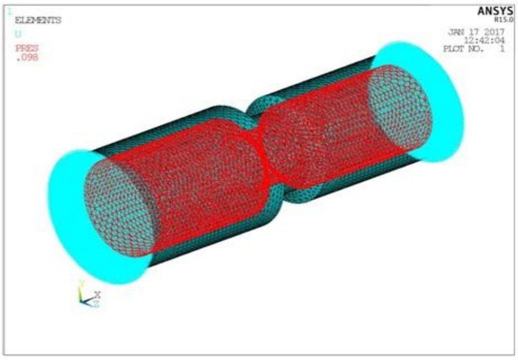


Fig. shows the Boundary conditions applied on Carburettor for static analysis

DEFLECTIONS:

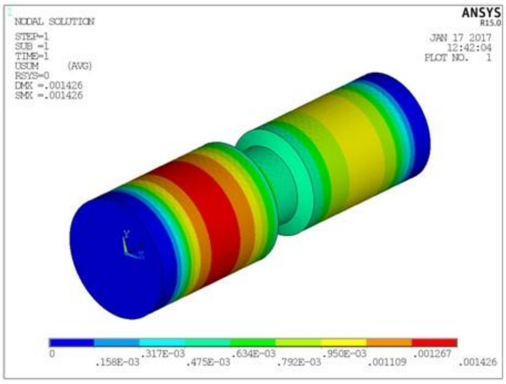


Fig. shows Total Deflection for static analysis of carburettor

STRESSES:

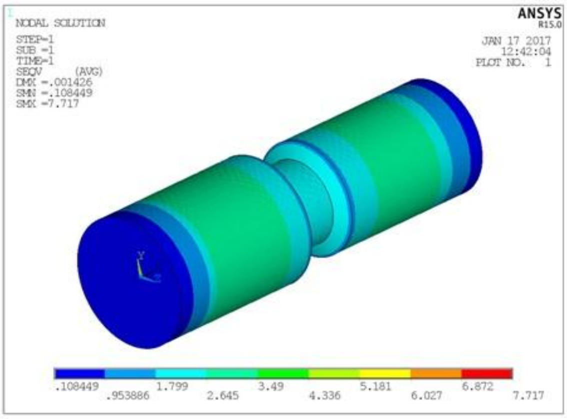


Fig Shows Von Misses stress for static analysis of Carburettor

From the analysis, it is observed that the maximum deformation 0.001mm and Von Misses stress 7.71MPa observed on Carburettor. The yield strength of the material (Aluminium) used for Carburettor is 276 MPa. The FOS at most of the locations is 276/7.71 = 35.

CASE: 2 Static analysis of carburettor for cast-iron material:

Young's modulus = 82 GPa

Yield Strength = 240 Mpa

Density = 7200 kg/m3

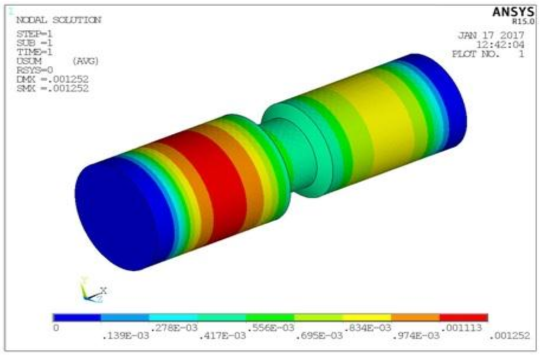


Fig. shows Total Deflection for static analysis of carburettor

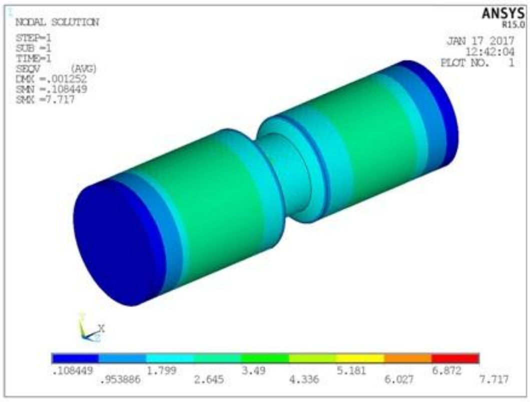


Fig Shows Von Mises stress for static analysis of Carburettor

From the analysis, it is observed that the maximum deformation 0.001mm and Von Mises stress 7.71MPa observed on Carburettor. The yield strength of the material (Cast Iron) used for Carburettor is 240 MPa. The FOS at most of the locations is 240/7.71 = 31.

CASE-3: Static analysis of carburettor for Zinc material:

Young's modulus = 108 GPa

Yield Strength = 246 MPa

Density = 7130 kg/m3

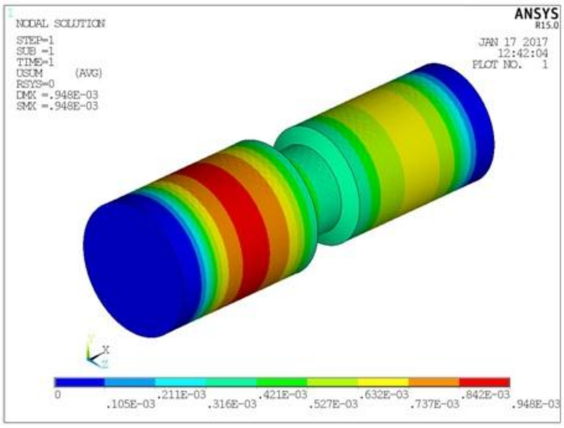


Fig. shows Total Deflection for static analysis of carburettor

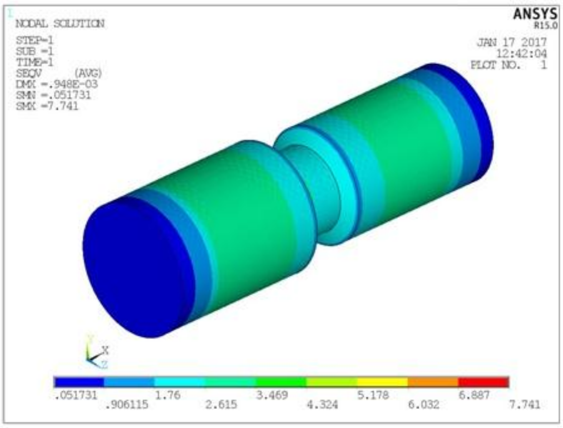


Fig Shows Von Mises stress for static analysis of Carburettor

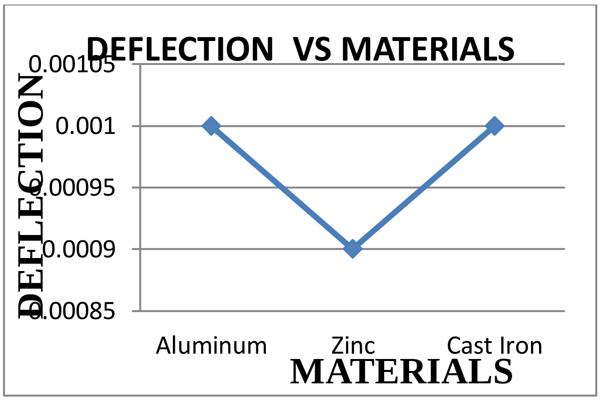
From the analysis, it is observed that the maximum deformation 0.0009mm and Von Mises stress 7.74MPa observed on Carburettor. The yield strength of the material (Zinc) used for Carburettor is 246 MPa. The FOS at most of the locations is 246/7.74 = 31.

Comparison of deflections and stresses of carburettor for different materials

MATERIALS	DEFLECTION (mm)	STRESSES (Mpa)	FACTOR OF SAFETY
Aluminum	0.001	7.71	35
Zinc	0.0009	7.74	31
Cast Iron	0.001	7.71	31

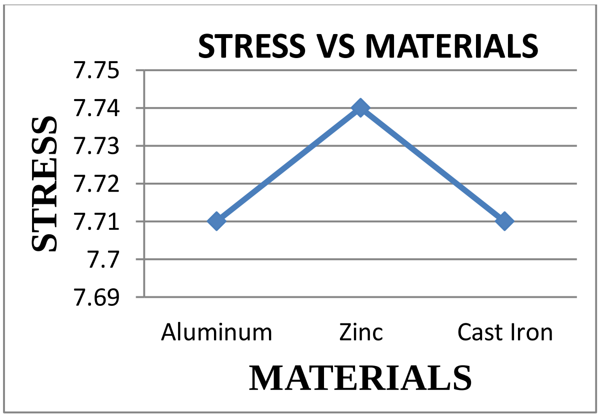
Graphs:

Graph-1: Comparison of Deflection of carburettor for different materials



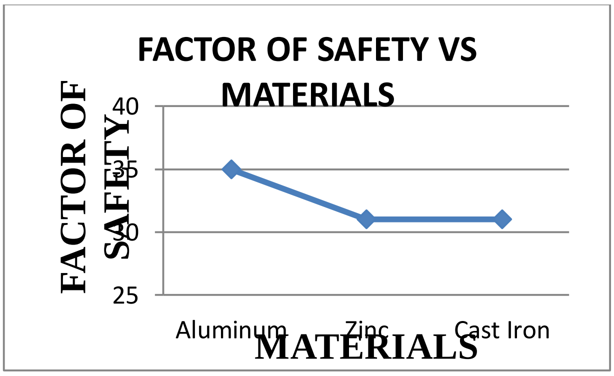
Graph shows comparison of Deflection values of carburettor for different materials

Graph-2: Comparison of Stress values of carburettor for different materials



Graph shows comparison of Stress values of carburettor for different materials

3: Comparison of factor of safety of carburettor for different materials



Graph shows comparison of factor of safety of carburettor for different materials

RESULTS AND CONCLUSION

Carburettor was studied for flow analysis and static analysis. In flow analysis, carburettor was studied for different angles of venturi to optimize the pressure of the carburettor. In static analysis carburettor was studied for different materials (i.e. Aluminium, Zinc, and Cast Iron).

CASE-1: Flow analysis of carburettor for different angles (i.e. 30^0, 45^0, 60^0) of venturi:

Comparison of pressure and velocity at different locations of carburettor for different angles of venturi

LOCATION	VENTURI ANGLE					
	ANGLE 30^0		ANGLE 45^0		ANGLE 60^0	
	Pressure [Pa]	Velocity [m/s]	Pressure [Pa]	Velocity [m/s]	Pressure [Pa]	Velocity [m/s]
Convergent	97729.9	68.63	99266.4	53.0	98902.09	60.77971
Open of venturi	95048.5	94.88	95684.3	94.4	91577.22	126.5504
End of venturi	89478.1	138.3	91841.5	124.4	87947.87	150.9275
Divergent	89825.9	133.8	92371.8	120.1	90513.7	137.2439

CASE-2: Static analysis of carburettor for different materials (i.e. Aluminium, Zinc, and Cast Iron):

Comparison of deflections and stresses of carburettor for different materials

S.NO	MATERIALS	DEFLECTION (mm)	STRESSES (Mpa)	FACTOR OF SAFETY
1	Aluminum	0.001	7.71	35
2	Zinc	0.0009	7.74	31
3	Cast Iron	0.001	7.71	31

Conclusion:

Carburettor was developed in UNIGRAPHS software. Flow analysis of carburettor was done using SOLID WORKS STIMULATION. Static analysis of carburettor was done using ANSYS software. Flow analysis was done on carburettor for different angles (i.e. **30^0, 45^0, and 60^0**) of venturi to optimize the pressure of carburettor. From Flow analysis, Venturi with 45^0 angle has optimized pressure value for carburettor. The optimized pressure of 98Mpa was obtained was taken as input for Static analysis of carburettor. Static analysis was done on carburettor for different materials (i.e. Aluminium, Zinc, and Cast Iron). From static analysis, all materials have Von misses less than their yield strengths. So, all the materials are suitable for carburettor but, by considering Factor of safety, Aluminium has high Factor of safety value than Zinc and Cast Iron materials. Hence, it was concluded that Aluminium is best suitable material for carburettor.

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