Investigation of nozzle design and performance test in motorbike engines

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Abstract: Nozzle could also be a unit used to transfer the K.E. from the thermo energy created among the combustion chamber. It converts warmth and atmosphere gas into temperature and depression gas. Nozzle converges the pressure gas to provide high speed that emerges the craft to fly higher.CD Nozzles area unit utilized in dominant the flow and conjointly the speed of flow and momentum that happens from them. By this investigation, the generator meter check was applied to the image model of the nozzle to analysis the performance of the bike engine.

Index Terms - **Nozzle expansion Ratio, Ansys, Air fuel Ratio, Dynamo meter, Back pressure.**

I. INTRODUCTION

Nozzle is a device used to convert the heat energy produced into high velocity energy. It converts the gas of low velocity into gas of high velocity. These mach regimes constitute to be subsonic, sonic, supersonic and hyper sonic regimes. The nozzle type mainly depends on the outlet velocity of the flow through nozzle and it's design. The main applications of the nozzle covers majority of the engineering, chemical and medical fields. However. the design and optimization of the duct is considered prior, to attain high efficiency and low work stream.

Dynamo meter is a unit used to calculate the force, torque and power. For instant, the power produced by an engine ,can be deliberated by concurrently torque and rotational speed measurement. The power absorption unit of the device absorbs the power developed by the machine. This power absorbed is then converted into thermal energy, which generally vanishes into the atmosphere. The dynamo meter should be able to operate at any rotational speed and should withstand the load to either level of torque that requires to test.

II. MODELLING

The design and modeling of Convergent-Divergent Nozzle is done using CATIA software. The ANSYS fluent Software is used to carry out the Analysis section of the nozzle. Ansys Fluent is widely used to carry out the fluid flow used simulationworks. The modeling and analyzing of the nozzle was referred [3].

Draw the half portion of the CD nozzle with the specified dimensions given in Table 1. Make sure that the sketch drawn is closed completely and dimensions are precise while modeling. The closed part is now revolved with respect to the central axis to complete the nozzle surface.

Table 1: Dimensions of the Convergent - Divergent Nozzle

S.no	Specifications	Dimensions (cm)
1	Total length	65.81902
2	Divergent angle	11 degrees
3	Convergent length	18.92808
4	Throat radius	7.75716
5	Inlet radius	16.51
6	Exit radius	12.5476

This paper focuses on the simulation work which is carrying out by employing a suitable turbulence modeling method.
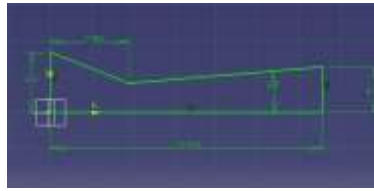

Fig-1:Sectional view of the nozzle at 11^0 angle of divergence

The experiment is then repeated by varying the divergent angle and exit radius and keeping the length of the nozzle as constant. The following table prescribes the Expansion Raton of the nozzle with the respective divergent angle and exit radius.

Table 2: Exit Radii & Expansion ratios for different Divergence angles

Divergence Angle (deg)	Exit Radius (mm)	Expansion Ratio
5	9.73074	1.5342
9	11.38174	2.0262
11	12.5476	2.4026
15	13.8303	2.84
20	15.9512	3.6172
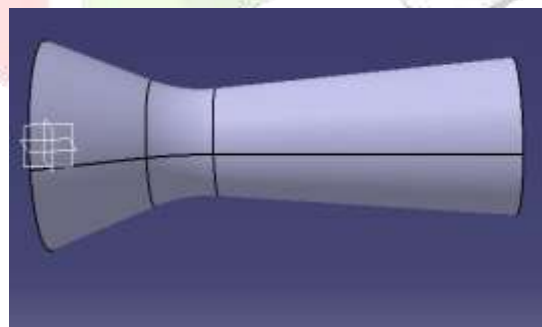
Fig-2: Generated Nozzle for 11^0 angle of divergence

III. ANALYSIS

The tool used to fluid flow analysis is ANSYS 18.2 and the solver chosen is Ansys fluent. The Energy, Momentum and Continuity equations are the main equations used to solve for the solution. To find the solution theoretically, Reynolds Averaged Navier Strokes (RANS) equations are used generally. But, a numerical method must be used to replace the RANS equations with the algebraic approximations for the real fluid flow problems.

The nozzle modelled in CATIA is imported to Ansys Workbench 18.2 where the solver chosen is Ansys fluent. As the nozzle flow simulation is an internal flow type, there is no further construction of geometry is required.. Meshing is done after modelling and

importing of the design by giving respective details in ANSYS and the details are given in Table 3.

Table -3: Details and Sizing inputs of a mesh

Physics Preference	ANSYS
Solver Preference	Fluent
Advanced size function	On: Proximity & Curvature
Relevance centre	Fine
Smoothing	High
Maximum element size	1.1781e-004m
Growth rate	1.850

Depending on the type of fluid used, the material input and properties are given.In our analysis,the air is used as gas and the properties are given in Table 4.

Table-4: Material input and Properties for Air Thermodynamic Properties

Equation of State	Ideal gas (Air)
Molar mass	28.96 Kgk/mol
Specific heat Capacity	1004.4 J/KgK
Transport Properties	
Dynamic Viscosity	1.831e-05 Kg/ms
Thermal Conductivity	0.0261 W/mK

After window pop up as the Result is completed normally,the Post Processing stage is undergone with the contour plots as shown in Figures 3 and 4.
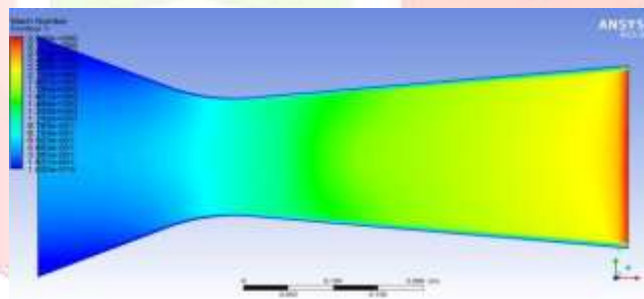
Fig-3: Mach Contours for 11^0 divergence angle
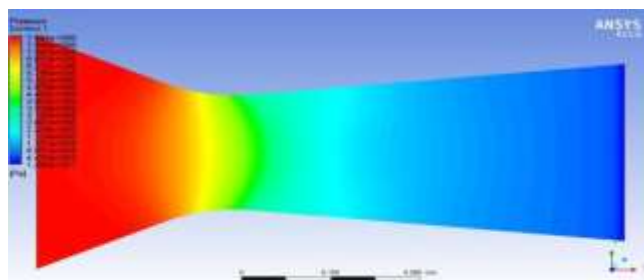
Fig-4: Pressure Contours for 11^0 divergence angle

IV. EXPERIMENTAL SETUP

The Designed and fabricated CD Nozzle is then replaced with the ordinary exhaust system of the moppet and the results are comparatively taken using Chassis Dynamo meter.

The Test was carried out by replacing the ordinary exhaust system in the moppet with our CD Nozzle type exhaust. Initially, no filter and catalytic convertor was attached in the exhaust to analyze the exhaust flow as it is.

Fig.4 Chassis Dynamometer with CD Nozzle type exhaust

The dyno consists of a metallic frame of 60 x 60 mm that is fitted in the ground with the help of rubber feet. The front wheel is holded by the rubber piece on its sides.The 325 mm diameter iron is used as the roller.The mooring is done in the roller so that no other is requied.The central band in the roller helps in tractioning the wheel.The front and top vies of the chassis dynamometer is taken from [17] and the figure is shown in fig.5
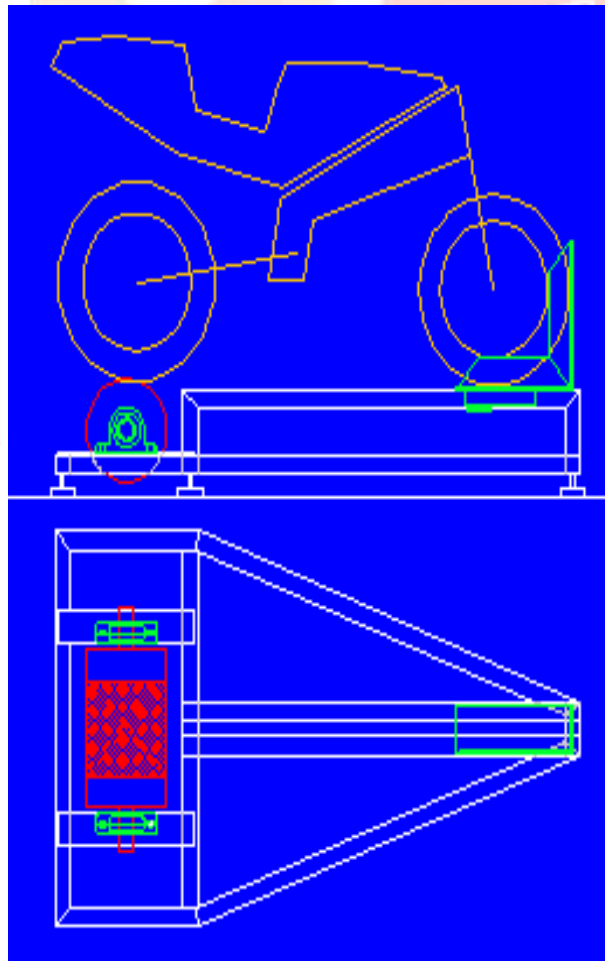

Fig 5: Front and top view of the roller in chassis dynamometer

The moppet is hold in the Dynamometer and the connections are given to the display. By giving acceleration, a graph can be attained for time to torque, horsepower and engine RPM. In this performance analysis, the graph for both the normal moppet exhaust system and CD Nozzle exhaust system was shown.

V. RESULT AND DISCUSSION

The graph of time to torque, horsepower and engine RPM for both the convergent (CD Nozzle) and Divergent (Ordinary exhaust) respectively are shown in Figure .6
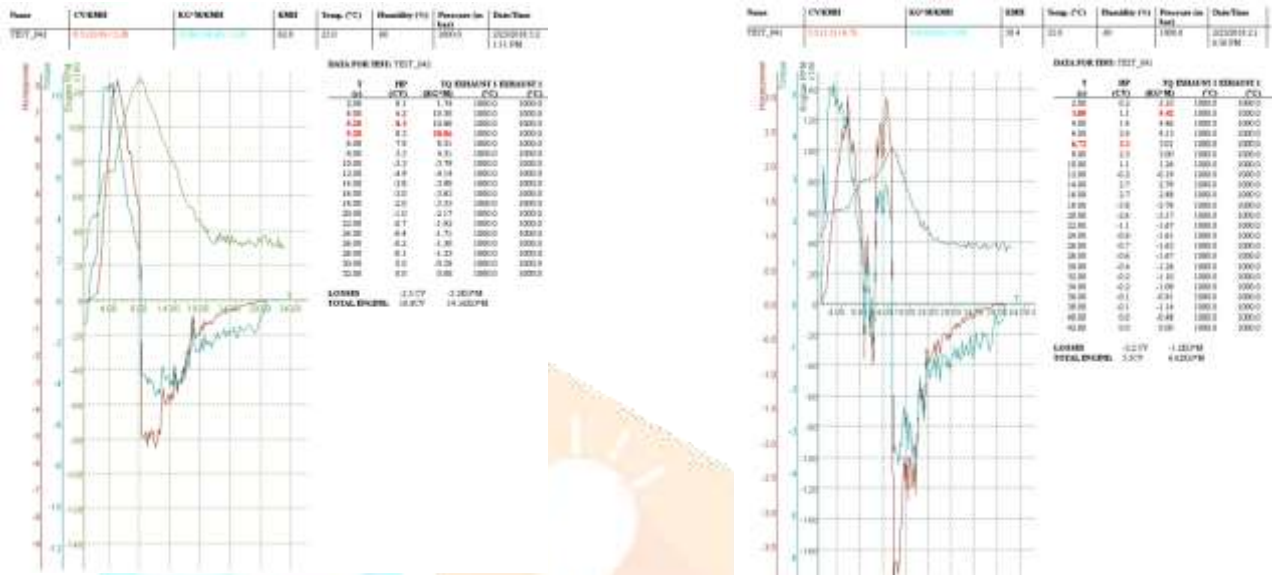

Fig 6: Graph between Time to Horsepower, Torque and Engine RPM

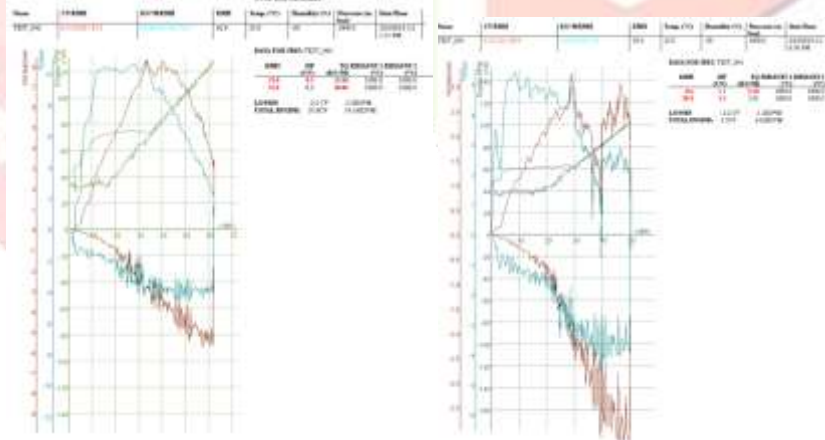The graph of time to Km-h , Engie RPM and Torque are as shown in figure 7

Fig.7.1 The graph plotted between time(s) and Km-h

Fig.7.2 The graph plotted between time(s) and Engine RPM

 By comparing the above two exhaust systems, the engine RPMs are 12,030 and 10,100 for CD Nozzle and Divergent Exhaust respectively. The Torque for CD Nozzle and Divergent Nozzle are 10.8 Nm and 5.2 Nm respectively. And the total engine is given to be 10.8 CV and 5.5 CV for our exhaust and default exhaust respectively.

VI. CONCLUSION

From this analysis we have done, the following conclusions have been drawn.

- The Engine maximum RPM is obtained by using the special exhaust of lower cc automobile.
- The torque achieved is higher when compared to the existing exhaust.
- The horsepower is increased while using the special exhaust system.

Thus this paper concludes that, the engine performance, torque and power will be increase while using this special type exhaust.

VII. REFERENCE

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