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Improvement of Volumetric Efficiency using Manifold Design

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Abstract: *Intake manifold is the breathing system of the car engine which supplies air to the engine cylinders where the combustion of the fuel occurs. The final objective of an intake manifold is to allow maximum air flow into engine cylinder during intake stroke. Increasing the air flow through the intake system means more fuel can be burn to boost the engine efficiency to obtain better performance. The optimum solution is to achieve the maximum mass flow rate of air in the engine. The intake manifold plenum length/volume is highly effective on engine performance characteristics especially with the fuel consumption parameters for SI engines with multipoint fuel injection system. The engine performance can be improved by using continuously variable intake plenum length and its optimum geometry. Favorable effects of the variable length intake manifold plenum appeared at high load and low engine speeds. Therefore, variable length and geometry of intake manifold plenum is useful especially on urban and suburban areas (roads) with the frequent stops and acceleration at starting conditions, it is necessary to determine the length and geometry of additional plenum components for another engine and intake system with sensitive experimental studies.*

Keywords:*component; formatting; style; styling; insert (key words)*

1. INTRODUCTION

intake manifold (in American English) is the part of an engine that supplies the fuel/air mixture to the cylinders The primary function of the intake manifold is to *evenly* distribute the combustion mixture (or just air in a direct injection engine) to each intake port in the cylinder head(s). Even distribution is important to optimize the efficiency and performance of the engine. It may also serve as a mount for the carburetor, throttle body, fuel injectors and other components of the engine.

Volumetric efficiency (VE) in internal combustion engine is defined as the ratio of the mass density of the air-fuel mixture drawn into the cylinder at atmospheric pressure (during the intake stroke) to the mass density of the same volume of air in the intake manifold. The term is also used in other engineering contexts, such as hydraulic pumps and electronic components Output engine parameters like power, torque, fuel consumption, etc. essentially depend on characters of processes that develop during exhaust and intake strokes. Design conception and dimensions of intake-exhaust engine system have a large influence over the flow processes in pipes and characters of both exhaust and intake processes development.

2. LITERATURE REVIEW

David Gosman (1985) studied the multidimensional modeling of cold flows and turbulence in reciprocating engines. Hall (1989) developed a design optimization for engine induction systems with different optimization techniques and methodology. Reciprocating engines are always operating under transient that is time varying, gas dynamic conditions. The value of the volumetric efficiency mainly depends on the engine parameters like crank shaft speed, the intake and exhaust pressures, air-fuel ratio the design geometry of the system and many others.

De Nicolao et al(1996a) Studied the various modeling and volumetric efficiency of internal combustion engines with different techniques, which were useful for engine modeling. Physical models of volumetric efficiency required the knowledge of some quantities usually not available in normal operating conditions. A black box approach was often used to determine the dependence of volumetric efficiency. Various black box approaches for the estimation of volumetric efficiency were reviewed from parametric models. The benefits and limitations of these approaches were examined and compared.

Tillock et al(1996) studied the mass flow measuring techniques and modeling of thermal flows in an air cooled engine. The speed density method is used to calculate the engine air mass flow.

This method requires detailed knowledge of the engine's volumetric efficiency characteristics. A further important factor to consider with reciprocating engines was that the flow was highly unsteady, even at steady engine speed and load. This means that in a firm thermodynamic sense, a steady state equilibrium condition is never achieved. Reciprocating engines are, therefore, always operating under transient, i.e. time varying, gas dynamic conditions. Transient heat transfer modeling in automotive exhaust systems is well described by Konstantinidis et al(1997).

Christopher Depcik et al (2001) described that the heat transfer was an important phenomenon in both the intake and exhaust system of an internal combustion engine. On the intake side, heat transfer affects the breathing of the engine reducing the volumetric efficiency. With stricter emission regulations, the ability to get the after treatment system to the proper temperature during cold starts was crucial. Losing energy would cause this system to take longer to reach its maximum effectiveness and result in more tailpipe emissions. Therefore, the ability to calculate heat transfer as accurately as possible was necessary due to different correlations for the geometry of each engine.On the exhaust side, heat transfer robs the flow of available energy. Since flow is the precursor to heat transfer, the same magnitude of flow in two different engines can give two different heat transfer values. In addition, frequencies based on valve events, as well as pipe lengths, drastically alter the flow patterns and change the heat transfer relationship

Convergent angles	10	12	14	16	18
Divergent angles					
6	97939.4	98016.1	96922.7	97393.3	97142
8	96701.6	97138	96983.2	96778.4	96581.5
10	95662.5	95060.4	95078.1	95097.8	94838.2
12	95095.7	94105	94076	93815.7	93955.9

Table: *Total pressure at engine head*

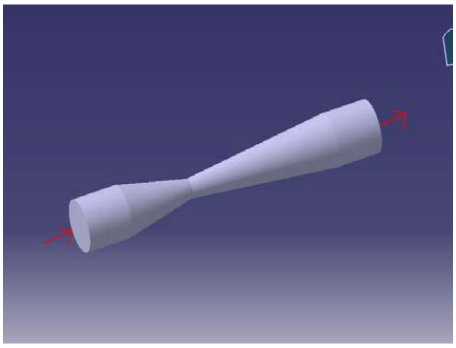


Fig: *Ansys results of venturi & intake manifold.*

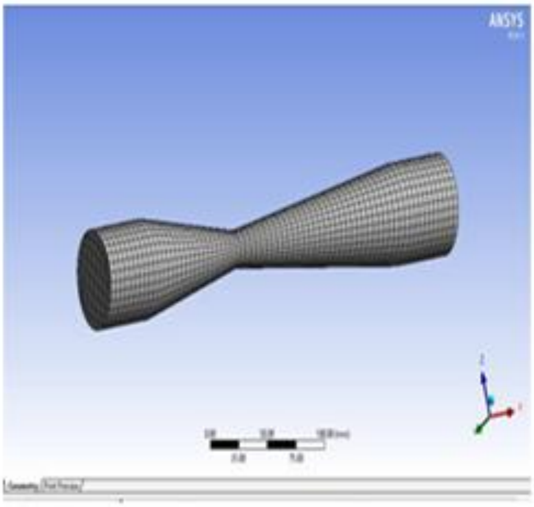
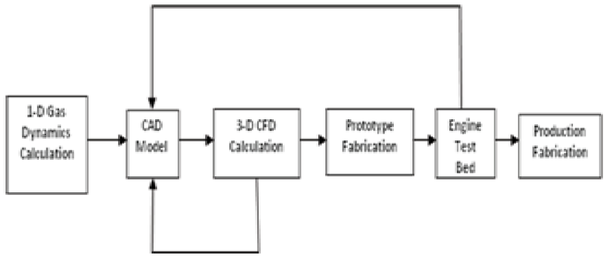


Figure 3: Meshed Model in ANSYS Workbench

3. Methodology



The first step was model making after the designing process was completed. A model was made using foam after giving it the desired shape according to the design. It was then covered with plaster to give it strength and then its finishing was hand done. Then resin was applied over the model which would give the inner surface of the intake system a smooth finish. Then after it's dried up, a layer of FRP is applied on it. Then the mold is removed and the FRP plaster is glued back using a cross breaded resin. The number of layers of the resin depends on the required thickness and strength.

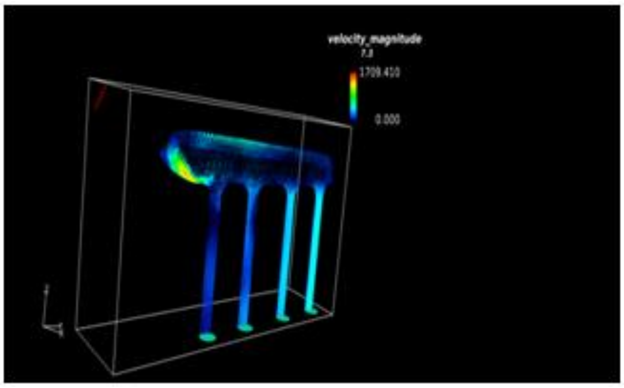


Fig: *Ansys simulation of cad design*

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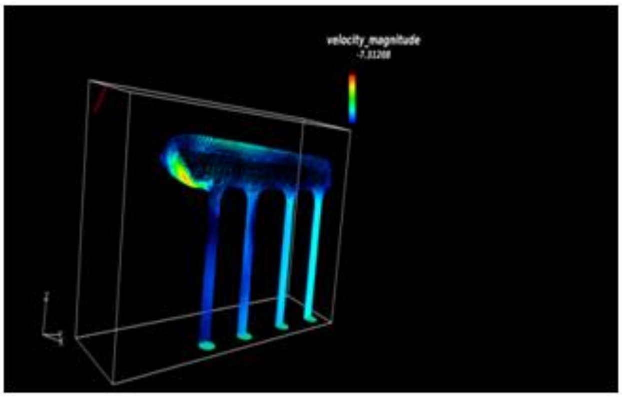

Fig: *Ansys simulation of cad design*

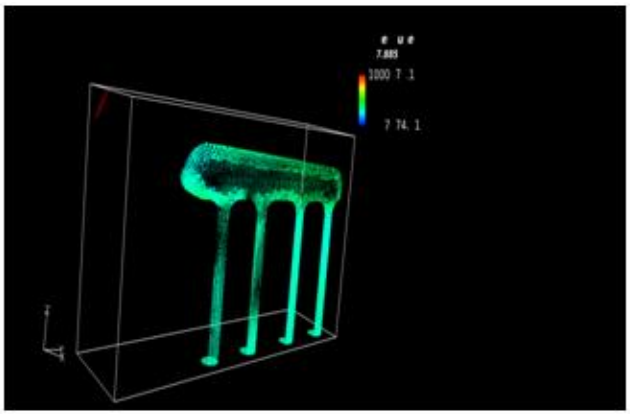

Fig: *Ansys simulation of cad design*

4. CONCLUSION

Three important conclusions may be drawn from

this study:

* Comparison between theoretical prediction and experimental measurements for the design of y-section configuration has been satisfactory, proving the validity of the developed model, while providing a sound foundation for engine performance comparisons of the model cases considered.

* The quasi-steady assumption, as applied to transient Automotive internal combustion engine volumetric efficiency under full load throttle conditions, is a valid one. Gas dynamic phenomena are capable of adjusting to even pathological rates of change of engine speed in a matter of a few engine cycles. For all practical purposes it is probably safe to assume response time scales of the order of milliseconds to even the most extreme of automotive in-service conditions.

* The computer simulation and analysis tools for engine performance analysis like GT Power6.2 provides an essential aid to the appraisal of engine performance of multi cylinder diesel engine. These advanced simulation tools authorize an analysis of engine processes at the most deep-seated level, providing valuable insight into the intricate causal inter-relationships characterizing internal combustion engine operation.

REFERENCES

[1] Deshmukh, D., Kumar, R., Garg, M., Nayeem, M. J., and Lakshminarasimhan, V., „Optimisation of Gas Exchange Process on a Multi Cylinder Small 4-Stroke Engine by Intake and Exhaust Tuning: Experimentation and Simulation,‟ SAE Paper 2004-32-0007.

[2] Gilbert Sammut and Alex C. Alkidas, "Relative Contributions of Intake and Exhaust Tuning on SI Engine Breathing - A Computational Study" SAE Paper 2007-01-0492.

[3] L. J. Hamilton, J. S. Cowart and J. J. Rozich, "The Effects of Intake Geometry on SI Engine Performance" SAE Paper 2009-01-0302.

[4] Old ich Vítek and Miloš Polášek, "Tuned Manifold Systems – Application of 1-D Pipe Model" SAE Paper 2002-01-0004.

