EFFECTS ON ENGINE PERFORMANCE DUE TO CHANGE IN THE INTAKE MANIFOLD LENGTH

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ABSTRACT

This research paper shows the effect of intake length in the engine parameters like power, torque, and volumetric efficiency of the vehicle. the engine used for the experiment is a Honda cbr250r as we know that there is a pipe between engine and carburetor or throttle body from which air fuel mixture is fed into combustion chamber. in the engines commercially used the length of the manifold is optimized in a way in which the engine is tuned at an acceptable range of performance, but by varying the length of the intake manifold there can be a huge change in the torque, volumetric efficiency and brake power. the theory used to calculate the value of the length of the manifold at a given rpm is done by understanding the Chrysler ram theory. After which the given value of the intake is simulated in a 1-D CFD simulation software called lotus engine simulation, where the length of the intake is varied, and the output is noted down on graphical representations at different ranges of rpm.

INTRODUCTION

The varying length intake manifold length is to change the intake manifold length at every rpm of engine. the length of intake manifold is having key role in deciding volumetric efficiency of engine. this increases in getting optimum mileage, torque and power due to which it reduces the carbon emission.

in this paper length of the intake is varied in order to find out the change in torque output of the engine. The theory used is the ***Chrysler ram theory,*** this theory deals with the compression wave that is generated at the cylinder head due to the pressure build up at the point of valve close duration.

in conclusion there is an oscillating wave produced that generates a push of the intake charge and acts like a positive pressure device that increases the engine performance.

THEORY

There are two types of waves that are induced inside the manifold, they are compression wave and the rarefaction wave. The compression wave is induced due to the IVC time. When the inlet valve closes there is a high-pressure area which is created at the head of the valve and then the compression wave bounces back due to the spring back effect of the gas (wave dynamics). The tuning of the intake manifold is done in such a way that the oscillating pressure wave reaches the inlet valve after number of oscillations giving the engine a supercharging effect. Thus increasing the VE of the engine at different loads.

CHRYSLER RAM THEORY

The air flow dynamics inside the inlet manifold is alike unless the inlet valve closes. when the intake valve closes the gas, dynamics gets disturbed. this highly pressurized wave keeps on oscillating in the intake manifold unless the inlet valve opens, if we tune the inlet manifold length properly this highly pressurized wave will enter the cylinder when the inlet valve opens after oscillating in the inlet manifold.

if you can increase the mass of air flowing through the engine, you can increase power. you can increase air flow either by an external device such as a supercharger, or you can increase air

flow by designing resonance into the manifold systems. the Chrysler "ram induction" manifold is a resonating manifold.

CALCULATIONS

TABLE-1 ENGINE PARAMETERS

ENGINE	250cc CBR HONDA
BORE x STROKE	76mm x 55mm
DISPLACEMENT	249cc
COMPRESSION RATIO	10.7:1
MAX. NET POWER	22.11BHP @ 9,300RPM
MAX. NET TORQUE	20NM. @ 6,900

Using ***Chrysler ram theory*** -

Starting at 3000rpm

$720^0 – 235^0 = 485^0$ of crank rotation our intake valve remains closed.

Let’s say a 3000rpm

3000/60=50 rev/sec

50rev/sec * 360^0 rev/sec = 18000/sec

485^0/18000 = 0.026944 seconds for compression wave to travel back to intake valve when it opens again.

0.026944*343 m/s = 9.2417 m

This is the length which wave travels at speed of sound. Now wave must travel rearward to intake valve, so intake length becomes half because wave travels ascend & descend the intake which is 4.6208 m.

Installing that much elongated intake is practically difficult so integer multiple (3, 6,…12) of that length can be used without much affecting the perk of ram effect.

So, by taking integer multiple of length we get intake length 0.5134m.

RPM	LENGTH(m)
2000	0.7701
3000	0.0513
4000	0.3508
5000	0.3080
6000	0.2567

TABLE-2 RPM-LENGTH OF INTAKE MANIFOLD

SIMULATION RESULTS

By the results showed in the simulation done on lotus engine simulation 1-D CFD software, clearly shows the increase in the break torque at mid-range rpms at different rpms with the respective length of the intake manifold tact.

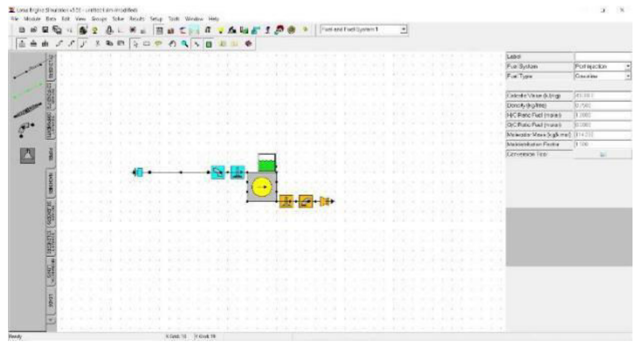

FIG-1 LOTUS ENGINE SIMULATION 1-D CFD SOFTWARE

The graphs shown below represent the performance characteristics as follows

Blue line shows: indicated torque (Nm)

Green line shows: total indicated power

Red line shows: brake torque(Nm)

Brown line shows: vol. efficiency (%)

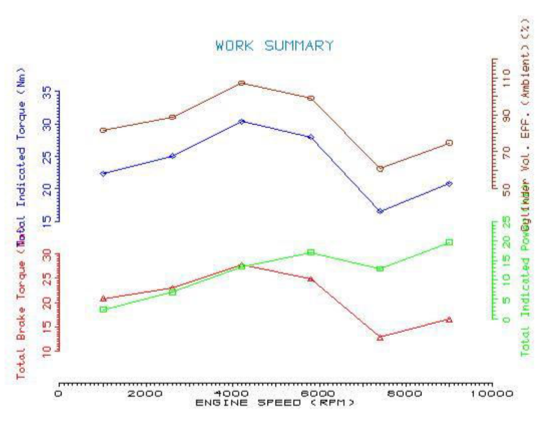

FIG-2 GRAPH FOR MANIFOLD LENGTH – 700mm

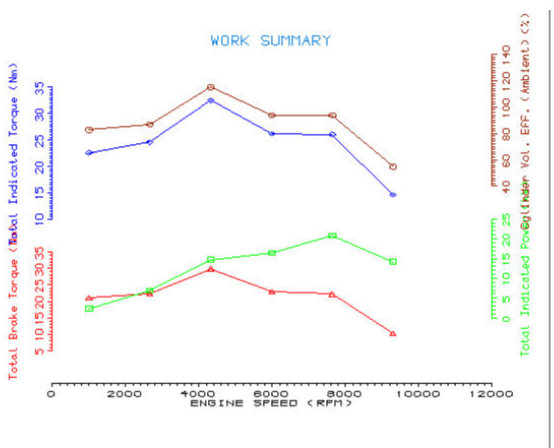

FIG-3 GRAPH FOR MANIFOLD LENGTH – 550mm

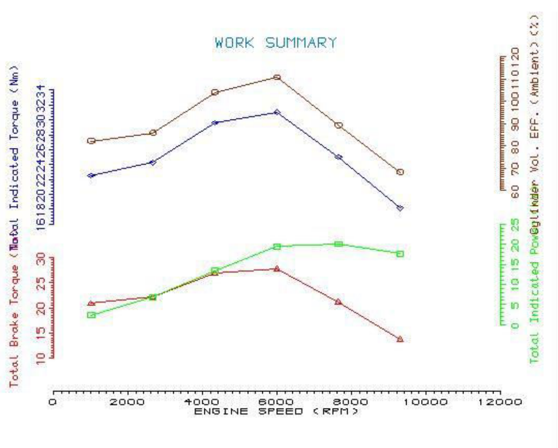

FIG-4 GRAPH FOR MANIFOLD LENGTH – 500mm

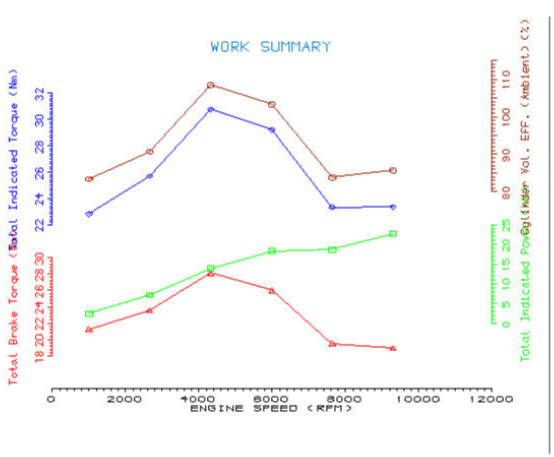

FIG-5 GRAPH FOR MANIFOLD LENGTH – 450mm

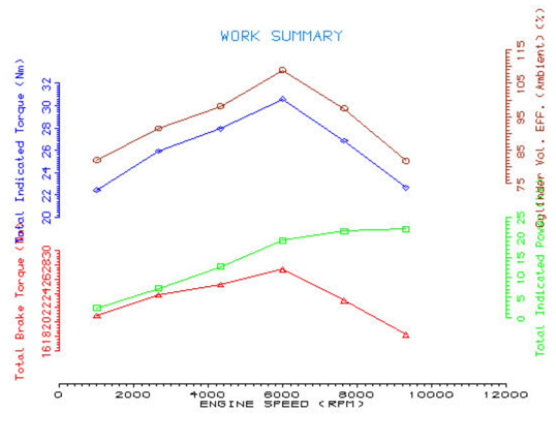

FIG-6 GRAPH FOR MANIFOLD LENGTH – 400mm

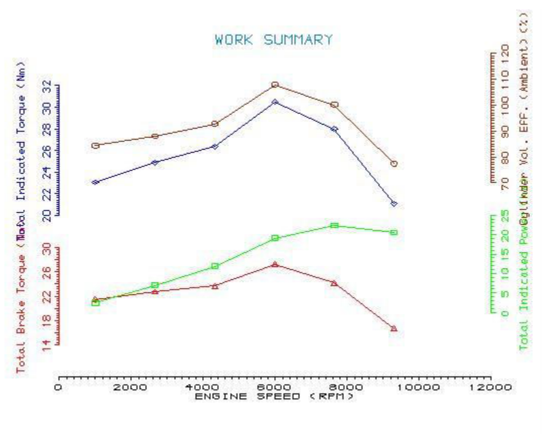

FIG-7 GRAPH FOR MANIFOLD LENGTH – 350mm

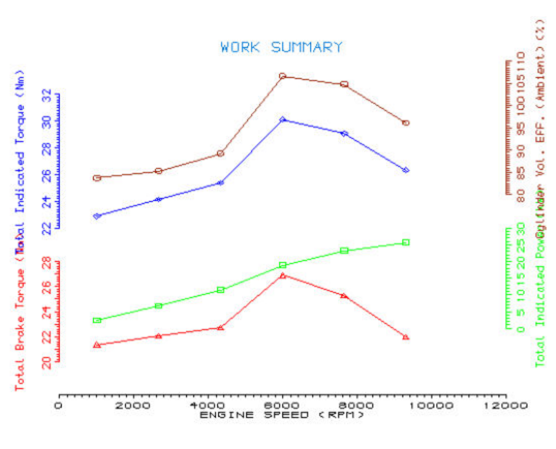

FIG-8 GRAPH FOR MANIFOLD LENGTH – 300mm

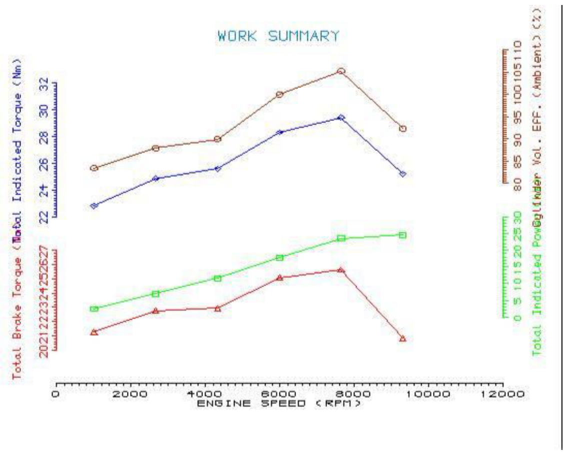

FIG-9 GRAPH FOR MANIFOLD LENGTH – 250mm

CONCLUSION

After performing simulation and practical there is increase in torque and power at different rpms.

There is significant change in the volumetric efficiency over a range of rpm of the engine with the change in the length of the intake manifold.

A change in the brake torque of the engine is also seen with a gradual increase and decrease in it.

The total power of engine is constant through the process of changing of manifold length with slight change over higher engine rpms.

Hence, we can understand that there is performance enhancement by varying intake manifold length.