

Four Cylinder Four stroke SI Engine

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Abstract

The present paper deals with layout of cylinder & cylinder head with air cooling device for four strokes 4 cylinder SI engine .the main goal of design is to reduce weight to power ratio & will bring about generating excessive specific energy. The authors have proposed initial design cylinder & cylinder head of a horizontally adverse SI engine, which develops 120 BHP and posses the maximum rotational speed of 6000rpm. 4 stroke opposed engine is inherently well balanced due to opposite vicinity of shifting loads and also it presents efficient air cooling. For the necessity of weight diminishment the texture chosen for plan of barrel and chamber head is Aluminum compound that is LM-13. The chamber bore covering the utilization of NIKASIL covering changed into completed to enhance power of barrel with least weight.

INTRODUCTION

Horizontally adverse four stroke four cylinder SI engine:- A flat-4 or horizontally-opposed-four is a flat engine with 4 cylinders arranged horizontally in two banks of cylinders on each facet of a primary crankcase. The pistons are normally hooked up at the crankshaft such that opposing pistons circulate backward and forward in opposite guidelines on the same time. The general layout of this engine is proven in fig.1

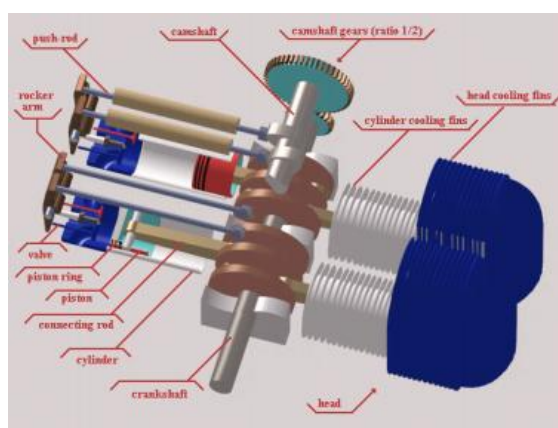


Fig. 1:Layout of 4 cylinders, 4 stroke SI Engine

The configuration results in inherently exact stability of the reciprocating

components, a low centre of gravity, and a totally short engine duration. The layout additionally lends itself to efficient air cooling. However, it is a luxurious design to fabricate, and really too huge for compact car engine booths, which makes it more appropriate for cruising motorcycles and aircraft than ordinary passenger vehicles.

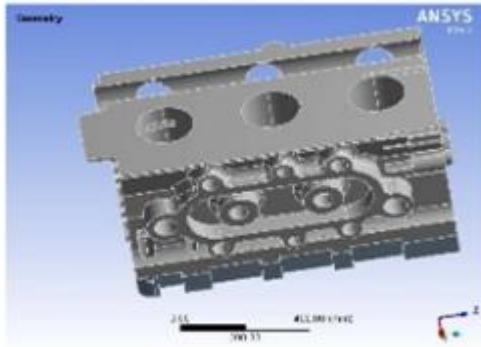
This is no longer a common configuration, however a few manufacturers of car use such engines and it's miles a commonplace configuration for smaller aircraft engines which includes made with the aid of Continental. Even though they may be particularly superior to in-line 4stroke engines in terms of vibrations, they've largely fallen out of favour because they have two cylinder banks therefore requiring twice as many camshafts as for in-line engines.

MATTER SELECTION

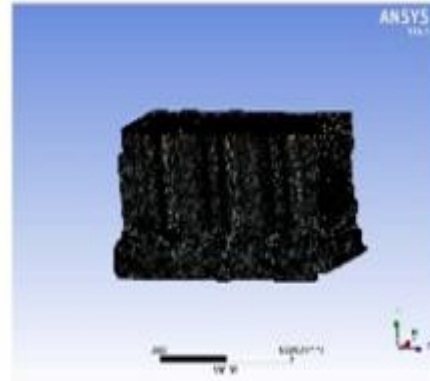
As method for decreasing weight, there are numerous methods to be had substituting light weight materials for traditional materials, that is to lower specific gravities, explanation of shape (lower the variety of parts through integration), & downsizing

(lower the quantity of each element). In the beyond, the engine overall performance has been compromised in

order to improve emission. The methods supplied here, but are essentially extraordinary from the beyond one.

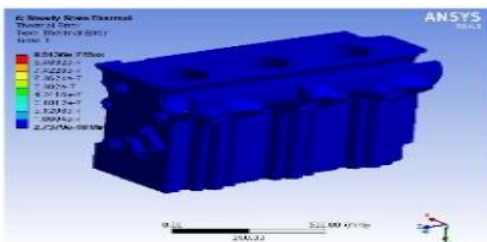
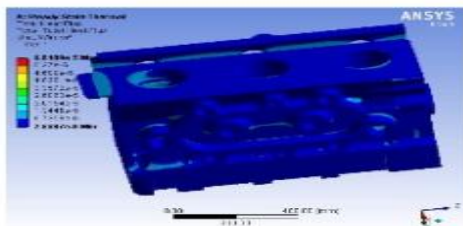


The above image shows engine block imported model



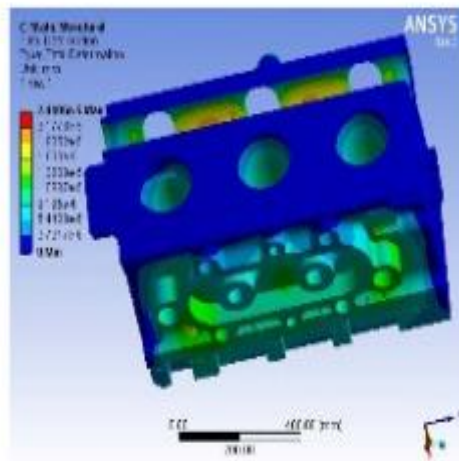
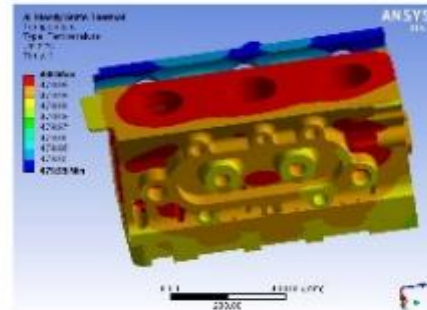
The above image shows engine block mesh model

Fig 2: Couple Field Analysis of Engine Block using Cast Iron



Structural analysis:

Thermal Analysis:



The engine weight has reduced by using 37 Kg from a base considered one of 162 Kg (except engine oil). This corresponds to 23% weight reduction. As shown in fig. 2 the element weight ratio of the materials are fifty three% metallic for the weight-reduced engine (86% within the base engine), 33% (thirteen%) Aluminum alloys, 7% (1%) plastics & elastomers, 6% (zero%) other mild weight substances together with titanium alloys & magnesium alloy, & 1% (0%) ceramics.

The materials substitutions carried out for the engine structure factor represented by using a cylinder is no greater than simple weight reduction. However, while applied this to several moving & functional components, it no longer only weight discount technique but also contributes to improve engines & emission overall performance.

CYLINDER BORE COATING

The critical parameters for mild weight & excessive pace engine utility are the choice of the cloth & the floor change by way of tough coating on bore of cylinder block. The electricity to weight ratio has additionally come to be a critical parameter for the layout attention as it has more than one benefits e.g. progressed gas efficiency, load wearing potential and so on. For the development of lightweight cylinder block for air borne software, using solid iron liner has been changed via tough coating era at the cylinder wall surface. In INDIA the tough layer coating technology on Aluminum is determined in application. Mirror Bore Coating is shown in fig 3.

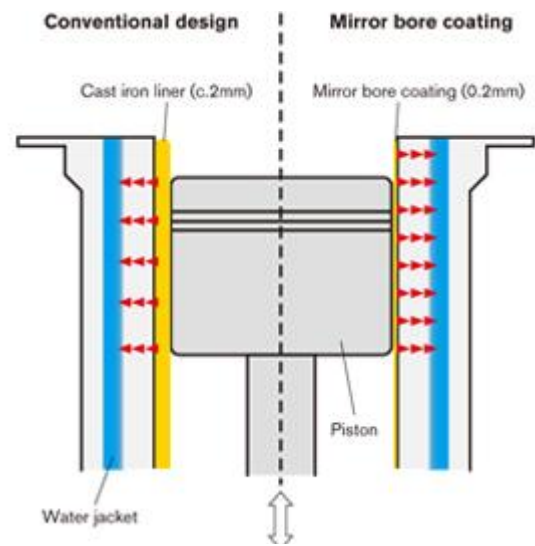


Fig. 3: Mirror Bore Coating

Following types of difficult layer floor coating over Aluminum has been effectively finished in foreign countries.

- a) Nikasil (Ni + SiC composite coating)
- b) Tough chrome coating.
- c) Apticoat 750 (Ni + Ceramic composite) evolved via M/s SAT Poeton Ltd., united kingdom for racing vehicle.

a) Nikasil Coating [9]:-

It is largely an electrochemical dispersion coating on the cylinder bore in which the Silicon Carbide debris (SiC) are dispersed in the Nickel matrix. It is generally desired to deposit the coating as unfastened as feasible to tensile stress. In this situation NIKASIL exhibits a very favorable behavior wherein the strain do now not exceeds 120N/mm^2 . The Nickel matrix is characterized with the aid of hardness as much as 550 VPN in addition to positive amount of ductility.

The strengthened Silicon Carbide debris, which may be identified in Nickel matrix as darkish dots underneath microscope having hardness approximate 2500 VPN. the size of particle is confined to four micron because the coarser particles are not favorable in wear condition with the mating parts (piston ring). The uniform dispersion of Silicon Carbide debris inside the Nickel matrix especially relies upon on

the ratio of aggregate of nickel & Silicon Carbide & also the modern density. NIKASIL coated cylinder blocks have a better engine performance over the cast iron blocks or Aluminum blocks with cast iron liner.

b) Tough Chrome Plating [9]

The intense chrome plating on chamber square of Aluminum composite is proficient through electroplating statement. In this procedure barrel squares are made cathode and the anode, commonly made of lead (Pb), corrosive arrangement. The measurement of the anode depends upon at the drag width and stroke time of chamber piece. The thickness of covering is controlled by understanding the entire

floor region of the chamber bore and modifying the contemporary thickness. it has been said that a covering thickness of 60-70 microns on bore floor of Aluminum chamber piece offers better gas execution and warm conductivity in evaluation with produced Iron chamber squares or Aluminum barrel outfitted with strong Iron liner.

Selected Coating

NIKASIL coating is selected for coating of cylinder bore as it has were given better performance compared to difficult chrome plating. also NIKASIL coating has were given hardness approximately 2500 VPN wherein as chrome plating has best 800-900 VPN.

SIMPLE ENGINE DESIGN LAYOUT OF CYLINDER:

Design parameters	Calculated value
D	78mm
L	78mm
Bmep	11.76 bar
Imep	13.85 bar
Pmax	138.5 bar
Volume	1500cc
Indiacatedpower	141.176 HP
FrictionPower	21.176 HP
Mechanical Efficiency(assumed)	85%
Break power	120 HP

Robust modeling of Cylinder



Fig. 4 & 5: Model of cylinder

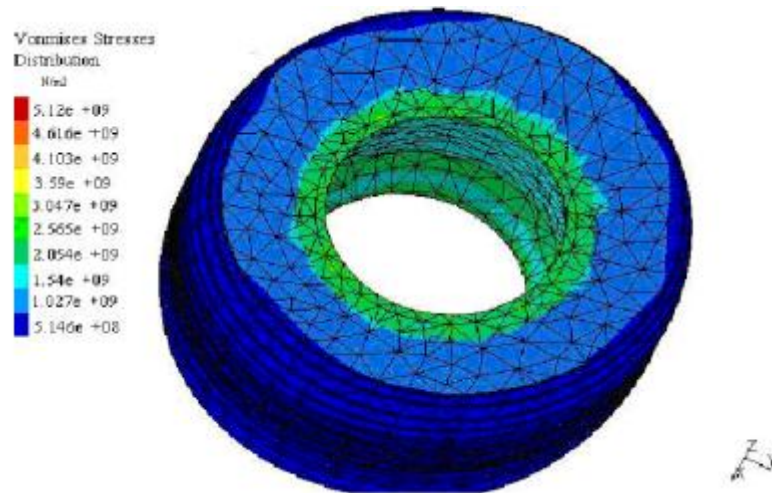


Fig. 6 : Analysis of cylinder

CONCLUSION

From the analytical solution & the evaluation end result we get the values of stresses produced in cylinder and cylinder head because of software of temperature and stress are within permissible restrict. Hence we concluded that the primary layout of cylinder and cylinder head is safe with reference of strain and temperature basis. Due to the usage of mild weight material i.e. LM-13 with NIKASIL cylinder bore coating, we are able to efficiently lessen the burden of cylinder and cylinder head with progressed strength. Additionally due to the usage of air cooling system a green and faster cooling of engine completed.

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