ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Design and Analysis of Cylinder Head

Mr. G.Venkanna
M.Tech (CAD\CAM)
Tudi Ram Reddy Institute of Technology and Science.

Ms G. Pranathi, M.Tech
Assistant Professor
Tudi Ram Reddy Institute of Technology and Science.

ABSTRACT

A cylinder head is made of box type of section of considerable depth to accommodate ports of air and gas passages, inlet valve, exhaust valve and spark plug. The studs or bolts are screwed up tightly along with a metal gasket or asbestos packing to provide a leak proof joint between the cylinder and cylinder head. The cylinder head is subjected to temperatures due to combustion in cylinder and pressure on surface.

The aim of the project is to design a cylinder head and analysis is done by using materials. Cylinder head is modeled using catia software. Catia is a 3d modeling software widely used in the design process. Catia is used by the automotive and aerospace industries for automobile and aircraft product and tooling design.ANSYS is general-purpose analysis software package Analysis is a numerical method of deconstructing a complex system into very small pieces (of user-designated size) called elements. Analysis is done on the model by using different materials. Comparison between the two materials is done by observing the results of displacement and stress. Thermal analysis is also done. Analysis is done by using software ANSYS.

1. INTRODUCTION

The two-stroke cylinder head certainly doesn't look very exciting but its design has a large bearing on how well your engine will run. Manufacturers use various external shapes and cooling fin patterns but the main requirement here is that the cooling area be large enough to adequately cool the engine. Some people feel that the head must have radial fins to be any good, but I disagree. Conventional finning is entirely adequate. It is the surface area which counts, not the fin pattern.

1.1 DEVELOPMENT CONTEXT

The move from extensive use of discrete elements (via separate castings) to extensive integration of elements (such as in most modern engine blocks) was a gradual progression that passed through various phases of Monobloc engine development, wherein certain elements were integrated while others remained discrete. This evolution has occurred throughout the history of reciprocating engines, with various instances of every conceptual variation coexisting here and there. (This is an example of how the history of technology is a profusion of scattered data points with the waxing and waning of themes and trends, as opposed to any simplistic linear progression from "bad" to "good".)

1.2 CYLINDER HEAD AND CRANKCASE INTEGRATED

Casting technology at the dawn of the internal combustion engine could reliably cast either large castings, or castings with complex internal cores to allow for water jackets, but not both simultaneously. Most early engines, particularly those with more than four cylinders, had their cylinders cast as pairs or triplets of cylinders, then bolted to a single crankcase. As casting techniques improved, an entire cylinder block of 4, 6, or 8 cylinders could be cast as one. This was a simpler construction, thus less expensive (unit-wise) to make. For straight engines, this meant that one engine block could now comprise *all* the cylinders plus the crankcase. Monobloc straight fours, uncommon when the Ford Model T was introduced with one in 1908, became common during the next decade, and Monobloc straight sixes followed soon after.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

1.3 COMBINED HEAD AND CRANKCASE

Light-duty consumer-grade Honda GC-family small engines use a monobloc design where the cylinder head, block, and half the crankcase share the same casting, termed 'uniblock' by Honda. One reason for this, apart from cost, is to produce an overall lower engine height. Being an air-cooled OHC design, this is possible thanks to current aluminum casting techniques and lack of complex hollow spaces for liquid cooling.

1.5 MATERIALS

- Cast aluminium
- Good thermal conductivity, light weight, good cast process.
- The high thermal expansion coefficient, easy distorted, high price, and used in the Small high-speed engine.
- Cast iron: high temperature resistance, good casting process, and cheaper.
- Cast steel: high tensile strength, high toughness, high-temperature strength, not prone to cause fatigue cracks, poor technology.

1.6THE FORMS OF THE CYLINDER STRUCTURE

- There are various structure forms. Classified by the number of cylinders, there are separate cylinder head that there is a cylinder head for each cylinder and single-cylinder head that serves all cylinders.
- Classified by structure, there are combined cylinder head, welded cylinder head, double bottom cylinder, bored-cooling cylinder, and so on. Several typical cylinders are introduced below.
- The separate cylinder (animation): There is a cylinder head for each cylinder.

Advantages:

1.7STRUCTURE CHARACTERISTICS

- There is a lobe on the bottom of the cylinder, matched with the annular grooves which is on the cylinder linear. These two parts are sealed with copper gasket.
- Outlet of the water is in the highest to prevent the surface from local overheating.
- (figure shows separate cylinder head) (virtual model).

1.8SINGLECYLINDER (ANIMATION)

Linking several cylinder head as a whole is a single-cylinder.

- Advantages: excellent rigidity, the short distance of the cylinder centres, convenient layout for exhaust passages. It is commonly used in the high-speed diesel engine.

1.9STRUCTURALCHARACTERISTICS

- 4 valves per cylinder: two for intake and two for exhaust.
- There is intake manifold in the medial of the V-shaped cylinder, and exhaust manifold in the lateral.

1.10BLOCKTYPE CYLINDER HEAD (ANIMATION)

Between the separate and single-cylinder head, one cylinder head can serve two cylinders like 2, 4, 6, 12.

1.11 DOUBLE BOTTOM CYLINDER HEAD

- For the cylinder itself, it works under the high temperature combustion gas, uneven temperature distribution, and large thermal stress.
- Especial on the bottom surface, it is prone to cause cracks easily for the board between intake and exhaust gallery and the gas gallery holes and the injector seat holes. If the substrate thickness is large, the temperature difference between the internal and external surface is greater, and so is the thermal stress.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

1.12 STRUCTURAL CHARACTERISTICS

- The adding clapboard increase the thickness, which increase the rigidity.
- The thickness of bottom board can be thinned, which result in the reduction of temperature difference and thermal stress.

1.13LARGE LOWSPEED TWO-STROKE DIESEL ENGINE CYLINDER HEAD (ANIMATION)

- It is divided into two parts:
- Upper cylinder head: Casting steel, a small thickness, reduces the thermal stress.
- Lower cylinder head: Casting iron, a large thickness, reduces the mechanical stress.
- L6 cylinder head (virtual model) and cylinder cover (virtual model)

1.14 CYLINDER LINER FUNCTION

- Constitute the work cycle space.
- As the guiding hand for the piston, and there are slider plate and guide board for the crosshead.

1.15WORKING CONDITIONS (VERY BAD)

- The inner surface stand up the repeatedly high temperature and high pressure of the combustion gas (about 2273K).
- It is blow by the inlet air which about 373K in the intake stroke.
- The outer surface is corroded and eroded by coolant.

1.16REQUIREMENTS

- Strength: Mechanical strength and thermal strength, mechanical load and thermal load.
- Stiffness: Do not have great distortion when installation and work.
- The inner surface has a high accuracy and finish, good resistant to abrasion and corrosion.

1.17STRUCTURE OF THE CYLINDER LINER (VIRTUAL MODEL)

The wet and dry cylinder liners: Installed in difference ways.

1.18 IN COMPARISONWET

- Good for cooling.
- Thick board, convenient to manufacture and replacement (for marine diesel).
- Having the corrosion and cavitations of coolant.

DRY

- No corrosion and cavitations of coolant.
- Thin board, distance between cylinders centre be reduced, compact structure, low stiffness.

1.19LOCATION (FIGURE)

Axial position: The low end is not fixed, and it can elongate under heating.

Radical position: Flange prevents it from lateral moving.

- Seal: Place a flexible gasket between the cylinder head and cylinder liner (legend).
- Gas-tight seal (legend)

1.20THE MATERIAL

Aluminium, asbestos covered with copper, mild steel.Corresponding cylinder head, there are main two types of cylinder gasket: en-bloc type and single-ring type.

1.21WATER TIGHT SEAL (LEGEND)

The temperature is low in the lower of the cylinder liner; it can be sealed with elastic ring.

- Bored cooling cylinder liner (animation)
- The upper shoulder is high and thick, the hole forms an angle with centreline, and have a good cooling effect.
- The strength and the stiffness are increased, but the processing cost also increased.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

1.22ENGINE BLOCK AND BED PLATE

Classification: According to the structure of the main bearing.

- normal-seat main bearing type;
- Upside-down-seat main bearing type;

REVIEW OF LITTERATURE

The first successfully working internal combustion engine used in an automobile was built by Siegfried Marcus in approximately 1864 [1]. It was an upright single-cylinder, two-stroke petroleum-fuelled engine that also utilized a carburetor to deliver fuel to the engine.

The engine was placed on a cart with four wheels and successfully ran under its own power. Not only has Marcus produced the first engine that is the direct predecessor to today's engines, he had also built the first automobile in history, some 20 years before Gottlieb Daimler's automobile.

3. DESING AND ANALYSIS TO DEVELOP THE WORK

3.1 INTRODUCTION THE CATIA

CATIA is a robust theapplication that enables you to create rich and complex designs. The goalsof the CATIA course are to teach you how to build parts and assemblies in CATIA, and howto make simple drawings of those parts and assemblies. This course focuses on thefundamental skills and concepts that enable you to create a solid foundation for your designs

3.2 CATIA

CATIA is mechanical design software. It is a feature-based, parametric solid modeling design tool that takes advantage of the easy-to-learn Windows graphical user interface. You can create fully associative3-D solid models with or without constraints while utilizing automatic or user-defined relations to capture design intent. To further clarify this definition, the italic terms above will be further defined:

3.7 MODELLING OF CYLINDER HEAD

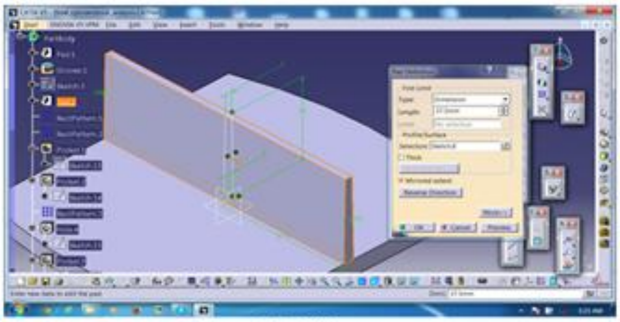


FIGURE NO 6, PAD - D 37.5mm.

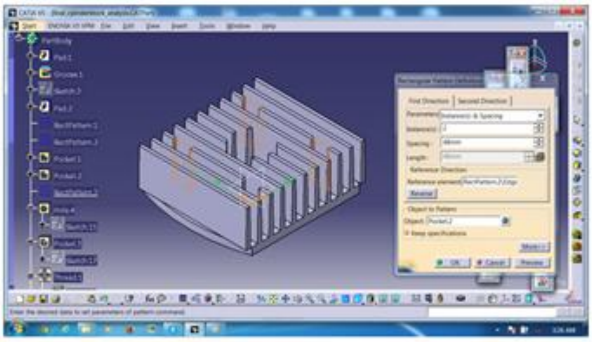


FIGURE NO 13 RECT PATTERN 2 - INCHE 2, SPACING 48mm, L 48mm

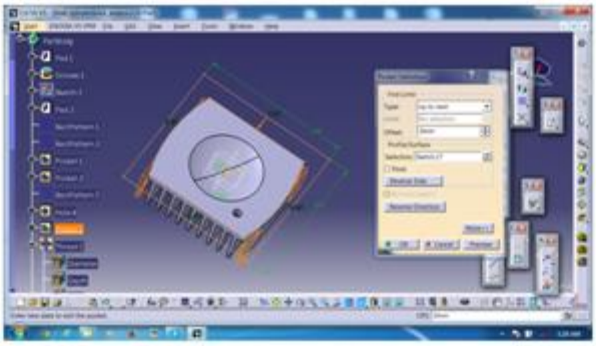


FIGURE NO 16 POCKET - UPTO NEXT

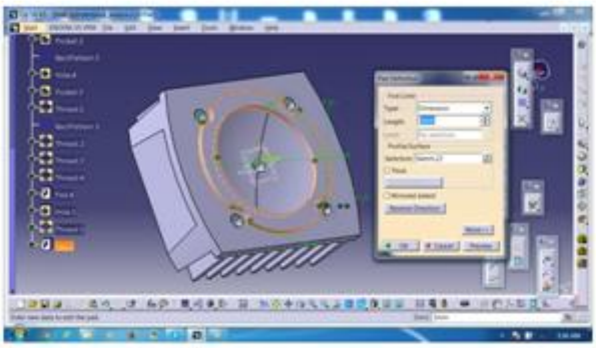


FIGURE NO 27 CYLINDER PAD - D 10mm, L 3mm

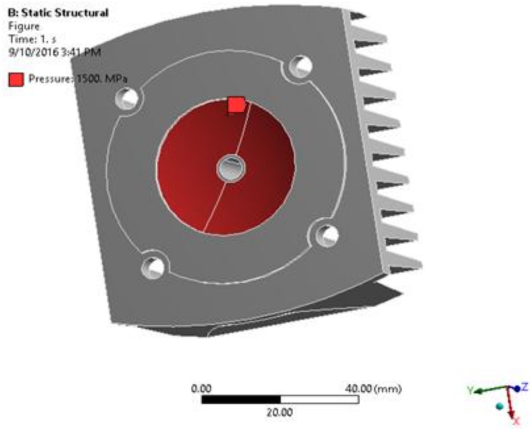
ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

3.8 DRAFTING OF CYLINDER HEAD INTRODUCTION

By the analysis was limited to expensive mainframe computers generally owned by the aeronautics, automotive, defense, and nuclear industries. Since the rapid decline in the cost of computers and the phenomenal increase in computing power, analysis has been developed to an incredible precision. Present day supercomputers are now able to produce accurate results for all kinds of parameters.

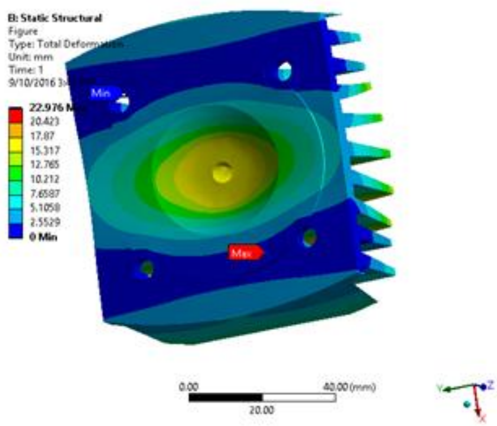
A wide range of objective functions (variables within the system) are available for minimization or maximization:

4. STATIC ANALYSIS

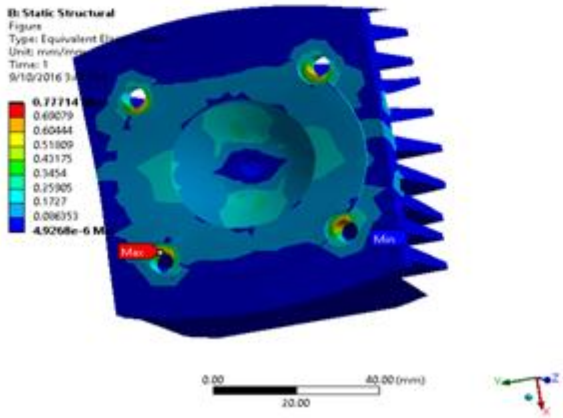


CYLINDER HEAD STATICSTRUCTURA PRESSURE

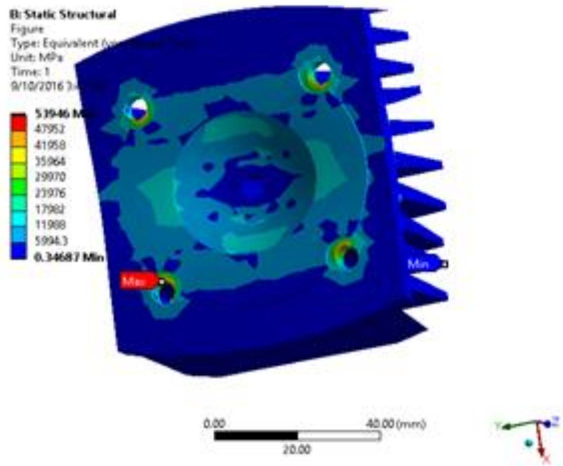
TOTAL DEFORMATION



CYLINDER HEAD TOTAL DEFORMATION

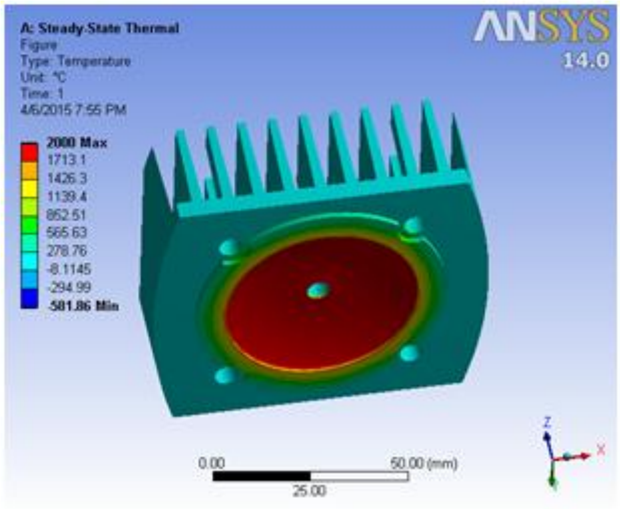


EQUIVALENT ELASTIC STRAIN



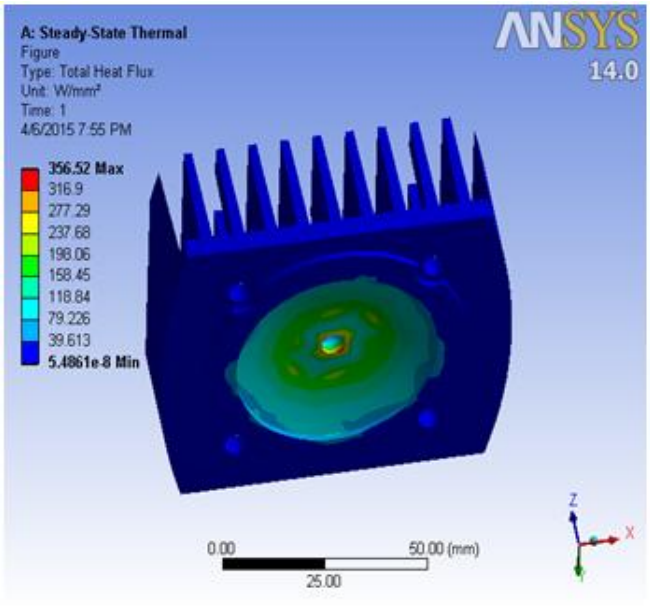
CYLINDER HEAD EQUIVALENT STRESS

4.9THERMAL ANALYSIS



CYLINDER HEAD TEMPERATURE

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal



CYLINDER HEAD TOTAL HEAT FLUX

4.9.8 MATERIAL DATA

Aluminum Alloy

TABLE 40

Aluminum Alloy > Constants

Density	2.77e-006 kg mm^-3
Coefficient of Thermal Expansion	2.3e-005 C^-1
Specific Heat	8.75e+005 mJ kg^-1 C^-1

CHAPTER – 5
RESULT

5.1 Static analysis of cylinder head

	Minimum	Maximum
Total Deformation	0	22.976
Strain	4.9268 e-6	0.77714
Stress	0.34687	53946

5.2 Thermal Analysis Cylinder Head

	Minimum	Maximum
Temperature	-581.86	2000
Total heat flux	5.4861 e-8	356.52

Total deformation of a cylinder head 2.2976 by using aluminum material .this which standing for the processing generator and cylinder head, this has analyzed by using static analyzing in analysis.

The total temperature which standing of cylinder heads up to 2000 and this thermal condition is with standing so the cylinder head has no more remarks by analyzing.

CONCLUSION

In our project we have designed an assembly of cylinder and cylinder head. The materials conserved are two different Aluminum alloys. Thermal analysis And Statistic analysis is done on the cylinder to determine the thermal behavior for original model and also by reducing the thickness of the cylinder head.

By reducing the thickness, the weight of the component reduces. By observing the thermal analysis results, thermal flux is more for the modified model than for original model.

By comparing the results between two alloys, thermal flux is more for Aluminum alloy.So we can conclude that using Aluminum alloy and by reducing the thickness of cylinder is better.

6.1 FUTURE SCOPE

As the orientation of the fin plays an important role in heat transfer. There is scope of improvement in the heat transfer of air cooled engine cylinder by choosing vertical over horizontal by varying the

- Fin thickness of vertical fin
- Orientation of the fin
- Different types of engine oils can be used inside the bore
- The present work is limited to experimental setup, hence numerical techniques can also be used
- Different other fluids can be used as working medium for future work

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Author Details

Mr. G.Venkanna
M.Tech (CAD\CAM)
Tudi Ram Reddy Institute of Technology and Science.

Ms G. Pranathi, M.Tech
Assistant Professor
Tudi Ram Reddy Institute of Technology and Science.