MODELING OF AN ENGINE GASKET BY USING CATIA SOFTWARE

N. RAMADEVI, RAJU AMBATI, S. SUSHMA
4.BOLAMREDDY BABU REDDY, 5.Dr.K.SAMMAIAH
Department of Mechanical Engineering,
Ellenki Collage of Engineeringand Technology, Patelguda, Telangana.
ramanune07@gmail.com

Abstract **- Gasket sits between the engine block and cylinder head in an engine. Its purpose is to seal the cylinders to ensure maximum compression and avoid leakage of coolant or engine oil into the cylinders. From our project, we would like to modify the material and design of the gasket of four cylinder engine. MLS or Multiple Layers Steel (These typically consist of three layers of steel) and asbestos – Most modern head engines are produced with MLS gaskets. The contact faces are usually coated with a rubber-like coating such as Viton that adheres to the cylinder block and cylinder head while the thicker center layer is left bare. Because of the health risk of fine asbestos fibers, gasket manufacturers are forced to look for alternatives to asbestos**

The gasket diagram is done by using catia The gasket material is considered as 3D solid.

1. Introduction

This project is an investigation into the efficiency of engine gasket sealing and the stress/strain behavior of cylinder head under various loading conditions using contact theory and thermal stress analysis. Apart from sealing the cylinder, the head gasket also seals water and oil conduits between the head and block. Any connectivity between them will cause engine failure, or significant problems like burning oil (smoke from the exhaust). The compression in the cylinder will cause a leak to form in the gasket and the gasket will have to be replaced, or severe damage can take place (a "blown" head gasket). This problem has been exacerbated by the use of alumina epoxy cylinder head gasket. In carbon fiber, Kevlar fiber, pyrosic ceramic glass fiber has a much greater thermal expansion rate, which in turn causes a great deal more stress to be placed on the head gasket.

1.1 Internal combustion engine:- An internal combustion engine (ICE) is a heat engine in which the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit. In an internal combustion engine, the expansion of the high-temperature and high-pressure gases produced by combustion applies direct force to some component of the engine. The force is applied typically to pistons, turbine blades, rotor or a nozzle. This force moves the component over a distance, transforming chemical energy into useful work. This replaced the external combustion engine for applications where weight or size of the engine is important.

1.2 HISTORY OF INTERNAL COMBUSTION ENGINE - The first practical internal combustion engine based heavily on experience from the production of steam engines. The engine had a horizontal cylinder; slide valves were used to draw in the fuel-air mixture; and it was double acting, the mixture being fed into the cylinder alternately at either end of the piston. Once it is in the cylinder the mixture was ignited by electric sparks generated at spark plugs by a coil and a battery. This ignition system, a primitive ancestor of modern electric ignition, was unreliable. Because the first internal combustion engine was unreliable, many later pioneers made improvements of the first internal combustion engine. As a result

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-4, ISSUE-5, 2017
DOI: 10.21276/ijcesr.2017.4.5.3

many new engines were made. Such engines were the two and four stroke engine and the petrol engine. Siegfried Marcus in Austria in 1864 was able to create an engine that uses petrol as a fuel. The first internal combustion engine is the basic form for modern car engines. Now a day's all engines and industries use the connecting rods for power transmission purpose.

2. Literature Review

V.Arjun, Mr. V.V. Ramakrishna, Mr. S. Rajasekhar, al. [2015], Thermal Analysis of an Engine Gasket At Different Operating Temperatures, Gasket sits between the engine block and cylinder head in an engine. Its purpose is to seal the cylinders to ensure maximum compression and avoid leakage of coolant or engine oil into the cylinders. From our project, we would like to modify the material and design of the gasket of four cylinder engine. MLS or Multiple Layers Steel (These typically consist of three layers of steel) and asbestos – Most modern head engines are produced with MLS gaskets. The contact faces are usually coated with a rubber-like coating such as Viton that adheres to the cylinder block and cylinder head while the thicker center layer is left bare. Because of the health risk of fine asbestos fibers, gasket manufacturers are forced to look for alternatives to asbestos.

M.Srikanth1 B.M.Balakrishnan2, al. [2015], Cylinder Head Gasket Analysis to Improve its Thermal Characteristics Using Advanced Fem Tool, Gasket sits between the engine block and cylinder head in an engine. Its purpose is to seal the cylinders to ensure maximum compression and avoid leakage of coolant or engine oil into the cylinders. From our project, we would like to modify the material and design of the gasket of four cylinder engine. MLS or Multiple Layers Steel (These typically consist of three layers of steel)and asbestos – Most modern head engines are produced with MLS gaskets. The contact faces are usually coated with a rubber-like coating such as viton that adheres to the cylinder block and cylinder head while the thicker center layer is left bare. Because of the health risk of fine asbestos fibers, gasket manufacturers are forced to look for alternatives to asbestos. Various possibilities of substituting asbestos in cylinder head gaskets are characterized by different problems of development. Elastomer-bonded soft materials, i.e. combinations of Kevlar fibers, carbon fibre, pyrosic ceramic glass fiber materials.

L.Vijayabaskar, al. [2016], Thermal Analysis of Cylinder Head Gasket Using Ansys, To perform a thermal analysis test on the cylinder head gasket of the 4 stroke engine. This analysis can be used for knowing the failures occur in the cylinder head gasket and make the comparison between two gasket materials. Mainly the deformation in the gasket materials occurs due to the temperature difference. In this report, the commercial FEM software, ANSYS, is introduced into the numerical simulation of the thermal analysis. The gasket diagram is done by using pro-E software. The imported diagram from the pro-E software is used for analysis. Inner and outer temperature value of gasket is taken by the experimental method. Thermocouple sensor is used for the determination of temperature. The gasket material is considered as 3D solid.

Jerry e. Kashmerick, al (1991) in this Different cylinder head gasket materials are in use today, primarily due to the elimination of the standard asbestos millboard, new engine designs, requirements on compressed thickness, and increasing durability and sealing standards. The history of small engine cylinder head gaskets is reviewed. Current and future head gasket requirements and gasket material and types are outlined. The affect of these materials on heat transfer is summarized. Design considerations directed to attaining and maintaining clamp loads and clamp load loss are addressed. Static and dynamic testing to improve and verify the suitability of designs is explained. A smooth transition from a tested prototype to production product requires attention to clamp load related details.

Chang chun lee, cuoningchiang,al. (2004-2005) in this paper avoid the escaping gas from the engine affecting the overall performance of the engine during operation, both the proper pre-stressing force of the bolts as well as the gasket design are critical factors in enhancing the efficiency of the sealing of the gasket. In this investigation, both the distribution of the contact pressure on the gasket, and the stresses

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-4, ISSUE-5, 2017
DOI: 10.21276/ijcesr.2017.4.5.3

of the cylinder head at Different loading conditions, such as cold assembly, hot assembly, cold start, and hot firing, are explored by numerical calculation based on the finite element method (FEM). The results reveal that the efficiency of the sealing of the head gasket depends on the pre-stressing force of the hold-down bolts, without taking into consideration any thermal stresses resulting from the temperature distribution in the cylinder head. However, the location of maximum contact pressure on the gasket is transformed when the thermal loading is taken into account. In addition, this research also conducts the parametric analyses for the pre-stressing force of the bolts and compares the differences between cold assembly and cold start conditions.

Vishal Sapkal1, Kamal Ukey2, at.[2005] DESIGN AND ANALYSIS OF CYLINDER HEAD OF AN ENGINE. Cylinder head is a critical part of an I C engines cylinder head is used to seal the working ends of the cylinder and accommodates combustion chamber in its cavity, spark plug and valves. The heat generated in combustion chamber is highly dynamic and allows very little time (few micro seconds) to transfer the heat if not distributed will lead to squeezing of piston due to overheating. Hence an effective waste heat distribution through cylinder head plays a very important role in smooth function of I C engine. Heat Transfer through cylinder head consists of conduction through walls and convective heat transfer due to surrounding air flow. As the shape of cylinder head is complex and temperature within the combustion chamber is still fairly unknown. Conventional methods of evaluating heat transfer are very complex this project aims at evaluating heat transfer through cylinder head using finite element analysis as well as the structural analysis. Geometrical models of Cylinder head with and without fins are developed in Auto CAD software .Thus developed models are exported to ANSYS software, and finite element model for thermal analysis done

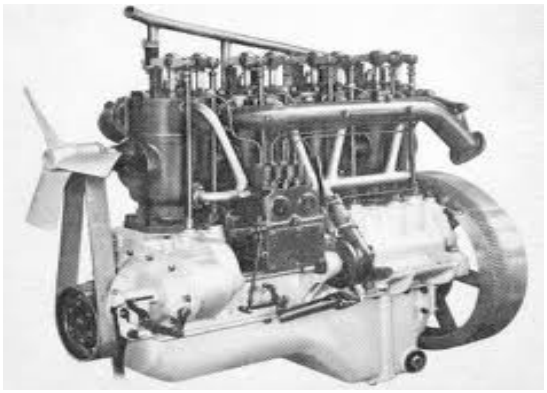


Fig1.1 compression ignition engine

Fig1.2. spark ignition engine.

Introduction of gasket:-

1. **Gasket Function:**

A cylinder head gasket is required to affect a seal between the cylinder head and block of an Oil engine. It is an integral component of the engine and is required to perform many functions at the same time during engine operation. The head gasket must maintain the seal around the combustion chamber at peak operating temperature and pressure.

2. **Gasket Design:**

Every application requires a unique cylinder head gasket design to meet the specific performance needs of the engine. The materials and designs used are a result of testing and engineering various metals, composites and chemicals into a gasket that is intended to maintain the necessary sealing capabilities for the life of the engine. The most widely used materials are as follows:

1. Copper And Asbestos combination..
2. Fibre based composite materials. Graphite in various densities
3. Combination of Aluminium and fibre

3. Gasket Analysis:

Both the design and the development of the automobile engine are complicated processes. To acquire the best performance of an engine in any operating condition, including harsh natural environments are used to find the optimum parameters for engine design. However, numerous measured results point out that the gas escaping from the engine not only affects the output efficiency of the horsepower substantially, but also pollutes the environment.

Engine Specifications:

Technical Data	WATER COOLED MODEL
Engine Type	8 H.P.
No. Of Cylinders	One
Kw(BHP)	5.9
R.P.M.	1600
Bore	87.5 mm
Stroke	110 mm
Cubic Capacity(Swept Vol.)	661 c.c.
Bumping Clearance (Between Head And Piston)	1.32 mm to 1.778 mm
Weight	170 kgs
Water Outlet Temp.	60 to 70 C

Working of Gasket:

Its purpose is to provide a gas tight seal between the cylinder(s), the water jackets, oil passages and the ambient air, liquids and gases. The area of the gasket around the cylinder must be robust enough to withstand the same pressures that are exerted on the pistons while ensuring that there is no leakage of coolant or combustion gases among the three volumes. It must be able to accomplish this at all engine temperature and pressures without function, as a failure of the engine gasket usually results in a failure of the full engine. The complex arrangement of components in the diesel engine is often joined together with the help of gaskets. The gaskets serve as seals to prevent the leakage of the various fluids and gases in the oil engines but these seals do wear out with constant usage of the engines. Additionally the constant heating and cooling creates expansion and contraction that is detrimental to the various seals. Leakage of gases through these seals can cause minor or very dangerous oil leak which might cause serious accidents or incident.

Gasket for Diesel Engine

3. Introduction to CATIA

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

7.2Convergent-Divergent

7.2.1 Model length = 152mm

Table -5 Convergent-Divergent result for modal-1

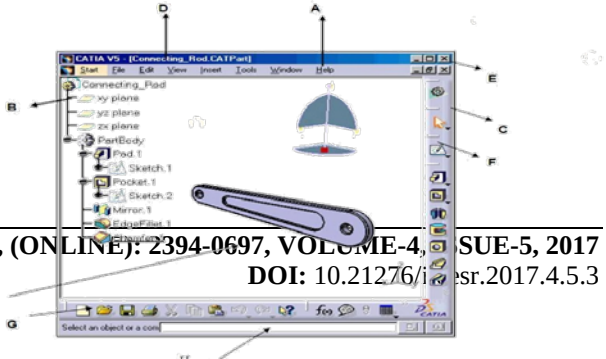
7.2.2 Model length = 162.814mm

Table -6Convergent-Divergent result for modal-2

7.2.3 Model length = 177.8

Table -7Convergent-Divergent result for modal-3

7.2.4 Model length = 188.214mm



CATIA User Interface:

1 CATIA

There are different modules in **CATIA** using which different tasks can be performed. The main window and modules of **CATIA** shown in figure:

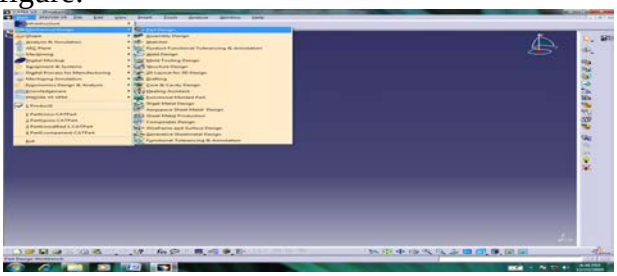
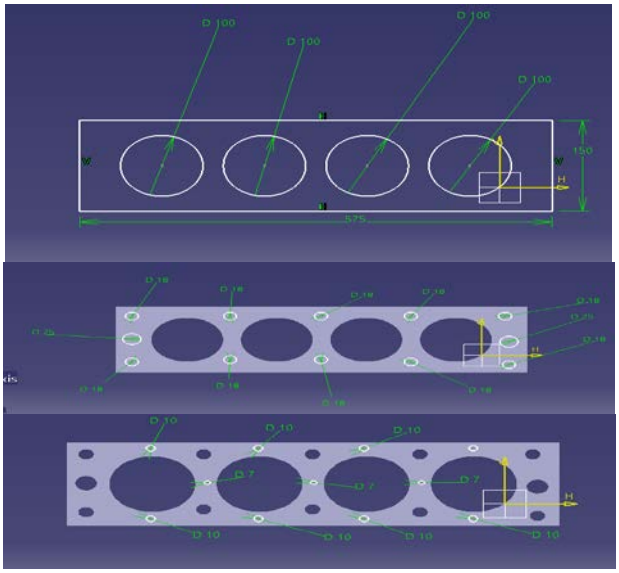


Fig 1.3 Main window of CATIA

Sketch of the Model:



4. Conclusion

This project successfully design cylinder head gasket made Engine head gasket design From the obtained from catia software with standard measurements design and observing the above design creating the 2D sketches using catia sketcher workbench then converting into 3D solid model using part design. Complete model design using catia software with standard measurements..

5. References

[1] G.P. Blair, C.D. McCartan, H. Hermann,(July 2005) "The Right Lift", Race Engine Technology, issue 009, ISSN 1740 -6803

[2] T. Belytschko, W.K. Liu, B.Moran,(2010) Nonlinear Finite Elements for Continua and Structures, Wiley, New York, 2000pp. 569 - 613.

[3] Bormane, G., Nishiwaki, K.,(2011) "Internal Combustion Engine Heat Transfer", ProgEnergycombustion Science, vol.13, PP.1 - 46.

[4] B. Corona, M. Nakano, H. Pérez,(2007) "Adaptive Watermarking Algorithm for Binary Image Watermarks", Lecture Notes in Computer Science, Springer, pp. 207 -215 .

[5] S.K. Chan, I.S. Tuba,(2008) A finite element method for contact problem of solid bodies part -1, theory and validation, Int. J. Mech. Sci. 18 (13) 615 - 625.

[6] R.Jonathan,(2011) Modeling diesel engine cylinder head gaskets using the gasket material option of the SOLID185 element, ANAYS User's Conference.

[7] F.Macek Heat,(2003) "Analysis of Engine Head gasket", Abstracts of 20th Danubia Adria Symposium on Experimental Methods in Solid Mechanics. University of Applied Sciences, s. 74 - 75.ISBN 963 -9058 -20.

[8]J. Montgomery,(2002) Methods for modeling bolts in the bolted joint, ANSYS User's Confeerence. [9] A.R.Mijar, J.S. Arora,(2008) review of formulations for elastostatic frictional contact problems, Struct. Multidiscip. Optim. 167 -189.

[10] S.Othe,(2008) Finite element analysis of elastic contact problems, Bull. JSME 16 (95) 797 -804.

[11] Raub, J. H. (2006), "Structural Analysis of Diesel Engine Cylinder Head Gasket Joints," SAE Paper 921725

[12] Saniel, M. - Macek, J. - Diviš, M. - Tichánek,(2003) R. Steady State Heat Analysis of Engine Head, Abstracts of 20th Danubia - Adria Symposium on Experimental Methods in Solid Mechanics. Gyor: Széchenyi István University of Applied Sciences, s. 74 -75.ISBN 963 -9058 -20 -3.

[13] Thermal Analysis Guide.

[14] S.Yasumasa,(2003) Analysis of gasket flanges with ordinat elements using APDL control, ANSYS User's Conference.