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

Design/Modeling and Thermal Analysis on Cylinder Head of I.C Engine

G.Bahadur Vali
Department of Mechanical,
Chebrolu Engineering College.

Krishna Veni
Associate professor,
Department of Mechanical,
Chebrolu Engineering College.

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. Optimal Design means the best of all feasible designs proposed in phase one , i.e., the conceptual design. Optimization is the processes of maximizing a desired quantity or minimizing an undesired one. Optimization theory is the body of mathematics that deals with the properties of maxima and minima, and how to find maxima and minima numerically.

INTRODUCTION:

The internal combustion engine is an engine in which the combustion of a fuel (normally a fossil 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 (ICE) the expansion of the high-temperature and high-pressure gases produced by combustion apply direct force to some component of the engine. The force is applied typically to pistons, turbine blades, or a nozzle. This force moves the component over a distance, transforming chemical energy into useful mechanical energy.

The ICE is quite different from external combustion engines, such as steam or Sterling engines, in which the energy is delivered to a working fluid not consisting of, mixed with, or contaminated by combustion products. Working fluids can be air, hot water, pressurized water or even liquid sodium, heated in some kind of boiler.

ICEs are usually powered by energy-dense fuels such as gasoline or diesel, liquids derived from fossil fuels. In an internal combustion engine, the cylinder head (often informally abbreviated to just head) sits above the cylinders on top of the cylinder block. It consists of a platform containing part of the combustion chamber (usually, though not always), and the location of the poppet valves and spark plugs. In a flathead engine, the mechanical parts of the valve train are all contained within the block, and the head is essentially a flat plate of metal bolted to the top of the cylinder bank with a head gasket in between; this simplicity leads to ease of manufacture and repair, and accounts for the flathead engine's early success in production automobiles and continued success in small engines, such as lawnmowers.

Internally, the cylinder head has passages called ports or tracts for the fuel/air mixture to travel to the inlet valves from the intake manifold, for exhaust gasses to travel from the exhaust valves to the exhaust manifold. In the overhead valve (OHV) design, the cylinder head contains the poppet valves and the spark plugs, along with tracts or 'ports' for the inlet and exhaust gases. The operation of the valves is initiated by the engines camshaft, which is sited within the cylinder block, and its moment of operation is transmitted to the valves pushrods, and then rocker arms mounted on a rocker shaft - the rocker arms and shaft also being located within the cylinder head.

In the overhead camshaft (OHC) design, the cylinder head contains the valves, spark plugs and inlet/exhaust tracts just like the OHV engine, but the camshaft is now also contained within the cylinder head.

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

The number of cylinder heads in an engine is a function of the engine configuration. An inline or straight engine has only one cylinder head.

IMPLEMENTATION:

A V engine (or Vee engine) usually has two cylinder heads, one for each cylinder bank of the 'V'. Some engines, particularly medium- and large-capacity diesel engines built for industrial, power generation and traction purposes (trucks, locomotives, heavy equipment etc.) have individual cylinder heads for each cylinder. Cylinder head porting refers to the process of modifying the intake and exhaust ports of an internal combustion engine to improve the quality and quantity of the air flow.

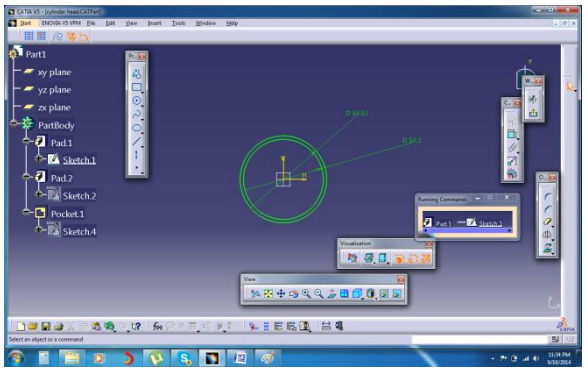
The design of the cylinder head is key to the performance and efficiency of the internal combustion engine, as the shape of the combustion chamber, inlet passages and ports (and to a lesser extent the exhaust) determines a major portion of the volumetric efficiency and compression ratio of the engine. Cylinder heads, as manufactured, are usually suboptimal due to design and manufacturing constraints. Porting the heads provides the finely detailed attention required to bring the engine to the highest level of efficiency.

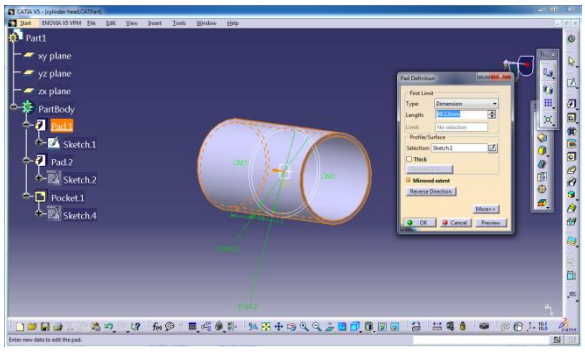
This process can be applied to a standard racing engine to optimize its power output as well as to a production engine to turn it into a racing engine, to enhance its power output for daily use or to alter its power output characteristics to suit a particular application.The cylinder head seals off the cylinders and is made of cast iron or aluminum. It must be strong and rigid to distribute the gas forces acting on the head as uniformly as possible through the engine block.The cylinder head contains the spark plug – for an SI engine - or fuel injector-for CI engine-, and in overhead valve engines, parts of the valve mechanism.

In the vast majority of four-stroke engines, the cylinder head mounts the entire valve gear and is a basic framework for housing the gas-exchange valves as well as the spark plugs and injectors. In car engines, one cylinder head is usually employed for all cylinders together. The cylinder heads on water-cooled diesel truck engines are usually made of cast iron. By contrast, all petrol and Diesel engines cars use aluminum cylinder heads due to the superior heat dissipation and lower weight. In cars, the cylinder head is normally made of aluminum even when the cylinder block is cast iron. In trucks and large industrial engines, individual cylinder heads are often used on each cylinder for better sealing force distribution and easier maintenance and repair. The three fluids, combustion gas, coolant and lubricating oil, flow independently in the cylinder head. These circuits follow complex three dimensional routes, so cylinder heads are generally produced by casting Gravity casting or low-pressure casting using Sand molds or Metal dies are used.

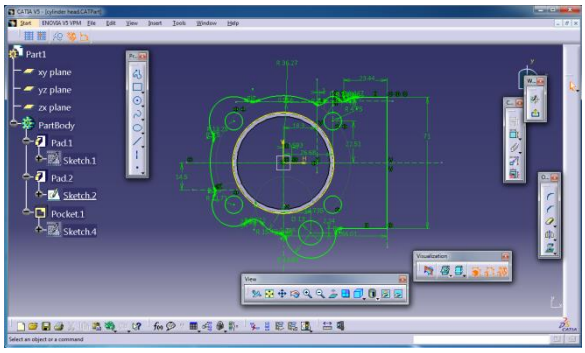
MODELS OF CYLINDER AND CYLINDER HEAD ASSEMBLY ORIGINAL MODEL

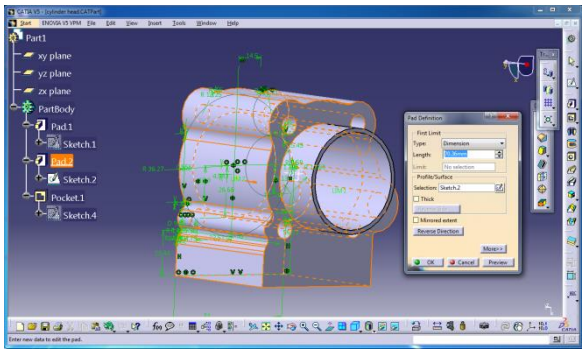
Cylinder

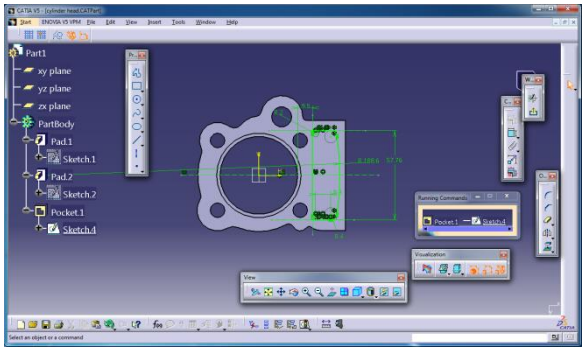


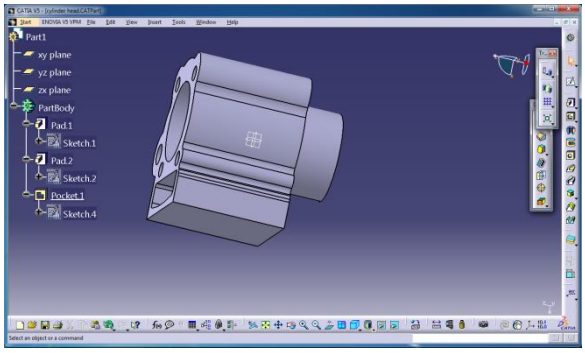


ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

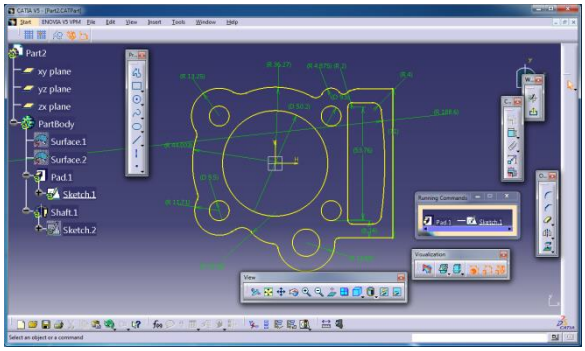


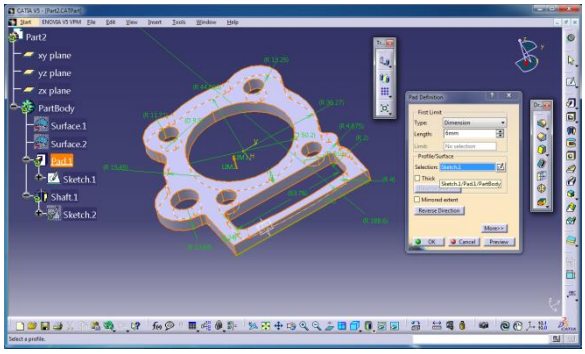


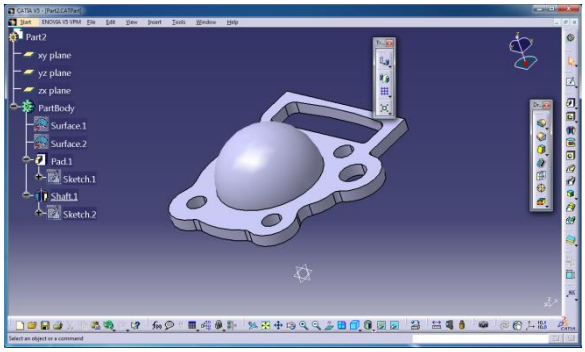




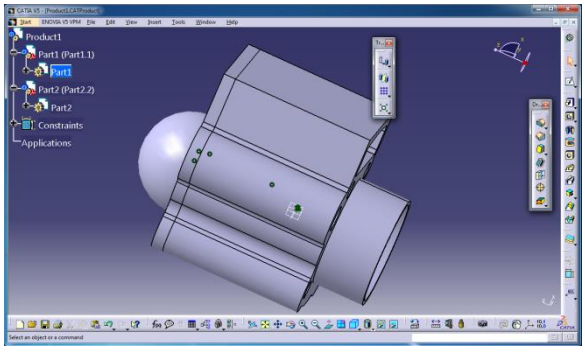
CYLINDER HEAD





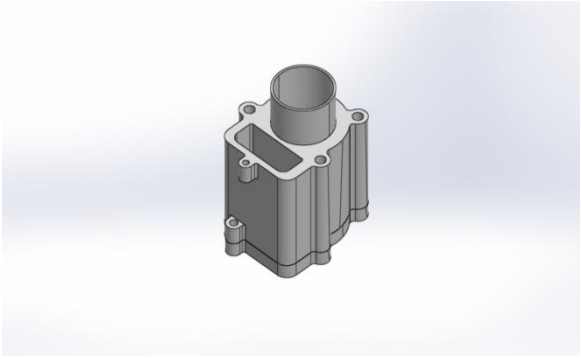


ASSEMBLY OF CYLINDER AND CYLINDER HEAD



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

ORGINAL MODEL ALUMINIUM 6061



STUDY PROPERTIES

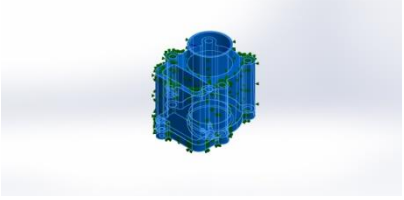
Study name	Al-6061_OrginalModel
Analysis type	Thermal(Steady state)
Mesh type	Solid Mesh
Solver type	FFEPlus
Solution type	Steady state
Contact resistance defined?	No
Result folder	SolidWorks document (E:\Projects Completed Ansys\SS)

Units

Unit system:	**SI (MKS)**
Length/Displacement	**mm**
Temperature	**Kelvin**
Angular velocity	**Rad/sec**
Pressure/Stress	**N/m^2**

MATERIAL PROPERTIES

Model Reference



Properties	
Name:	**Al_6061**
Model type:	**Linear Elastic Isotropic**
Default failure criterion:	**Max von Mises Stress**
Thermal conductivity:	**170 W/(m.K)**
Specific heat:	**1300 J/(kg.K)**
Mass density:	**2700 kg/m^3**

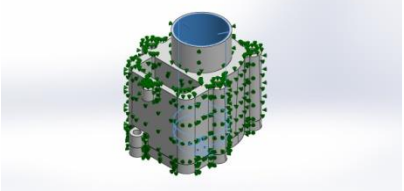
Components

SolidBody 1(Cut-Extrude4)(Cylinder_1-1),

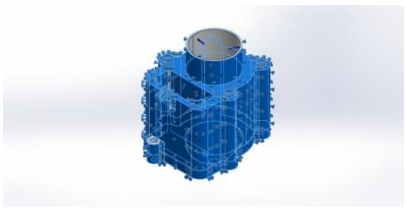
SolidBody 1(Cut-Extrude3)(Part4-1)

THERMAL LOADS & CONTACT INFO

Contact	Contact Properties	
Global Contact	**Type:**	**Bonded**
	Components:	**1 component(s)**
	Options:	**Compatible mesh**

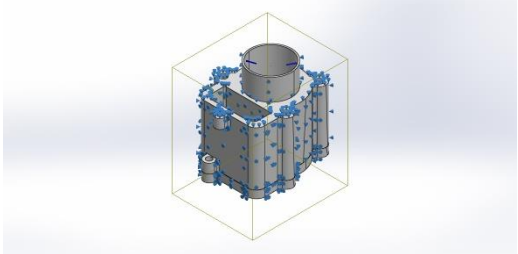
Load name	Load Image
Temperature-1	

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

Convection-1	

Load name	Load Details	
Temperature-1	**Entities:**	**5 face(s)**
	Temperature:	**550 Kelvin**
Convection-1	**Entities:**	**54 face(s)**
	Convection Coefficient:	**39.9 (W/m^2)/K**
	Time variation:	**Off**
	Temperature variation:	**Off**
	Bulk Ambient Temperature:	**40 Kelvin**
	Time variation:	**Off**

Contact Image

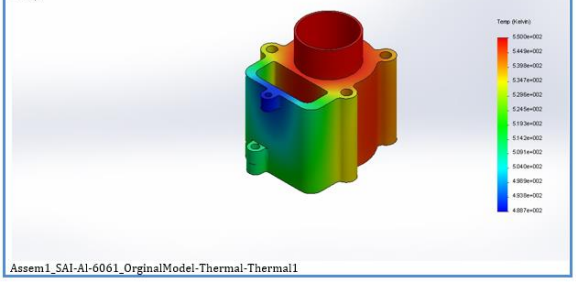


MESH INFORMATION

Mesh type	**Solid Mesh**
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	7.21317 mm
Tolerance	0.360659 mm
Mesh Quality	High
Remesh failed parts with incompatible mesh	Off

STUDY RESULT

Name	Type	Min	Max
Thermal1	TEMP: Temperature	488.688 Kelvin Node: 56	550 Kelvin Node: 432



Result Table Original

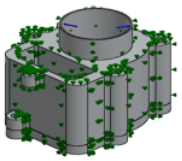
Materials	**Temperature (K)**	**Gradient (K/m)**	**Flux (W/m^2)**
Aluminum 6061	**550**	**2734.95**	**464942**
Aluminum 7475	**550**	**3102.79**	**456111**

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

Result Table Modified

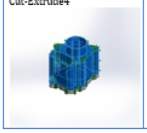
Materials	Temperature (K)	Gradient (K/m)	Flux (W/m^2)
Aluminum 6061	550	23831.7	$4.051e^6$
Aluminum 7475	550	27358.8	$4.022 e^6$

Aluminum Alloy 7475



Model name: Assembly_Cylinder and bore
Current Configuration: Default

Solid Bodies

<L_MdlInf_SldBd_Nm/>	Treated As	Volumetric Properties	Document Path/D
Cut-Extrude4 	Solid Body	Mass:0.804228 kg Volume:0.000297862 m^3 Density:2700 kg/m^3 Weight:7.88143 N	C:\Documents and Settings\Ravi\Desktop\Cylinder_Modifies\Cylinder_1.SLDPRT
Cut-Extrude3 	Solid Body	Mass:0.196481 kg Volume:7.27707e-005 m^3 Density:2700 kg/m^3 Weight:1.92551 N	C:\Documents and Settings\Ravi\Desktop\Cylinder_Modifies\Part4.sldprt

CONCLUSION:

In our project we have designed an assembly of cylinder and cylinder head. The materials conserved are two different Aluminum alloys 6061 and 7475.Thermal analysis is done on the cylinder to determine the thermal behavior for two aluminum alloys 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 6061 than aluminum alloy 7475.So we can conclude that using Aluminum alloy 6061 and by reducing the thickness of cylinder is better.