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Design and Thermal Analysis on Cylinder Head

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ABSTRACT:

A cylinder block is an integrated structure comprising the cylinder(s) of a reciprocating engine and often some or all of their associated surrounding structures (coolant passages, intake and exhaust passages and ports, and crankcase). The term engine block is often used synonymously with "cylinder block" In the basic terms of machine elements, the various main parts of an engine (such as cylinder(s), cylinder head(s), coolant passages, intake and exhaust passages, and crankcase) are conceptually distinct, and these concepts can all be instantiated as discrete pieces that are bolted together. Such construction was very widespread in the early decades of the commercialization of internal combustion engines (1880s to 1920s), and it is still sometimes used in certain applications where it remains advantageous (especially very large engines, but also some small engines). However, it is no longer the normal way of building most petrol engines and diesel engines, because for any given engine configuration, there are more efficient ways of designing for manufacture (and also for maintenance and repair). These generally involve integrating multiple machine elements into one discrete part, and doing the making (such as casting, stamping, and machining) for multiple elements in one setup with one machine coordinate system (of a machine tool or other piece of manufacturing machinery). This yields lower unit cost of production (and/or maintenance and repair). Today most engines for cars, trucks, buses, tractors, and so on are built with fairly highly integrated design, so the words "mono block" and "en bloc" are seldom used in describing them; such construction is often implicit. Thus "engine block", "cylinder block", or simply "block" are the terms likely to be heard in the garage or on the street.

INTRODUCTION:

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. Today's engines are an integral component of an automobile that are built in a number of configurations and are considerably more complex than early automotive engines. Technological innovations such as electronic fuel injection, drive-by-wire (i.e., computer-controlled) throttles, and cylinder-deactivation have made engines more efficient and powerful. The use of lighter and stronger engineering materials to manufacture various components of the engine has also had an impact; it has allowed engineers to increase the power-to-weight of the engine, and thus the automobile. Common components found in an engine include pistons, camshafts, timing chains, rocker arms, and other various parts. When fully stripped of all components, the core of the engine can be seen: the cylinder block. The cylinder block (popularly known as the engine block) is the strongest component of an engine that provides much of the housing for the hundreds of parts found in a modern engine. Since it is also a relatively large component, it constitutes 20-25% of the total weight of an engine [2]. Thus there is much interest in reducing the block's weight. Many early engine blocks were manufactured from cast iron alloys primarily due to its high strength and low cost.

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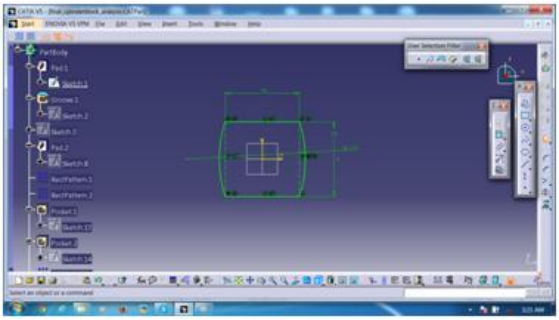
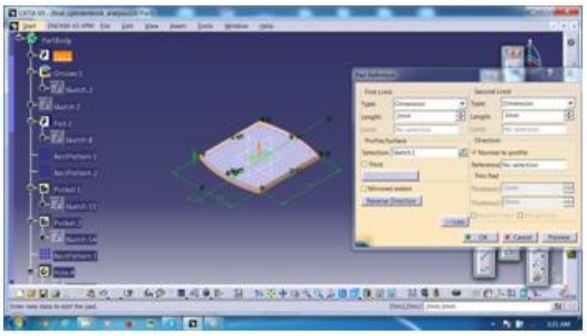
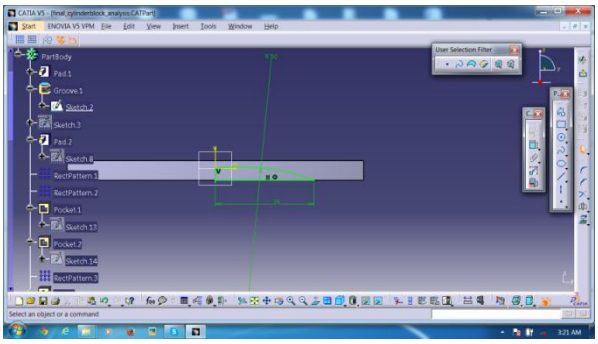
But, as engine designs became more complicated, the weight of the engine (and the vehicle) had increased. Consequently, the desire among manufacturers to use lighter alloys that were as strong as cast irons arose. One such material that was being used as a substitute was aluminium alloys. Used sparingly in the 1930's (due to problems with durability) [3], aluminium alloy use in engine blocks increased during the 1960's and 1970's as a way to increase fuel efficiency and performance. Together, these two metals were used exclusively to fabricate engine blocks. As of late, however, a new material process has made magnesium alloy suitable for use in engines. The alloy, called AMC-SC1, weighs less than both cast iron and aluminium alloys and represents new possibilities in engine manufacturing.

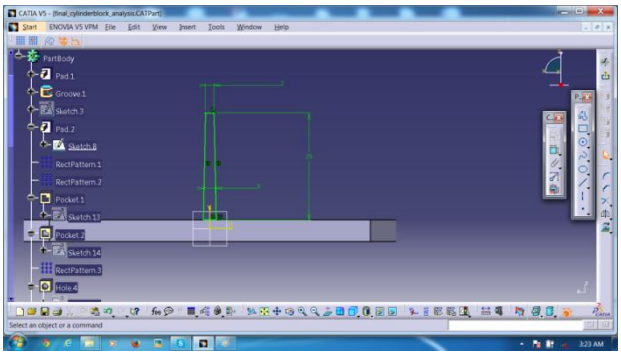
A new manufacturing process have made compacted graphite cast iron (CGI) a viable alternative to gray cast iron for the manufacture of diesel engine blocks. Like magnesium alloys, this material offers a higher strength and lower weight than gray cast iron. In this paper, materials used to manufacture engine blocks for passenger vehicles will be discussed. The discussion of the component, its functional requirements, and the materials used to manufacture the part are included. The mechanical properties of the individual alloys will be incorporated, as well as the manufacturing processes used to fabricate the component.

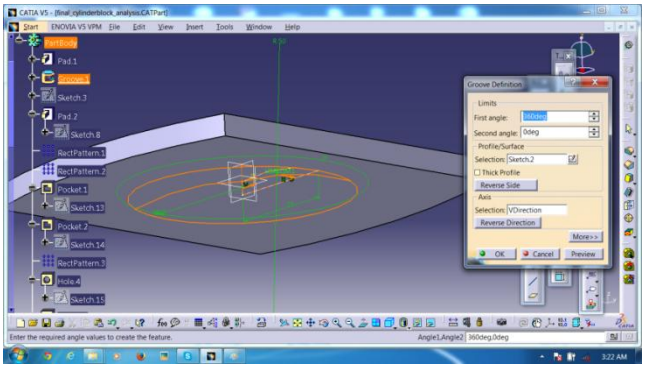
MODELLING OF CYLINDER HEAD











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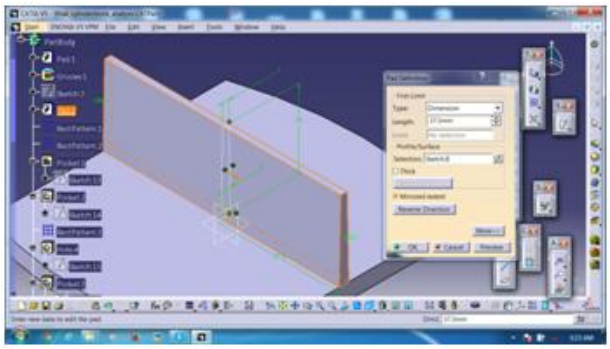

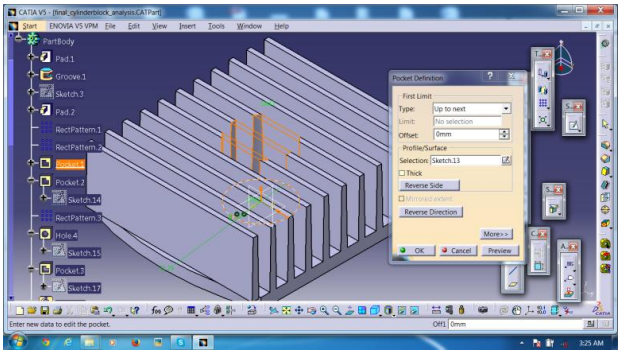

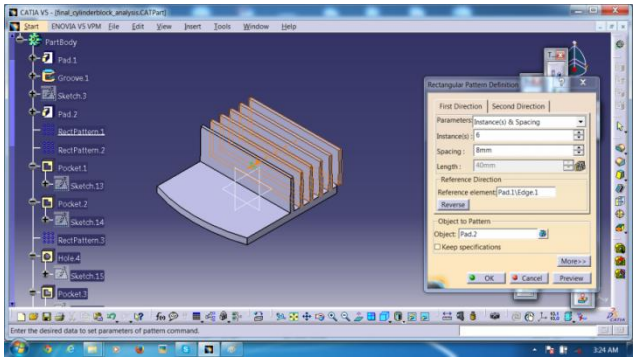

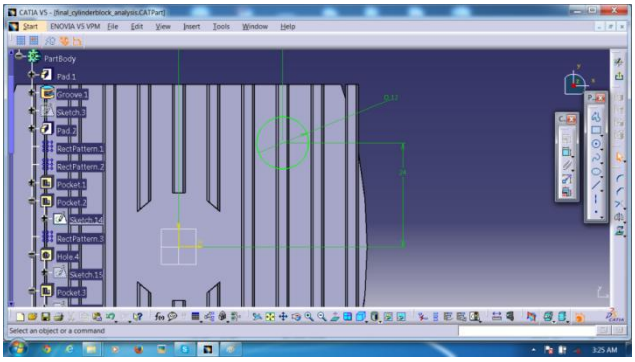

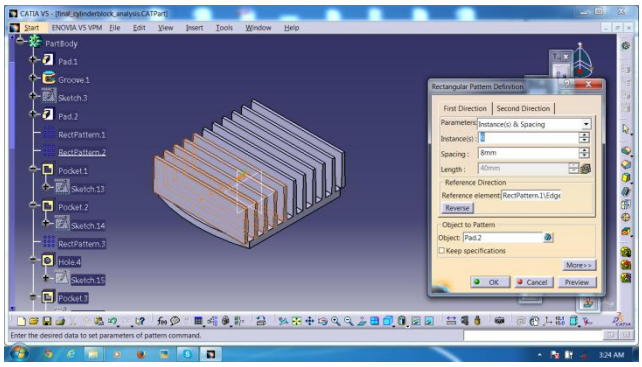

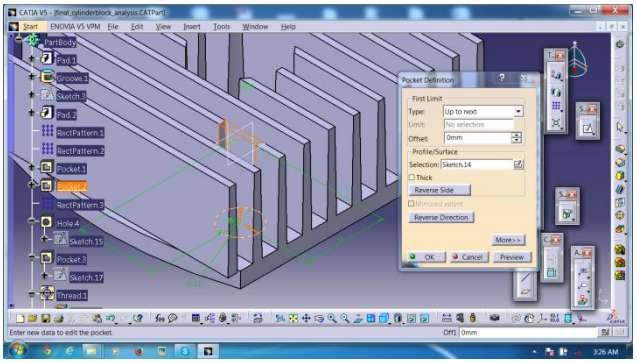

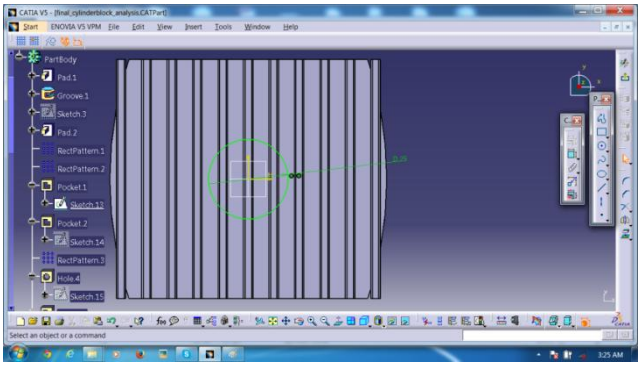

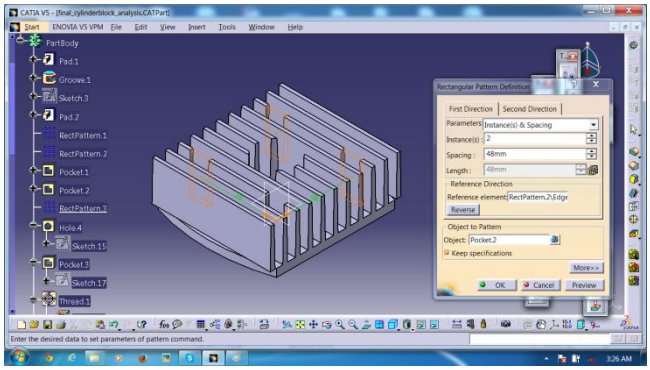

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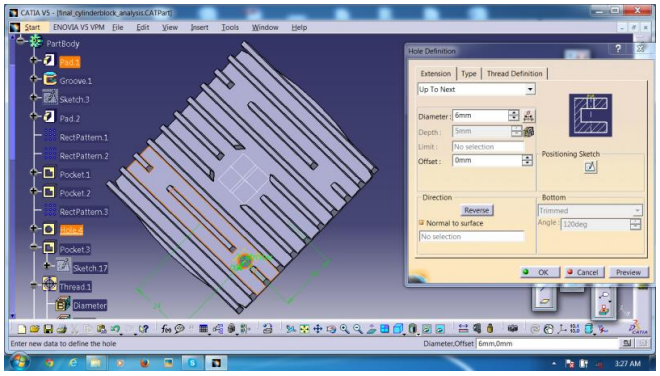
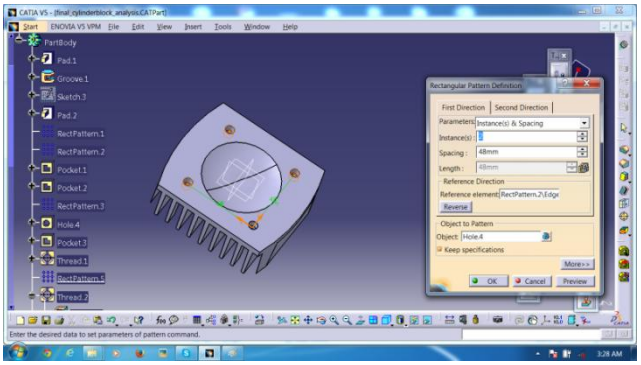
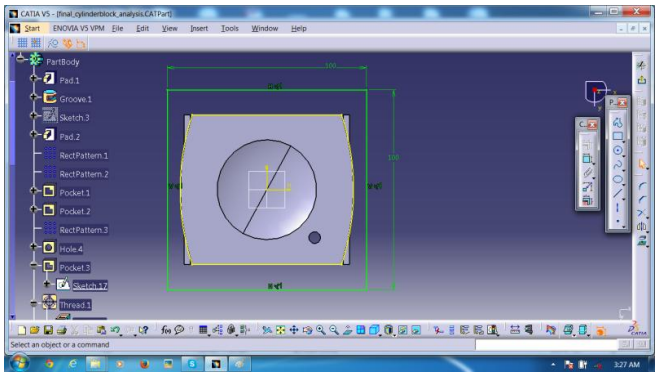
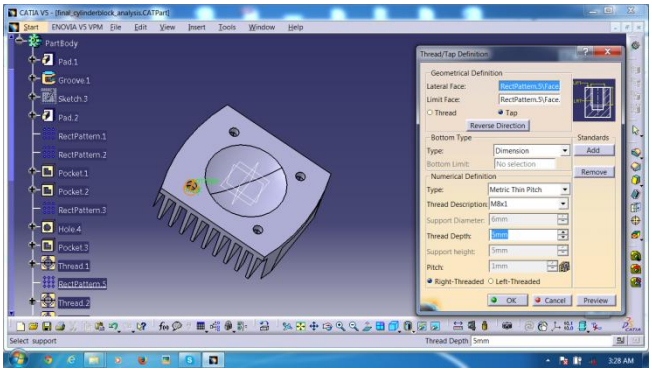
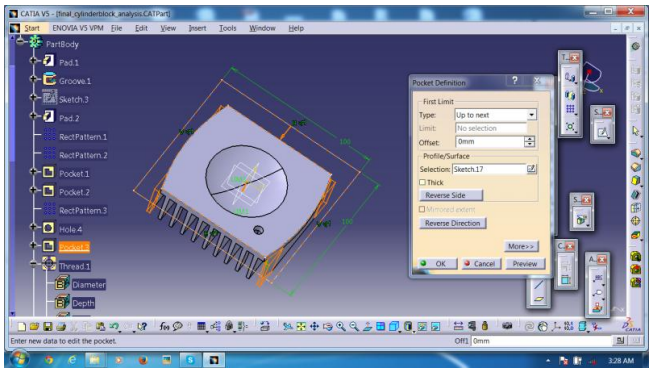
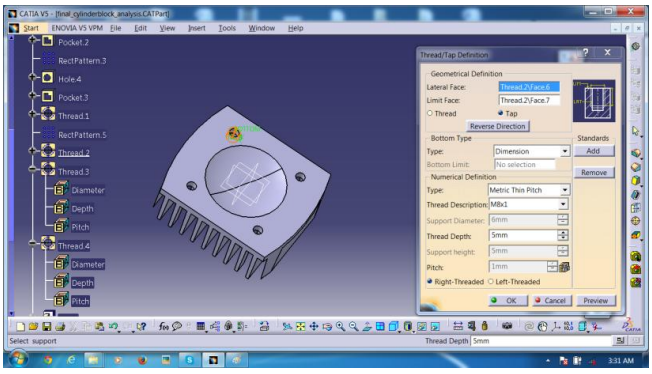
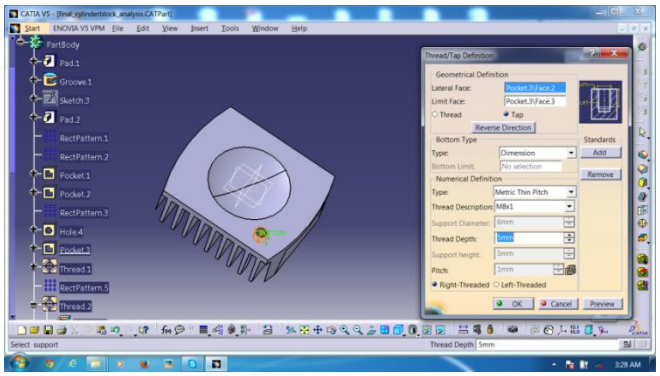
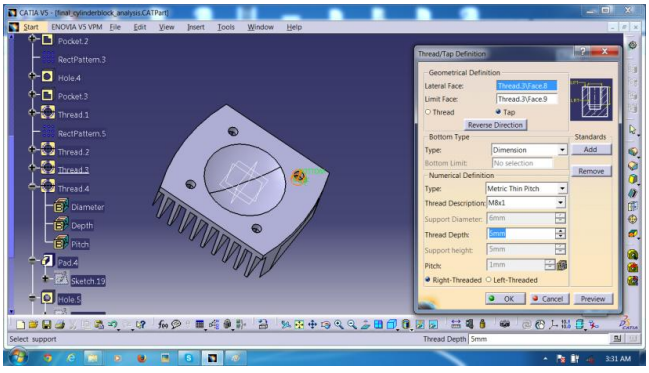

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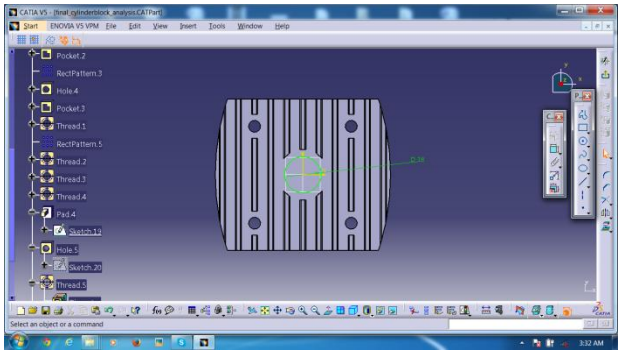
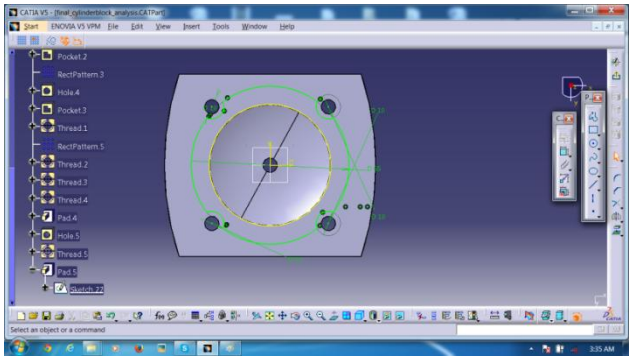
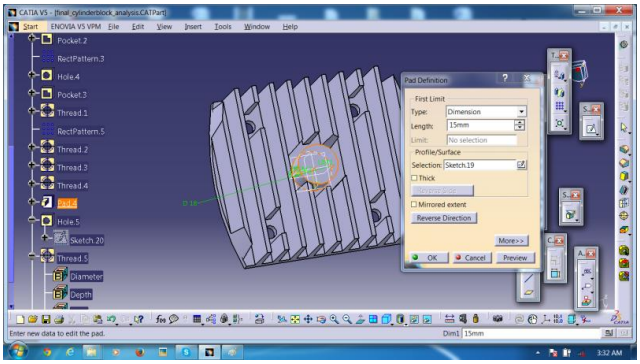
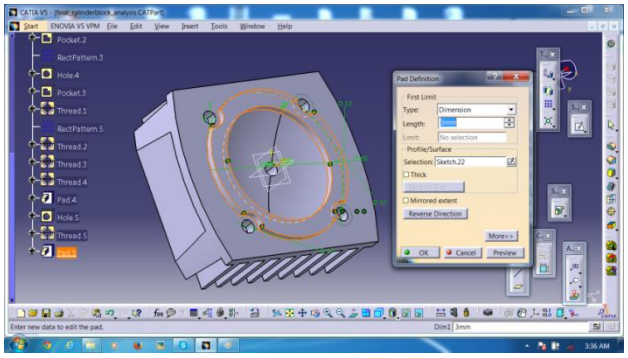
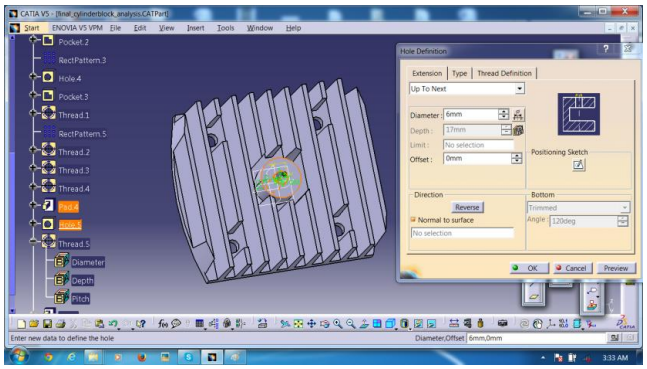


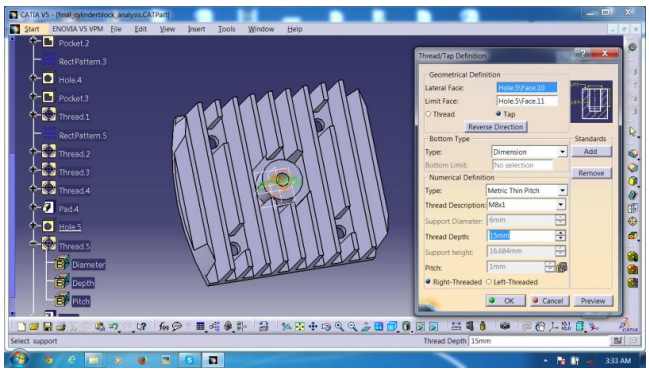


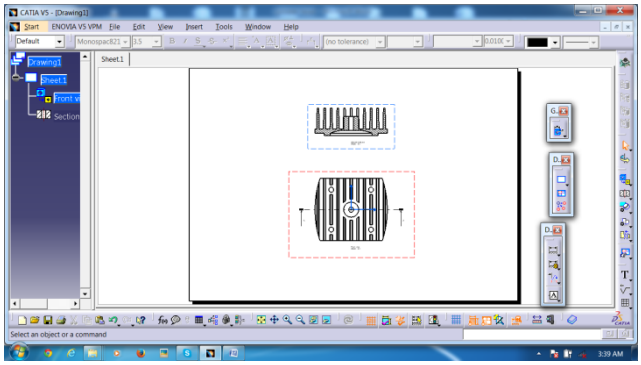






DRAFTING OF CYLINDER HEAD





- Material Data
  - Aluminum Alloy

FIGURE 3Model (A4) > Steady-State Thermal (A5) > Solution (A6) > Temperature > Figure

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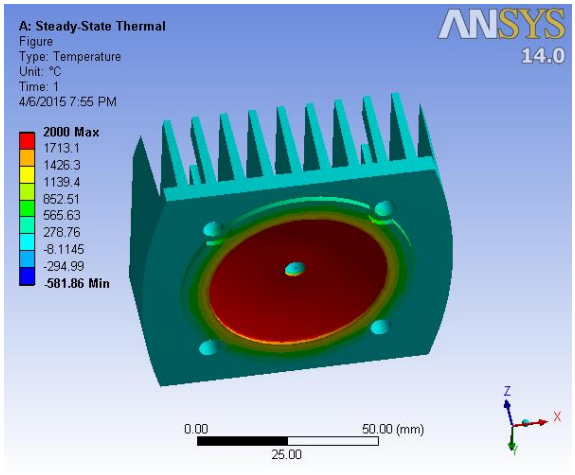
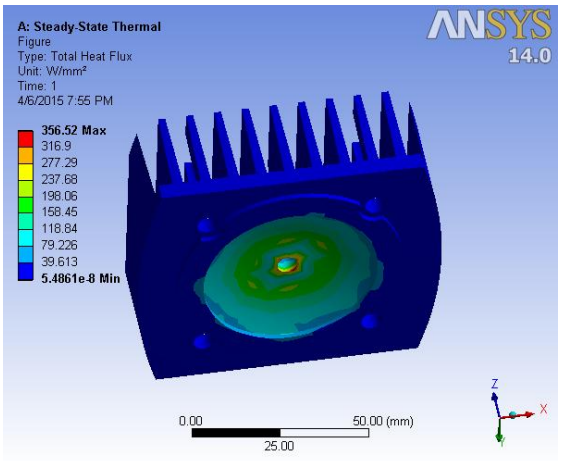


FIGURE 4 Model (A4) > Steady-State Thermal (A5) > Solution (A6) > Total Heat Flux > Figure



Material Data

Aluminum Alloy

TABLE 15 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

Conclusion:

The stress analysis on cylinder head was done with two different materials namely Aluminium LM13 and Aluminium A356 alloys. From the result obtained it was seen that the maximum stress values are lower than the permissible values of the materials. Hence we concluded that the basic design of cylinder and cylinder head is safe with reference of pressure. By using these materials we can effectively reduce the weight of cylinder and cylinder head with improved strength. Also we can see that by using Aluminium LM 13 alloy the maximum stress value is slightly lesser than that of Aluminium A356 alloy. Thus concluded that by the use of Aluminium LM13 alloy we can produce lightweight cylinder heads for IC engines.

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