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"THERMAL TRANSIENT ANALYSIS OF A TWO WHEELER PISTON WITH DIFFERENT MATERIALS BY USING FEM"

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ABSTRACT

Typical, most frequently found failures of pistons used in 06 cylinder internal combustion engines. Typical piston failures caused by the poor quality of fuel, the maladjustment of the engine feed system or wrong engine operation have been discussed. The most common cause of piston failures is an incorrectly performed repair of the engine or its improper operation. Here take two material like that AL 6061 without coating and another material is Al 6061 with coating 1 mm layer of beryllium aluminium material.

Here take thermal boundary condition is 42 ^{0}C and piston crown temperature put-up 420 0C and film coefficient 5e-006 w/m²C .Then here find out temperature results for exiting material AL6061 is 377.78 ^{0}C and Magnesium Alloy 377.78 0C when take another beryllium aluminium coated material used then find out less temperature results like 375.75 ^{0}C. Then here find out heat flux results for exiting material AL6061 is 9.2 w/mm² and Magnesium Alloy 7.60 w/mm² when take another coated material used then find out less heat flux results like 14.028 w/mm². So it is clear that Al 6061 with beryllium aluminium coated material is best for exiting material AL 6061 and Magnesium Alloy on the basis on more heat transferred and less temperature value.

***Keyword**: Piston Alloys, beryllium aluminium material, AL6061 , 6 cylinder , heat flux , coating, piston failures*

I. INTRODUCTION

The current design of the internal piston fire engines has contributed to improved performance and reliability of the piston-cylinder assembly components. Many research and development centers and sciences at home and abroad conduct studies aimed at increasing net energy and torque and reducing fuel consumption, while meeting EU standards for effective emissions of fire hazards [1, 2]. One of the main objectives of car manufacturers is to ensure the highest durability and reliability of the engine [7, 9]. The piston is a feature of the crankshaft assembly, which participates in the conversion of heat energy into a working machine [6, 10]. The piston head forms the moving part of the fire chamber. Piston grooves hold piston rings that enclose the cylinder working space, while individual piston pin holders have a piston pin bear-mounted on them, which transmits electrical energy to the crankshaft. The main function of the piston is to absorb the piston head-space pressure by the piston head. This force, increased by the inertia force, is transmitted to the piston, the piston pin and, through the connecting rod, to the crankshaft. The design of the piston must withstand high thermal and mechanical loads [8]. It is necessary to: - take heat from the head of the hot piston, heated by high temperature gas, to the walls of the cool cylinders, -

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lead the piston to the cylinder sleeve and take the pressure of the lateral piston on the cylinder bearing above, - cause very low friction loss, and - confirm the use of engine oil lubricant. The materials used for pistons in internal combustion engines include: - aluminum alloys, - alloy steels, and cast iron. The most commonly used materials for making pistons include: stainless steel, alloy steel and aluminum alloys, aluminum-silicon alloys (Al-Si) and aluminum-copper alloys (Al-Cu) These alloys are characterized by low density, being useful due to the small weight of the piston, and the large coefficient of thermal conductivity [5]. Aluminum alloys are distinguished by good posture during dispersion and mechanical efficiency (machine cutting). The main disadvantages of these alloys include: large coefficient of thermal elasticity, low hardness and low power indicators at high temperatures. Cast-iron pistons are rarely used. They are available in low-speed exercise engines. They are characterized by good slide structures, which maintain good mechanical properties at high temperatures, and a small coefficient of thermal expansion. The main disadvantages of using cast-iron pistons in modern high-speed engines are: the coefficient of low thermal conductivity and high magnitude leading to a large number of pistons and high inertia potential.

II. PROBLEM FORMULATION

Typical, most frequently found failures of pistons used in four-stroke internal combustion engines. Typical piston failures caused by the poor quality of fuel, the adjustment of the engine feed system or wrong engine operation have been discussed. The most common cause of piston failures is an incorrectly performed repair of the engine or its improper operation.

III. METHODOLOGY

1.1 FINITE ELEMENT MODEL

Establish a balanced and accurate element model that is the most important part of piston finite element analysis, thus marking the grid elements to get accurate results in the end. According to the piston structure symmetry, to facilitate calculation and reduce the workload, cut the established piston model to save 1/4 and import the model into the limited element analysis software to the piston according to good interface between modeling software and limited analytics software. During the import process, some details are left out, such as the chamfer and the snap ring of the piston pin etc. The geometric model of the piston is shown in Figure 1. The Body Structures of the Piston are shown in table1. During the production of piston model space, based on experience.

IV. MODELING & SIMULATION

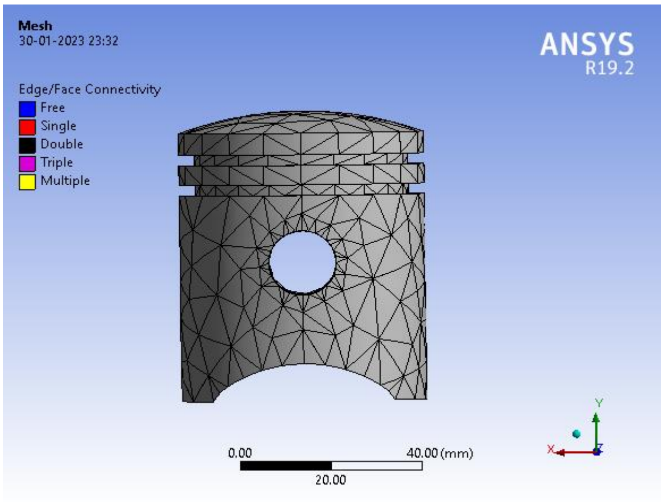

Fig.1 Piston meshing model

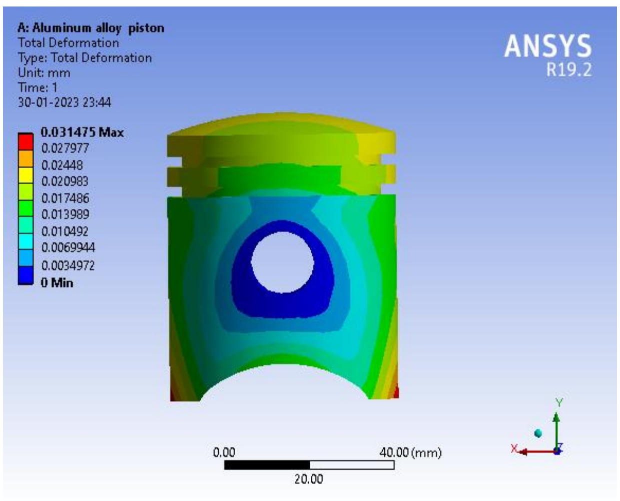

Fig. 2 Aluminum alloy piston deformation results

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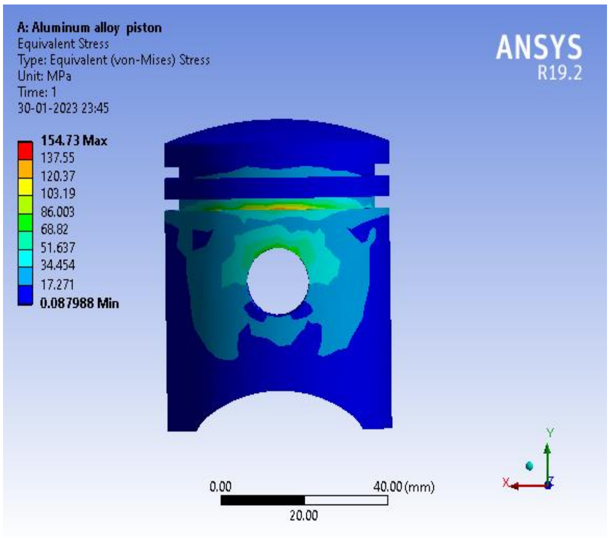


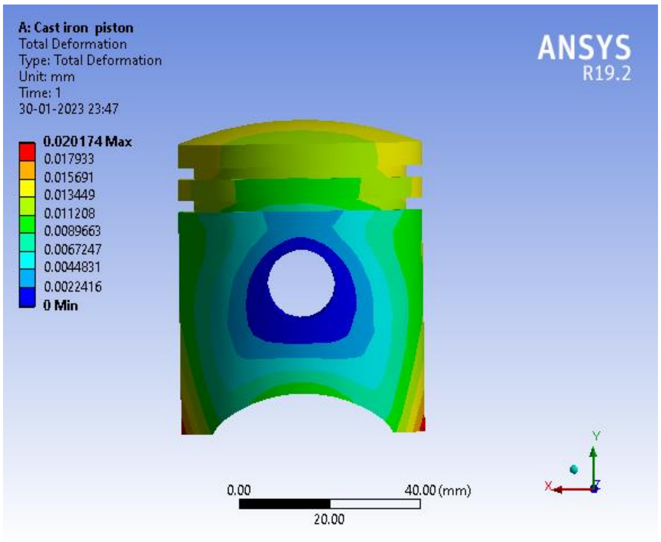


Fig. 3 Aluminum alloy piston stresses results   Fig.4 Cast iron alloy piston deformation results

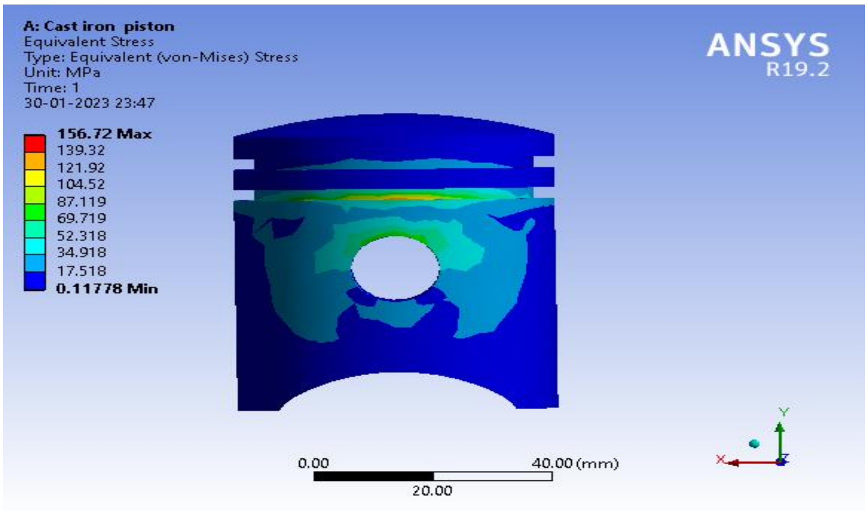
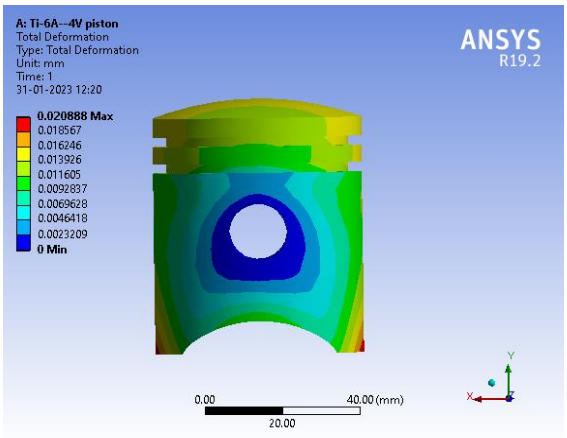


Fig. 5 Cast iron alloy piston stresses results

TI-6A- 4V



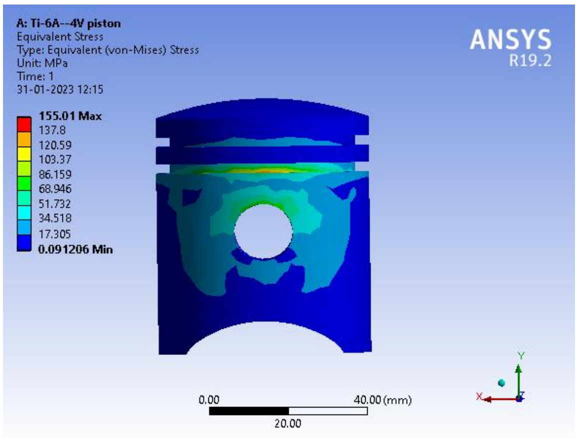


Fig.6 TI-6A- 4V alloy piston deformation results   Fig. 7 TI-6A- 4V alloy piston stresses results

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V. RESULT & DISCUSSION

Based on the measured dimensions, three-dimensional piston models were created using SOLIDWORKV5R20, a three-dimensional model. Then, for evaluation, these models were imported into ANSYS WORKBNCH 19.2. A check of the static structure of the pistons is carried out. An automatic meshing process is used to produce high quality mesh. Fuel pressure is applied to the piston pin and a frictionless guide is applied to the entire piston surface as well as the piston pin holes to evaluate the static transient structure. Then the results of von Misses strain and maximum elastic strain are obtained. These results are compared and the most suitable aluminum alloy is selected according to the parameters. Static structural assessments of cast iron, 6061 aluminum alloy and Ti-Al-4V were performed and results were obtained for thermal stress, temperature, strain and heat flow. We can confirm that a cast iron piston produces a maximum pressure of 155 MPa under equivalent pressure (von-mis). The maximum stress for 6061 aluminum alloy is calculated as 156.72 MPa, while Ti-Al-4V is calculated as 155 MPa.

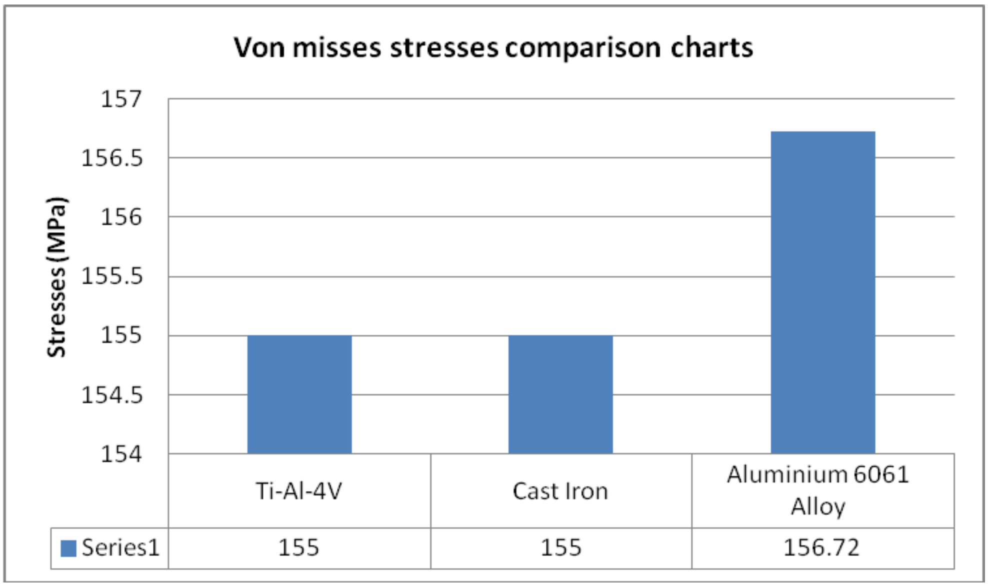

Fig.6.1Von misses thermal stresses comparison charts

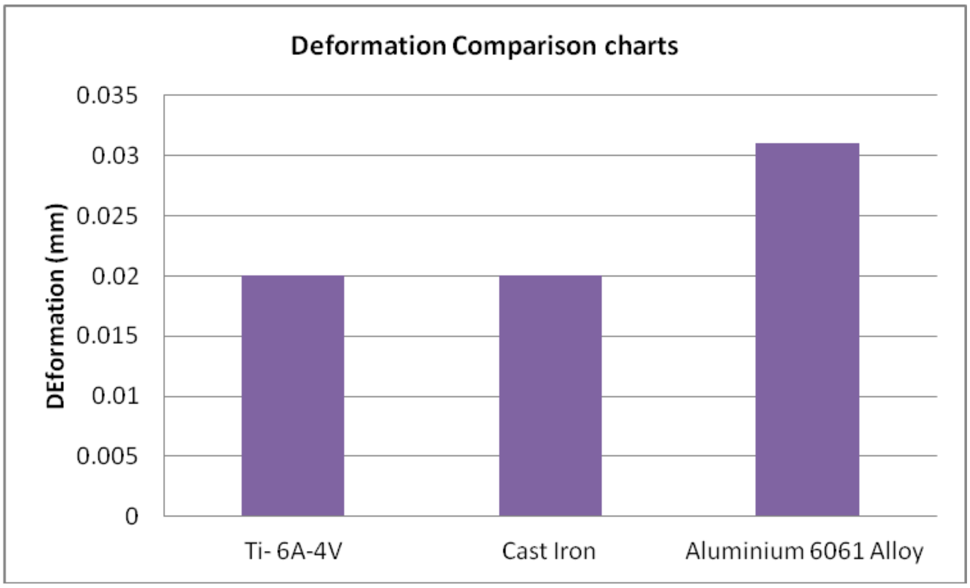

Fig . 6.2 Deformation Comparison charts

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VI. Conclusion

The basic ideas and outline techniques worried approximately single barrels petroleum engine have been considered on this paper the outcomes located through the usage of this systematic strategy are nearly equivalent to the genuine measurements utilized now a days.Henceforth 6 it gives a quick strategy to outline a piston which can be moreover enhanced through the usage of different programming and strategies. The three maximum critical element is that less time is required to outline the piston and only a couple of essential detail of the engine. Pistons made of numerous materilas like Aluminium 6061 Alloy,Cast Iron and Ti AL-4V were outlined and investigated effectively.

- In static-auxiliary investigation, the pistons were examined to discover the proportional (von-mises) stress, comparable flexible pressure and deformation.
- It tends to be seen that greatest stress force is on the base surface of the piston crown in every one of the materials.
- Here we decided on Ti AL-4V aloythis material has greater warmth flux fee with different materials. So we will be recommended this material for future work.

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