A PROJECT ON DESIGN AND THERMAL ANALYSIS OF CERAMIC LAYER PISTON WITH AL-2014& 5019 MATERIALS

A major project report submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

in

MECHANICAL ENGINEERING

by

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June 2021

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ABSTRACT

A piston is a disc which reciprocates within a cylinder. It is either moved by the fluid or it moves the fluid which enters the cylinder. The main function of the piston of an IC engine is to receive the impulse from the expanding gas and to transmit the energy to the crankshaft through the connecting rod. The piston must also disperse a large amount of heat from the combustion chamber to the cylinder walls00. Cast iron, Aluminium Alloy and Cast Steel etc. are the common materials used for piston of an Internal Combustion Engine. In this project here we taken steel as an existing material and aluminium 5 series materials.

The aim of our project is to design a piston for a two wheeler using theoretical calculations, designing with solid works software. Tools which are used in these project are CAD tool: Solid works; CAE tool: Ansys Workbench.

The material used is Aluminium 2014&5019 and steel (existing material) are used to determine the good material for manufacture of the piston.Here we analyse the two materials with the help of fem. In order to get better results here we are adding 0.25mm ceramic (Si3N4& ZrB2) layer for both material and analysed with same boundary conditions. And calculating results like deformation, stress, safety factor. And total temperature and heat flux also.

The main objective piston is investigate and analysed the thermal stress distribution of piston at the real engine condition during combustion process, in this process we applied temperature and convection as boundary conditions and we determining total temperature on the body, total heat flux values.By knowing 2 different conditions results with suitable tables and graphs project can be concluded each piston limitations and advantages &disadvantages

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CONCLUSION

In this paper piston modeling were developed by using solid works software and analyzing it by using Ansys workbench with 2 different (al-2014& al 5019) materials, after analyzing these piston materials individually by applying static and thermal boundary conditions, these both piston materials can withstand up to 10Mpa of pressure on it when it is used in combustion chamber, among these 2 materials al-2014 materials has highest (2.4546 safety factor value), it means this material more stronger than al 5019 (1.6013 safety factor) in static boundary conditions, after completing static analysis , thermal boundary condition were applied and calculated temperature and heat flux values for each material, in this case also al 2014 has got better thermal results than al 5019,

To improve the performance of the piston, here 2 ceramic layers were chosen (si3n4 & zrb2) and assembled on each piston, both these ceramics are good at their mechanical and thermal properties and this is the main reason behind choosing these two , and these ceramics having high yield limit values than al-2014&5019 materials, from static analysis results, zrb2 is having above 2 safety factor for both al-2014& 5019 material, when comes to thermal analysis this zrb2 ceramic with al 2014 materials is having high amount of temperature (256.42*c) at TDC compare to other ceramics and materials, it means nearly 50*c more temperature is observed this ceramic at TDC and this extra amount of energy can convert into mechanical energy by transmitting through crank shaft, so that energy wastage has been reduces and more mechanical energy will be generated by using al2014 material with zrb2 ceramic layer. Finally thesis concluded with al2014 material with zrb2 ceramic layer is optimum among all.

Advantages of zrb2 ceramic layers pistons

- Thermal efficiency will increases
- Exhaust wastage will reduces
- It has high melting point range, so that durability of the object will increases

Disadvantages of zrb2 ceramic layers pistons

- Thermal stress are more compare to normal piston, but these stress values all are under yield limit only so that no damage will occur on piston
- Compare to normal piston the cost will be high, by considering performance and fuel consumption it can consider as one time investment with lifelong benefits

DAMAGE IDENTIFICATION OF AEROSPACE BEAM STRUCTURES USING HARMONIC ANALYSIS

A major project report submitted in partial fulfillment of the requirements

for the award of the degree of

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ABSTRACT

Cracks in vibrating component can initiate catastrophic failures. The presences of cracks changethe physical characteristics of a structure which in turn alter its dynamic response characteristics.Therefore there is need to understand dynamics of cracked structures. Crack depth and location are the main parameters for the vibration analysis.

So it becomes very important to monitor the changes in the response parameters of the structureto access structural integrity, performance and safety. To examine the effect of the crack to the natural frequency of beams.

In the present study, vibration analysis is carried out on a cantilever beam with two open transverse cracks, to study the response characteristics. In first phase local compliance matricesof different degree of freedom have been used model transverse cracks in beam on available expression of stress intensity factors and the associated expressions for strain energy release rates. Suitable boundary condition are used to find out natural frequency and mode shapes. Theresults obtained numerically are validated with the results obtained from the simulation. The simulations have done with the help of ANSYS software.

A neural network for the cracked structure is trained to approximate the response of the structureby the data set prepared for various crack sizes and locations. Feed-forward multilayer neural networks trained by back-propagation are used to learn the input (the location and depth of a crack)-output (the structural frequencies) relation of the structural system. With this trained neural network minimizing the difference from the measured frequencies. It is verified from bothcomputational and simulation analysis that the presence of crack decreases the natural frequency of vibration. The mode shapes also changes considerably due to the presence of crack.

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CHAPTER-5
CONCLUSION

The investigation analysis of the present work is to conduct harmonic analysis of cantilever beam and simply supported beam made of structural steel consist of with and without crack. As the crack location increases from fixed end the natural frequency increases up to the center of beam and after it decreases. The natural frequency of beam decreases with increasing when crack depth from 1mm to 5mm. The lowest and highest frequency of beam with crack depth of 5mm are shown as 16.2 Hz, 1059.6 Hz and without crack is 8.1932 Hz, 694.57 Hz which are having huge difference in natural frequency.

Using this approach, damage detection can be done using natural frequency. The followings are the conclusions made from the present study:

- The present method to detect crack location and size is fast and efficient.
- Crack with larger crack depth ratio (a/h) imparts greater reductions in natural frequency than that of the smaller crack depth ratio. Hence, the accuracy of results improves as crack depth increases.
- Crack present near to fixed end imparts greater reductions in natural frequency than that to present at away from the fixed end.

A

MAJOR PROJECT REPORT

ON

Investigation of Mechanical Properties of Al6061/SiC Metal Matrix Composites

A dissertation submitted in the partial fulfilment of the Academic requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

in

MECHANICAL ENGINEERING

by

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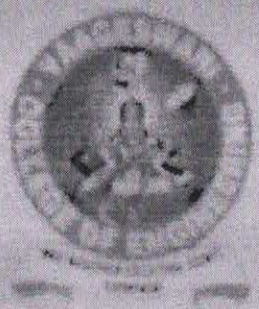

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This is to certify that major project report entitled **Investigation of Mechanical Properties of Al6061/SiC Metal Matrix Composites,** submitted by the following students in partial fulfillment of the requirement for the award of the degree of bachelor of technology In **MECHANICAL ENGINEERING** and is a bonafide record of the work performed by

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ABSTRACT

Metal Matrix Composites (MMCs) have evoked a keen interest in recent times for potential applications in aerospace and automotive industries owing to their superior strength to weight ratio and high temperature resistance. The widespread adoption of particulate metal matrix composites for engineering applications has been hindered by the high cost of producing components. Although several technical challenges exist with casting technology yet it can be used to overcome this problem. Achieving a uniform distribution of reinforcement within the matrix is one such challenge, which affects directly on the properties and quality of composite material. In the present study a modest attempt has been made to develop aluminium based silicon carbide particulate MMCs with an objective to develop a conventional low cost method of producing MMCs and to obtain homogenous dispersion of ceramic material. To achieve these objectives two step-mixing method of stir casting technique has been adopted and subsequent property analysis has been made.

Aluminium6061 (97.06% C.P) and SiC (320-grit) has been chosen as matrix and reinforcement material respectively. Experiments have been conducted by varying weight fraction of SiC (0%, 3%,6% and9%) while keeping all other parameters constant. The resultsindicated that the 'developed method' is quite successful to obtain uniform dispersion of reinforcement in the matrix. An increasing trend of Tensile Test with increase in weight percentage of SiC has been observed. The results were further justified by comparing with other investigators.

Keywords: Metal Matrix Composites MMC's, Silicon Carbide SiC.

Chapter-5

CONCLUISON

Al6061 based ceramics reinforced Metal Matrix composites have been successfully prepared using stir casting technique. Mechanical properties such as tensile strength, hardness of the specimens were tabulated and the following conclusions were drawn:

- The tensile test shows that the Al6061-6% SiC has better ultimate tensile strength of 153 N/mm^2 when compared to Al6061 which has ultimate tensile strength of 110 N/mm^2.
- Tensile test results shows that the Al6061-6% SiC MMC material has good ultimate tensile strength property when compared toother ceramic reinforced MMCs.
- The hardness of ceramic reinforced MMCs is greater than the base alloy Al6061. Al6061-6 % SiC composite materials shows better hardness property of 76.6 BHN while Al6061has hardness property of 63 BHN.
- Al6061-6%SiC composite shows uniform distribution of reinforcement particles in the base alloy. Due to this the Tensile strength and hardness of this composite is increased.
- It is observe that hardness increses to 13.6% t o AL alloy.
- From tensile graph we have seen that tensile stength is highest at AL6061+6%SIC

DESIGN THERMAL AND CFD ANALYSIS OF STEAM BOILER USED IN POWER PLANTS

A major project report submitted in partial fulfilment of the requirements for the award of the degree of
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ABSTRACT

Boilers are used to generate steam that then provides heat or power. Water is converted steam in the boiler. This steam travels through the heating apparatus which can be any piece o equipment that requires steam for operation. The cooled steam is then condensed into water and returns to the boiler to start the cycle again. Steam boilers heat water to produce steam, which is then used to generate energy or heat for other processes .In this thesis the steam flow in steam boiler tubes is modelled using solid works design software. The thesis will focus on static and thermal and CFD analysis with different velocities (15, 30, 45& 60m/s).Thermal analysis done for the steam boiler by steel, steel416 & brass at different heat transfer coefficient values. These values are taken from CFD analysis at different velocities. In this thesis the CFD analysis to determine the heat transfer coefficient, heat transfer rate, pressure drop and thermal analysis to determine the temperature distribution, heat flux with different materials. 3D modelled parametric software solid works and analysis done in ANSY.

CHAPTER.9

Conclusion

In this present thesis steam boiler modeling were devolved by using solid works and then imported into Ansys workbench to calculate the static and thermal and fluent behavior of the of the object by varying different materials (steel, brass, steel 416). In this process from static analysis results it is observed that this steam boiler can withstand maximum of 45Mpa of pressure in it, among all steel 416 material is having better safety factor values, so that this steel 416 material can with stand more pressure compare to remain 2 materials,

From thermal boundary conditions, brass is having high heat flux values, whereas steel, steel 416 materials are having nearby values, so that if brass material is implemented in real time there will be huge heat transformation from inside of the pressure vessel to atmosphere, and it is not suggestable because whenever there is huge heat losses are there the object wont perform to maximum level, so that this brass material is not suggestable even though it is good at static and fluent conditions,

From fluent analysis results it is observe that steel 416 materials has high outlet temperature values with low heat transfer coefficient values, so that this steel 416 material is good at static and thermal and even fluent boundary conditions also, compare to other materials this steel 416 material is consider as optimum materials and it is a replacement of steel material in real time,