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Design and Manufacturing of Spark Plug and Injector using Rapid Prototyping

Dr. U. V. Kongre#1, Dr. R. M. Sherekar*2, Ojas Gandhewar #3, Abhishek Sharma #4

HOD, Department of Mechanical Engineering, J.D.I.E.T.,Yavatmal, Maharashtra, India[1]
Assistant Professor, Department of Mechanical Engineering, J.D.I.E.T.,Yavatmal, Maharashtra, India[2]
U.G. Student, Department of Mechanical Engineering, J.D.I.E.T.,Yavatmal, Maharashtra, India[3-4]

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ABSTRACT

Rapid prototyping is a technique generally used for manufacturing complex product geometries, which otherwise require to produce with multiple operations and processes using traditional manufacturing. This paper discusses about 3D modelling in CATIA, its features, benefits, and how it is used in the engineering design process. CATIA offers various features, including parametric modelling, assembly modelling, surface modelling, and drafting, which provide many benefits such as increased design accuracy, improved design communication, faster design iterations, and reduced manufacturing costs. 3D modelling is an essential part of the engineering design process and is used for conceptual design, detailed design, and manufacturing. The rapid prototyping process involves creating a digital model, slicing the model, preparing the printer, printing the model, and finishing the model. This paper describes real-time design and manufacturing of spark plug and injector using Rp machine.

Keywords :- 3D modelling, CATIA, RP

I. INTRODUCTION

In this project we have designed and manufactured the automobile components using a very rapidly growing technology called rapid prototyping. In which it includes different software's for different purposes. The process of designing and modelling is completely done in the software named CATIA V5 there after the desired designed component is been converted into the stl (standard triangulated language) file. This was all about the designing process. This paper also explains about methodology and manufacturing of the automobile component. The methodology of 3d printing a component is to slice the stl file and convert it into the cfff file, and then it is provided to a 3d printer, which uses an additive manufacturing technique. The manufacturing process of a component is carried out by the 3d printer which is used in the project (Wipro F300-1).

II. MODELLING

CATIA offers number capabilities, which allows us to create models that can be easily modified and updated. This feature is particularly useful when making design changes or iterating on designs [2].Thus we used catia for our 3d modelling. In which we have use various types of commands like pad, pocket, etc. As shown in fig.1

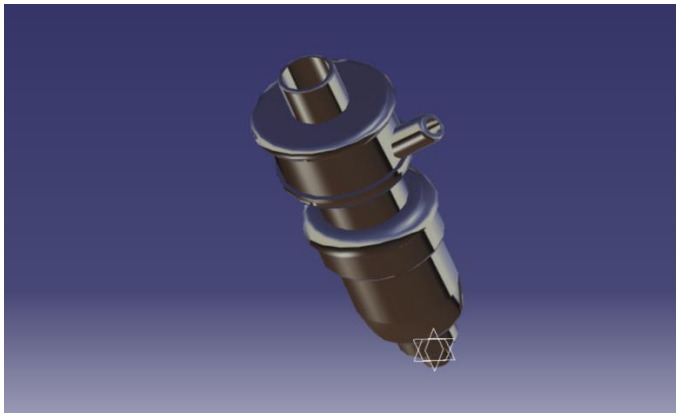

Fig.1: Design of fuel injector

After creating complex assemblies and combining multiple parts and sub-assemblies. This feature is particularly useful when designing machines or other complex systems [3].As shown in Fig.2 First of all we designed each and every part separately like crankshaft, connecting rod, piston head, piston pin, upper head, lower Block. Then it is assembled in the part assembly which makes the different parts assembled together.

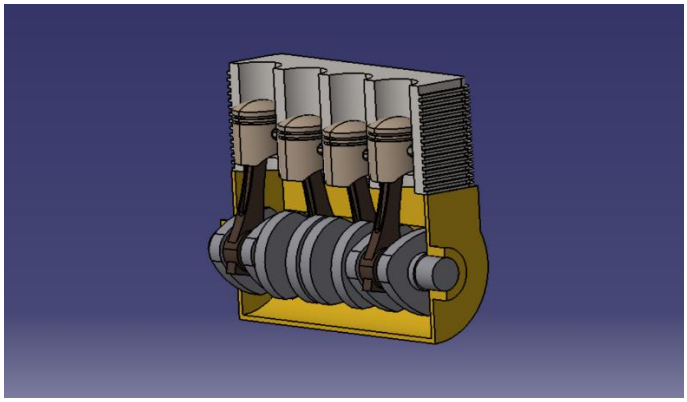

Fig.2: Design of Engine for Fabrication

This geometry of spark plug is designed in catia with the help of advanced surface modelling capabilities, which allowed us to create complex and organic shapes. It is particularly useful for designing electronic devices [4].As a spark plug is a very complex and critical geometry, we designed it with the help of surface modelling. As shown in fig.3.

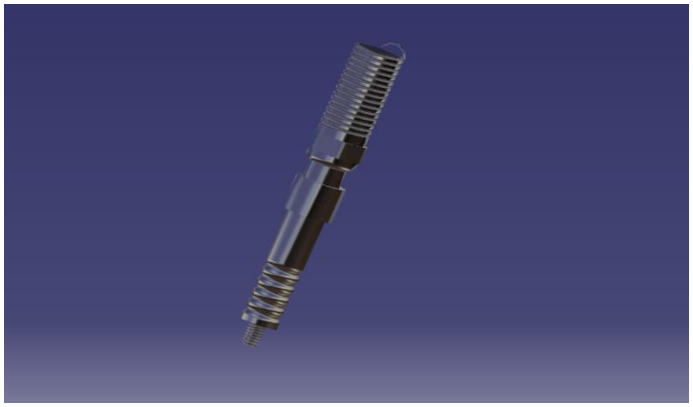

Fig.3: Design of Spark Plug

III.METHODOLOGY

Step-by-Step Processes of 3D Printing: The 3D printing process typically involves the following steps:

The very first step is to creating a digital model using 3D modelling software [7].As shown in fig.1, fig.2; fig.3.we designed a desired geometry of a component to print the model using RP. Proceeding to next step. The next step is slicing the model. The digital model is then sliced into thin layers using slicing software. The thickness of each layer depends on the resolution of the printer [8].The slicing software we used for slicing is ultimaker cura which converts the stl file into the gcod. The language which is understandable to the 3d printer. It is also known as (Cartesian fuse filament fabrication) cfff file. The references are shown in fig.4 and fig.5.

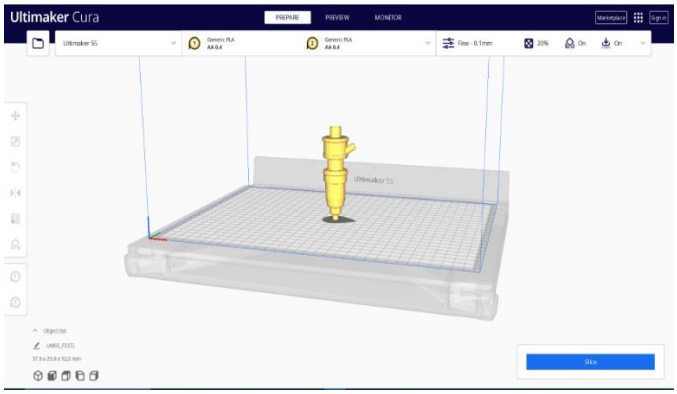

Fig.4: Slicing FI in Cura

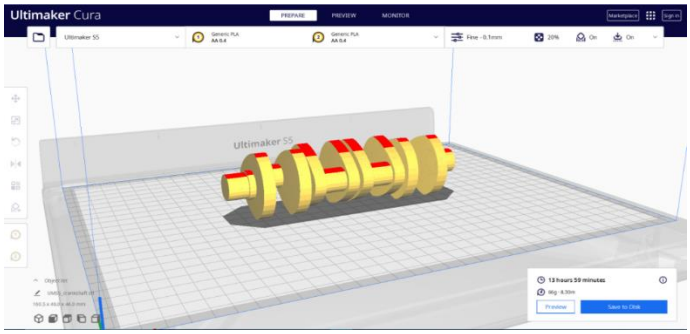

Fig.5: Slicing Crank Shaft in Cura

After conversion of stl to cfff the printer is been prepared by selecting the appropriate material, loading it into the printer, and calibrating the printer settings [9]. Then final we proceed towards to the printing of a model. The printer then begins to print the model layer by layer using the selected material. The process can take anywhere from a few minutes to several hours or Days, depending on the complexity of the design and the size of the object [9]. The process of printing the model using RP is shown in fig.6 and fig.7.

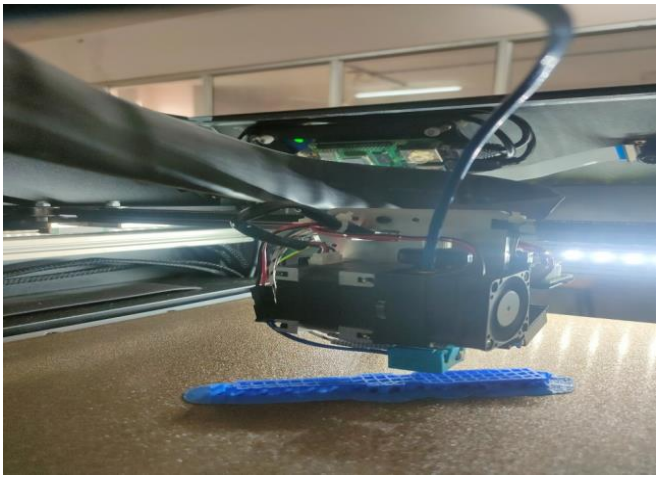

Fig.6: Fabrication of Spark Plug

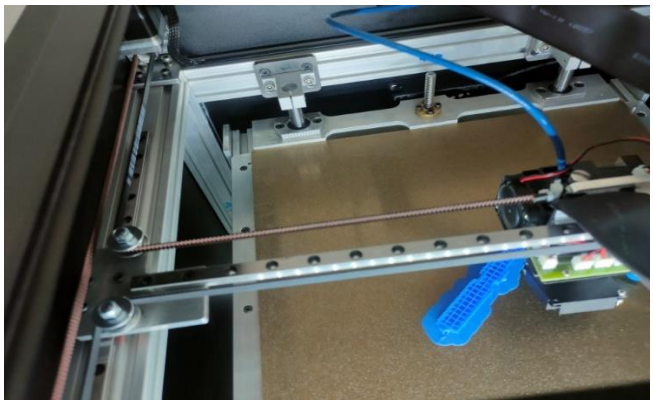

Fig.7: Fabrication in Wipro F300-1

Once the model is printed, it is removed from the printer and any support structures are removed. The model also requires additional finishing steps, such as sanding or painting, depending on the desired finish. We finished our project with the finishing of the component printed with the RP. The finished product is shown in fig.8.

Fig.8: Finished product

Materials used in 3d printing: Thermoplastics such as ABS and PLA are commonly used in FDM printers. Resins: such as photopolymer resins, are commonly used in SLA printers. Metals such as titanium, stainless steel, and aluminium, are commonly used in SLS printers.

IV. CONCLUSION

This paper explores the design of engine components, spark plug and injector along with the details of designed tool and the manufacturing process. The tool used Catia v5 for design the geometry of the component and imported into Cura and afterwards in WIPRO F300-1 printer. The results of outcomes are satisfactory and helpful to achieve the complex manufacturing in 6 hours. It is concluded that the RP technology will open the doors of complex geometry manufactured product and will considered to be best option for traditional manufacturing.

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