Design and 3D Printing of Connecting Rod

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Abstract— Connecting rod interconnects piston to crankshaft and it is responsible for transferring power from piston to the crankshaft and sending it to the transmission. Connecting rods are traditionally manufactured using mould casting method which has high moulding cost and requires highly skilled designer to design the mould which is also more costly. So there is a need to optimise the manufacturing process of connecting rod. In this project work, Objective is to use advance manufacturing processes to produces connecting rod using 3d printing methods.

Keywords: 3D Printing Methods, Connecting Rod, Poly Lactic Acid (PLA)

I. INTRODUCTION

3D printing creates solid parts by building up objects one layer at a time. Producing parts via this method offers many advantages over traditional manufacturing techniques. 3D printing is unlikely to replace many traditional manufacturing methods yet there are many applications where a 3D printer is able to deliver a design quickly, with high accuracy from a functional material. Understanding the advantages of 3D printing allows designers to make better decisions when selecting a manufacturing technique that results delivery of the optimal product. One of the main advantages of additive manufacture is the speed at which parts can be produced compared to traditional manufacturing methods. Complex designs can be uploaded from a CAD model and printed in a few hours. The advantage of this is the rapid verification and development of design ideas. Where in the past it may have taken days or even weeks to receive a prototype, additive manufacturing places a model in the hands of the designer within a few hours. While the more industrial additive manufacturing machines take longer to print and post process a part, the ability to produce functional end parts at low to mid volumes offers a huge time saving advantage when compared to traditional manufacturing techniques. In this paper, an attempt is made to design a new concept of manufacturing connecting rod using additive manufacturing where there is a requirement for customized order or single product without investing into mold manufacturing cost.

It consists of three main parts Pin End (Small End) Shank Section (Middle) Crank end (Big End).

Fig. 1: Connecting Rod

Connecting Rod Traditionally Connecting rods are manufactured using Alloy steel, who's manufacturing cost is high due to mold casting, quenching processes etc. So there is a need to design a 3D printed Connecting rod using advanced 3D printing methods & materials which can be made quickly and easily, with high strength, durability and performance.

II. LITERATURE REVIEW

The idea of printing 3D objects conceptualized and was patented by Chuck Hull of 3D Systems Inc. in 1986. Sachs et al. at MIT obtained a patent for making a component by depositing a first layer of a fluent porous material, such as a powder, in a confined region and then depositing a binder material to selected regions of the layer of powder material to produce a layer of bonded powder material at the selected regions. Such steps are repeated at selected number of times to produce successive layers of selected regions of bonded powder material so as to form the desired component. The un-bonded powder material is then removed

Berman in his paper examined the characteristics and applications of 3D printing for mass customization. He argued that there are a number of promising applications exist in the production of replacement parts, dental crowns, and artificial limbs, as well as in bridge manufacturing. 3D printing market allow firms to profitably serve small market segments, and enable companies to operate with little or no inventory and significantly reduce the need for factory workers

Singh et al. reviewed the recent technological advancements in materials and in technological aspects of 3D printing, identified future challenges and potential applications in engineering, manufacturing and tissue engineering. Also provided number of patents filed in materials, their applications and industry-wise patent filing trends. Thompson et al. provided an overview of the major advancements, challenges and physical attributes related to Direct Laser Deposition (DLD) process. The Part I focused on the thermal/fluidic phenomena during the powder-fed DLD process, which directly influence the solidification heat transfer, which thus affects the part's microstructure and associated thermo-mechanical properties. In Part II Shamsaei et al. focused on the mechanical properties, characteristics, behavior and microstructure of parts manufactured via DLD and post DLD process parameters (e.g. heat treatment, machining). Methods for controlling/ optimizing the DLD process for targeted part design discussed – with an emphasis on monitored part temperature and/or melt pool morphology.

III. METHODOLOGY AND GENERAL PRINCIPLES

A. Modeling

3D printable models can be created with the help of CATIA design packages or via 3D scanner. The manual modeling

process of preparing geometric data for 3D computer graphics is similar to method sculpting. 3D modeling is a process of analyzing and collecting data on the shape and appearance of an object. Based on this data, 3D models of the scanned object can be produced. Both manual and automatic creations of 3Dprinted models are very difficult for average consumers. That is why several market-places have emerged over the last years among the world. The most popular are shape ways, Thing verse, My Mini Factory, and Threading.

B. Printing

Before printing a 3D model from .STL file, it must be processed by a piece of software called a "slicer" which converts the 3D model into a series of thin layers and produces a G-code file from .STL file containing instructions to a printer. There are several open source slicer programs exist, including, Slic3r, KISSlicer, and Cura. The 3D printer follows the G-code instructions to put down successive layers of liquid, powder, or sheet material to build a model from a series of cross-sections of a model. These layers, which correspond to the virtual cross sections from the CAD model are joined or fused to create the final shape of a model. The main advantage of this technique is its ability to create almost any shape or geometric model. Construction of a model with existing methods can take anywhere from several hours today's, depending on the method used and the size and complexity of the model. Additive systems can typically reduce this time to very few hours; it varies widely depending on the type of machine used and the size and number of models being produced.

C. Finishing

Although the printer-produced resolution is sufficient for many applications, printing a slightly oversized version of the object in standard resolution and then removing material with a higher-resolution process can achieve greater precision. As with the AccurateiD-20 and other machines Press Release. International Manufacturing Technology shows some additive manufacturing techniques are capable of using multiple materials in the course of constructing parts.

IV. 3D PRINTING TECHNIQUE

A. Fused Deposition Modelling

Fused deposition modeling (FDM) method was developed by S. Scott Crump in the late 1980s and was designed in 1990 by Stratasys. After the patent on this technology expired, a large open source development community developed and commercial variants utilizing this type of 3D printer appeared. As a result, the price of FDM technology has dropped by two orders of magnitude since its creation. In this technique, the model is produced by extruding small beads of material which harden to form layers. A thermoplastic filament or wire that is wound into a coil is unwinding to supply material to an extrusion nozzle head. The nozzle head heats the material up to the certain temperature and turns the flow on and off. Typically the stepper motors are employed to move the extrusion head in the z-direction and adjust the flow according to the requirements. The head can be moved in both horizontal and vertical directions, and control of the mechanism is done by a computer-aided manufacturing (CAM) software package running on a microcontroller.

V. MATERIAL USED

A. Poly Lactic Acid (PLA)

Poly lactic acid (PLA) (is derived from corn and is biodegradable) is another well-spread material among 3Dprinting enthusiasts. It is a biodegradable thermoplastic that is derived from renewable resources. As a result PLA materials are more environmentally friendly among other plastic materials. The other great feature of PLA is its Bio compatibility with a human body. The structure of PLA is harder than the one of ABS and material melts at 180 –220°C which is lower than ABS. PLA glass transition temperature is between 60 – 65°C, so PLA together with ABS could be some good options for any of your projects.

VI. PROCEDURE FOR SLICING AND 3D PRINTING

A. Adding and repairing your model

To add your model, click on the plus icon in the middle. Choose your file and it will be loaded onto the screen. Use the "Pan", "Move" and "Rotate" tools to look around. You can also use the shortcuts. One thing you might notice is an orange warning sign. This means your models are "Invalid" and that they need to be repaired. If you unselect them, they will be colored red. Repairing is a very smooth and efficient process in Idea Maker. Here's how to do it:

1) Select the model.
2) Click "Repair" on the toolbar

VII. RESULT

Connecting rod is designed and 3D printed by using Fused Deposition Modeling

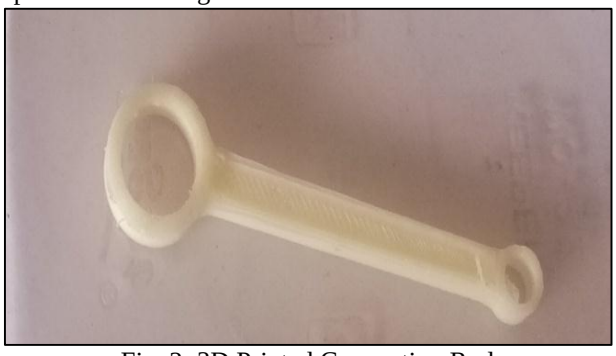

Fig. 2: 3D Printed Connecting Rod

The final 3D printed object is a prototype of connecting rod made by 3D printing to identify the minute errors and solve them to manufacture a perfect model of connecting rod.

VIII. CONCLUSION

In this journal modeling of a CRANKSHAFT is carried out with the of CATIA v5 Software by using of machine design. After creating model we save the component in stl. file. Import the component into the 3D Printing machine. And then we apply the G-CODES to the component. And then we get the component.

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