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Design And Prototype Of Elliptical Trammel Using 3D Printing

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Abstract: Additive Manufacturing (AM) is a group of 3D printing techniques aiming design verification, visualization, and kinematic functionality testing. This includes several methods such as selective laser sintering (SLS), fused deposition modelling (FDM), stereolithography (SLA) and three-dimensional printing (3DP). In this paper we use FDM methodology. It is the most common 3D printing method. On the contrary of advantages of FDM method, there are some uncontrollable production problems to be solved such as incomplete bottom layers, hanging strands, missing walls, pillowing, shifted layers, unfinished parts, and delamination of layers, warping syndrome, burn marks and irregular walls. Various three-dimensional printing (3-DP) techniques are available for fabricating parts by offering better quality characteristics regarding materials and performance. In the proposed work, the performance characteristics of the FDM fabricated parts using Polylactic Acid plus known as "PLA plus".
In this study, FDM process use to print a prototype of Elliptical Trammel. During production problems are investigated and grouped. Also, solution approaches are presented to prevent those production flaws. AM has implemented a novel method of production in design, manufacture, and delivery to end-users. Accordingly, AM technologies have given great flexibility in design for building complex components, highly customized products, effective waste minimization, high material variety, and sustainable products.

Keywords: Additive Manufacturing, 3D printing, FDM, PLA Material etc.

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I. INTRODUCTION

The term Rapid Prototyping (or RP) is used in a variety of industries to describe a Process for rapidly creating a system or part representation before final release or Commercialization. In other words, the emphasis is on creating something quickly and that the output is a prototype or basis model from which further models and eventually the final product will be derived. A recently formed Technical Committee within ASTM International agreed that new terminology should be adopted. While this is still under debate, recently adopted ASTM Consensus standards now use the term Additive Manufacturing. (AM) is an advanced and one of the most promising methods to produce prototypes and models can be directly used in several fields, and layered manufacturing is the most common technique for AM aiming the design verification, visualization, and kinematic functionality testing [4, 5]. There are several methods for AM, which are selective laser sintering (SLS), fused deposition modeling (FDM), stereolithography (SLA).
FDM (Fused deposition modeling) , the name itself also explains the method that the fused material is deposited in layers to produce a part, is the one of most promising RP method considering cost- effectiveness and production speed. It is widely used, and almost half of the 3D printing machines are in this category [5, 6,]. Dimensional accuracy is one of the important variables in the manufacturing, and comparing with conventional manufacturing processes AM methods is inaccurate. So that, to increase dimensional accuracy, the method should be understood clearly to avoid undesired production problems like skewness, and low dimensional accuracy.
The FDM method was developed in 1988 by Steven Scott Crump who also founded Stratasys and commercialized the FDM process after one year later. This company put the first 3D printing device on the market with the name of 3D Modeler in 1992

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II. LITERATURE REVIEW

S.NO.	AUTHER'S NAME	CONCLUSION
1.	L. Bochmann, C. Bayley, M. Helu, R. Transchel, K. Wegener, and D. Dornfeld, "Understanding error generation in fused deposition modeling," Surf. Topogr. Metrol. Prop., vol. 3, no. 1, p. 14002, 2015	There are several factor that affect the print quality considering FDM printing method. Some of them can be understood and learned by eexperiences. For avoiding bad prints, some measures should be taken. Especially the room where FDM machines are located should be lack of draughts, and the table or surface where the printer is stood should be sturdy and flat. Besides, to prevent low-quality prints, high-quality filaments should be used and 3D printing flaws, slicing software options and FDM machine working principles should be understood clearly to take precautions.
2.	Dr. Ian Gibson Department of Mechanical & Production Engineering National University of Singapore 9 Engineering Drive 1 Singapore 117576 Singapore	From this book we learn brief knowledge about rapid manufacturing to digital manufacturing as well as all the processes in additive manufacturing[8]
3.	Ashutosh Kumar Gupta, Mohammad Taufik 2021	Effect of process variables on performances measured in filament and pellet based extrusion process[4]
4.	Kaufui V. Wong1 and Aldo Hernandez Department of Mechanical and Aerospace Engineering, University of Miami, Coral Gables, FL 33146, USA	In this paper discussion of the relevant additive manufacturing processes and their applications. The aerospace industry employs them because of the possibility of manufacturing lighter structures to reduce weight[6]

III. METHODOLOGY

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. In this Project we use Cura software for Slicing.

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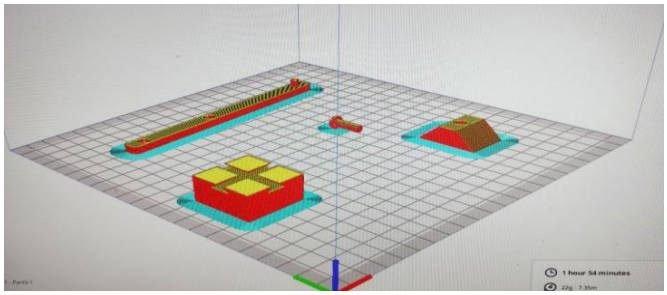
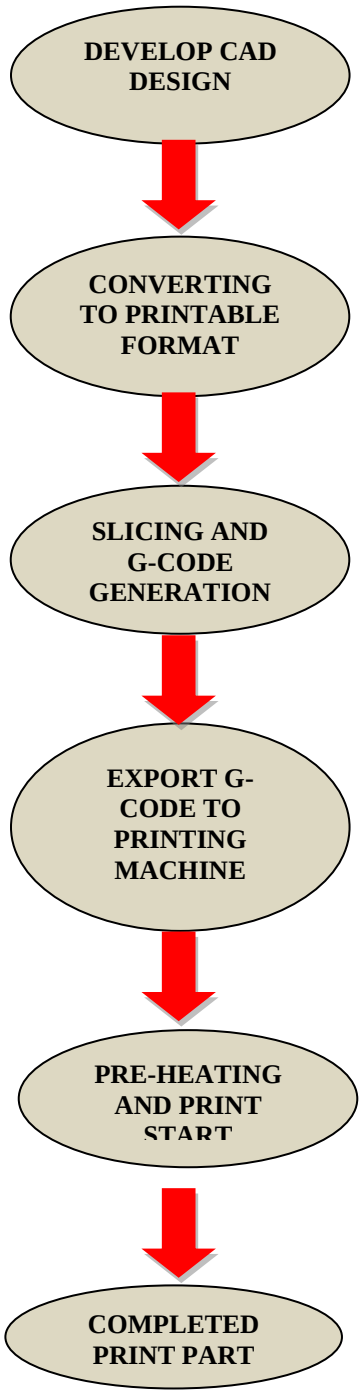


Fig. 1 Component of Elliptical Trammel after Slicing

Process Flowchart



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FDM Process

In this project a prototype of elliptical trammel drawn with the help of 3D printer (Anet ET4Pro) model and conclude several problems arise during printing and try to overcome it.

Most common extrusion-based AM technology is Fused Deposition Modeling (FDM), produced and developed by Stratasys, USA [6]. FDM uses a heating chamber to liquefy polymer that is fed into the system as a filament. The filament is pushed into the chamber by a tractor wheel arrangement and it is this pushing that generates the extrusion pressure. The initial FDM patent was awarded to Stratasys founder Scott Crump in 1992 and the company has gone from strength to strength to the point where there are more FDM machines than any other AM machine type in the world. The major strength of FDM is in the range of materials and the effective mechanical properties of resulting parts made using this technology. Parts made using FDM are amongst the strongest for any polymer-based additive manufacturing process.

For making elliptical trammel we use Fused Deposition Modeling (FDM) process comes under additive process, the name itself gives the idea that the parts are formed by deposition of the fused material in layers. This RP technique is used in modeling, prototyping and production applications. FDM was developed by S. Scott Crump in the late 1980s and was commercialized in 1990 by Stratasys.

IV. CAD Model Of ELLIPTICAL TRAMMEL

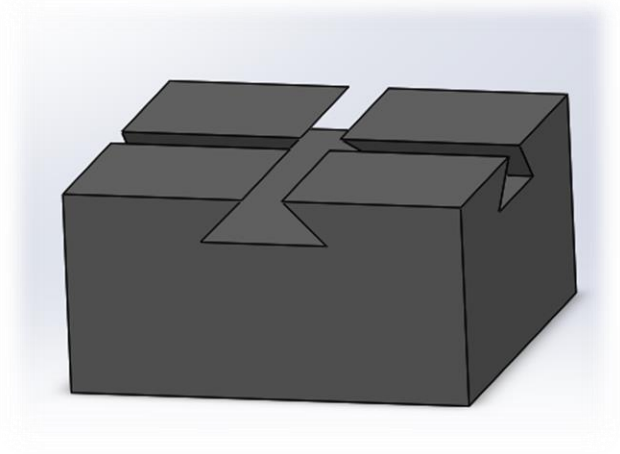

Fig. 1 Channel

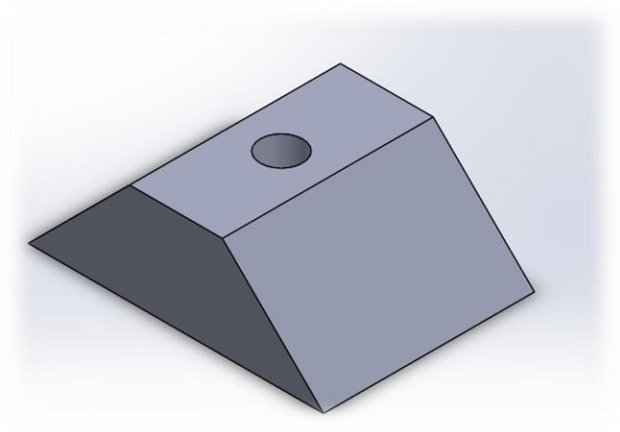

Fig. 2 Shuttle

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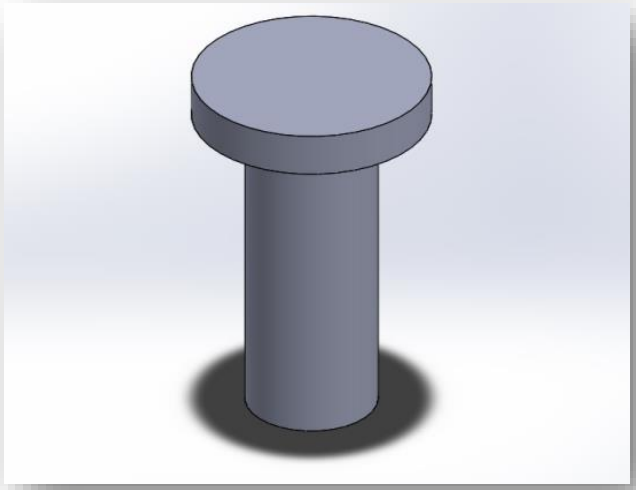

Fig. 3 Pivot

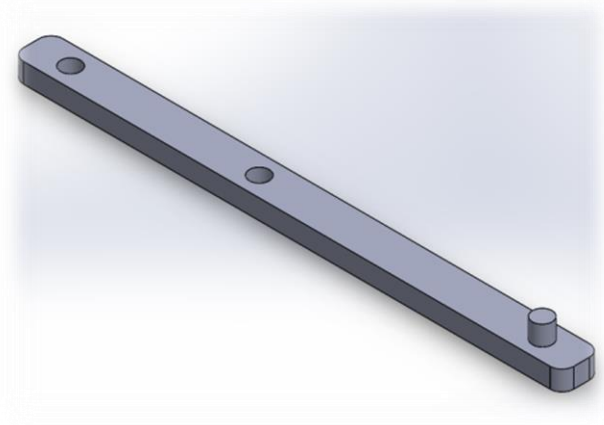

Fig. 4 Rod

V. CONCLUSION

This paper all about the 3D printing of Elliptical trammel from additive manufacturing process. After printing of object object (ET) from 3D printing, we specified the different problems which we see and optimize during the printing process. There are several problems which is see like heating defects , surface roughness , layer shifting , first layer adhesive problem , clogging of nozzle and so on. There all are the problems on which there should be a future research and work is done so that to overcome all that problems. This study has identified the additive manufacturing field's scope by using a 3D printing process made from polymer filament for the future research in optimizing and characterizing FDM processes and materials. It has been emphasized that FDM is characterized by a large number of process parameters that determine mechanical properties and the quality of results. Nevertheless, there are still some relationships between factors and parameters that are not yet clear, making future work very important to be determined to give the best results. So, if we worked on that factor than the title fit imperfection of the 3D printing is removed and it can be more acquirable in industries.

ACKNOWLEDGMENT

We would like to express our sincere gratitude and honour to our project supervisor **Mr. Darshan Srivastav**, Assistant Professor, Department of Mechanical Engineering, BIT, for supervising and guiding us during our final year project entitled "Design And Prototype Of Elliptical Trammel Using 3D Printing" as a partial fulfilment of Bachelor's degree in Mechanical Engineering. It was almost impossible to complete this project without his support, suggestion and guidance..

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