Design and Manufacture of Machining Fixture Using 3D-Printing Technology

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Abstract- *3D-Printing Technology has gained a large amount of importance in the recent times. This is mainly due to the fact that it has outstanding advantages in terms of time and cost. Due to flexibility and relative mobility of 3D-printnig, it is speculated that 3D-Printing could help to meet the growing demands of manufacturing industries in developing world. Realizing the above factors as convenient means of a replacement for conventional method of manufacturing a fixture has made us to design and fabricate the machining fixture in 3D-Printing technology. This technology proved that it is versatile and rapid process, which involves the accelerating innovations, reducing wastage and minimizing the cost and time for manufacturing a fixture or any other parts*

Keywords- Machining fixture, Rapid process, Time and Cost reduction

I. INTRODUCTION

3D-Printing or Additive manufacturing is a process of making 3D objects from digital file. In the modern manufacturing area 3D-Printing Technology has proven promising and is called rapid prototyping. The first 3D-Printer was invented by Charles Hull in 1984.

In an additive process an object is manufactured by laying down successive layer of material until the object is produced. The main difference in principle of working between traditional manufacturing and 3D-Printing is that the 3D-Printing involves additive approach and Traditional manufacturing involves subtractive approach the includes various machining processes like grinding, forging, molding, bending cutting, welding etc. . Interestingly the cost and time has been decreasing with the advancement in different technologies of 3D-Printing manufacturing.

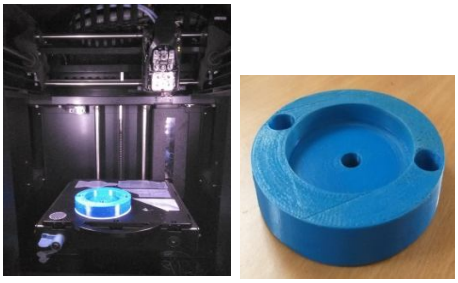

Fig 1:- Fixture made in 3D-Printing

TYPES OF 3D-PRINTING TECHNOLOGIES

1. Fused Deposition Modeling (FDM)
2. Stereolithography (SLA)
3. Digital Light Processing (DLP)
4. Selective Laser Sintering (SLS)
5. Laminated Object Manufacturing (LOM)

Fused Deposition Modeling (FDM)

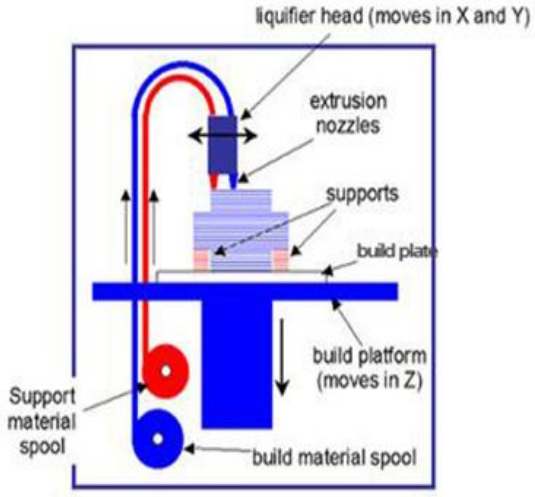

Fig 2:- FDM process

Fused Deposition Modeling (FDM) works on Additive principle which is used for making prototypes as well as models. FDM Technology in 3D-Printing build apart layer by layer by heating and extruding ABS430 filament according to the 3D data given to the printer. Each layer forms bond

solidifies when filament is put down. The heated filament is extruded from extrusion head and build a part layer by layer on the supporting structure that is built first over build platform. Extrusion head travels in horizontal and vertical directions by numerically controlled mechanism. FDM process is only limited to thermoplastic materials. As compared to SLA, FDM process is less accurate. Overall FDM is a reliable process suitable for prototypes and home use applications.

II. LITERATURE REVIEW

Elizabeth Matias, et. al. 3D-Printing or AM is the technology which saves manufacturing time because of its high speed and also the wastage of material is reduced because of its accuracy, which ultimately brings down the product cost and increases the quality of the product [1].

Dragos Florin Chitariu, et. al. Fixture manufactured in 3D-Printing using FDM technology found light in weight and that can be used in machining where forces are low [2].

Denver White, et. al. Developing of algorithms for 3D-Printing may result in customer satisfaction, optimized cost and time for manufacturing and inspection of fixture [3].

Nino Krznar, et. al. Reverse Engineering overcomes the difficulties faced during the modeling of 3D part which are having complex geometric shapes [4].

Hua Wei Guan, et. al. After comparison of Curved Layer Fused Deposition modeling (CLFDM) with FDM technology, it is found that the parts or fixture manufactured using CLFDM technology can withstand 55% more force than the parts manufactured in FDM [5].

Shiwpursad Jasveer, et. al. In comparison with all 3D-Printing technologies Stereolithography technique found very accurate and FDM technique is less expensive method [6].

CH. Venu Madhav, et. al. 3D-Printing has more advantages over the convention method of manufacturing because of its less time, less cost in manufacturing and has wide range of application in various fields [7].

III. OBJECTIVES OF THE WORK

- To design a new fixture to carry out milling operation.
- To manufacture a designed fixture in 3D-Printing using FDM technique.
- To optimize the time and cost required to manufacture a fixture in conventional method.
- To analyze the process of manufacturing a fixture in 3D-Printing and Conventional method.

IV. METHODOLOGY

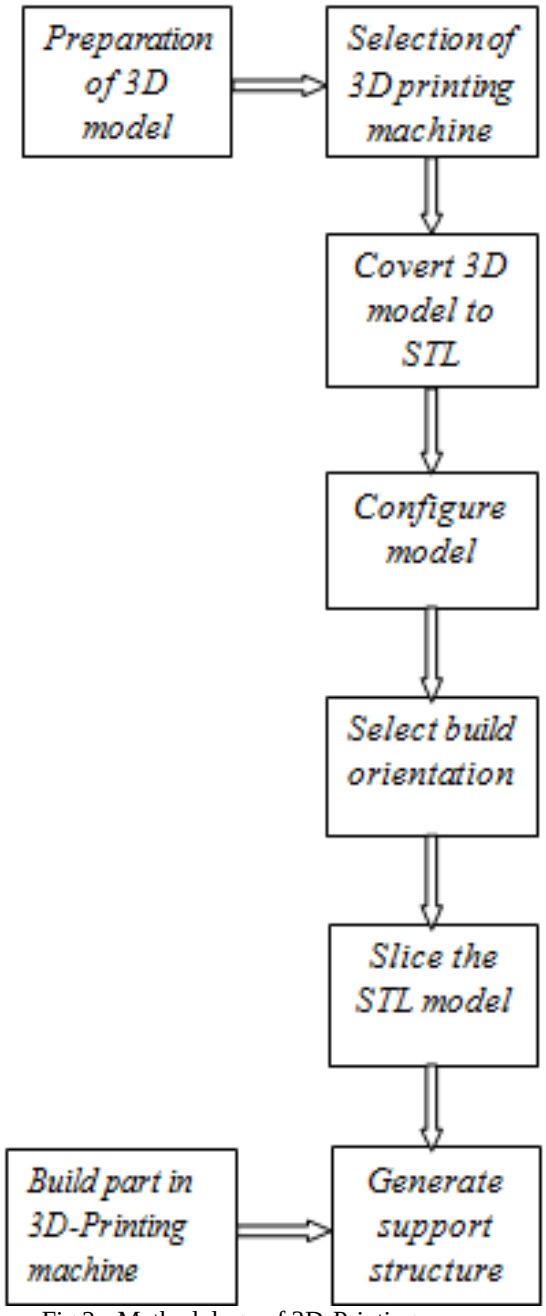

Fig 2:- Methodology of 3D-Printing process

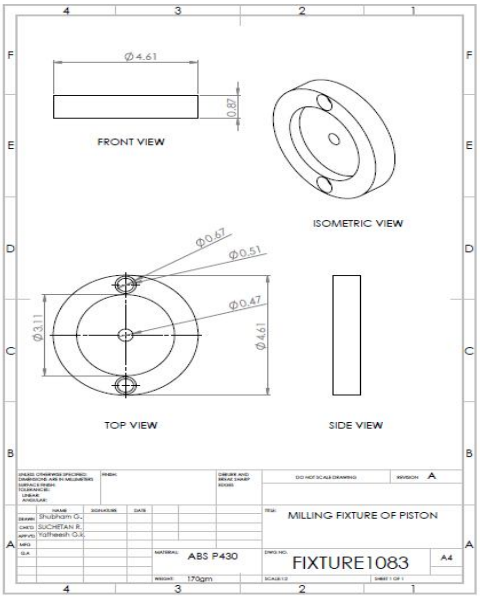

Fig 3:- 2D drawing of fixture

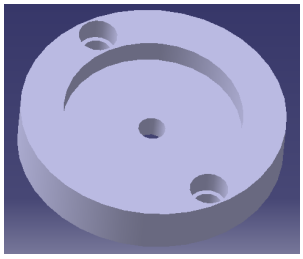

Fig 4:- 3D model of fixture

V. RESULTS AND DISCUSSION

In this work the results are discussed in terms of time and cost that is involved in manufacture of a machining fixture.

a) Time

- Time required to manufacture a designed fixture in conventional method takes nearly 8.5 to 9 hrs. Main issues in conventional method of manufacturing a designed fixture are, availability of raw material and machines in time. Sometimes it may take more than one day to manufacture a fixture.

- Manufacturing a designed fixture in 3D-Printing Technology saves more time. 3D-Printing requires only 4 to 4.5hrs for manufacturing a designed fixture. After comparing the conventional method and 3D-printing method of manufacturing, it is found that 3D-Printing reduces the 51% of time required to manufacture a fixture in conventional method.

b) Cost

- Manufacturing a designed fixture in Conventional method includes various machining processes. Cost of Mild Steel Raw material increasing and various machining processes requires more cost to manufacture a fixture. According to research made on this, a designed fixture requires nearly 1640 to 1700Rs to manufacture it in house.

- Manufacturing of a designed fixture using 3D-Printing has proven cheaper because the raw material (filament) is available at less cost, labour and machining cost is also less expensive. After comparing both methods, there will be cost reduction up to 25% in manufacturing of a designed fixture in 3D-Printing over Conventional method of manufacturing.

VI. ADVANTAGES OF 3D-PRINTING

- Faster Production
- Cost effectiveness
- Elimination of wastage and risk reduction
- Unlimited shapes and geometry
- Easily Accessible and Simplified work handling
- Build your Imagination

VII. APPLICATIONS OF 3D-PRINTING TECHNOLOGY

- Automotive parts
- Consumer Goods
- Industrial/Business machines
- Medical equipments
- Academic Institutions
- Aerospace components
- Government and Military

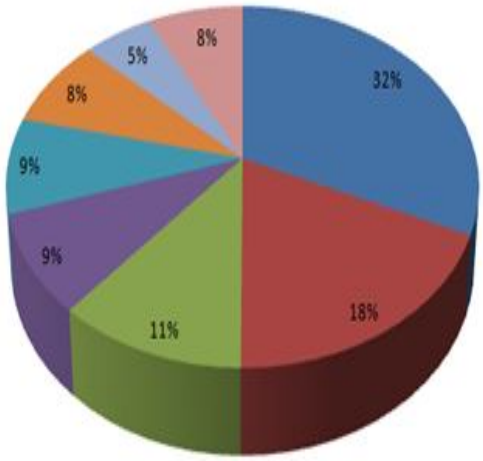

Fig 3:- Application of 3D-Printing in different fields

Color code	Field of application
	Automotive industry
	Consumer goods
	Business machines
	Medical equipments
	Academic institutions
	Aerospace components
	Government and military
	Others

VIII. CONCLUSION

3D-Printing Technology has revolutionized the way of manufacturing a parts and fixtures. 3D-Printing offers unimaginable level of design freedom to create a parts and fixtures which are impossible to do in Conventional method. From experiment it is proved that 3D-Printing Technology is a versatile and effective process by reducing 25% of cost incurred in manufacturing a fixture and also this technology has proved that time required to manufacture a fixture is less by reducing 51% of lead time and manufacturing time compared to Conventional method. From experiment it is also found that air gap and raster angle affect tensile strength of ABS material. Compressive strength of parts made in Fused Deposition Modeling process is higher than the tensile strength. Fixture and other parts made by 3D-Printing Technology can be used in machining process where high precision of work part is not required and forces are low.

IX. FUTURE SCOPE

Increase in fill gap affects the strength of the 3D printed part, so in future some another technique should be used to avoid the fill gaps in 3D printed parts and mainly in fixtures. Resin can also be used to fill the gap in 3D printed parts, which provides extra strength and mechanical properties to withstand high forces acting on 3D printed parts. Further up-gradation can be made in 3D-Printing Technology to manufacture a rigid fixture or other parts with higher precision and wear resisting capacity

REFERENCES

[1] Elizabeth Matias, Bharat Rao, “3D- Printing on its Historical Evolution and the Implications for Business”, Volume 1, pp 551-558, 2015.

[2] Dragos-Florin Chitaria, Adriana Munteanu, “Research on 3D Printed fixture components”, Volume 1, pp 1-6, 2018.

[3] Denver White, Glen Bright, Anthony Walkev, Shaniel Davrajh, “Development of an optimization Algorithm for Inspection of Customizable Jigs and Fixtures”, Volume 1, pp 1-6, 2017.

[4] Nino Krznar, Ana Pilipovic, Mladen Sercer,”A Manufacturing of Fixture for Automised 3D scanning-case study”, Volume 1, pp 197-202, 2016.

[5] Hue Wei Guan, Monica Mahesh Savalani, Ian Gibson, Olaf Diegel, “Influence of Fill Gap on Flexural Strength of parts Fabricated by Curved Layer Fused Deposition Modeling”, Volume 1, pp 243-248, 2015.

[6] Shiwpursad Jasveer, Xue Jianbin, “Camparison of Different Types of 3D printing Technologies”, Volume 8, issue 4, pp 1-9, 2018.

[7] CH. Venu Mahav, R. Sri Nidhi Hrushi Kesav, Y. Shivraj Narayan, “Importance and Utilisation of 3D Printing in Various Applications’, Volume 1, pp 24-29, 2016