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Study on the Effect of orientation on printing parts in FDM Technology

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Abstract

Rapid Prototyping technique is one among the material adding manufacturing process, building up its unique potential in the present scenario. This technique helps manufacture a product from the basic design of the component, thus optimizing the iterative product development processing time and creating geometrically complex parts to precise dimensions. This paper aims to study the effect of various offsets with various orientation of the product on the prototyping parameters.

Keywords: *offset ,orientation, material composition.*

1. Introduction

Rapid prototyping (RP), refers to the physical modelling of a design using specialized machining technology. RP systems quickly produces models and prototype parts from CAD models, MRI scan data created from 3D digitizing systems. The evolution from prototyping to production is stressed for the inherent advantages of the layered method. The prototypes thus obtained permit better communications and more interactions within associates and between associates and customers also these physical models help to see, understand and analyze characteristics of the final product. Presently the trend is towards manufacturing functional models from RP process. This process is called Rapid Manufacturing (RM), which is slowly integrating into the commercialization cycle model. **F**ew companies are now using it to produce final manufactured parts. Because of rapid manufacturing, there are no more shape or complexity constraints. The effectiveness of a prototype for functionality is recognized from the quality characteristics imparted to it by the RP process.

2. Objective of work

The paper aims to study the effect of orientation/ position and offset on the machining time, Material consumption and estimated cost and to indentify the best positions and offsets in 3d printing

3. PROBLEM STATEMENT

Rapid Prototyping (RP) or Layer Manufacturing (LM) refers to fabrication of layer-by-layer. Additional layer or fewer layers will affect to plastic product. Mostly, plastic product manufacturing requires more process time. Plastic product manufacturing play a significant role in increasing production cost. Therefore, parameter control during RP process is compulsory in order to reduce plastic product defect. Therefore study is carried out to find the effect on printing time, material consumption and estimation cost by varying orientation and nozzle offset keeping other parameters constant.

4. EXPERIMENTAL SETUP

Rapid prototyping machine RPX 2200, was used to carry out additive fabrication of the desired part as shown in fig 1.

Fig No 1 Rapid prototyping Machine

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5. METHODLOGY:

Following are the steps adopted to develop or manufacture a prototype model using a RP machine (as shown in fig 2).

Fig no 2 steps involved in product manufacturing

6. EXPERIMENTAL PLAN

Compressor top cover is selected carrying out the study as compressor a compressor is used in most of the industrial applications here we are taking studying the prototyping effect on the compressor upper cover which is designed for a particular application used in automotive industry. The cover was designed and developed in solid modeling software the 3d model (as shown in fig no 3) is prototyped using RPX 2000 machine.

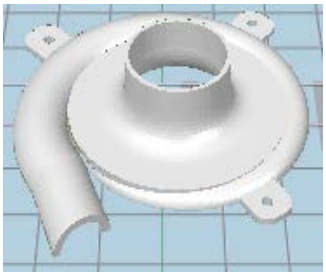


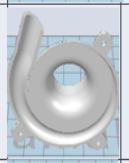
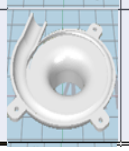
Fig no 3 Solid model of compressor top cover

7. Results and Discussions

7.1 Effect on printing time

As printing time parameter plays a very important role in manufacturing sector as the products have to be produced at a faster rate from the following experiments with three different orientations/positions and two different horizontal and vertical offsets keeping all other parameters constant i.e wire density, fill density, layer height and first layer thickness constant as shown in table 1

Table no 1: Effect on printing time

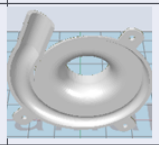
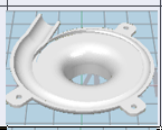
Sr.NO	Orientation/position	PART	off set	Time for Printing	off set	Time For Printing
1		Top Cover	horizantal offset 0.70 mm vertical offset 0.15 mm	2Hrs,58min,1sec	horizantal offset 0.15 vertical offset 0.70	2hr,50min,6sec
2			horizantal offset 0.70 mm vertical offset 0.15 mm	4 Hrs,17min,25 sec	horizantal offset 0.15 vertical offset 0.70	4Hrs,16min,10sec
3			horizantal offset 0.70 mm vertical offset 0.15 mm	4hrs,27min,30sec	horizantal offset 0.15 vertical offset 0.70	4hrs,16min,19sec

From table no 1 it can be seen that the orientation no 1 produces a least print time for horizontal offset of 0.15 and vertical offset of 0.70 therefore we can conclude that minimum horizontal offset and maximum vertical offset produces a minimum printing time.

7.2 Effect on Material consumption

Table no 2 shows the effect of orientation and offset on the material consumption (i.e PLA with 0.3 mm dia)

Table no 2: Effect on Material consumption

Sr.NO	Orientation/position	PART	off set	Material Consumption /lengthof wire consumed	off set	Material consumption/length of wire consumed
1		Top Cover	horizantal offset 0.70 mm vertical offset 0.15 mm	20.2 g/1.91m	horizantal offset 0.15 vertical offset 0.70	16.4g/1.87m
2			horizantal offset 0.70 mm vertical offset 0.15 mm	16.5g/1.89m	horizantal offset 0.15 vertical offset 0.70	16.4g/1.87m
3			horizantal offset 0.70 mm vertical offset 0.15 mm	26.3g/3.00m	horizantal offset 0.15 vertical offset 0.70	25.1g/2.86m

From the table 2 it can been seen that minimum horizontal offset and maximum vertical offset has a minimum material consumption rate

7.3 Effect on Estimated cost (in $)

Table no 2 shows the effect of orientation and offset on the material consumption (i.e PLA with 0.3 mm dia)

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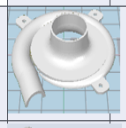
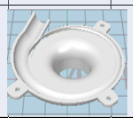
Table no 3: Effect on Estimated cost

Sr.NO	Orientation/position	PART	off set	Estimated cost	off set	Estimated cost
1		Top Cover	horizantal offset 0.70 mm vertical offset 0.15 mm	0.5	horizantal offset 0.15 vertical offset 0.70	0.49
2			horizantal offset 0.70 mm vertical offset 0.15 mm	0.5	horizantal offset 0.15 vertical offset 0.70	0.49
3			horizantal offset 0.70 mm vertical offset 0.15 mm	0.79	horizantal offset 0.15 vertical offset 0.70	0.75

From the table 3 it can been seen that minimum horizontal offset and maximum vertical offset is much more economical compared to vertical and horizontal offsets and any of the positions i.e either 1 or 2 can provide is used to achieve a better result

8. Conclusions

Study was carried out to find out the effect of 3 different positions/ orientation along with the variation of horizontal and vertical offsets values (i.e 1) horizontal offset 0.70 mm and vertical offset 0.15 mm , 2) horizontal offset 0.15 and vertical offset 0.70) on printing time , Material consumption and estimated cost . From the experiments conducted it can be concluded that

1) Using minimum horizontal offset (i.e 0.15) and maximum vertical offset (i.e 0.70) provides a minimum printing time with position 1 (Table no 1)
2) Using minimum horizontal offset (i.e 0.15) and maximum vertical offset (i.e 0.70) provides a minimum Material consumption with position 2 or 1 (Table no 2)
3) Using minimum horizontal offset (i.e 0.15) and maximum vertical offset (i.e 0.70) provides a minimum estimated cost with position 1 (Table no 3)

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