Design of table bush Die and Development of G and M Codes for Plastic Injection Hand Molding Machine

Dr. V.Vijendra kumar;
Department of Mechanical engineering, M.S.Engineering College,
Abhinandan KS; Mohanambal V;
Students, Mechanical engineering, M.S.Engineering College,

Abstract: Injection molding is one of the major and important processes in plastic manufacturing industry, more than one-third of all plastic materials are injection molded, and the mold is one of the main components in the injection molding process. The aim of this engineering paper is to show detailed steps on how to design and a complete mold and using the simulation software to analyze the material flow and defects in the product

In small scale Industries Design and Development of G and M Codes for a small plastic injection moulding machine for forming small-scale plastic articles is very important for manufacture of Accurate Dies are important and expensive to produce and develop these Codes. G and M Code is a language in which we can simulate in a computer before the manufacturing of Die which will save the expenditure of material and man power which will economical to make a Die of the model. The majority common circumstances is that, within a machine tool, a cutting tool is moved according to these commands through a tool path and removes material to leave only the finished Die of the model. Our Project which entailed design, development of table bush Die for generating the G and M Codes, CATIA software an open source is used to design the Die and further helps in generating the G and M Codes and simulated in the computer.

An attempt is made on this and the Die was produced in CNC machine from outsource and tested in the laboratory.

I. INTRODUCTION

The injection mold has seen stable growth ever since its beginnings in the late 1800's. The method has evolved from the production of the simple things in the vein of combs and buttons to foremost consumer, industrial, medical, and aerospace products. This injection molds was renowned and achieved by John Wesley he injected warm celluloid into a mold which resulted in billiard balls which were used as a replacement for ivory which be base on the pressure die casting technique used for metals. The manufacture progressed slowly over the years, producing products such as collar stays, buttons, and hair combs. The manufacturing of moulds expanded rapidly in the 1940s because World War II created a huge demand for inexpensive, mass-produced products. In 1946, American inventor James Watson Hendry built the first screw injection molding machine, which allowed much more precise control over the speed of injection and the quality of articles produced. This mechanism furthermore allows material to be various mixed colours required before injection, so that colored or recycled plastic could be added to virgin material and mixed thoroughly before being injected. The major perception of plastic molding is placing a polymer in a molten form into the mold cavity, So that the polymer can take the required shape with the help of varying temperature and pressure. There are different behaviors of molding a plastic; some of them are blow molding, Injection molding, rotational molding and compression molding. Each technique has their own advantages in the manufacturing of specific item.

The project work will involve design and development of G and M Code for a Common General use table Bush that will entail design of machine will be provided to assist investors that want to venture into construction of this machine. Development of small injection moulding die for forming small plastic articles in small-scale industries was borne out of the fact that most injection moulding die were of big size and the majority of small-scale industries in developing countries could not avoid buying them due to their costs. In solving this calamity in attendance and need to design small injection moulding machine bush die accuracy frequently that avoidable by small scale industries for production of small plastic articles, this is the rationale behind this work.

Objective

- To prepare a product design for ’’ Table Bush Die plastic injection mold for the specific product •
- To Generate G and M Codes for a Bush Die
- Using Mold Flow to simulate the polymer flow and finding out maximum clamp force and Fill time.

Methodology

It consists of Identification of worn-out bush, creation of drawing called boundary conditions, part drawing and modeling, part simulation, generation of G and M Codes, mould flow analysis, manufacture of bush and testing. The generated G and M codes from the CATIA software is exported and saved in a file and this imported to CNC machine to manufacture three parts of a bush die with tolerance of ± 0.5 mm. The complete process of Code generation, mould flow Analysis of bush and Die are shown in figure 1, figure 4. And figure 7.

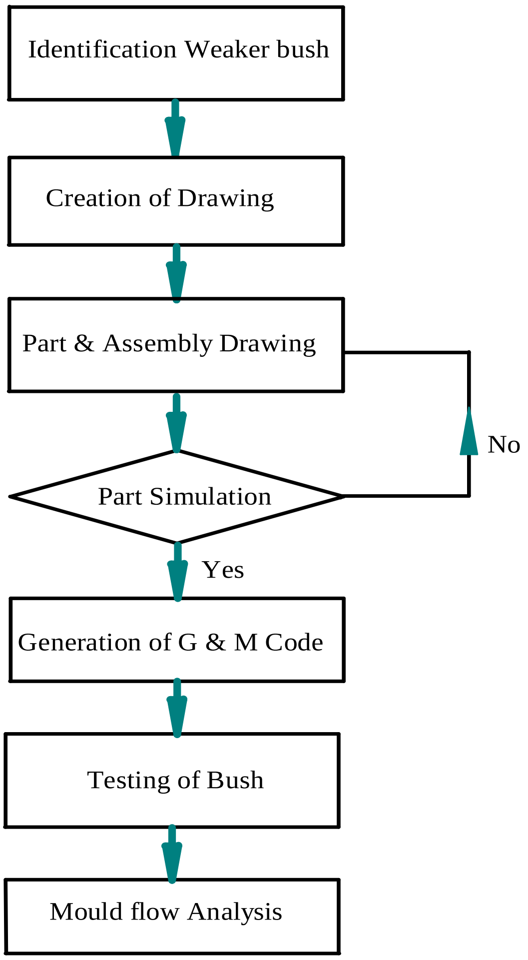

Fig. 1. Flow chart

Table Damaged bush:

Fig. 2. Damaged Bush

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1. Bush Model

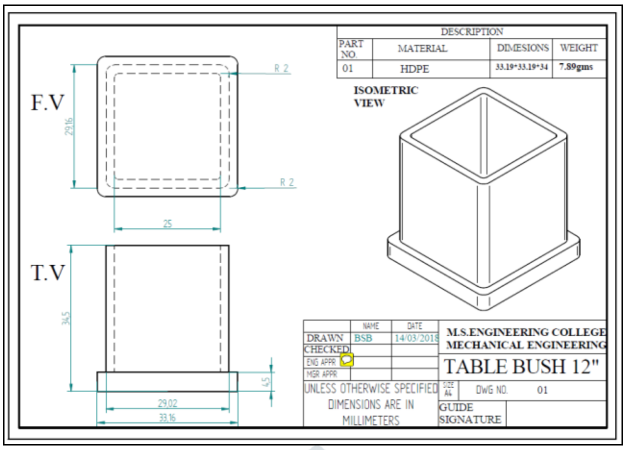


Fig. 3. 2D Bush Model

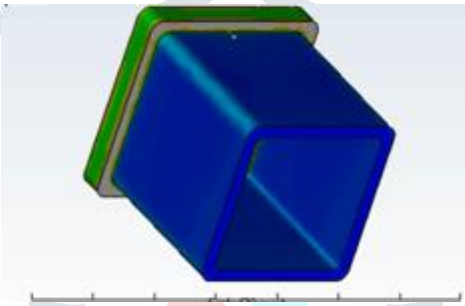


Fig. 4. 3D Model of a Bush

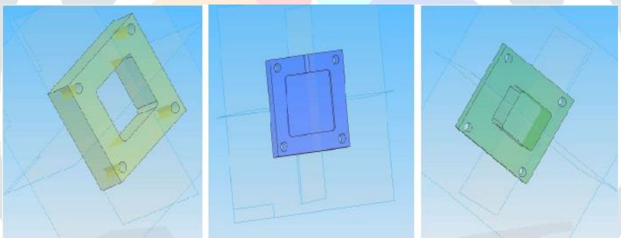


Fig. 5 Three part Die

DIE ASSEMBLY:

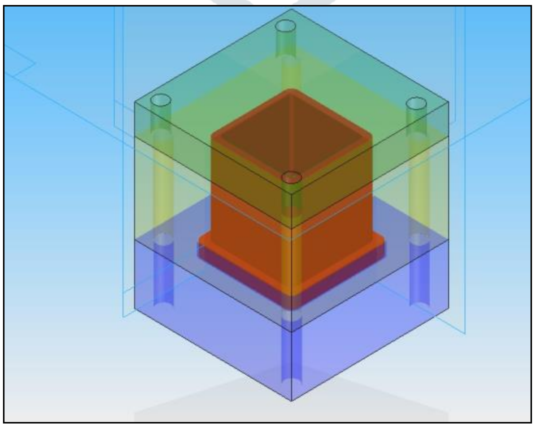


Fig. 6 Three part Die

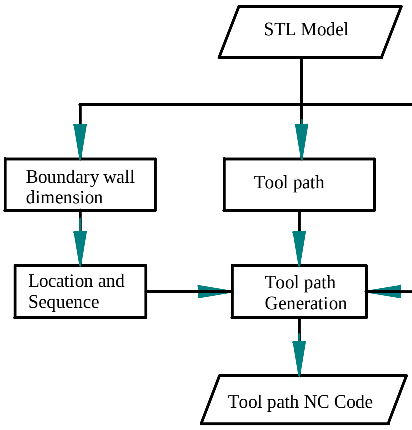


Fig. 7 Three part Die

Development G and M Codes

The popular and important part about using the CATIA V5 NC is to generate G-codes. In this paper we show how to create a sample program. There are certain steps required to create the program successfully and specified the directory where the files to go in the Tools-Options

Part 1:

```
%1000. G71
N1 G40 G90 G80 G17 G1
N2 G99 T1 L+1 R+5
N3 G99 T2 L+2 R+5
N4 G99 T3 L+3 R+5
N5 G99 T4 L+4 R+1.5
N6 G99 T5 L+5 R+.75
; T1 END MILL D 10
N7 G90
N8 G17 T1
N9 G0 X-44.923 Y-38.5 S70 M6 M3
N10 Z-6
N11 G1 X-47.625 F1000 M8
N12 X-50.077 Y-41.5
N13 X-47.375
N14 X-44.923 Y-38.5
N15 Y-36
N16 Y-33.5
N17 X-50.232
N18 G2 X-61.5 Y-44.768 R+38.5
N19 G1 Y-46.5
N20 X-44.768
N21 G2 X-33.5 Y-35.232 R+38.5
N22 G1 Y-33.5
N23 X-44.923
N24 Y-31
N25 Y-28.5
N26 X-53.068
```

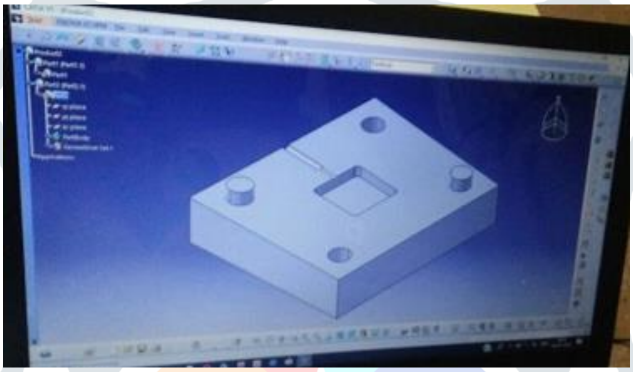
```
N27 G2 X-66.5 Y-41.932 R+33.5
N28 G1 Y-51.5
N29 X-41.932
N30 G2 X-28.5 Y-38.068 R+33.5
N31 G1 Y-28.5
N32 X-44.923
N33 Y-26
N34 Y-23.5
N35 X-56.208
N36 G2 X-71.5 Y-38.792 R+28.5
N37 G1 Y-56.5
N38 X-38.792
N39 G2 X-23.5 Y-41.208 R+28.5
N40 G1 Y-23.5
N41 X-44.923
N42 Y-21
N43 Y-18.5
N44 X-59.779
N45 G2 X-76.5 Y-35.221 R+23.5
N46 G1 Y-61.5
N47 X-35.221
N48 G2 X-18.5 Y-44.779 R+23.5
N49 G1 Y-18.5
N50 X-44.923
N51 Y-16
N52 Y-13.5
N53 X-64.027
N54 G2 X-81.5 Y-30.973 R+18.5
N55 G1 Y-66.5
N56 X-30.973
N57 G2 X-13.5 Y-49.027 R+18.5
N58 G1 Y-13.5
N59 X-44.923
N60 Y-11
N61 Y-8.5
N62 X-69.606
N63 G2 X-86.5 Y-25.394 R+13.5
N64 G1 Y-71.5
N65 X-25.394
N66 G2 X-8.5 Y-54.606 R+13.5
N67 G1 Y-8.5
N68 X-44.923
N69 Y-6
N70 Y-3.5
N71 X-91.5
N72 Y-76.5
N73 X-3.5
N74 Y-3.5
```

```
N75 X-44.923
N76 X-75.816 Y-17.751
N77 G2 X-82.5 Y-21 R+8.5
N78 G2 X-91 Y-12.5
N79 G2 X-82.5 Y-4
N80 G2 X-74 Y-12.5
N81 G2 X-75.816 Y-17.751
N82 G1 X-19.184 Y-62.249
N83 G2 X-12.5 Y-59 R+8.5
N84 G2 X-4 Y-67.5
N85 G2 X-12.5 Y-76
N86 G2 X-21 Y-67.5
N87 G2 X-19.184 Y-62.249
; T2 END MILL D 10
N88 G90
N89 G17 T2
N90 G0 X-45 Y-42.5 S70 M6 M3
N91 Z-11
N92 G1 Y-37.5 F1000 M8
N93 X-50
N94 Y-42.5
N95 X-45
N96 Y-45
N97 Y-47.5
N98 X-40
N99 Y-32.5
N100 X-55
N101 Y-47.5
N102 X-45
; T3 DRILL D 10
N103 G90
N104 G17 T3
N105 G0 X-12.5 Y-12.5 S70 M6 M3
N106 Z-5
N107 G83 P01 1 P02 -23 P03 23 P04 0 P05 1000 M8
N108 X-12.5 Y-12.5 Z-6 M99
N109 X-82.5 Y-67.5 M99
; T4 END MILL D 10
N110 G90
N111 G17 T4
N112 G0 X-47.5 Y-62.6 S70 M6 M3
N113 Z-7.5
N114 G1 Y-78.465 F1000 M8
N115 Y-62.5
; T5 END MILL D 10
N116 G90
N117 G17 T5
N118 G0 Y-53.35 S70 M6 M3
```

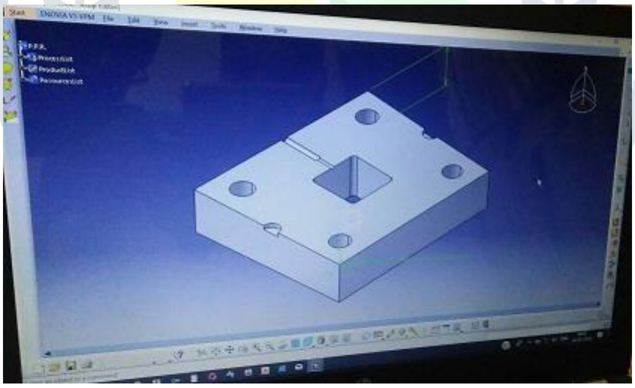
N119 Z-6.75
N120 G1 Y-60.218 F1000 M8
N121 Y-53.297
N122 M5
N123 M30
N124 M2
N125 M30
%
Similarly for *Part 2* and *Part 3*

Simulation of Die Parts:

Part 1:



Part 2:



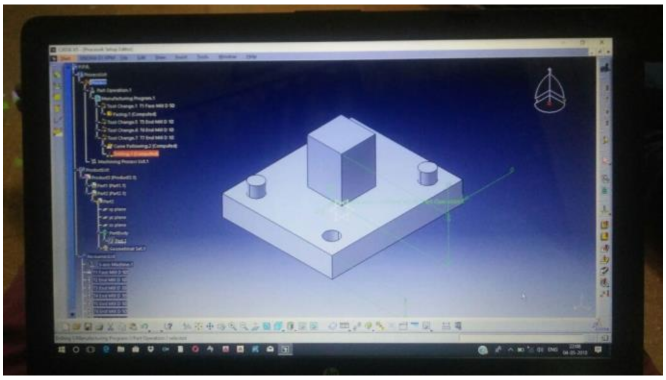


Fig. 8 Simulated Parts 1,2 & 3

FINAL DIE OF THE TABLE BUSH:

The main component or the heart of the machine is die in which the molten material flows down and occupies the cavity inside the die.

Part 1:

Part 2:

Part 3:

Fig. 9 Manufactured Parts 1,2 & 3

Assembled Part:

Fig. 10 Assemled Parts 1,2 & 3

Experimental Setup:

1. **Clamping:-** Basically clamping holds the two halves of the injection mould under pressure during the injection and cooling.
2. **Injection:-** The plunger is uphill position in beginning of feed hopper, and the plastic granules are free to fall into

the feed cylinder. The plunger moves from upward to downward forcing the accumulated granules into the heating cylinder, where they are changed into a fluid mass. This plunger also displaces the fluid material at the nozzle and forces in into a closed mould cavity of the die.

3. **Dwelling:** The fluid material is injected into mould and uniform pressure is applied to make sure all mold cavities are completely filled, were the molded product are formed to their exact profile with proper
4. **Mould opening:-** The bush die clamp is opened which separate the two halves of mould after the pressure is relative both mould members is unlocked and the moveable member is moved away from the fixed member, carrying the finished product with it.
5. **Ejection:-** An ejection rod and plate eject the finished piece from the mould. The unused spruces and runners can be recycled from use again in future moulds and is rapidly performed. The moulding machine may be operated at six to seven shots per minute.

MOULD PROCESS:

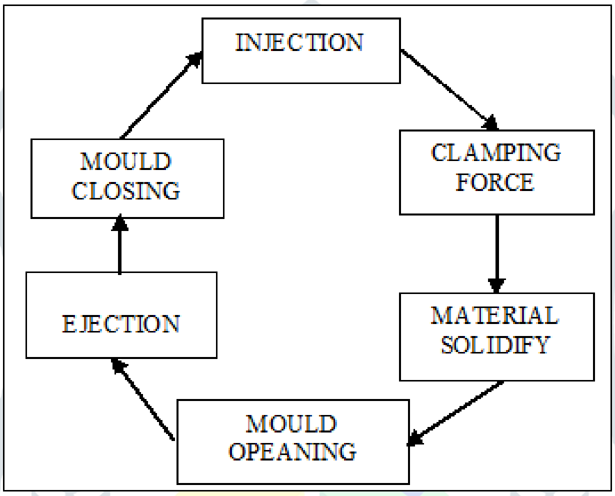


Fig. 11 Molding Process

6. Quality checking and testing:-

The final stage is where the obtained product is analyzed on the basis of design and quality. Finally the product is launched. The processes are as shown in figure 11 and finished products in figure 12 which ar firmly fit into the table legs.

FINAL PRODUCT:

Fig. 12 Samples of finished Bush

V. Conclusions

Our aim is to understand practical examples of machining technology and tool path in CNC machines CATIA proves the relevance and coherence of the new technologies, materials, machinery and information tools that enable more efficient to produce lower costs. One objective of the object was to suggest the possibility of creating CNC program production process components on a table bush and DIE with minimal handling. This paper presents a method of machining technology of table bush with the introduction of computer graphics contained in the CAM systems are used for preparing data and creating NC programs for manufacturing three piece Die component. The first step in the simulation of the manufacturing process is the selection of appropriate boundary and semi-finished parts. The manufacturing process was designed to model assemblies constructed in CATIA. The manufacturing process was first designed and simulated using the CAM system. A significant reduction in production time contributed towards lower production costs. Manufacturing operations chosen with respect to the geometry and the required precision assembly. The outcomes presented in this manuscript can be further exploited in the process of teaching courses and programming CNC machines and technical practice for upgrading older solutions and processes of the main and additional times, while maintaining the dimensional accuracy of machine parts.

VI. REFERENCE

[1] *Ching-Chih Tsai, Shih-Min Hsieh, Huai-En Kao* "Mechatronic design and injection speed control of an ultra-high speed plastic injection moulding machine" in mechatronics Volume 19(March 2009),Pages 147-155.

[2] *William Liu* "The microscopic features of cavitation erosion and the solution in the plastic injection moulding machines" in Engineering Failure Analysis Volume 36, (January 2014) Pages 253-261.

[3] *Egon Müller, Rainer Schillig* "Improvement of Injection Moulding Processes by Using Dual Energy Signatures" in Procedia CIRPVolume 17(2014),Pages 704-709

[4] *A.G. Gerber, R. Dubay, A. Healy.* "CFD-based predictive control of melt temperature in plastic injection moulding" in Applied Mathematical Modelling Volume 30, (Sep.2006), Pages 884-903.

[5] *S.J Bull, R.I Davidson, E.H Fisher, A.R McCabe, A.M Jones* "A simulation test for the selection of coatings and surface treatments for plastics injection moulding machines" in Surface and Coatings Technology, Volume 130, Issues 2–3, 21 August 2000, Pages 257-265.

[6] *C. Sasikumar, S. Srikanth, S.K. Das* "Analysis of premature failure of a tie bar in an injection moulding machine" in Engineering Failure Analysis, Volume 13, Issue 8, December 2006, Pages 1246-1259