

Experimental Review of Machining Time Cycles between Manual Programming Vs CAM Programming on Vertical Milling Machine with General Observation

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Abstract - This paper is review of CNC machining time cycle study and general observation between manual CNC programming Vs CAM programming under same cutting parameter & material. In CNC machining, reducing the machining time cycle for simple & complex part is a key to increase the production. CAM software's programs are playing a significant role to reducing machining time cycle, to improve quality, to better utilization of machines & tools.

Key Words: CNC, Machining time cycle, MasterCAM, CAM Program, manual CNC program.

1. INTRODUCTION

In the metal cutting industries CNC machines are used. These machines required program to cut the material as required shape, dimension & tolerance. There are mainly three type of mode for CNC programming

1. Manual CNC programming
2. Conversational programming
3. CAM programming

Manual CNC programming required the numerous calculation, a better understanding of the controller and codes. For error free execution of manual program, it must be prepared as per the controller language and definition. Conversational programming is feature wizard programming mode that hide the codes. Conversational controls don't require any Calculation and programmer can easily generate the part programs with defining the feature data.

CAM stands for computer aided manufacturing. CAM programming offer a great control on part programming and flexibility. CAM software provides different toolpath cutting strategy for rouging and finishing. They make easy of programming for simple & complex part, save the machining time, increase efficiency and better utilization of tool & machines.

In CNC manufacturing the part program and the optimization of program is important to reduce the machining time cycle. This demands the highly skilled programmer. Generation of manual programming need mathematical calculation to find-out the tool movement as per desired profile.

CAM programmers are very helpful in the atmosphere of less skilled programmer, lower cost of the part program, avoid

the calculation and provide the optimize program. All method has their own advantage and dis advantage. We made analysis of machining time cycle for simple object between manual programming & CAM programming.

2. EXPERIMENTAL DETAILS:

This experiment is involved mainly five type of setup

1. Machine setup
2. Cutting tool material
3. Work piece material
4. Cutting data sheet
5. CAM software

2.1 Machine Setup:

This experiment is performed on the CNC milling machine. X & Y movements on the table and Z movement on the spindle which represent the depth of cut. All the tools used for this experiment were measured by the standard tool measuring machine and data (tool length & diameter) feed to tool offset section in the machine controller. After defining the workpiece zero point, tools move as per coordinates defined in the program.

2.2 Cutting tool material:

Selection of the cutting tool is very important in the metal cutting. It's depend on the type of material to be cut. For our experiment, HSS and carbide tools are used. HSS Co-8%, end mill is used for roughing & finishing operation. Inserted carbide tool is used for the facing operation. The cutting tools used for different operations are represented in Table.1.

2.3 Work piece material:

This experiment is performed on standard Aluminum alloy workpiece, grade 6082. It is a medium strength alloy with excellent corrosion resistance. It has the highest strength of the 6000 series alloys and known as a structural alloy. In plate form, most commonly used for machining purpose.

Chemical composition and mechanical properties of the work piece material are indicated in Table. 2. and Table.3. respectively.

Table -1: Cutting tool material

Tool material	Operation	Size (mm)
Inserted carbide (face mill)	facing	Dia. 50
HSS (End mill)	Roughing	Dia. 10
HSS (End mill)	Finishing	Dia. 8
HSS(Spot drill)	Gen. Chamf.	Dia. 10

Table -2: Chemical Composition

Chemical Element	% Present
Manganese (Mn)	0.40 - 1.00
Iron (Fe)	0.0 - 0.50
Magnesium (Mg)	0.60 - 1.20
Silicon (Si)	0.70 - 1.30
Copper (Cu)	0.0 - 0.10
Zinc (Zn)	0.0 - 0.20
Titanium (Ti)	0.0 - 0.10
Chromium (Cr)	0.0 - 0.25
Other (Each)	0.0 - 0.05
Others (Total)	0.0 - 0.15
Aluminium (Al)	Balance

Table -3: Mechanical Properties

Mechanical Property	Value
Proof Stress	240 Min MPa
Tensile Strength	295 Min MPa
Hardness Brinell	89 HB

2.4 Cutting data Sheet:

Machining parameter selected based on recommendation by manufacturer of cutting tools. Cutting data sheet as per the operation given in Table. 4: and Depth of cut (DOC) and step over for different operation are shown in Table. 5.

Table -4: Cutting Data Sheet

Facing	
Cutting Speed	400 m/min
FPT	0.05 mm
Roughing	
Cutting Speed	80 m/min
FPT	0.06 mm
Finishing	
Cutting Speed	80 m/min
FPT	0.05 mm
Gen. chamfer	
Cutting speed	50 m/min
FPT	0.04 mm

2.5 CAM Software:

CAM software are used to control machine tools and manufacturing of workpiece. Software create the codes for CNC machine to follow during the metal cutting. Different types of software are available. In this experiment MasterCAM version 2019 is used for the programming.



MasterCAM is one platform solution for CNC machines such as Lathe, Milling, Turn-mill, Router and Wire cut

Table -5: Depth of cut (DOC) and step over for different operation

Operation	DOC(mm)	Step over
Facing	0.2	70% of tool dia.
Roughing	2	50% of tool dia.
Finishing	8	20% of tool dia.

3. DRAWING OF EXPERIMENT:

Engineering drawing of the part mainly having the pocket operation (open & close) and general chamfer.

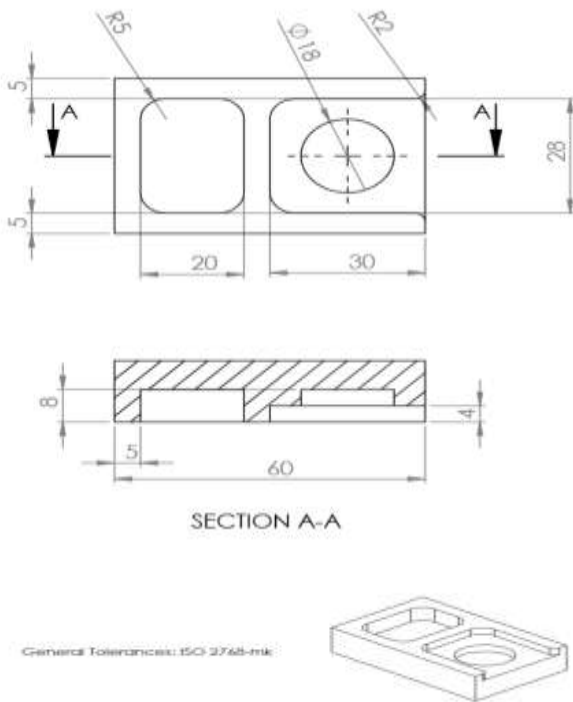


Fig. 1: Drawing of Experiment

The drawing shown in Fig. 1: has the standard General Tolerances: ISO 2768-mk for the dimensions. For this drawing both manual & cam program is made to analysis the machining time cycle.

4. RESULTS AND DISCUSSION:

Manual and CAM program made for the given drawing & run on the machine to analysis the time cycle. The time taken by the CAM Program is 7.36 Minutes and Manual program is 10.05 Minutes respectively.

5. CONCLUSIONS:

This experiment is study of the machining time cycle between the manual CNC programming Vs CAM programming under the same cutting parameter. As result strong result were observed. Observed result as following:

1. Less Machining time taken in the CAM programming over the manual programming.
2. CAM programming is easy over the manual programming.

3. No mathematical calculation required in cam programming while manual programming based on mathematical calculation.

REFERENCES

- [1] <https://www.mazakusa.com/news-events/blog/what-cnc-programming-style-best-suits-your-operations/>
- [2] <https://www.productionmachining.com/articles/simplifying-cadcam-programming>
- [3] <https://bobcad.com/cad-cam-programming-vs-conversational-programming/>
- [4] <https://www.cncci.com/resources/tips/manual%20conv.htm>
- [5] http://www.aalco.co.uk/datasheets/Aluminium-Alloy_6082-T6~T651_148.ashx
- [6] <https://www.quora.com/What-is-CAM-Software>
- [7] https://en.wikipedia.org/wiki/Computer-aided_manufacturing
- [8] <https://www.mastercam.com/en-us/>
- [9] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.
- [10] R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.
- [11] K. Elissa, "Title of paper if known," unpublished.