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Analysis of Side Milling Operation by Changing Different Parameters

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ABSTRACT: With the side milling cutter, we have machined a slot by changing the different parameters. In this Project we have adjusted the depth of cut, speed of machine and have done the operation on the square block. After milling operation, we have checked the surface roughness value of each operation with the help of surface roughness tester. The aim of this project is to get optimum surface roughness, which identify the parameter of machine. Surface roughness is one of the most specific consumer requirements in a machining process. Surface roughness actually means fine irregularities of surface texture. Also surface roughness takes place due to the tool chip interface and feed marks in machining process. The quality of surface plays an important role in evaluating productivity of machine tool and machined parts. Several parameters of milling process are there like speed of cutting, cutting depth, rate of material removal known as MRR and time taken by the machine etc. which play a critical role in surface roughness.

KEY WORDS: Milling Machine, Stub Arbor, Side Milling Cutter, D.O.C, Surface Roughness Tester, MRR.

I.INTRODUCTION

The side milling is the operation of production of a flat vertical surface on the side of a work piece by using a side-milling cutter. The depth of cut is adjusted by rotating vertical feed screw of table. These arbors mounted disc type cutters have a large number of cutting teeth at equal spacing on the periphery. Each tooth has a peripheral cutting edge and another cutting edge on one face in case of single side cutter and two more cutting edges on both the faces leading to double sided cutter.

Milling is the process of machining flat, curved, or Milling machines are basically classified as vertical or irregular surfaces by feeding the workpiece against a rotating horizontal. These machines are also classified as knee-type, cutter containing a number of cutting edges. The milling ram-type, manufacturing or bed type, and planer-type. Most machine consists basically of a motor driven spindle, which milling machines have self-contained electric drive motors, mounts and revolves the milling cutter, and a reciprocating coolant systems, variable spindle speeds, and power-operated adjustable worktable, which mounts and feeds the work piece.

Both sided cutters are used for making rectangular slots bounded by three flat surfaces. Slotting is also done by another similar cutter having only one straight peripheral cutting on each tooth. These cutters may be made from a single piece of HSS or its teeth may be of carbide blades brazed on the periphery or clamped type uncoated or coated carbide inserts for high production machining.

National and international standards are used to standardize the definitions, environmental requirements, and test methods used for milling. Selection of the standard to be used is an agreement between the supplier and the user and has some significance in the design of the mill. In the United States, ASME has developed the standards B5.45-1972 Milling Machines and B94.19-1997 Milling Cutters and End Mills.

II. SIGNIFICANCE OF THE SYSTEM

The paper mainly focuses on how good surface finish can be obtained by changing different parameters like cutting speed, DOC and on the basis of this we can find the production time and rate of production. The study of literature

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survey is presented in section III, Methodology is explained in section IV, section V covers the experimental results of the study, and section VI discusses the future study and Conclusion.

III. LITERATURE SURVEY

1. **R. Sridhar, R.E. Hohn, G.W.Long (May 1, 1968)** A Stability Algorithm for the General Milling Process: Contribution to Machine Tool Chatter Research in this paper, a method of stability analysis for the general milling process is given. Chatter still undermines the efforts of the machinist by reducing surface quality, productivity and increasing cost in damage repair. In this paper, an alternative approach to extracting the transfer function using the FEM modal analysis has been presented. The approach is based on the Fourier transform of the results obtained from the finite element analysis. The results are shown to agree with experimental results and hence the transfer function calculated. Its accuracy is further explored by its use in stability lobe predictions. This approach can be used to solve different problems encountered through the use of impact test, including obtaining the frequency response function in directions that can prove difficult experimentally.
2. **Dr. Nand. K. Jha (Nov 1990)** A Discrete Data Base Multiple Objective Optimization of Milling Operation through Geometric Programming the optimum process planning of the milling operation has been attempted through multiple objectives. A multiple objective function based on cost of production and rate of production in milling operations has been developed.The methodology presented in this paper helps to automatically model the high speed milling cutter design problem. The multidisciplinary nature of problem is taken care of by integrating material science, design, manufacturing, solid modelling, optimization, finite element analysis, fusion of IT technology along with multi-sensor systems such as REID and AE. The approach presented here also shows the cost of manufacturing along with the tool life. The manufacturing engineer can perform sensitivity analysis by changing the data and redesigning new cutter. The method presented not only supply the geometry of the tool designed but also generate the optimum cutting parameters which will produce the part of high quality at least cost.
3. **A. Antoniadis1, Savakis (4 April 2002)**This article presented the analysis of various milling parameters affecting surface roughness (Rz) after clear cylindrical HSM of hardened steel. A new surface roughness model, including cutter displacements, was also elaborated. In the high-speed milling (HSM) process of hardened steel, it is necessary to recognize that an increase in rotational speed n has an effect on centrifugal force growth, which thus increases cutter displacements.
4. **S. S. K. Deepak (25.10.2012**) In this research paper, the cutting speed and feed rate were modeled for the minimum production time of a turning operation. The maximum cutting speed, the maximum feed rate, maximum power available and the surface roughness was taken as constraints. The results of the model show that the proposed method provides a systematic and efficient method to obtain the minimum production time for turning. This approach helps in quick analysis of the optimal region which will yield a small production time rather than focusing too much on a particular point of optimization. It saves a lot of time and can be easily implemented by manufacturing firms. The developed model will provide with the optimal values of the cutting speed and feed rate that will satisfy the objective of production time minimization within the given operating constraints. The coefficients n, p and Z of the extended Taylor's tool life equation are not described in depth for all cutting tool and work piece combinations.
5. **R. Yildiz (2011.12.2016)** In this paper, the machining economies problem concerning the multi-pass turning has been addressed by a hybrid differential evolution optimization technique. The specific issue of this research is to introduce a new approach to solve machining optimization problems. In the current paper, a new improved two-stage DE is presented for the optimization of machining parameters considering minimum production cost under a set of machining constraints in turning operation. The results of the turning optimization problem indicate the strong influence of using a refined population of solutions over a DE without refined search space.
6. **Sanjay Kumar Mishra (18th October 2017)**It is observed from the literature survey that six researchers have taken speed of cutting, depth of cut and feed for their study, two have taken speed of spindle, depth of cut and feed, one has taken number of pass, depth of cut, spindle speed and feed rate and one has taken spindle speed, depth of cut, feed rate, flow of coolant and diameter of drill tool. Hence, this literature highlights three main parameters like speed of cutting, feed rate and depth of cut. The further study will be based on these three selected parameters.

IV. METHODOLOGY

GENERAL SETUP

The success of any milling operation depends, before setting up a job, be sure that the to a great extent, upon judgment in setting up the job, workpiece, the table, the taper in the spindle, selecting the proper milling cutter, and holding the

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cutter by the best means under the circumstances Some fundamental practices have been proved by experience to be necessary for and the arbor or cutter shank are all clean and good results on all jobs. Some of these practices are mentioned below...

•Before setting up a job, is sure that the workpiece, table, the taper in the spindle, and the arbor or cutter shank are free from chips, nicks, or burrs.
•Do not select a milling cutter of larger diameter than is necessary.
•Check the machine to see if it is in good running order and properly lubricated, and that it moves freely, but not too freely in all directions.
•Consider direction of rotation. Many cutters can be reversed on the arbor, so be sure you know whether the spindle is to rotate clockwise or counter clockwise.
•Feed the workpiece in a direction opposite the rotation of the milling cutter (conventional milling).
•Do not change feeds or speeds while the milling machine is in operation.
•When using clamps to secure a workpiece, be sure that they are tight and that the piece is held so it will not spring or vibrate under cut.
•Use recommended cutting oil liberally.
•Use good judgment and common sense in planning every job, and profit from previous mistakes.
•Set up every job as close to the milling machine spindle as circumstances will permit.

PROCEDURE

1. In order to produce a slot on a block, first we have properly clamped the workpiece on the milling machine at its correct position relative to the side milling machine.
2. Then we gave the required depth of cut (DOC) and then adjusted the speed of the milling machine, so that we can obtain a good surface finish at respective speed and depth of cut.
3. We have carried this process for 3 different blocks like Cast Iron, Mild Steel and Mild Steel (N31) at four different locations on the block by varying depth of cut and speed of machine.
4. After the completion of this operation, then we have checked the surface finish of each of the slot produced on the block by using surface roughness tester.
5. Then by comparing the surface finish obtained with the speed and DOC we have prepared proper analysis on it.

A. EQUIPMENT USED

1. Milling Machine
2. Square Blocks
• Cast Iron
• Mild Steel
• Mild Steel (N31)
3. Side Milling Cutter
4. Vernier Caliper
5. Surface Roughness Tester

B. MILLING MACHINE SETUP

Fig1. Milling Machine Setup

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C. SIDE MILLING CUTTER

Side milling cutters are essentially plain milling cutters with the addition of teeth on one or both sides. A plain side milling cutter has teeth on both sides and on the periphery. When teeth are added to one side only, the cutter is called a half-side milling cutter and is identified as being either a right-hand or left-hand cutter. Side milling cutters are generally used for slotting and straddle milling. Interlocking tooth side milling cutters and staggered tooth side milling cutters are used for cutting relatively wide slots with accuracy. Interlocking tooth side milling cutters can be repeatedly sharpened without changing the width of the slot they will machine.

D. SURFACE ROUGHNESS TESTER

A roughness tester, also referred to as roughness gauge or roughness meter, is a portable device that is used to quickly and easily measure the surface roughness (surface finish) of an object. Roughness Meter is a portable measuring instrument for determination of surface roughness according to Ra, Rz, Rq and Rt in just one device. The small roughness meter is especially designed for fast measuring of roughness. The roughness is a term of surface physics that describes unevenness of surface height. The roughness meter works according to the same piezoelectric micro probe principle like the highly accurate laboratory measuring instruments. The easy handling of the roughness meter as well as the high repetitive accuracy characterizes this device. After touching the button the piezoelectric micro probe of the roughness meter scans the surface within seconds and shows digitally, according to the preselected cut-off length, either the value Ra, Rz, Rq or Rt.

Fig 2. Surface Roughness Tester

V. EVALUATION AND TESTING

Sr No	Speed(Rev/min)	Depth of cut(mm)	Time (min)	Surface Roughness(Ra)
1	100	5	2.09	1.721
2	63	8	3.22	1.918
3	63	12	3.38	1.634
4	40	15	6.42	3.872

Table No1. Material -Mild Steel

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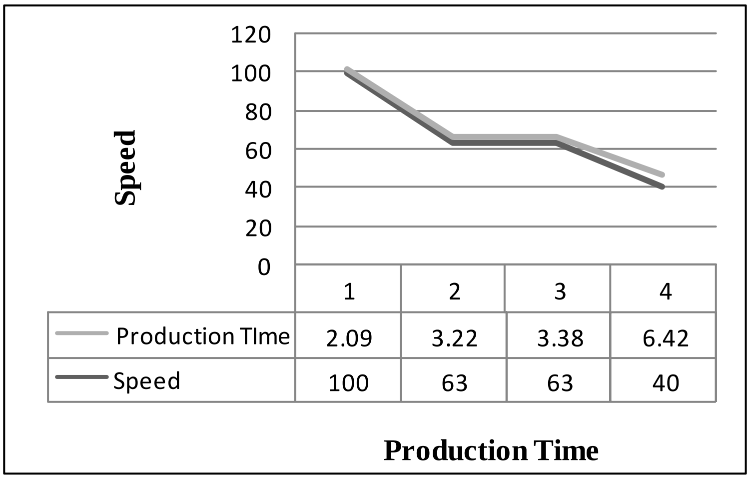
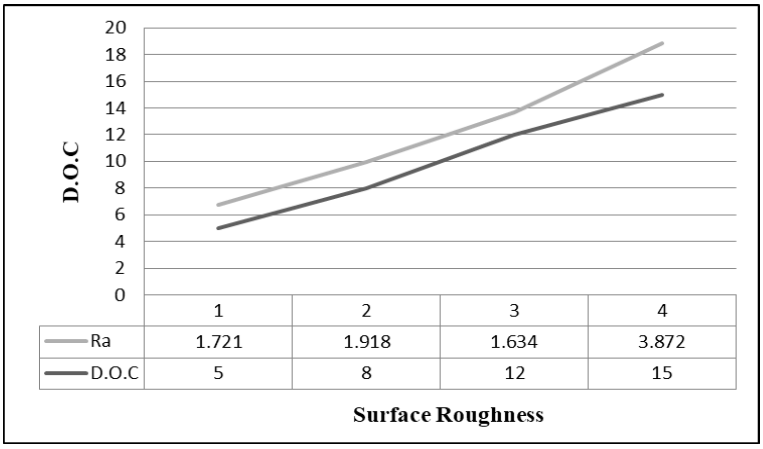
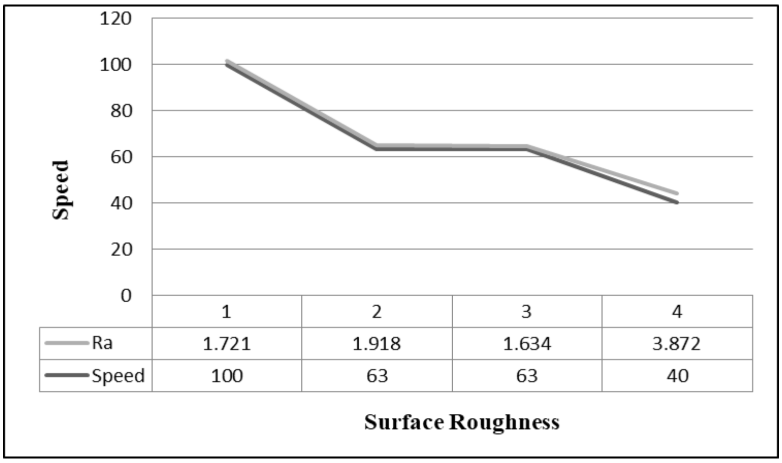


Graph 1. Speed vs. Surface Roughness



Graph 2.DOC vs. Surface Roughness



Graph 3. Speed vs. Production Time

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VI.CONCLUSIONS AND FUTURE ENHANCEMENTS

A. ANALYSIS OF RESULT

The curves obtained between production time and cutting speed reveal that a smaller value of cutting speed results in a high production time. It is due to the fact that a smaller cutting speed increases the production time of parts. Also, it will decrease the profit rate due to the production of a lesser number of parts. However, if the cutting speed is too high, it will also lead to a high production time due to excessive tool wear and increased machine downtime. The optimum cutting speed is somewhere between “too slow” and “too fast” which will yield the minimum production time.

The production time and the feed rate indicate that a small feed rate will result in high production time. A smaller feed rate means the number of revolutions should be increased. The more the number of revolutions, the more will be the production time. Even a very high feed rate is not advisable as it will increase the tool wear and surface roughness resulting in increased machining time and machine downtime resulting in high production time. So, the optimum feed rate is somewhere between “too small” and “too high” which will result in the minimum production time.

B. CONCLUSION

When the machining operation was carried on mild steel coolant was been used and it is a hard material and it is essential in order to obtain a good surface finish. When the cutting speed is taken high (i.e. 100 rev/min) and the DOC is low (i.e. 5mm) the production time required is low and rate of production increases. Under these conditions, the value of surface finish we get is good.

When the cutting speed is taken medium (i.e. 63 rev/min) and the DOC is also medium (i.e. 8mm to 12mm) it takes more time for production then the previous values. Under these conditions, the value of surface finish we get is superior and hence we can use these particular values for performing precision work.

When the cutting speed is low (i.e. 40 rev/min) and the DOC is also high (i.e.15mm) it takes more time for production and it lowers the production rate. Under these conditions, the value of surface finish we get is very poor and these values are not suitable when are going to perform precision work.

C. FUTURE SCOPE

1. Taguchi Method

Taguchi's work includes three principal contributions to statistics:

- A specific loss function
- The philosophy of off-line quality control; and
- Innovations in the design of experiments.

2. Analysis of Variance (ANOVA)

"Classical" ANOVA for balanced data does three things at once:

1) As exploratory data analysis, an ANOVA employs additive data decomposition, and its sums of squares indicate the variance of each component of the decomposition.

2) Comparisons of mean squares, along with an F-test ... allow testing of a nested sequence of models.

3)Closely related to the ANOVA is a linear model fit with coefficient estimates and standard errors.

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