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A review paper on development of optimum machining parameters tool for different workpiece material

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***Abstract*- In this, we work on cutting forces at a single point cutting tool-tip interface is determined. An investigation of cutting forces acting on the tool is carried out by subjecting it to the maximum possible working stress during a cutting operation. It is also determined that a change in cutting speed and depth of cut has the maximum effect on increasing cutting forces. By varying the material, the effect of those on cutting forces is compared with the experimental results and FEA results.**

The experimental results reveal that the main factors responsible for increasing cutting forces are cutting speed (v), feed rate (f), and depth of cut (d), respectively. In this paper, a FEM simulation technique is utilized to investigate the physical cutting and deformation of the tip of a single-point cutting tool under the influence of cutting forces.

***Key Points*: Cutting Speed, Depth of Cut, Feed Rate, Force, MRR, Surface Finish, Finite Element Analysis**

INTRODUCTION:

Factors such as tool life and wear, cutting forces, material removal rate, and power consumption decide the productivity and overall economy of manufacturing a product by machine. In actual practice, there are various parameters like tool material, rake angle, cutting edge geometry, workpiece material, cutting speed, feed, and depth of cut which affect these factors. So, it is essential to choose the most suitable machining condition in order to improve cutting efficiency. In turning operations, the material removal rate is the key aspect which has needs attention both from the industry and the researcher. In recent industry, one of the trends is to manufacture low-cost, high-quality products in less time. On the other hand, material removal rate is another main

The factor that greatly affects production rate and cost.
Single Point Cutting Tool Geometry
Cutting Forces
Cutting is a process of extensive stresses and plastic deformations. The high compressive and frictional contact stresses on the tool face result in a substantial cutting force F as shown in Fig 1.

Knowledge of the cutting forces is essential for the following reasons:
- Proper design of the cutting tools
- Proper design of the fixtures used to hold the workpiece and cutting tool
- Calculation of the machine tool power
- Selection of the cutting conditions to avoid an excessive distortion of the workpiece Cutting force components usually in orthogonal cutting, the total cutting force F is conveniently resolved into two components in the horizontal and vertical direction, which can be directly measured using a force measuring device called a dynamometer. If the force and force components are plotted at the tool point instead of at their actual application points along the shear plane and tool face, we obtain a convenient and compact diagram.

The two force components act against the tool:
Cutting force F_C: this force is in the direction of primary motion. The cutting force constitutes about 70~80 % of the total force F and is used to calculate the power P required to perform the machining operation,
$P = VF_C$
Thrust force F_D: this force is in the direction of feed motion in orthogonal cutting. The thrust force is used to calculate the power of feed motion. In three-dimensional oblique cutting, one more force component appears along the third axis. The thrust force F_D is further resolved into two more components, one in the direction of feed motion called feed force Ff, and the other perpendicular to it and to the cutting force F_C called back force Fp, which is in the direction of the cutting tool axis.

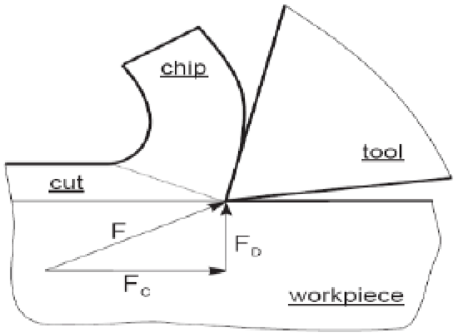

Fig 1: Total cutting force is resolved into two components horizontal component F_C vertical component F_D

LITERATURE REVIEW

V.Sivaraman and S.Sankaran analysis during machining multiphase micro-alloyed steel, the cutting forces decrease as the cutting speed increases. The cutting forces are increased as the feed and depth of the cut are increased for various cutting conditions. The ANOVA for means shows that feed and depth of cut are the significant parameters that influence the cutting

force than cutting speed. The optimum parameter to machine the multiphase micro-alloyed steel are a cutting velocity of 80 m/min, feed 0.05 mm/rev, and depth of cut 0.1 mm.[1]

N. Satheesh Kumar, and Ajay Shetty at all, from this study of the effect of spindle speed and feed rate on surface roughness of carbon alloy steels, it may be concluded that a better surface finish may be achieved by turning carbon alloy steels at a low feed rate and high spindle speeds. The outlying points in Graph: 1 to Graph: 10 can be attributed to factors such as the vibration of the machine, obliqueness in the workpiece, tool wear, temperature of the workpiece, and variation in material composition. It should also be noted that the turning operation for all workpieces is carried out sequentially. This also adds to tool wear.[2]

B.tulasiramarao, Dr. k.srinivas at, in this project, we have performed a detailed experiment of the cutting parameters influencing the surface roughness on metal after CNC Turning. In this work process, we have identified the values of the optimum cutting parameters to get the minimum Surface roughness. They have experimented with various combinations of the three cutting parameters, i.e., Spindle Speed, Depth of Cut, and Feed Rate. They have arrived at the conclusion that the minimum surface roughness in stainless steel is obtained when the Spindle speed is (1200 rpm approx.), Depth of cut and Feed Rate is minimum (i.e., 0.2 mm and 0.15 mm, respectively). In the case of aluminum, the minimum surface is obtained when the spindle speed is (800 rpm approx.), Depth of cut and Feed Rate is minimum (i.e., 0.3 mm and 0.15, respectively).[3]

Saurabh Singhvi, M.S.Khidiya, S. Jindal, and M.A.Saloda shows that both two parameters have their effect on the measured material removal rate. The effect of feed is more than the rake angle. Feed is the distance the tool travels per revolution of the workpiece, indicating the time for cutting the material from a workpiece. Hence for more feed, less time is required to cut the material for the desired length, which increases the material removal rate. It is clear from the given data in Table for a constant rake angle and spindle speed, but varying the feed shows more variation in material removal rate. For example, for a constant spindle speed of 52 rpm and rake angle of 6 degrees, changing the feed from 0.05 mm/rev to 0.10 mm/rev show an increment in material removal rate from 377 mm3/min to 654mm3/min, which is more significant. There is less effect of rake angle on material removal rate as the increase in rake angle leads to a less increment in material removal rate. After analysis of the data, the maximum material removal rate developed at 0.10 mm/rev of feed and at 6 degrees of rake angle, which save energy and useful production time. [4]

Gaurav Pant and Shivasheesh Kaushik Turning tests were performed on Aluminium Alloy 6063 workpiece using three parameters. The influences of cutting speed, feed rate, and depth of cut were investigated on the machined surface roughness and Material Removal Rate (MRR). Based on the results obtained, the following conclusions have been drawn: The analysis of the experimental observations highlights that MRR in the CNC turning process is greatly influenced by cutting speed followed by the depth of cut. It is observed that the feed most significantly influences the Surface Roughness (Ra). [5]

CHO CHO KHAING and EI EI THAR This paper emphasized the design calculation of saddle (carriage) and tool post, tool. In the lathe machine, the saddle supports the tool post. The design requirement of the saddle and tool post is high static and dynamic stiffness. These properties can be achieved by properly selecting the material and its cross-section. Maximum cutting forces acting on the saddle are 5.2kN for the x-axis, 3kN for the y-axis, and 1.1kN for the z-axis. In the stress analysis, it was founded that the maximum stress, maximum shear stress, and deflection due to the operation are less than the allowable strength of the material. So, this design is satisfied by using the checking method.[6]

Bharat Sharma can derive the following results, As the depth of cut increases, the feed force cutting force and radial force all increase, respectively. As the feed rate increases, the feed force remains almost constant. However, the cutting and radial forces increase, respectively. As the spindle speed increases, the feed force almost remains constant. However, the radial force varies unusually, and the cutting force decreases. As the depth of cut increases, the resultant cutting force increases. As the feed rate increases, the resultant cutting force increases. As the spindle speed increases, the resultant cutting force decreases [7]

Manoj Modi and Veerendra Patil, the empirical model of MR-R is formulated using the DA method. The comparative graph indicates that there is good agreement among experimental and theoretical values of MR- R, and both follow identical trends. The difference among the theoretical and experimental values of MR-R at exp. No. 6, 8, and 9 are comparatively more. It happened due to the availability of fewer numbers of test data for the development of an empirical model of MR-R. [8]

V. Sai Sanjay, V. Sai Manohar, and P. Ganesh Chowdary developed a mathematical model that can predict the force variation with very good accuracy. The comparison between the values shows good accuracy. The research was conducted on Aluminum 7050

T7451 using an end mill cutter (4 flutes), the future work that can be done is to develop a mathematical model in order to predict the residual stresses induced and also to develop a finite element model that will predict the cutting forces and residual stresses. [9]

PROBLEM STATEMENT:
To find the optimum machining parameters in order to get the minimum surface roughness. Study of review papers and analysis of tools under different loading conditions and different materials.

OBJECTIVES:
1. Calculate the force applied on the cutting tool due to different cutting conditions.
2. To analyze the tool under different conditions and determine the failure condition.
3. Analysis of tools under different workpiece materials.
4. To determine the relationship between work material and tool force generation.
5. To develop a logic for the calculation of force and optimized cutting parameter by using the MATLAB program

CONCLUSION:
From the study of all research papers, we have to conclude that all research work is on cutting parameters of single-point cutting tools considering the tool material. In all, no work is done on the workpiece material. The future work that can be done is to develop a mathematical model in order to predict the residual stresses induced and also to develop a finite element model that will predict the cutting forces and residual stresses.

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