

Review of Effect of Tool Nose Radius on Cutting Force and Surface Roughness

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Abstract – Machining is most important and common process in manufacturing. Various different types of cutting tool are used for cutting the different metals. There is a different type of cutting tool like single point cutting tool and multi-point cutting tool. Rake angle, flank angle, nose radius and other tool geometry are the different parameters of single point cutting point tool. The main effect on metal cutting is by rake angle, clearance angle, and nose radius. The nose radius having more effect on the surface roughness and cutting force. Feed rate also having the identical effect on the cutting force and surface roughness. Nose radius and cutting force and feed force are directly proportional and nose radius increases surface roughness is indirectly proportional.

In this paper, the various forces such as cutting force, feed force and the axial force have been found out with the variation in depth of cut for EN8 materials. Graphs are drawn on how these forces vary with the variation in the depth of cut. The cutting force during turning is measured by using two-dimensional tool dynamometer and surface roughness is measured by using profilometer.

Key Words: Tool nose radius, tool dynamometer, cutting force, surface roughness.

1. INTRODUCTION

In metal turning process, for achieving certain shape, layer, size and surface quality of work piece for cutting tool required. There are many type of cutting tool

developed to satisfy the requirement production for smooth running. The dimensions and shapes of work piece either determine by graphically and analytically during design. For greater productivity there are many researches are carried for decrease production cost and increase quality. There are many cutting parameter as follows:

- i. Rake angle
- ii. Depth of cut
- iii. Feed rate
- iv. Cutting speed

In machining process there are two type of method are implemented. To determine the effects of the parameters although most of the cutting processes are oblique, orthogonal cutting techniques are used in experiments of two dimensional mechanical workpiece. Important factors like cutting speed, tool rigidity and depth of cut, feed rate and tool geometry are determining the behavior of machinability of mechanical workpiece.

1.1 Types of Cutting Tools

1. Single point cutting tool
 2. Multi-point cutting tool
1. Single point cutting tool-

Single point cutting tool has only one cutting edge. This tool is used for various operation likes

boring, turning, shaping, facing this tool is used on a various machine like lathe machine, boring machine, shaper planer, etc.

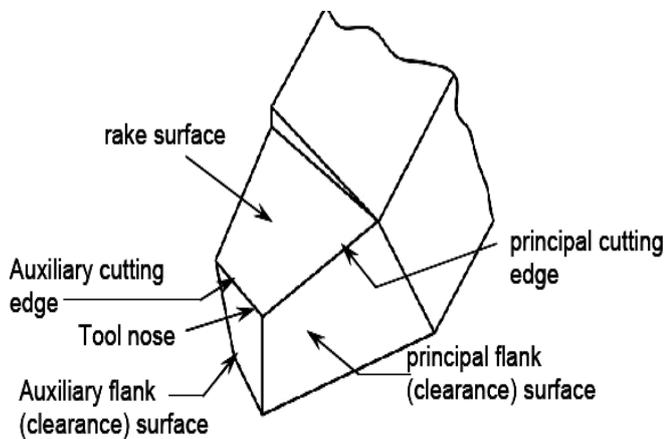


Fig-1: Features of a single point tool

1.2 The various cutting parameters

- i. Nose radius
- ii. Rack angle
- iii. Depth of cut
- iv. Feed rate
- v. Cutting speed
- vi. Cutting force
- vii. Surface roughness

i. Nose radius: Nose radius is joint of side and end cutting edges by means of small radius by this increased life of the tool and better.

ii. Rack angle: It is the angle between normal to the finished surface in a plane perpendicular to the cutting edge.

iii. Depth of cut: It is the volume of work piece material that can be removed by the machining process.

iv. Feed rate: It is the velocity of tool to the machining process.

v. Cutting speed: It is relative speed between the surface of work piece and cutting tool.

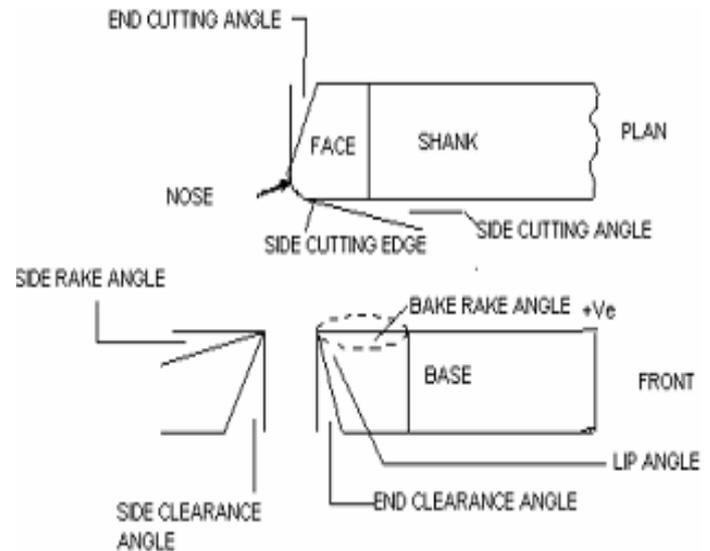


Fig-2: Various parts of single point cutting tool

1.3 Types of metal cutting process

Classification of metal cutting process

- a) Orthogonal cutting process (Two-dimensional cutting)
- b) Oblique cutting process (Three-dimensional cutting)

a) Orthogonal Cutting: The cutting edge of the tool is perpendicular to the work piece axis.

b) Oblique Cutting: The cutting edge is inclined at an acute angle with normal to the cutting velocity vector is called oblique cutting process

1.4 Tool Life

The time elapsed between two consecutive tool reshaping is called tool life. During this period the tool works effectively and efficiently.

Taylor's Tool Life Equation

$$Vt_n = C$$

Where t = Tool life in minute

V = Cutting speed in M/Min

n = Index depends upon tool and work

C = Constant

1.4.1 The Ways of Representing Tool Life

Some of the ways of expressing tool life:

1. Time unit
2. Volume of metal removed expressing tool life
3. Number of work piece machined per grind

1.4.2 The Factors Affecting Tool Life

1. Feed and depth of cut
2. Cutting speed
3. Tool material
4. Tool geometry
5. Work material
6. Cutting fluid
7. Rigidity of work, tool and machine

2. AIM AND OBJECTIVE OF WORK

Nose radius is a parameter used in various cutting and machining process. Describing the angle of cutting face. In tool geometry selection of tool nose radius is not an independent variable in process because the effect of tool nose radius depends on cutting tool geometry and cutting process.

The aim and objective of this study are as follows

1. To study the influence of nose radius on metal turning process.
2. To evaluate cutting force.
3. To find tool wear and decrease it.
4. To decreases residual stresses.

3. LITERATURE REVIEW

Y. Kevin Chou et al. 2004 [1] The tool nose radius effects is examined by finish turning of hardened AISI 52100 sheets of steel. The different conditions like

Surface finish, tool wear, cutting forces are observed while phase transformation, were white layer structure is obtained. Results show that only large tool nose radii give finer surface finish, but as compare to small nose radius tool wear in large tool nose radius is more. with tool nose radius Specific cutting energy slightly increases. For new tools, white layers only occur at aggressive feeds ($=0.3$ mm/rev) and small nose radius results in deeper white layers. For worn tools, white layers appear even at mild feeds (0.05 mm/rev), but in contrast, large nose radius leaves deeper white layers. Maheshwari Patil et al. 2014 [2] From this paper we focus on the effect of H.S.S. single point cutting tool nose radius on cutting edge strength and tool wear in machining of EN9. it is important to increase tool life because of cost of the cutting tool is high, so we have to pay attention to it. To understanding mechanics of turning tool geometry the effect of cutting tool geometry has long been an issue in understanding mechanics of turning tool geometry has a significant influence on chip formation, heat generation, tool wear and surface finish surface integrity during turning. This paper presents a survey on variation in tool geometry that is tool nose radius, rake angle, variable edge geometry and their effect on tool wear and cutting edge integrity in the turning operation of components from EN9 (C45) plain carbon steel. The Heat generated during turning is affected by edge preparation due to change in work material flow around the cutting edge Tool wear had the greatest influence on magnitude of residual stress the level of microstructural alteration The result which is obtained from various test is useful in selecting appropriate rake angle and nose radius for various conditions of speed, feed and depth of cut

which leads to economical machining and improved productivity.

J. Naga Malleswara Rao et al. 2010 [3] In this experiment new type of dynamometer to measure radial of a component of cutting force using strain gauges. Dynamometer is used to measure the cutting force in any metal cutting process. The working principle of dynamometer is calibrated and readings are obtained and specimen is tested for performance. It is mostly used in roller burnishing process on aluminum work piece under various conditions in rollers burnishing process, a hard roller is pressed against a rotating cylindrical work piece and parallel to the axis of the work piece on lathe. From different lubricant applications in roller burnishing operation Optimum values of burnishing force and the corresponding surface roughness value (Ra) are obtained. This dynamometer can be manufactured at a low cost. This dynamometer can be used for tests on lathe in metal cutting laboratories and engineering colleges. Variation in depth of cut can't influence of the corner radius on the cutting forces.

B.Tulasiramarao1 et al. 2014 [4] The cutting force can be measure by Research focusing on a lathe tool dynamometer, thrust/Axial force and also feed force by using strain gauge accelerometer has been Studied. The dynamometer applied in this experiment is a 500kg force 3-component system. To a data acquisition system the dynamometer is to be connected. When the tool comes in contact with the work piece the different forces are produces and they can capture and transformed into numerical form system. In these experiment different forces for four various materials

and the materials used in this project are aluminum, brass; mild steel & nylon have been noted down. The variation in depth of cut is studied by the forces on these different materials with it. Forces vary due to variation in depth of cut are shown by Graphical representation.

Moaz H. Ali et al. 2014 [5] In this work, they are focusing to use a wide range of tools and techniques to ensure that the designs they are created it saves. Sometimes accidents happen when they are work in the laboratories or factories. To know success industries need to know whether a product failed or how much percentage need.

4. CONCLUSIONS

After reviewing much paper related to nose radius, rack angle, feed rate etc. They can be affected the cutting force and surface roughness from above study it is clear that tool nose radius is a most important parameter in single cutting point tool. The result obtaining from the various literature surveys the following conclusion is state-

1. As a nose radius may be increased then effect on cutting force also get increases.
2. Surface roughness gets decreases with respect to increasing in nose radius.
3. Increase in feed rate can also increase the surface roughness.

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