CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

Machining is considered as an important technique in manufacturing processes. It can be defined as the process of removing material from a work piece in the form of chips. Variety of work, part shapes and special geometry features can be formed through machining process. A part of that machining will also influence the dimensional accuracy and surface finish achieved on the workpiece. In machining process, the most significant concern is improving surface finish and minimizes the machining time that nowadays becomes an important issue where the important aim is to achieve desire and high surface quality and reduce the cost of production. Surface roughness greatly influences the performance of mechanical parts as well as production cost.

The end milling process is widely used in industry because of its versatility and efficiency. In milling machining process, the type of cutting tool is milling cutter, tool geometries selection and cutting parameters are important factors to achieve good surface finishing and meet the part tolerance. Basically, cutting tool geometries are different in term of shapes, angles and other geometric aspects. Despite cutting parameters, end mill
tool geometries will influence the surface finish on machined part. The surface finishing is determined by the surface roughness of the workpiece that influence by lot of factors like the cutting tool geometry, depth of cut, cutting speed and feed rate. The basic geometry of an end mill includes cutter diameter, shank diameter, length of cutter, length of flutes, helix angle, clearance angle and rake angle which the factors to determine the machinability.

The basic geometry of an end mill includes clearance angle, rake angle, and helix angle shown in Figure 1.1 by (Technicae, Acta Facultatis, 2014).

![Figure 1.1: Basic geometry of end mill (a₀ – tool orthogonal clearance angle, g₀ – tool orthogonal rake angle, j – helix angle)](image)

Source: (Technicae, Acta Facultatis, 2014)

The variety geometry of the end mill tool is used depending on the type of surface geometry and the material that being milled. The different type of geometries gives the different surface finish. Flat end mill, ball end mill and bull end mill is three main type of milling cutter. Common tool bit types of end mill are square end cutters, ball end cutters and rounded edge cutters. Flat end mill have square end cutter tool bit, while ball end mill is ball end cutter tool bit and bull nose is corner radius end tool bit. Flat end mill consist of square end cutter used in machining that require a flat bottom and sharp corner and widely used in 2D milling to produce pockets or slots. A ball nose end mill is used for 3D milling with complex shape and all non-flat surfaces. Bull nose end mill have rounded edge end mill or known as corner radius end mills is a combination of flat end mill and 90 degree...
arcs in the corners. With rounded edges on the tips of the flutes, bull nose end mill is used for flat surfaces with corner radius and to create fillet on the bottom of a wall. With the rounded edges of the tips of the flutes, bull nose end mill can reduce chipping and lengthen the life of the tool. Figure 1.2 also shows the implication of three type end mill toward the machined surface.

![Figure 1.2](http://www.mcmaster.com/#end-mills/=zujxva)

- (a) Flat end mill
- (b) Bull nose end mill
- (c) Ball nose end mill

Tool path style is one a factor that contributed to machining time. The cycle time can be reduced by selection of proper tool path strategy and modifying some of the design parameters by Prajapati, Rakesh et.al, (2013).

## 1.2 PROBLEM STATEMENT

Tool geometries and play in important role in machining process. The demand for high quality and fully automated production focuses attention on the surface condition of the product, especially the roughness of the machined surface because of its effect on product appearance, function, and reliability. For these reasons it is important to maintain consistent tolerances and surface finish. Basically there are three type of end mill cutting