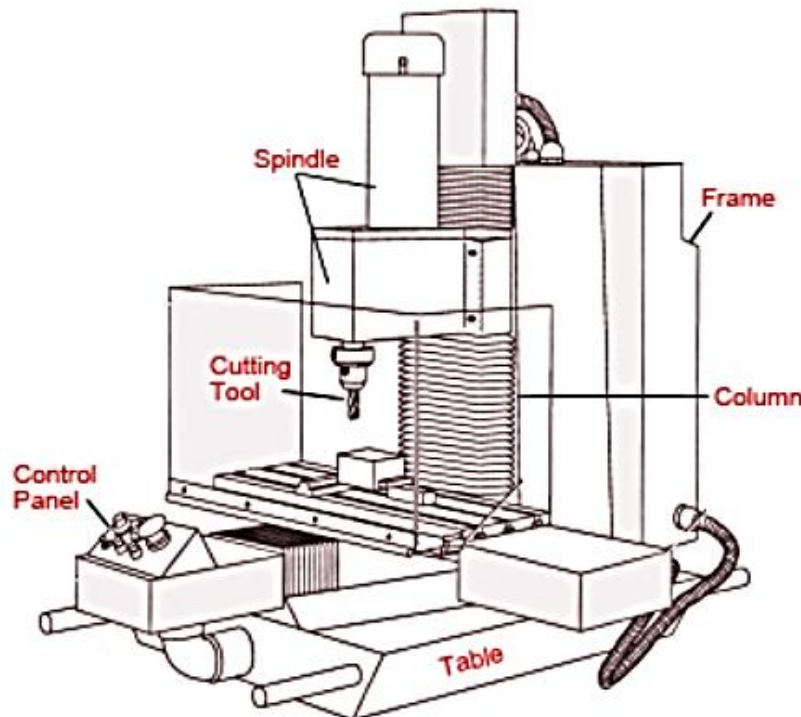


CNC Milling



Let's first familiarize ourselves with the critical components that comprise a CNC Milling machine.

1. Control panel: Control panel is the brain of a CNC milling machine. The machinist/controller feeds the G-code (required dimensions) using the keyboard which, in turn, instructs the axis motors to move the cutters and other components.

2. Table: The table is used to hold the workpiece stationary for the entirety of the milling process. The workpiece is fit to the metal/wooden/plastic table using T-slots and metal clamps.

3. Column: The columns run along the axis to give a backbone to the milling part.

4. Cutting tool: A cutting [CNC machine tool](#) is attached to the column. It moves across the axis to give the desired shape to the CNC machined parts.

5. Frame: As the name suggests, the frame gives sturdy support to the machine, providing them with maximum rigidity to withstand cutting forces. It is mainly built using cast iron.

6. Axes: The axes in a CNC milling machine allows cutting tool/workpiece to move around obtain the maximum possible precision.

7. Spindle: The spindle consists of a rotating assembly that holds the cutting tool and a motor that runs the entire workpiece.

8. Coolant supply tube: The coolant supply tubes are used to cool down the rapidly heating metal workpiece and to lubricate the cutting tool for smooth movement.

There are two types of CNC milling machines available with respect to its working- Vertical and Horizontal- with the major difference being in their spindle placement.

- **Vertical CNC Mills:** Vertical CNC milling machines have a vertical spindle axis. In this machine type, the cutters are placed vertically in the spindle and are able to make drilling or plunge cuts. Popular examples of Vertical CNC mills include Bed mills and Turret mills.
- **Horizontal CNC Mills:** In horizontal CNC milling machines, the cutters are placed horizontally on an arbor.

Here are a few features of a CNC Milling machine that makes it an ace in the CNC manufacturing industry.

1. **Safety**– Custom CNC Milling process is about 10x faster and safer than traditional milling machines'. With computer systems handling everything, there is minimal contact between the machines and the operators. The operator feeds in the codes and the machine is directed to produce custom machined parts with tight tolerances. The manual work is reduced by a multifold and the chances of human error is next to nothing.

2. **Accuracy** – CNC milling machines are notorious for producing guaranteed accuracy all thanks to its next-gen

features and innovative working. Tight tolerances are no big deal with CNC milling machines.

3. Versatility – CNC milling machines are not limited to producing machined parts out of one material type. From metals to industrial plastics and alloys, almost every

material type can be used with a CNC milling machine that too without compromising on the quality front.

4. Lower Overhead Costs – With a severely automated process in place with CNC milling machines, you save a huge chunk of machining and manufacturing costs which you can use in any other development facet.

HOME WORK: Draw CNC Milling and highlight the main parts.

PROBLEM: The contour in Fig. 1, of depth of 4mm with surface finishing of $R_a = 3.2\mu\text{m}$, so:

(1) Select the optimal operating conditions from table (1), for this job by using carbide end mill, the raw material is Low carbon-steel with dimensions 80mmx70mmx10mm.

(2) Calculate the revolutions of tool (RPM).

(3) Write CNC program for machining this contour. Hint:
 N01 G90 G80 T00; N02 G00 X.... Y.... Z....; N03 M03 S....; N04 X... Y.... Z....; N05 Z....; N06 G01 Z.... F....; N... cont. (17 marks)

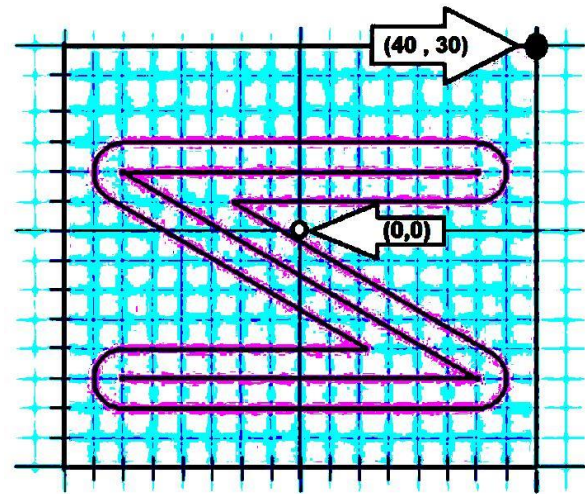
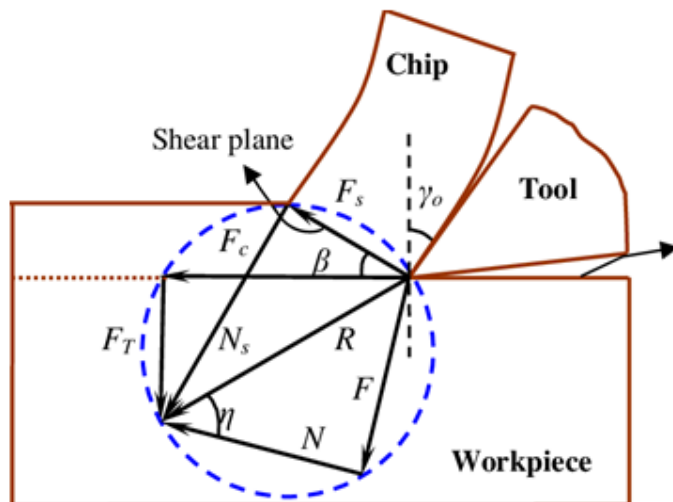
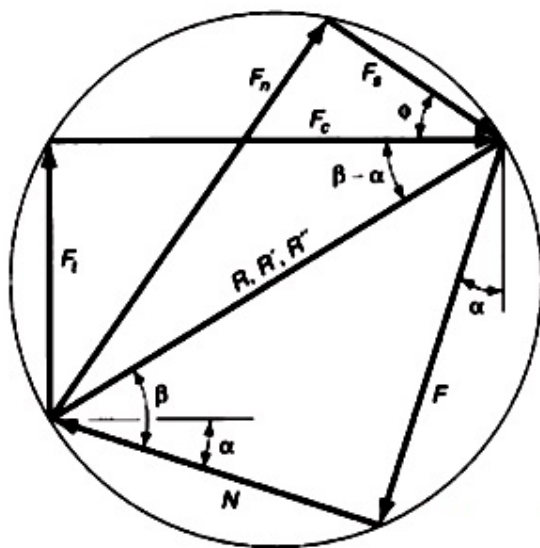


Fig. 1

CUTTING FORCES

cutting forces in turning Merchant's Circle Diagram



PROBLEM: In a machining operation, the cutting tool has a rake angle $= 7^\circ$. The chip thickness before the cut $t_o = 0.50\text{mm}$ and the chip thickness after the cut $t_c = 1.125\text{mm}$. (1) Calculate the shear plane angle and the shear strain. (2) determine the shear strength of the work material, if; $F_c = 1559\text{ N}$, $F_t = 1271\text{ N}$, and $w = 3.0\text{mm}$.
 HINT: The force diagram as shown in Fig.