INDIAN INSTITUTE OF TECHNOLOGY PATNA

ME110: MECHANICAL WORKSHOP

3rd

CNC

Milling Machine

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1701ME04

CONTENTS

INTRODUCTION

CNC is the acronym for Computer Numerically Controlled. CNC was purposely built to provide a default machining strategy of using any combination of milling and turning within the same work envelope. It can perform face milling, end milling, slot milling, drilling, boring and threading operations on the components of different parts in every industrial field, featuring high speed, high accuracy and productivity. It can easily create complex geometries and optimum working conditions are possible.

In CNC milling machine, functions and slide operators are controlled electronically by a computer program rather than by hand as in conventional milling machines. CNC uses a direct Numerical Control that uses a central computer to control several machi-nes at the same time.

WORKING OF CNC MACHINE

In a CNC machine, functions like feed, depth of cut, slide movements etc are controlled electronically

by using computer programs rather than by hands. Some of the enhancements that come along with CNC include: canned cycles, sub programming, cutter compensation, work coordinates, coordinate system rotation, automatic corner, rounding etc.

Languages of CNC machines is a fairly standard set of G and M codes.

CNC Works as follows:-

→ controlled by G and M codes
→ these are values and co-ordinates
→ typed in manually by machine operator or automati-cally generated by computer software.
→ movement is controlled by motors (actuators)
→ feedback is provided by sensors (transducers)
→ tool magzines are used to change tools automati-cally.

LANGUAGES USED IN CNC

CNC machines work on different types of codes with some variations in their application. Basically there are two types of codes in a CNC milling machine:-

→ G Codes (Primary Codes)
→ M Codes (Functional Codes)

Programming Key Letters

- O - Program number (used for program identification)
- N - Sequence number (used for line identification)
- G - Preparatory function
- X - X axis designation
- Y - Y axis designation
- Z - Z axis designation
- R - Radius designation
- F - Feed rate designation
- S - Spindle speed designation
- H - Tool length offset designation
- T - Tool designation
- M - Miscellaneous designation

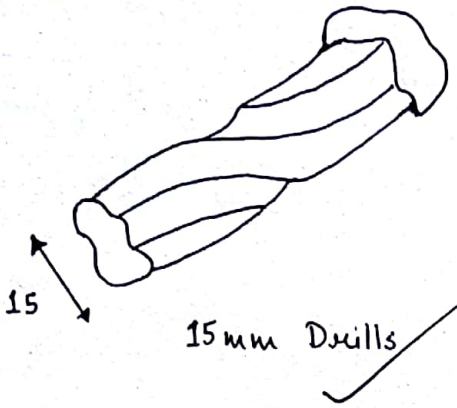
TOOLS

- Most tools are made from High Speed Steel (HSS), tungsten carbide or ceramics.
- Tools are designed to direct away from the material.
- Some tools need coolant such as oil to protect the tool and workpiece.

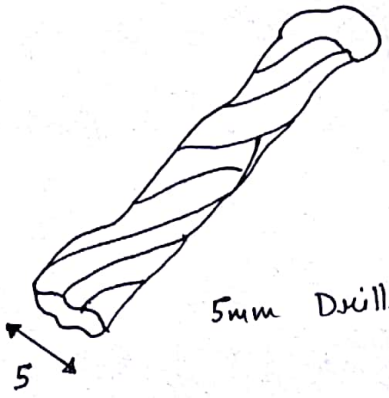
Tools Used

1. Drills
2. End milling and face milling tools
3. Clamps to fix the tool to the machine.

Drills

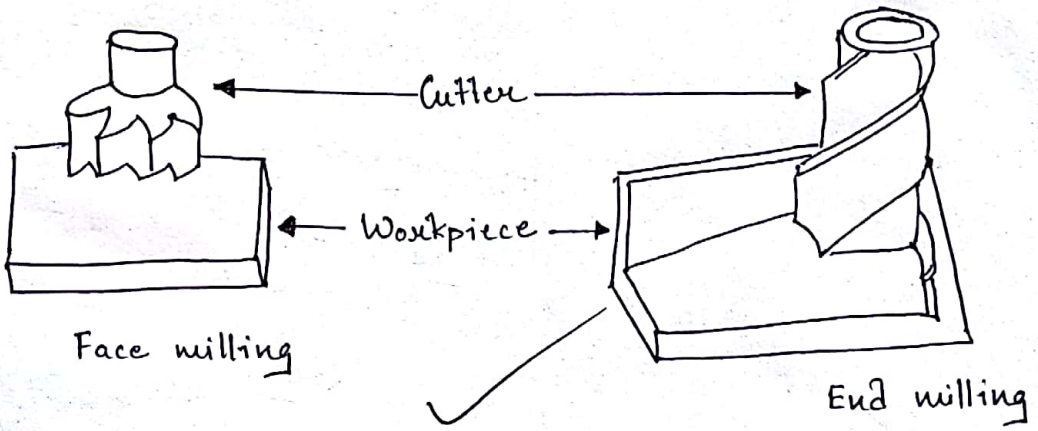


15mm Drills



5mm Drills

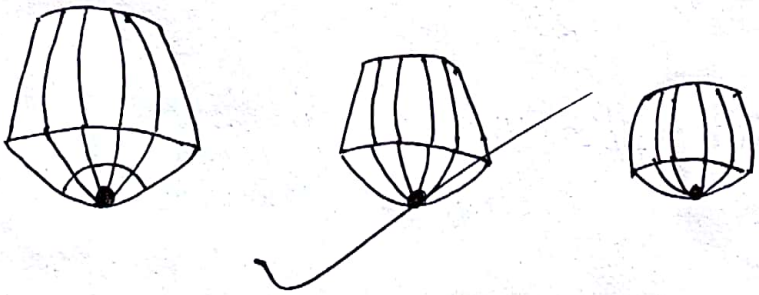
Milling Operations



Face milling

End milling

Clamps of Different Sizes



All dimensions are in mm.

COORDINATE SYSTEMS

We used the Cartesian coordinate system in the machine tool. We first identify the z axis, x and y axis will then follow using the Right Hand Coordinate System.

The CNC Machine can have maximum of 5 axis:-

→ Three linear axis:- X axis, Y axis, Z axis

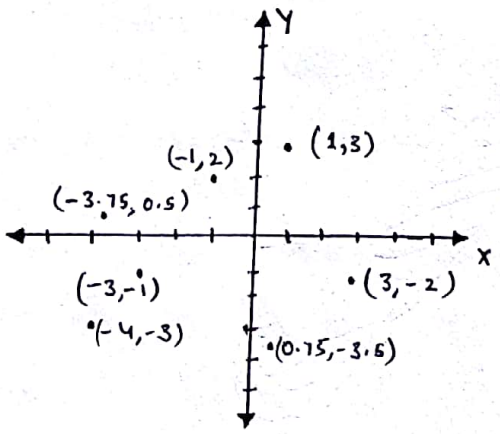
→ Two rotary axis:- rotation along z axis, rotation along Y axis.

Absolute Coordinate System:- It refers to a cartesian system that use X-axis, Y-axis and sometimes a Z-axis to establish a point some distance from a common origin (fixed origin).

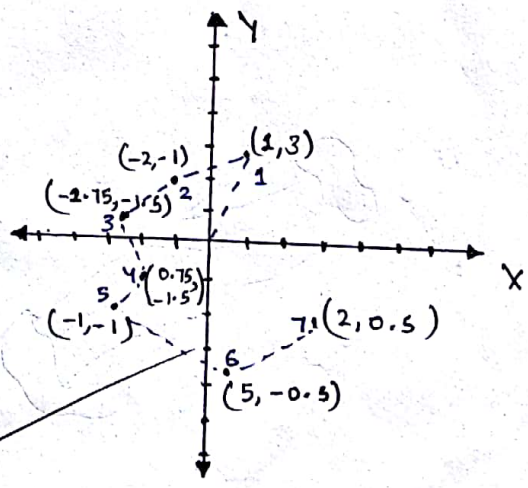
Incremental Coordinate System:- Every measurement refers to a previously dimensioned position (point-to-point). Incremental dimensions are the dimensions between two adjacent points.

Machine Coordinate System:- The origin starts from centre of machine.

Workpiece Coordinate System:- The origin starts from centre of workpiece.



Absolute Coordinate System



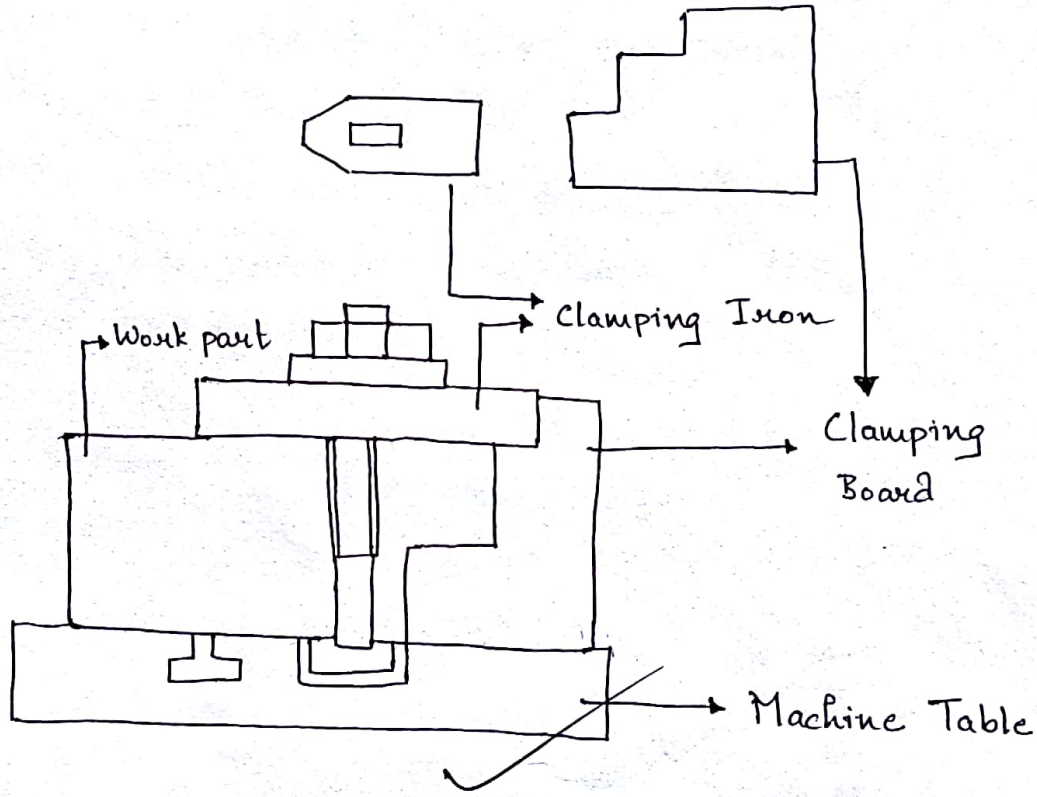
Incremental Coordinate System

PROGRAM INPUT

Different ways of data input are:-

→ M01 – Manual Data Input
→ Program Preparation with CAD/CAM.
→ Program Data transfer from PC to CNC Machine.
→ Program Data transfer from PC to NC operations.

MECHANICAL CLAMPING DEVICES



PROCEDURE OF USING CNC MACHINE

→ Procedure to start the machine:-

1. Switch ON from the main switch.
2. Switch ON 3-phase stabilizers.
3. Switch ON machine isolator switch.

4. Press CNC ON button (green button).
5. Release CNC emergency stop button (red button).
6. Press Reset button (white button).

Procedure to take offset:-

1. Press MPG button.
2. Put the tool (cutter) to corner of job.
3. Press OFF/SET button.
4. Press Work (Bring the cursor to 01 (G54), X Line then type X01.
5. Press measure and take Y0 - press measure.
6. Press ◀| button.
7. Press OFF/SET button.
8. Bring the cursor on (001) line.
9. Press REF (Z+/Y+ X+).
10. Press POS button.

Procedure to open new program:-

1. Press Edit → Program
2. Write O with 4-digit number and press insert → EOB button
3. Press insert button. (Now new program can be inserted).

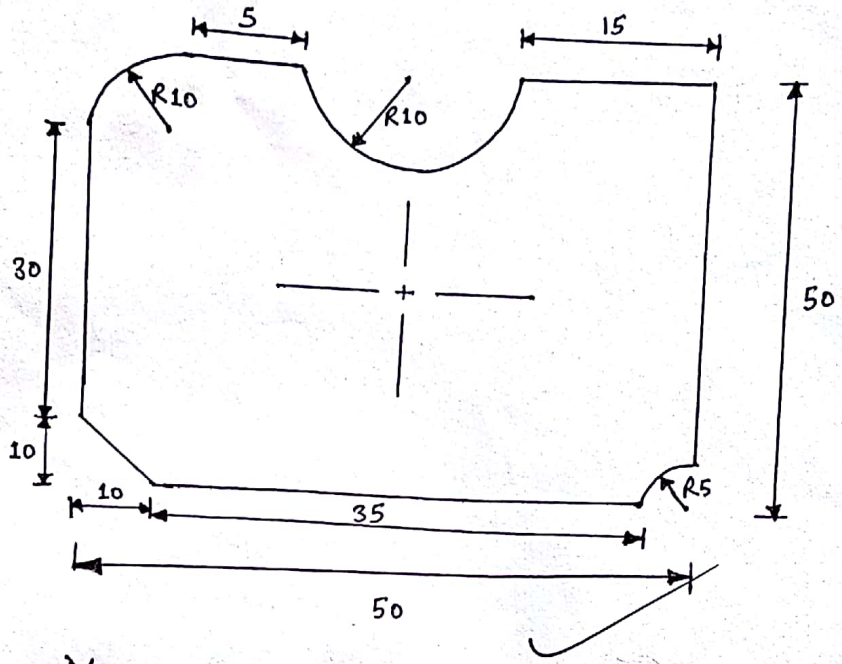
Procedure to check simulator:-

1. Open program → Press AUTO button → MLK button → DRN button → CSTM/GR button graph → Cycle start button

Procedure to start machine :-

1. Press PROG button → MLK button.
2. Release DRW button
3. Press AUTO button → CNC ON button

PROFILE → MILLING EXAMPLE



CODE → MILLING EXAMPLE

```
G15 G17 G94 G40 G69 G80;
G91 G28 Z0;
G28 X0 Y0;
M06 T1;
M03 S1200;
G90 G00 G54 X-25 Y-15;
G43 H1 Z10;
M08;
G01 Z-1 F120;
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```
G01Y15;
G02 X-15 Y25 R10;
G01 X-10;
G03 X10 Y25 R10;
G01 X25;
G01 Y-20;
G03 X20Y-25 R5;
G01 X-15;
G01 X-25 Y-15;
G00 Z5;
M09;
G91 G28 Z0;
G28 X0 Y0;
M05;
M30;
```

Good

ADVANTAGES OF CNC MACHINES

1. CNC machines are programmed with a design which can then be manufactured hundreds or thousands of times. Each manufactured product will be exactly the same.
2. Modern design software allows the designer to simulate the manufacture of his/her idea. There is need to make a prototype or a model. This saves time and money.
3. CNC enables the manufacture of products with complex design that cannot be made by manual

machines, even those used by skilled designers/engineers.

4. CNC milling machines are more safer than manual milling machines.
5. It also requires less paperwork and gives high precision in comparison to manual machines.

DISADVANTAGES OF CNC MACHINES

1. It requires very skilled workers and is very costly to setup.
2. Maintainance of the CNC machine is difficult.
3. Prerequisite knowledge of programming language is required.
4. Less number of workers are required to operate CNC which can lead to unemployment.

PRECAUTIONS WHILE USING CNC MACHINES

1. There are high voltage terminals on electric panel, motor and other equipments. Proper distance should be maintained while working.
2. Before touching the workpiece ensure that the spindle is not rotating and tools are away.
3. Ensure that workpiece and tools are screwed firmly.
4. Do not give rapid transverse code when the tool is in contact with workpiece.
5. Use coolant regularly when tool is working on piece.