

446.326A CAD/CAM

Manual NC

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Professor Sung-Hoon Ahn

TA: Hyung-Jung Kim

School of Mechanical and Aerospace Engineering
Seoul National University

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Words



1. N code

- Line number
ex. N001 O1234 → first line of the program and O1234 is the program number (usually the program # is located)

2. G code

- Prepare the controller for a given operation
ex. G00 X10.0 → move to positive X-direction by 10.0 mm
G00: point to point, positioning (use with combination point-to-point/contouring systems for indicating positioning operation)

3. Dimension words (X, Y, Z, A, and B words)

- Location and axis orientation of a cutter A, B are for machine with more than 3 axis
ex. Y + 500 → if the unit BLU (Basic Length Unit) is 0.0254 mm, it means 12.7 mm moving from Y location

Words (cont.)



4. F code (feed command)

- Cutter feed rate (mm/min, millimeters per minute)
ex. F2.0 → move 2 mm per minute

5. S code

- Specify spindle speed
ex. S5000 → Spindle speed is specified by 5000 rpm

6. T code

- Tool selection command
- Used when the machine is equipped with a tool turret
ex. T1 → call the tool # 1 in the tool turret

Words (cont.)



7. M code

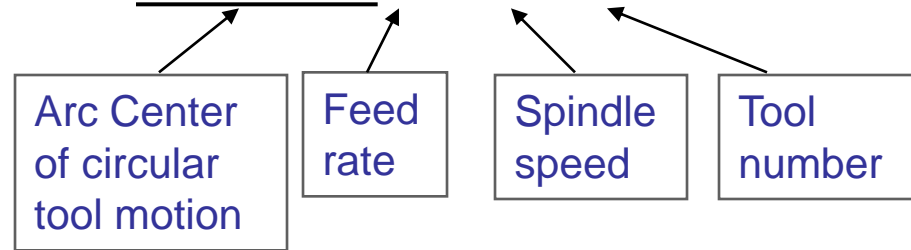
- Miscellaneous commands
- Coolant supply, spindle on/off, etc.
ex. M06 → tool change, executes the change of a tool (tools)
manually or automatically, not to include tool selection

Words (cont.)



▪ Word address format

- Used by most CNC controllers
- N_, G_, X_, Y_, Z_, I_, J_, K_, F_, S_, T_, M_



- ex. N0010 G01 X07500 Y06250 S612
- Omitted words are assumed to zero or to be the same as the value previously defined

```
N001 G92 G91 X0.0  
Y0.0 Z20 ;  
N002 G00 Z-8.0 ;  
N003 G01 Z-20.0 F80 ;  
N004 Y5.0 ;  
N005 X10.0 ;  
N006 G03 X12.5 Y12.5  
R12.5 ;  
N007 G02 X20 Y20  
R30 ;
```

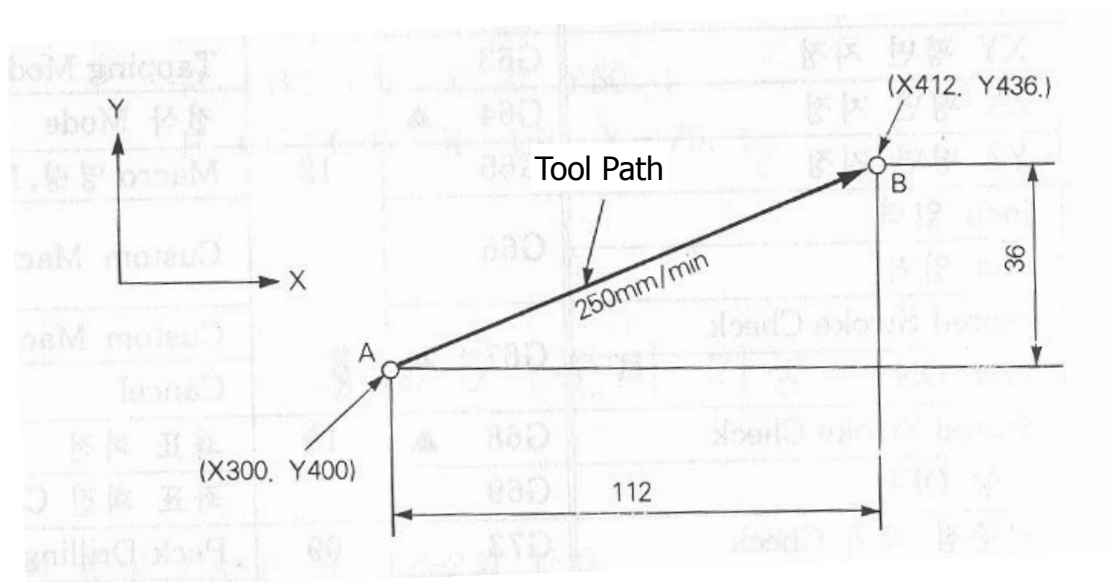
Basic preparatory commands



■ G Code

- G90 : Absolute dimension programming
- G91 : Incremental dimension programming
- G92 : Coordinate origin position setting

- G00 : Point to point, positioning
- G01 : Linear interpolation



Absolute dimension
G90 G01 X412. Y436. F250;

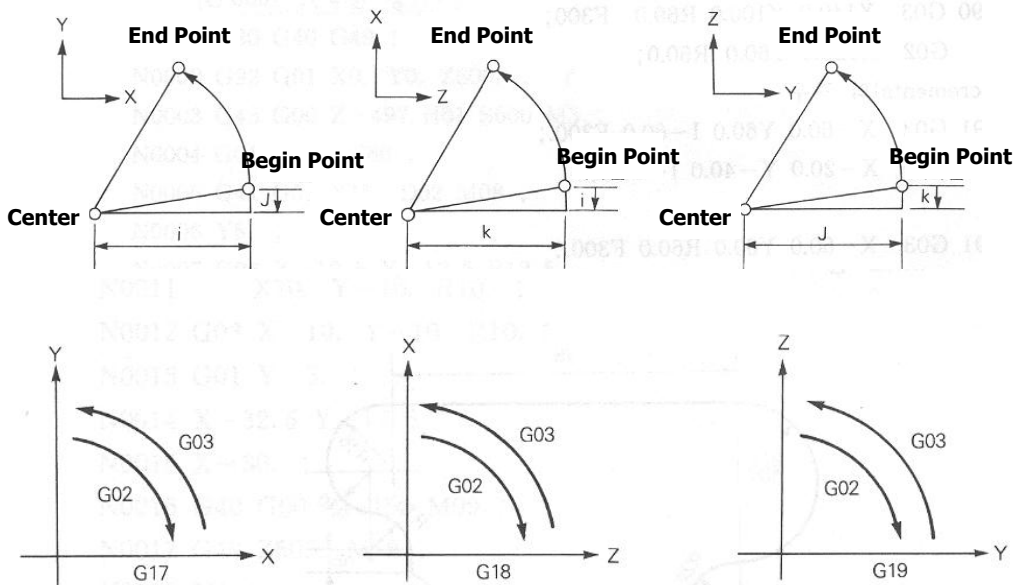
Incremental dimension
G91 G01 X112. Y36. F250;

Basic preparatory commands (cont.)

■ G Code

- G17 : XY Plane selection
- G18 : YZ Plane selection
- G19 : ZX Plane selection

- G02 : Circular interpolation arc CW
- G03 : Circular interpolation arc CCW



Example

```
G17  
G02 X-28.28 Y0.0 I14.14 J5.0
```

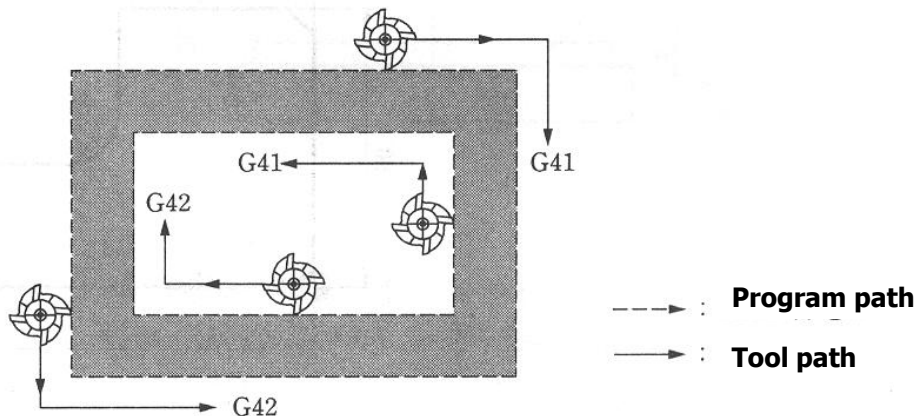
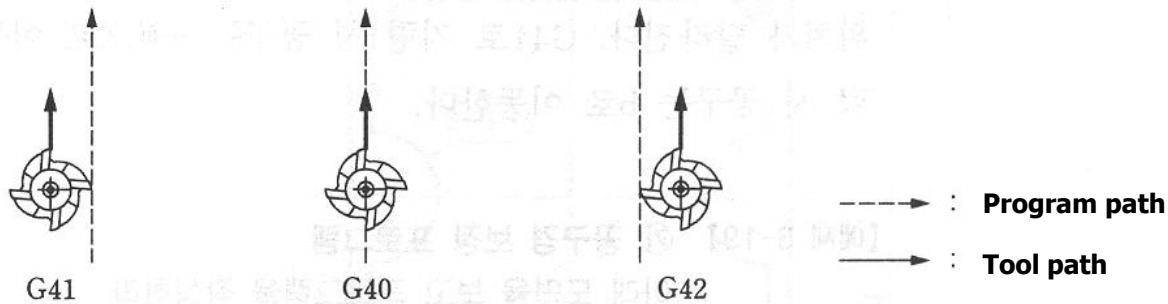
```
G18  
G02 Y0.0 Z5.0 J5.0 K5.0
```

```
G19  
G02 Z5.0 X10.0 K5.0 I5.0
```


Basic preparatory commands (cont.)

■ G Code

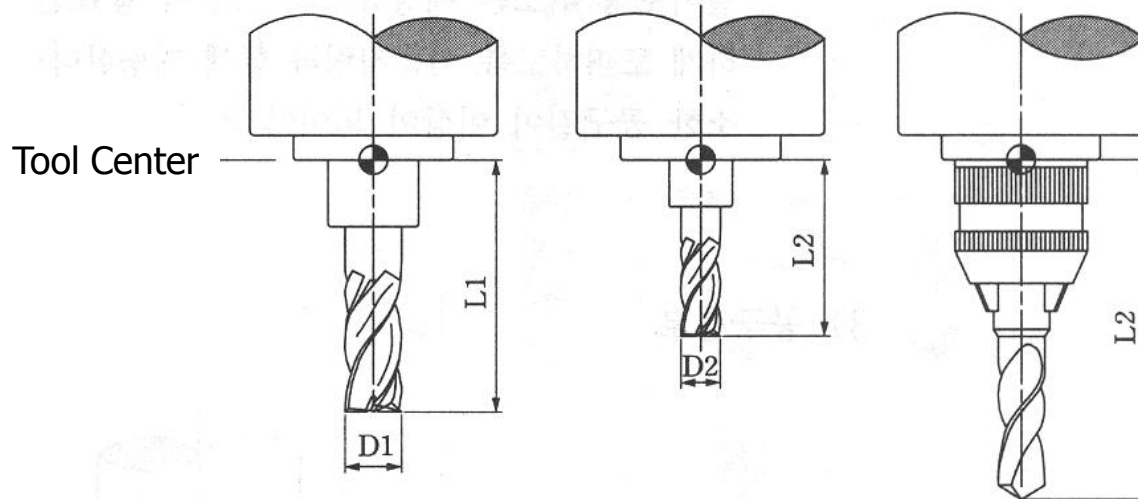
- G40 : Cutter compensation for tool diameter – cancel
- G41 : Cutter compensation for tool diameter – left
- G42 : Cutter compensation for tool diameter – right



Basic preparatory commands (cont.)

■ G Code

- G43 : Cutter compensation for tool length – “+”
- G44 : Cutter compensation for tool length – “-”
- G49 : Cutter compensation for tool length – Cancel



Basic miscellaneous commands



- **M Code**

- M02 : End of program
- M03 : Spindle CW
- M04 : Spindle CCW
- M05 : Spindle off
- M30 : End of tape

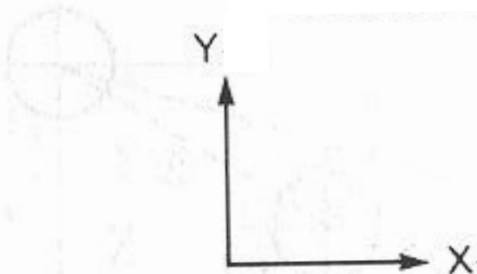
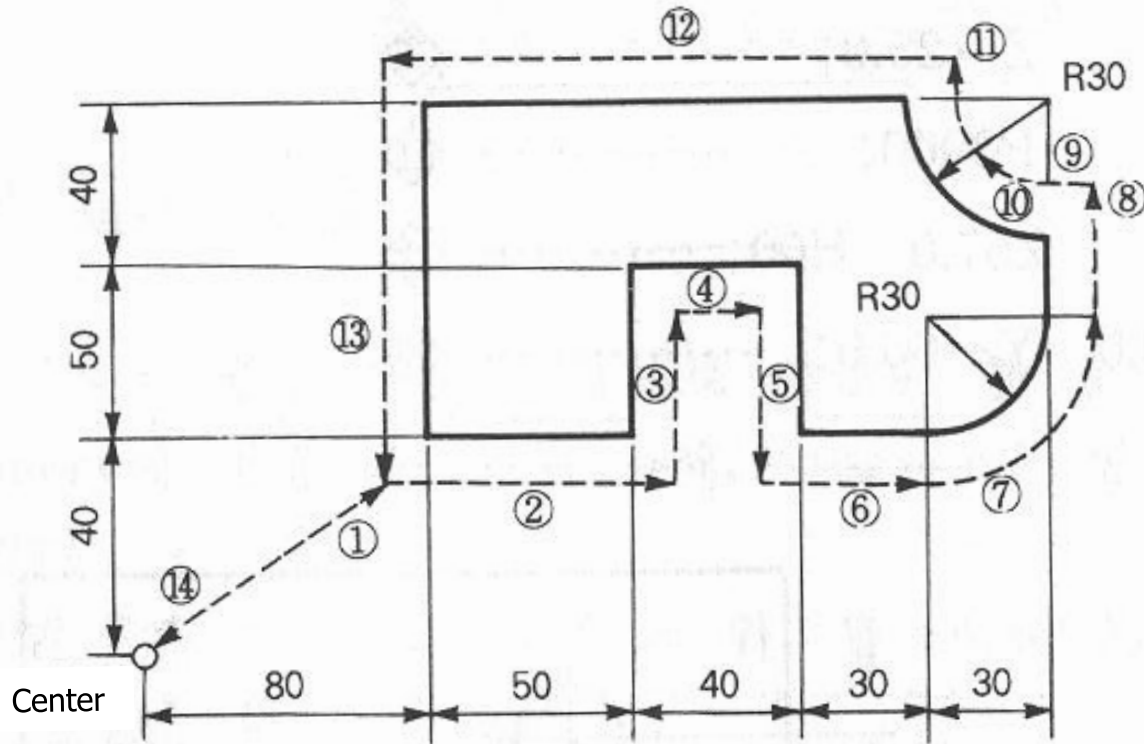
(Similar to M02, except that it is ready for the next work piece)

Manual NC Viewer



- **Gcode2000**
- **Download from the web class,
and extract it on your computer**

Simple Example



Tool Diameter $\phi 20$

Tool position : X0.0 Y0.0 Z3.0

Feed 120

Depth : 5

① and ⑭ are not for machining

Simple Example (cont.)



- **Initialization**

 - Absolute or Incremental dimension

 - Set feed rate and start spindle

- **Incremental dimension programming**

- ① **Path**

 - G92 G91 X0.0 Y0.0 Z3.0 ;

 - G00 X70 Y30 ;

 - M03;

 - G01 Z-8.0 F120;

Simple Example (cont.)



- **②~⑥ Path**

```
G01 X70.0;
```

```
G01 Y50.0;
```

```
G01 X20.0;
```

```
G01 Y-50.0;
```

```
G01 X40.0;
```

- **⑦ Path**

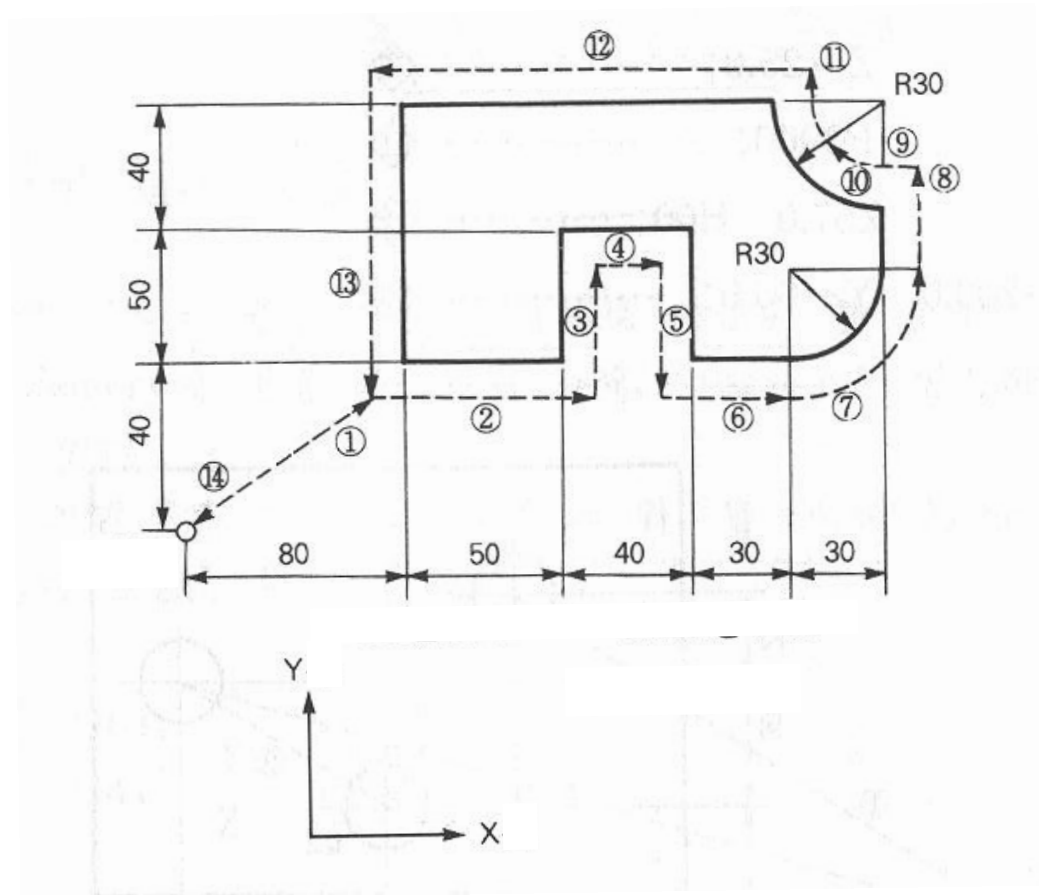
```
G03 X40.0 Y40.0 I0.0 J40.0;
```

```
(or G03 X40.0 Y40.0 R40.0;)
```

- **⑧~⑨ Path**

```
G01 Y40.0;
```

```
G01 X-10.0;
```



Simple Example (cont.)



- **⑩ Path**

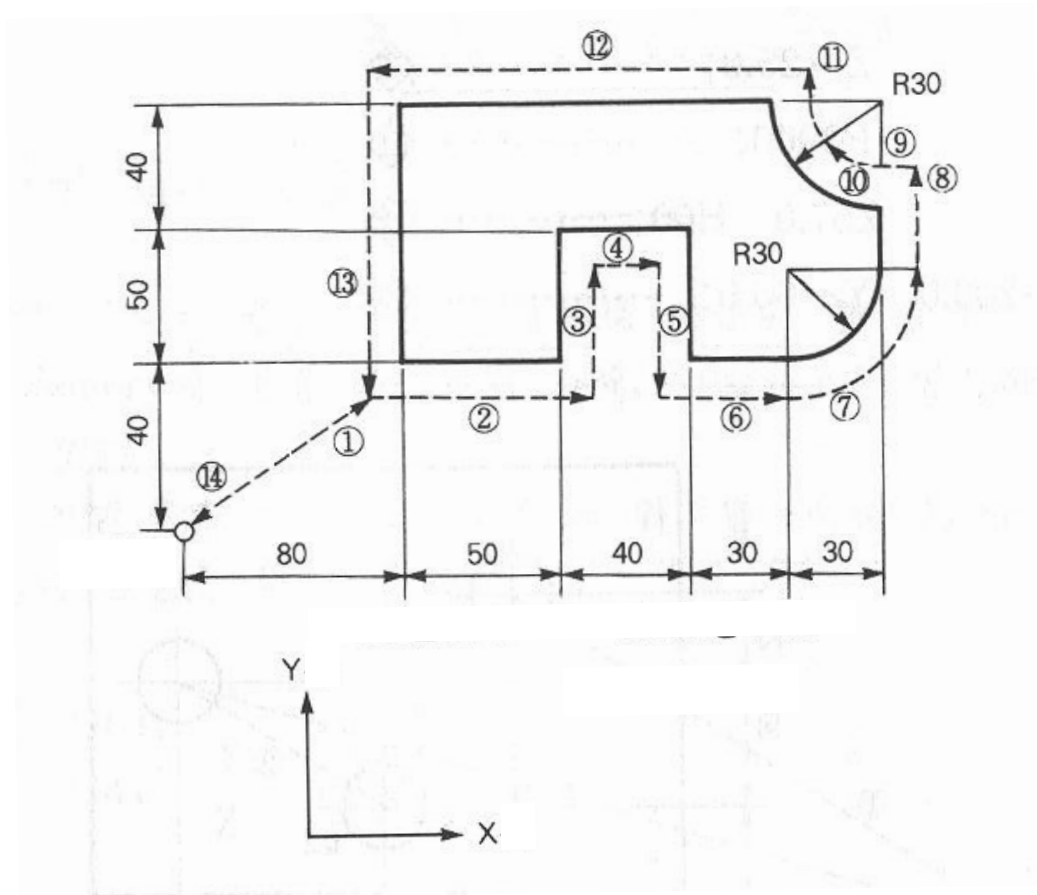
```
G02 X-20.0 Y20.0 I0.0 J20.0;  
(or G02 X-20.0 Y20.0 R20.0;)
```

- **⑪~⑬ Path**

```
G01 Y10.0;  
G01 X-140.0;  
G01 Y-110.0;
```

- **⑭ Path**

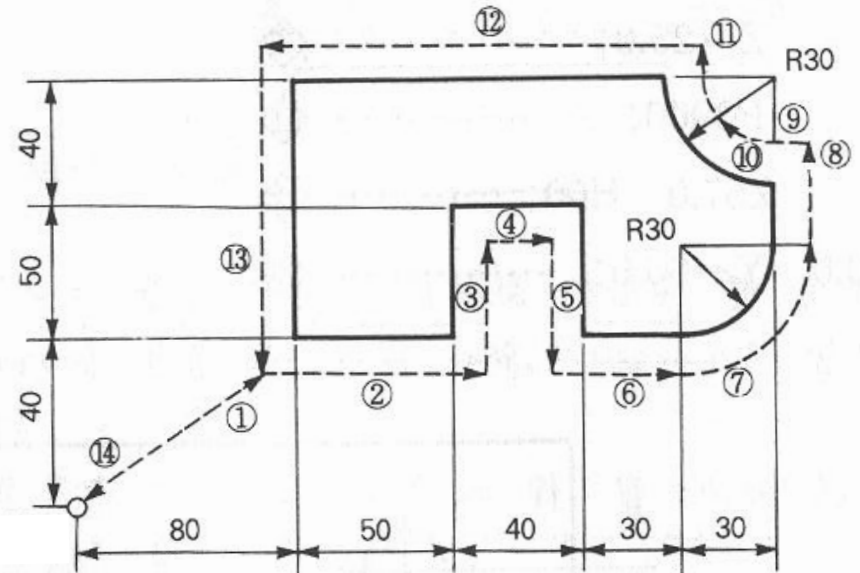
```
G01 Z8.0;  
M05;  
G00 X-70.0 Y-30.0  
M30
```



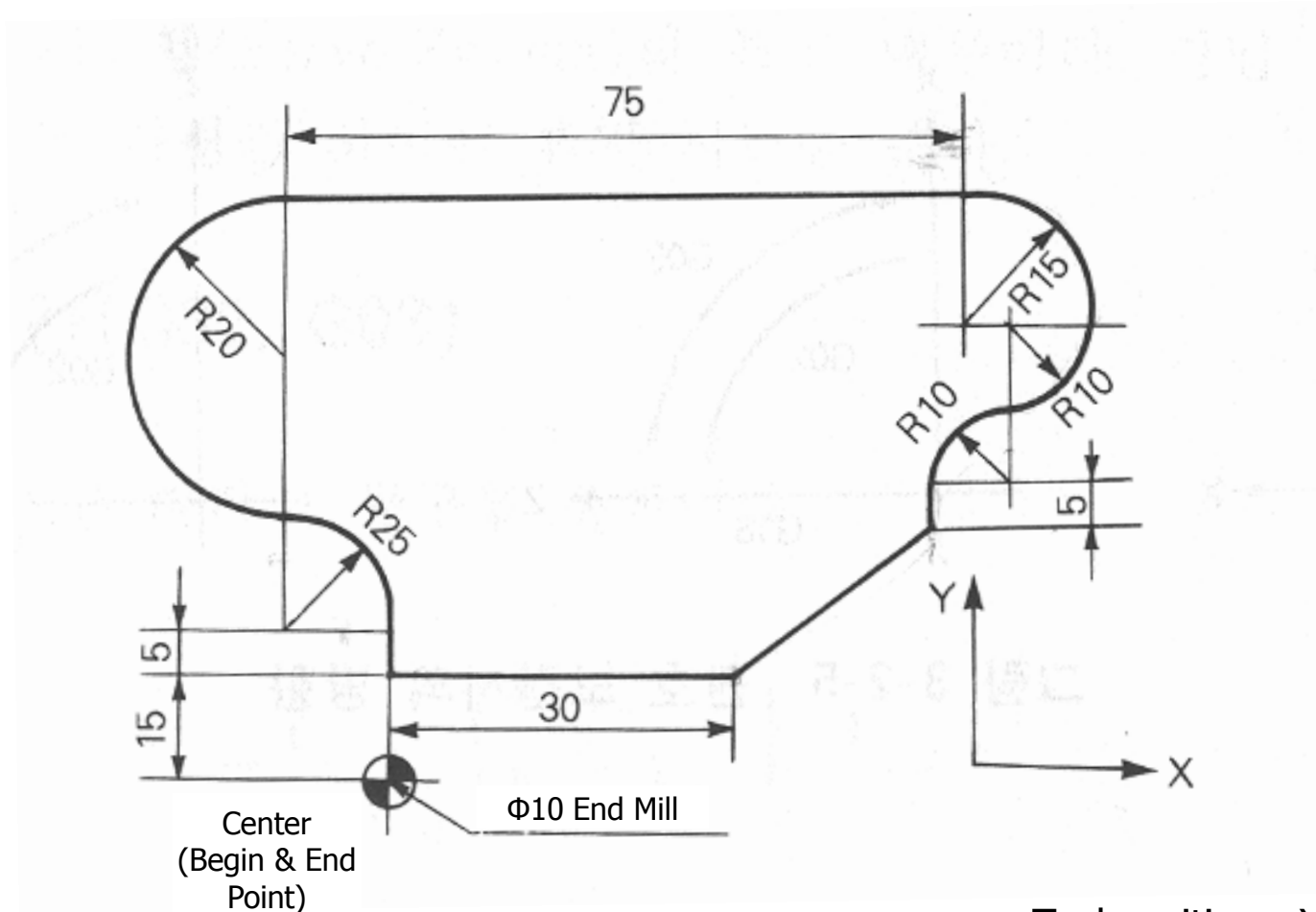
Simple Example (cont.)

- **Absolute dimension programming**

```
G92 G90 X0.0 Y0.0 Z3.0 ;  
G00 X70 Y30 ;  
M03;  
G01 Z-5.0 F120;  
G01 X140.0;  
G01 Y80.0;  
G01 X160.0;  
G01 Y30.0;  
G01 X200.0;  
G03 X240.0 Y70.0 I200.0 J70.0;  
G01 Y110.0;  
G01 X230.0;
```



Exercise problem 1

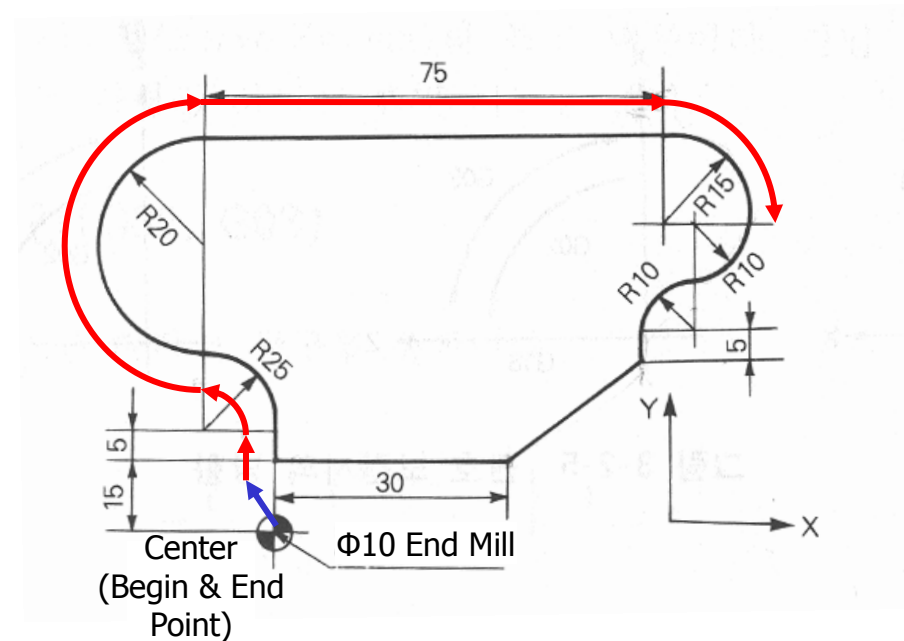


Tool position : X0.0 Y0.0 Z3.0
Feed 250
Depth : 3

Exercise 1 answer (I)

- Incremental dimension programming

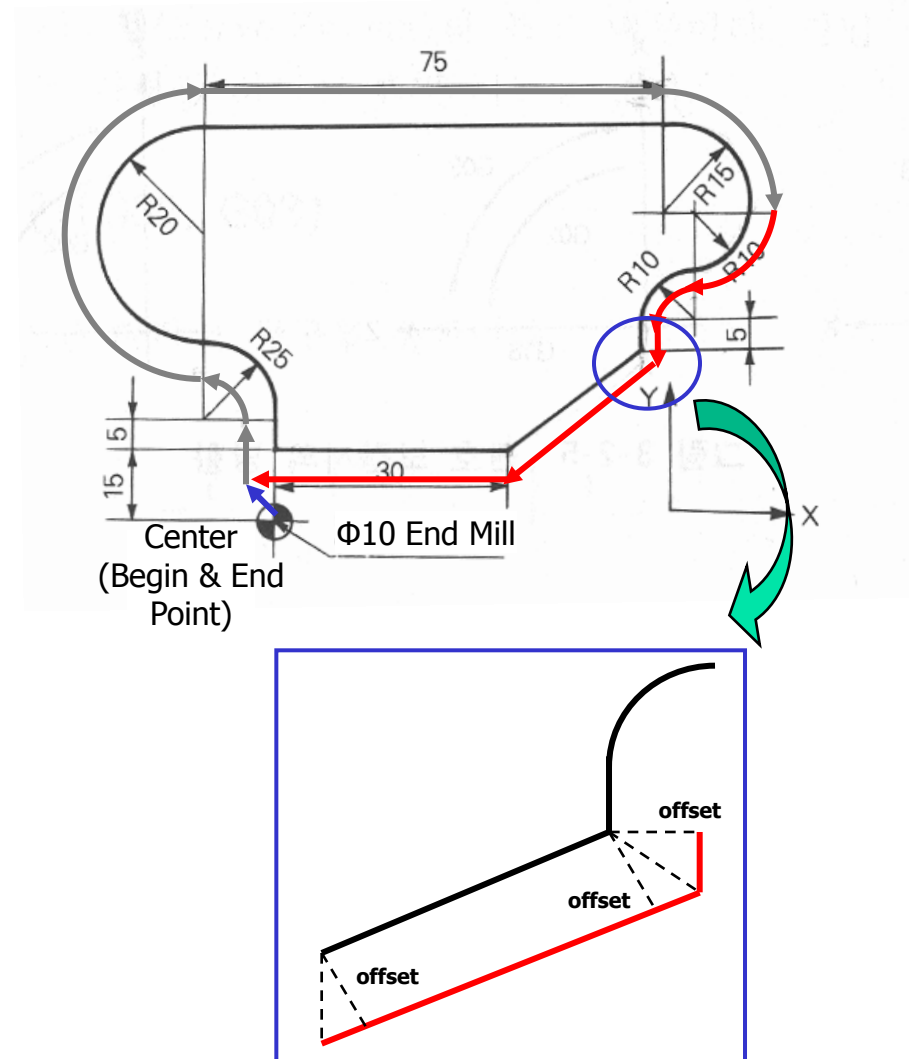
```
G92 G91 X0.0 Y0.0 Z3.0 ;  
G00 X-5 Y10 ;  
M03;  
G01 Z-6.0 F250;  
G01 Y10.0;  
G03 X-20.0 Y20.0 I-20.0 J0.0;  
G02 X0.0 Y50.0 I0.0 J25.0;  
G01 X75.0;  
G02 X20.0 Y-20.0 I0.0 J-20.0;
```



Exercise 1 answer (II)

- Incremental dimension programming

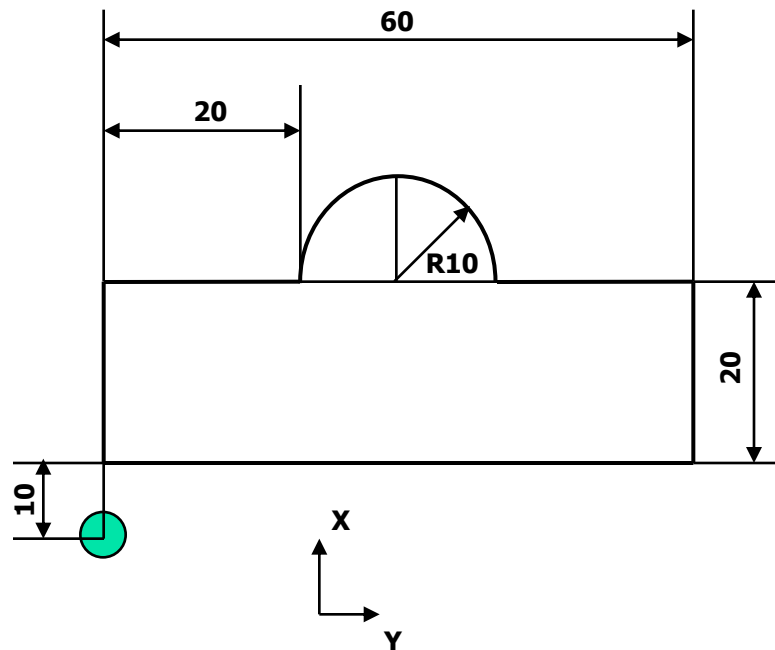
```
G02 X-15.0 Y-15.0 I-15.0 J0.0 ;  
G03 X-5.0 Y-5.0 I0.0 J-5.0 ;  
G01 Y-3.0903;  
G01 X-20.0 Y-31.9097  
G01 X-35.0 ;  
G01 Z6.0 ;  
M05 ;  
G00 X5 Y-10 ;  
M30 ;
```



Exercise problem 2



- **Pocket machining**



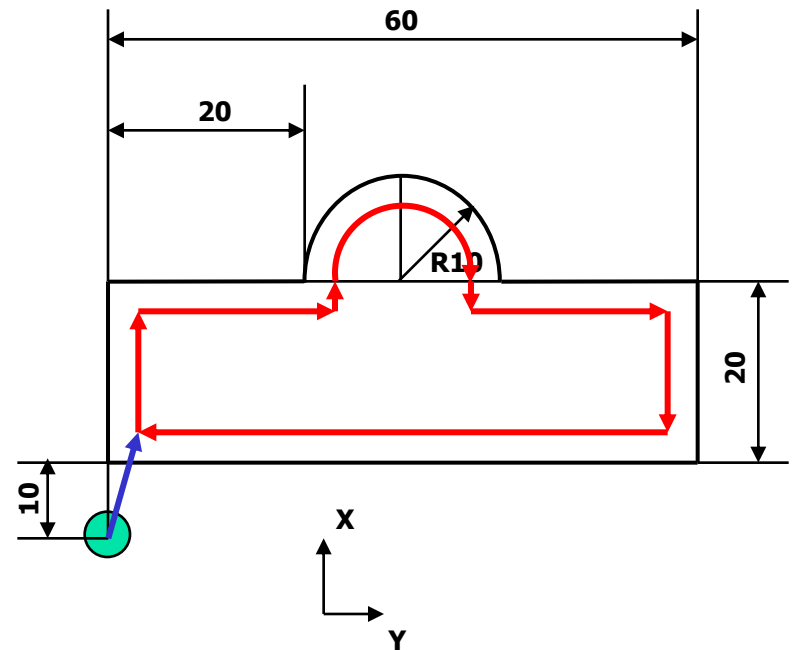
Tool position : X0.0 Y0.0 Z3.0
Feed 250
Depth : 3
Tool Diameter : 5

Exercise 2 answer (I)



- **Incremental dimension programming**

```
G92 G91 X0.0 Y0.0 Z3.0 ;  
G00 X2.5 Y12.5 ;  
M03;  
G01 Z-6.0 F250;  
G01 Y15.0;  
G01 X20.0;  
G01 Y2.5;  
G02 X15.0 Y0.0 I7.5 J0.0;  
G01 Y-2.5;  
G01 X20.0;  
G01 Y-15.0;  
G01 X-55.0;
```

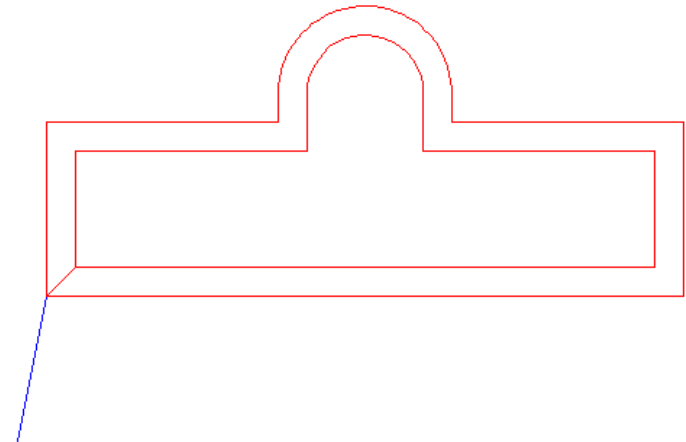


Exercise 2 answer (II)



- **Incremental dimension programming**

```
G01 X2.5 Y2.5;  
G01 Y10.0;  
G01 X20.0;  
G01 Y5.0;  
G02 X10.0 Y0.0 I5.0 J0.0;  
G01 Y-5.0;  
G01 X20.0;  
G01 Y-10.0;  
G01 X-50.0;
```



Exercise 2 answer (III)



- **Incremental dimension programming**

```
G01 X2.5 Y2.5;
```

```
G01 Y5.0;
```

```
G01 X20.0;
```

```
G01 Y7.5;
```

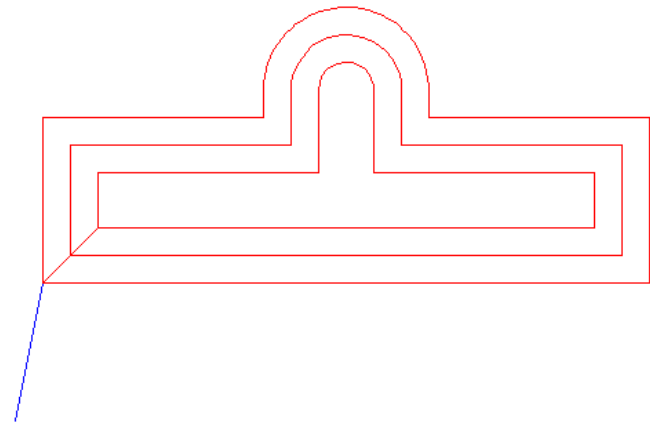
```
G02 X5.0 Y0.0 I2.5 J0.0;
```

```
G01 Y-7.5;
```

```
G01 X20.0;
```

```
G01 Y-5.0;
```

```
G01 X-45.0;
```



Exercise 2 answer (VI)



- **Incremental dimension programming**

```
G01 X2.5 Y2.5;
```

```
G01 X20.0;
```

```
G01 Y10.0;
```

```
G01 Y-10.0;
```

```
G01 X20.0;
```

```
G01 Z6.0;
```

```
M05 ;
```

```
G00 X-50.0 Y-20.0 ;
```

```
M30 ;
```

