1 Feedrate Calculation:

① Find actual travel

$X_{final} - X_{initial} = X_t$

$Y_{final} - Y_{initial} = Y_t$

$Z_{final} - Z_{initial} = Z_t$

② Find compound motion (L)

$$L = \sqrt{X_t^2 + Y_t^2 + Z_t^2}$$

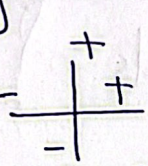
③ Feedrates for axes:

$$F_X = \frac{X_t}{L} \times F \quad , \quad F_Y = \frac{Y_t}{L} \times F \quad , \quad F_Z = \frac{Z_t}{L} \times F$$

2 Some notes for G-coding:

① G90 → absolute بالنسبة لنقطة الأصل

G91 → incremental بالنسبة لنقطة قبلها



يعبر عن موقع نقطة بالنسبة لنقطة قبلها

② if a coordinate doesn't change for next point, (X, Y, Z) no need to recode it. (G01 modal)

③ G04 dwell time, P is always in milliseconds.

④ F feedrate.
S spindle speed.

[3] minimum dwell time = $\frac{60}{\text{rev/min (spindle speed)}}$

round up

dwell time = $\frac{60 \times \text{num of spindle rev.}}{\text{spindle speed}}$

[4] Inclined Surfaces:

After doing procedure for inclined cases, you should have a triangle with unknown Δx or Δy incline

$\Delta Y = \frac{R \rightarrow \text{tool cutter radius.}}{\tan\left(\frac{180-\theta}{2}\right)}$, $\Delta X = \frac{R}{\tan\left(\frac{180-\theta}{2}\right)}$

[5] All Kinds of drilling:

Drill center or ream cycle: G81 X_n Y_n Z_n R_n F_n
- Z_n: depth of drill
- R_n: Rplane
- F_n: feed rate.

Counter bore or spot face cycle: G82 X_n Y_n Z_n R_n P_n F_n.
- P_n: dwell time inside hole.

Deep drill or peck drill cycle: G83 X_n Y_n Z_n R_n Q_n F_n.
- Q_n: Peck distance 2Qn, 3Qn, 4Qn

Tap cycle = G84 X_n Y_n Z_n R_n F_n

Bore cycle: G85 X_n Y_n Z_n R_n F_n.

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continuing [5] : tap cycle.

F = rpm (spindle speed) x Lead of tap.

[6] Circular interpolation:

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Circular feed rate:

Linear feedrate = $F_l = \frac{r}{\text{min}} \times F_t \times n$.

r → spindle speed; F_t → feed per tooth; n → num of teeth.

Outside feedrate arc = $F_o = \frac{F_l \times (R + r)}{R}$

(R + r) → outside arc radius; r → cutter radius.

Inside arc feedrate = $F_i = \frac{F_l \times (R - r)}{R}$

(R − r) → inside arc radius; r → ~~cut~~ cutter diameter.

In boss milling: boss radius + tool radius = tool center position.

In cavity milling: cavity radius − tool radius = tool center position.

On circle we do not need much ~~ēēō~~

7) Finite Element Analysis:

$$K\,U = f$$

- K: stiffness or property
- U: displacement node vector
- f: nodal force vector

$$\text{Error} = \|(\text{Exact solution}) - (\text{FEM solution})\|$$

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