Drilling Mechanics Summary - P1

Jan 7, '23

1. Kinematics

Nomenclature:

Symbol	Defn	units
D	drilling diameter	[mm]
f (sometimes s)	drilling feed (feed)	[mm/rev] — range: 0.025 – 0.30
A_{cut}	C.S.A. of drilled hole ($=\pi r^2 = \frac{\pi D^2}{4}$)	[mm²]
N	rotational speed	[rev/min]
v ("small V")	drilling velocity (or feed rate)	[mm/min]
V	surface speed	[m/min]
MRR (Q)	material removal rate	[mm³/s]
t (t_m)	drilling time (machining)	[s]
A_{chip}	chip area	[mm²]
l (or L)	hole depth (or length)	[mm]

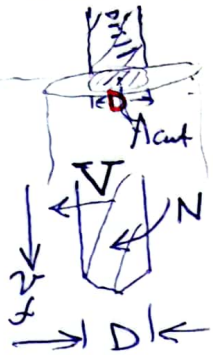
$$V = f \cdot N$$ [mm/rev] [rev/min]

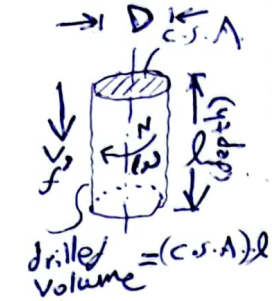
$$V = \frac{\pi D N}{1000}$$ [rev/min]; mm → m (/1000)

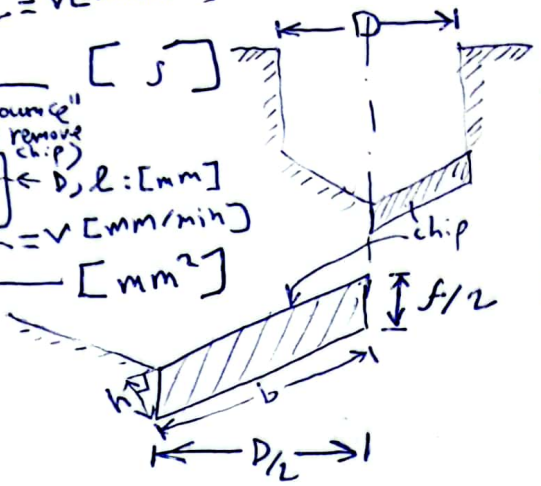
$$MRR = (C.S.A)(v) = \frac{\pi D^2}{4} \cdot f N = v$$ [mm²] = [mm/min]

$$t = \frac{l + D/4}{fN} = \frac{l + D/4}{v}$$ [min]; "allowance" (to remove chip); D, l: [mm]; v [mm/min]

$$A_{chip} = b \cdot h = \frac{f}{2} \cdot \frac{D}{2} = \frac{fD}{4}$$







Cont. Drilling Mechanics Summary – P1 (Kinematics)

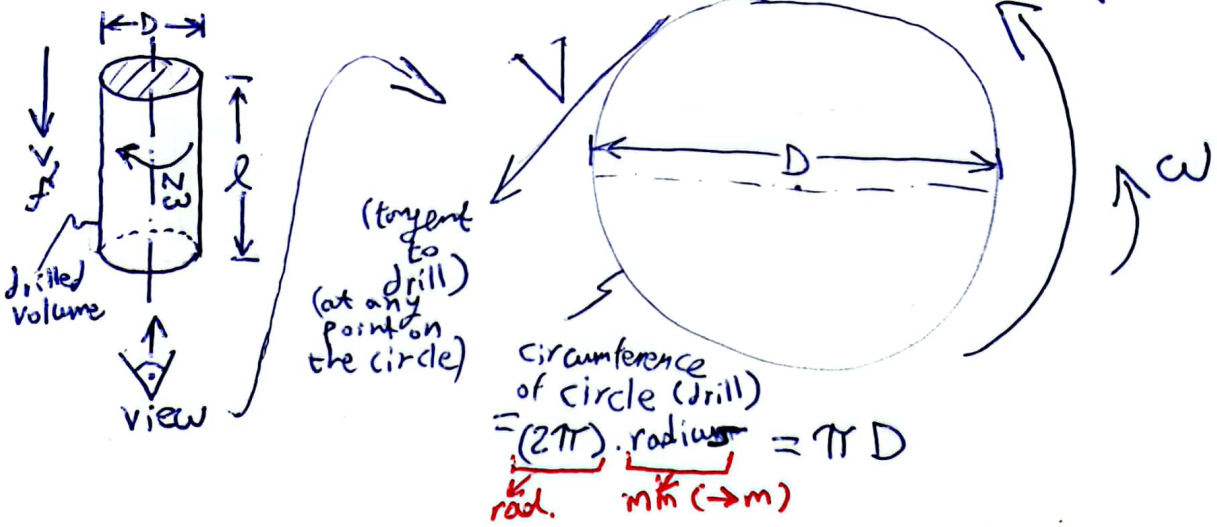
Note about V vs. N vs. ω

JW Jan 8, '23

Symbol	Def^n	Units
V	Surface speed ($V = \pi D N$)	[m/min]
N	rotational speed	[rev/min]
ω "omega"	angular speed	[rad/min]

Note, $V = 2\pi$ [rad/rev] $\cdot \frac{D}{2}$ [m] $\cdot N$ [rev/min] (unitless or dimensionless)

$\Rightarrow \boxed{V = \pi D N \text{ [m/min]}}$



Also Note, $\omega = 2\pi$ [rad/rev] $\cdot N$ [rev/min]

$\Rightarrow \boxed{\omega = 2\pi N \text{ [rad/min]}} \quad = \frac{2\pi}{60} \cdot N \text{ [rad/s]}$

or $N = \frac{\omega}{2\pi}$

Substitute in eq^n for V: (m) [rad/min]

$$V = \pi D N = \pi D \frac{\omega}{2\pi}$$

$$\Rightarrow \boxed{V = \omega \cdot \frac{D}{2} \text{ [m/min]}}$$

2/4