제 11 장

문제 1 풀이

* $1N$ = mass $1kg \times 1m/sec^2 = 10^5 dyne$.
Hz (Hertz) : unit of frequency (= cycle/sec)

條件. $F_{max} = 200N$, 진폭 $A_{max} = 0.1414mm$

$f_r = 50Hz$, $f_a = 45Hz$, $f_b = 55Hz$

$\underset{\text{damping coefficient}}{\eta} = \pi(f_b - f_a) = \pi(55-45) = \pi \times 10 = 31.42 S^{-1}$

$A = \dfrac{A_{max}}{\sqrt{2}} = \dfrac{F_0}{2\sqrt{2} \cdot \eta \cdot \omega_n}$ 에서

$$m_2 = \frac{F_{max}}{4\pi \cdot A_{max} \cdot \eta \cdot f_r} = \frac{200}{4\pi \times 0.1414 \times 10^{-3} \times 31.42 \times 50}$$

$= 7.18 kg$.

$C_d = 2 \cdot m_e \cdot n = 2 \times 7.18 \times 31.42 = 452\ N \cdot S/m$

$(*.\ 1N = 1kg \cdot mass \times 1m/sec^2 \rightarrow 1kg\ mass = \frac{1N \cdot sec^2}{m})$

식 (11.23) 에서

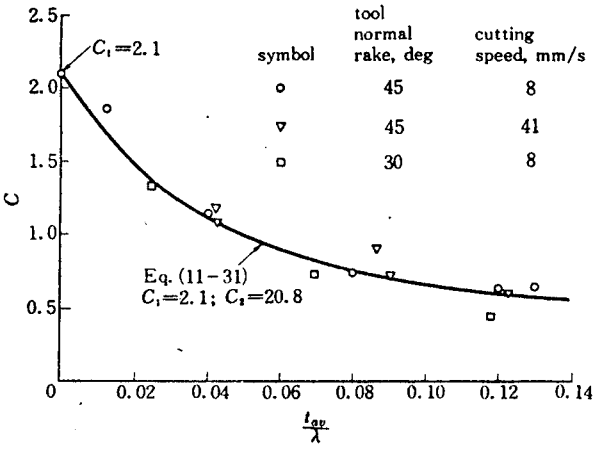
$$S_e = \frac{F_{max} \cdot \omega_n}{2 \cdot n \cdot A_{max}} \overset{\leftarrow 2\pi fr}{=} \frac{F_{max} \cdot 2\pi fr}{2n \cdot A_{max}}$$

$$= \frac{200N \times 2\pi \times 50}{2 \times 31.42 \times 0.1414mm} = 7067.42\ N/mm.$$

[답] · 점성감쇠 상수 $C_d = 452\ N \cdot S/m$

· Spring 상수 $S_e = 7067\ N/mm$

문제 2 풀이



t_{av} : mean uncut chip thickness, λ : wavelength of work-surface variations. (*After Sarnicola and Boothroyd.*)

effect of wavelength on the parameter C for a work material of 85/15 brass

안정 조건에서

$$C_d > \frac{b_w \cdot t_{av}}{V}\left[\frac{\tau_s \cdot C}{\theta'}(1 + \cot^2\phi_{av}) - \tau_s\left(\frac{\sin\alpha_n\{\cot\phi_{av} + (1+C)\cdot\tan(\alpha_n - \phi_{av})\} + \cos\alpha_n}{\sin\phi_{av}\cdot\cos(\alpha_n - \phi_{av})}\right) - \tau_t\right]$$

그런데 $b_w = 10 \times 10^{-3}m$,

$t_{av} = 0.02 \times 10^{-3}m$.

$V = 1m/sec$

$\tau_s = 350 \times 10^6 N/m^2$

$\tau_t = 200 \times 10^6 N/m^2$

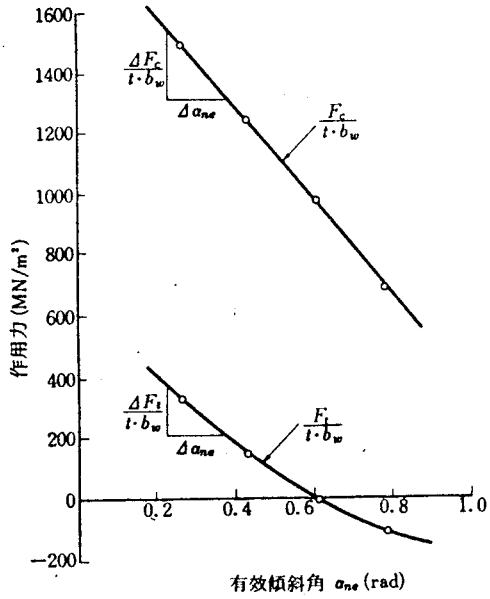
$\phi_{av} = 15°,\ \alpha_n = 15°\ (= 0.062\ rad)$

$$\therefore \theta' = \frac{\tau_s}{\tau_t \cdot K} = \frac{\tau_s}{\tau_t} \cdot \frac{t_c}{l_{st}} = \frac{\tau_s}{\tau_t} \cdot \frac{l_{st}}{l_{st}} = \frac{\tau_s}{\tau_t} = \frac{350 \times 10^6}{200 \times 10^6} = 1.75$$

문제에 의하여.

$$\frac{\Delta}{t_{av}} = \frac{V}{f \cdot t_{av}} \text{ 에서}$$

$$\frac{t_{av}}{\Delta} = t_{av} \cdot \frac{f}{V} = \frac{0.02 \times 10^{-3} \times 50}{1} = 0.001$$



cutting speed : 0.2 m/s, uncut chip thickness : 0.5 mm,
F_c : cutting force, F_t : thrust, t : uncut chip thickness,
b_w : width of cut

effect of working normal α_{ne} on cutting forces for a work material of 85/15 brass

Fig 11-15 에서 $\Rightarrow C = 2.1$

Fig 11-17 에서

$$\beta_t = \frac{\Delta F_t}{t \cdot b_w \cdot \Delta \alpha_{ne}} = \frac{\Delta F_t}{t \cdot b_w} \Big/ \Delta \alpha_{ne}$$

$$= \frac{200 \times 10^6 N/m^2}{0.18} = 1.11 \times 10^9 N/m^2$$

$$\therefore C_d > \frac{10 \times 10^{-3} \times 0.02 \times 10^{-3}}{1} \left\{ \frac{350 \times 10^6 \times 2.1}{1.75} (1 + \cot^2 15^\circ) \right.$$

$$\left. - 350 \times 10^6 \left\{ \frac{\sin 15^\circ \cdot \cot 15^\circ + \cos 15^\circ}{\sin 15^\circ} \right\} + 1.11 \times 10^9 \right\}$$

$$= 924 \, Ns/m$$

[답] 공작계의 상당 최소 점성감쇠 상수

C_d = **924** N·S/m