

# 不規則波による応答.

$$f(t) = \int_0^t I'(t-\tau) g(\tau) d\tau.$$

$$\ddot{y} + 2hw\dot{y} + w^2y = -g(t) \quad \text{地動加速度.}$$

$$\begin{aligned} s^2 Y(s) - sy(0) - y'(0) + 2hw(sY(s) - y(0)) + w^2 Y(s) &= \mathcal{L}\{-g(t)\} \\ y(0)=0, \quad y'(0)=0 &\quad \leftarrow \text{初期条件} \\ (s^2 + 2hw s + w^2) Y(s) &= -G(s) \end{aligned}$$

$$\therefore \frac{Y(s)}{G(s)} = \frac{-1}{s^2 + 2hw s + w^2} \quad \text{伝達関数.}$$

$$\frac{I(s)}{U(s)} = \frac{I(s)}{\left(\frac{1}{s}\right)} = \frac{-1}{s^2 + 2hw s + w^2}$$

$$I(s) = \frac{-1}{s(s^2 + 2hw s + w^2)} = \frac{A}{s} + \frac{Bs + C}{s^2 + 2hw s + w^2}$$

$$A + B = 0, \quad (2hwA + C) = 0, \quad Aw^2 = -1.$$

$$\therefore A = -\frac{1}{w^2}, \quad \frac{1}{B} = \frac{1}{w^2}, \quad C = \frac{2h}{w}$$

$$I(s) = -\frac{1}{w^2} \cdot \frac{1}{s} + \frac{\frac{1}{w^2}s + \frac{2h}{w}}{(s+hw)^2 + (w\sqrt{1-h^2})^2}$$

$$= -\frac{1}{w^2} \cdot \frac{1}{s} + \frac{1}{w^2} \cdot \frac{s+hw + \frac{h}{w}}{(s+hw)^2 + (w\sqrt{1-h^2})^2}$$

$\rightarrow$  3rd step of analysis.

$$I(t) = -\frac{1}{w^2} + \frac{1}{w^2} e^{-hwt} \left( \cos w\sqrt{1-h^2}t + \frac{h}{\sqrt{1-h^2}} \sin w\sqrt{1-h^2}t \right)$$

$$I'(t) = \frac{1}{w^2} (-hw) e^{-hwt} \left( \cos w\sqrt{1-h^2}t + \frac{h}{\sqrt{1-h^2}} \sin w\sqrt{1-h^2}t \right)$$

$$+ \frac{1}{w^2} e^{-hwt} \left( -w\sqrt{1-h^2} \sin w\sqrt{1-h^2}t + hw \cos w\sqrt{1-h^2}t \right)$$

$$= e^{-hwt} \left( \frac{-h^2 w}{w^2 \sqrt{1-h^2}} - w(1-h^2) \right) \sin w\sqrt{1-h^2}t = \frac{-1}{w\sqrt{1-h^2}} e^{-hwt} \cdot \sin w\sqrt{1-h^2}t$$

$$\therefore f(t) = \int_0^t I'(t-\tau) g(\tau) d\tau = -\frac{1}{w\sqrt{1-h^2}} \int_0^t e^{-hwt-\tau} \left\{ \frac{h}{\sqrt{1-h^2}} \sin w\sqrt{1-h^2}(t-\tau) \right\} g(\tau) d\tau$$

$$\begin{aligned} I''(t) &= \frac{hw}{w\sqrt{1-h^2}} e^{-hwt} \sin w\sqrt{1-h^2}t + \frac{-1}{w\sqrt{1-h^2}} e^{-hwt} w\sqrt{1-h^2} \cos w\sqrt{1-h^2}t \\ &= e^{-hwt} \left\{ \frac{h}{\sqrt{1-h^2}} \sin w\sqrt{1-h^2}t - \cos w\sqrt{1-h^2}t \right\} \end{aligned}$$

$$I'''(t) = (-hw) e^{-hwt} \left\{ \frac{h}{\sqrt{1-h^2}} \sin w\sqrt{1-h^2}t - \cos w\sqrt{1-h^2}t \right\}$$

$$+ e^{-hwt} \left\{ hw \cos w\sqrt{1-h^2}t + w\sqrt{1-h^2} \sin w\sqrt{1-h^2}t \right\}$$

$$= e^{-hwt} \left\{ \frac{w(1-2h^2)}{\sqrt{1-h^2}} \sin w\sqrt{1-h^2}t + 2hw \cos w\sqrt{1-h^2}t \right\}$$

相对速度响应

$$f'(t) = \int_0^t I''(t-\tau) g(\tau) d\tau$$

$$= \int_0^t e^{-h\omega(t-\tau)} \left\{ \frac{h}{\sqrt{1-h^2}} \sin[\omega\sqrt{1-h^2}(t-\tau)] - \cos[\omega\sqrt{1-h^2}(t-\tau)] \right\} g(\tau) d\tau$$

绝对加速度响应

$$f''(t) = \int_0^t I'''(t-\tau) g(\tau) d\tau$$

$$= \int_0^t e^{-h\omega(t-\tau)} \left[ \frac{h\omega(1-2h^2)}{\sqrt{1-h^2}} \sin[\omega\sqrt{1-h^2}(t-\tau)] + 2h\omega \cos[\omega\sqrt{1-h^2}(t-\tau)] \right] g(\tau) d\tau$$