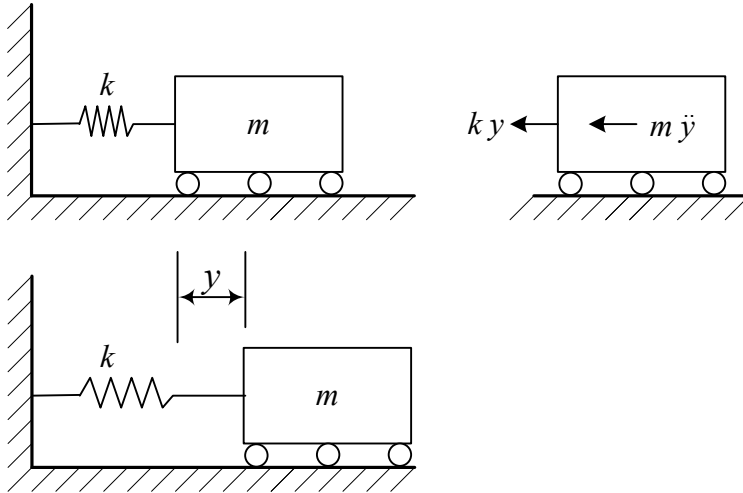


**GETARAN BEBAS PADA SISTEM BERDERAJAT KEBEBASAN TUNGGAL,  
TANPA REDAMAN (SDOF, UNDAMPED )**

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Getaran Bebas (*free-vibration*)

$$m\ddot{y} + ky = 0$$

Jawaban 1 :  $y = A \cos \omega t$

$$\dot{y} = -A\omega \sin \omega t$$

$$\ddot{y} = -A\omega^2 \cos \omega t$$

Maka persamaan di atas menjadi :

$$-mA\omega^2 \cos \omega t + kA \cos \omega t = 0$$

$$(-m\omega^2 + k)A \cos \omega t = 0$$

$$-m\omega^2 + k = 0$$

$$\omega = \sqrt{\frac{k}{m}}$$

Jawaban 2 :  $y = B \sin \omega t$

Jawaban umum :  $y = A \cos \omega t + B \sin \omega t$

$$\dot{y} = -A\omega \sin \omega t + B\omega \cos \omega t$$

$$\ddot{y} = -A\omega^2 \cos \omega t - B\omega^2 \sin \omega t$$

$$m\ddot{y} + ky = 0 \rightarrow \ddot{y} + \omega^2 y = 0$$

---

Keadaan awal (*initial condition*)

pada saat  $t = 0$ ,  $y = y_0$

$$\dot{y} = \dot{y}_0$$

$$y = A \cos \omega t + B \sin \omega t$$

$$\dot{y} = -A\omega \sin \omega t + B\omega \cos \omega t$$

$$t = 0 \rightarrow y = A = y_0$$

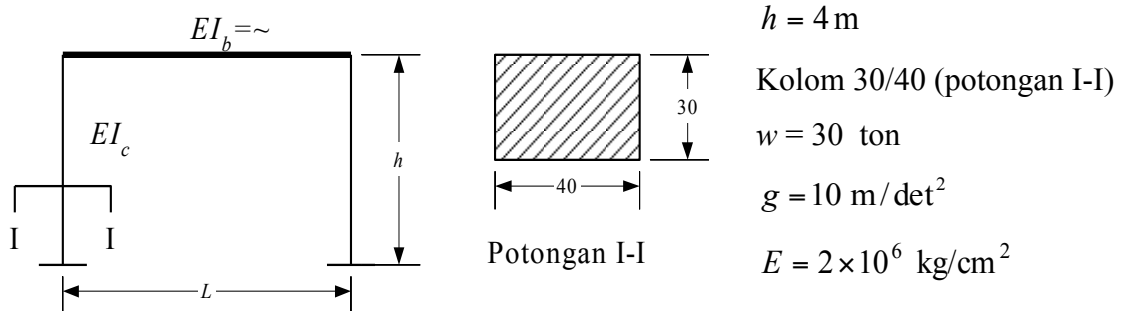
$$t = 0 \rightarrow \dot{y} = B\omega = \dot{y}_0 \rightarrow B = \frac{\dot{y}_0}{\omega}$$

Jawaban umum menjadi :

$$y = y_0 \cos \omega t + \frac{\dot{y}_0}{\omega} \sin \omega t$$

**Contoh Soal:**

Diketahui :

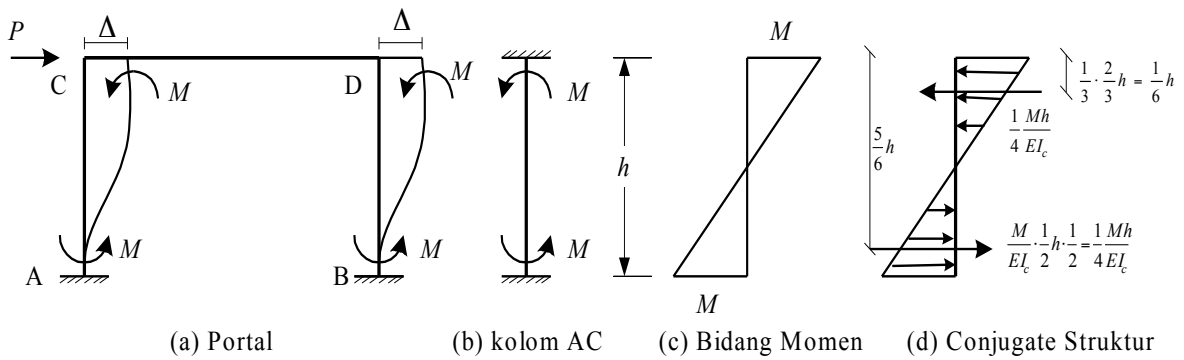


**Gambar 2.1. Contoh 2.1.**

Ditanyakan :

- Perioda struktur
- Jika  $y_0 = 5 \text{ cm}$  dan  $\dot{y}_0 = 3 \text{ cm/detik}$ , hitung simpangan pada  $t = 1, 2, 3, 4, 5 \text{ detik}$

Jawaban :



$$\Delta = \left( \frac{1}{4} \frac{Mh}{EI_c} \times \frac{5}{6} h \right) - \left( \frac{1}{4} \frac{Mh}{EI_c} \times \frac{1}{6} h \right) = \frac{1}{6} \frac{Mh^2}{EI_c} \Rightarrow M = \frac{6EI_c}{h^2} \times \Delta$$

$$V = \frac{2M}{h} = \frac{12EI_c}{h^3} \times \Delta$$

$$P = 2V = \frac{24EI_c}{h^3} \times \Delta$$

$$k = \frac{24EI_c}{h^3}$$

$$I_c = \frac{1}{12} \times 30 \times 40^3 = 160.000 \text{ cm}^4 = 0,0016 \text{ m}^4$$

$$k = \frac{24 \times 2 \times 10^6 \times 160.000}{400^3} = 120.000 \text{ kg/cm} = 12 \times 10^6 \text{ kg/cm}$$

$$m = \frac{W}{g} = \frac{30.000}{10} = 3.000 \text{ kg} \cdot \text{dt}^2 / \text{m}$$

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{12 \times 10^6}{3.000}} = 63,14 \text{ 1/det}$$

$$f = \frac{\omega}{2\pi} = 10,066 \text{ getaran/det}$$

$$T = \frac{1}{f} = 0,0993 \text{ det}$$

$$y = y_0 \cos \omega t + \frac{\dot{y}_0}{\omega} \sin \omega t$$

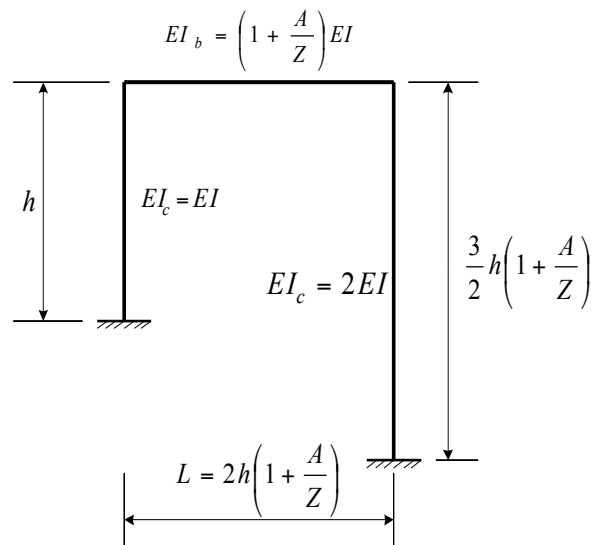
$$y = 5 \cos 63,14t + \frac{3}{63,14} \sin 63,14t$$

t (detik)	y (cm)
0	5
1	4.778897
2	4.107595
3	3.049335
4	1.70381
5	0.197778

Kesimpulan :

1. Jika nilai  $h$  bertambah tinggi maka nilai  $k$ ,  $\omega$  dan  $f$  akan bertambah kecil, sedangkan nilai  $T$  akan bertambah besar.
2. Jika nilai  $m$  bertambah besar maka nilai  $\omega$  akan bertambah kecil, sedangkan  $T$  akan bertambah besar.

### Tugas 1



$h = 4 \text{ m}$        $E = 2 \times 10^6 \text{ kg/cm}^2$     Ukuran Kolom 30/40 cm

$Z =$  tahun angkatan

Danil NIM = 41111110004 – A = 04 Z = 2011

Hitung: (1) Perioda struktur di atas, (2) Jika  $y_0 = 5 \text{ cm}$  dan  $\dot{y}_0 = 3 \text{ cm/detik}$ , hitung dan gambar simpangan pada  $t = 1, 2, 3, 4, \dots, 30$  detik

Dikumpulkan terakhir Sabtu, 28 Maret 2015 jam 23.59 ke [pariatmono@hotmail.com](mailto:pariatmono@hotmail.com)

Print-out dikumpulkan menggunakan kertas bekas pada hari Ahad, 29 Maret 2015