(i)

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iD : 7722

Sec : "C"

final term Assignment/Quiz.

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Subj : Intro to Dynomic and Earthquack.

Dep : BS (Civil)

Duration time : 6hour.

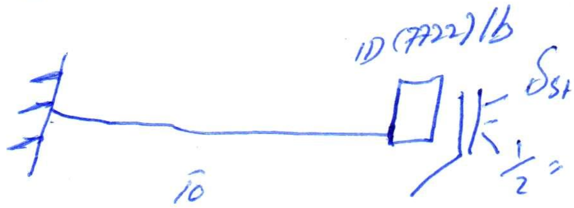
Q No # 1

Given data:

$E = 29,000 ksi$

$I = 150 \ in^4$

$g = 7722 lb$



Solution

the general E.O.M for SDOF System is

$ku + c\dot{u} + m\ddot{u} = pt$

in our case system is undamped ($c=0$) undergoing free vibration $p(t)=0$

Hence general EOM become $ku + m\ddot{u} = 0$ ....(1)

$$K = \frac{3EI}{L^3}$$

$$K = \frac{~~1000~~ \ 3 \times 29000 \frac{k}{in^2} \times 150 in^4}{(10 \times 12 in)^3}$$

$$K = 7.55 K/in$$ ~~K = 7.55 208~~

in order to Eliminate the chance of ~~k~~ mistake during Calculation it is more appropriate to use fundemental unit like lb, ft sec, or kg, m, sec. $K = 7.55 \frac{K}{in} = 90625 \frac{lb}{ft}$.

$$m = \frac{7722 lb/sec^2}{32.2 ft} = 239.81 \ Slug.$$

$$w_n = \sqrt{\frac{K}{m}} = \sqrt{\frac{9\,0625}{239.81}} = \boxed{19.43 \text{ rad/sec}}$$

$$T_n = \frac{2\pi}{w_n} = \frac{2\pi}{19.48} = \boxed{10.322 \text{ sec}}$$

substituting the corresponing values in eq ①

$$Ku + m\ddot{u} = 0 \Rightarrow 9\,0625 + 239.81\,\ddot{u} = 0$$

where "K" in lb/ft and "m" in lb sec/ft² general solution to the EOM for undamped free vibration is —

$$u(t) = u(0)\cos(w_n t) + \frac{\dot{u}(0)}{w_n}\sin(w_n t)$$

$$U(0) = \frac{1}{2}" , \frac{1}{2 \times 12} = \frac{1}{24} \text{ ft} \quad \text{an} \quad \dot{u}(0) = 0$$

$$u(t) = \left(\frac{1}{24}\right) \times \cos(19.48t) + 0$$

Equivalent static force and any time "t" is

$$f_s(t) = K \cdot u(t) = \frac{90625 \times \cos(19.43t)}{24}$$

$$f_s(t) = 3776(19.43t)$$

Amplitude for dynamic displacement u_0 for undamped free vibration is

$$u_0 = \sqrt{\left[(u_0(0))^2 + \frac{\dot{u}(0)^2}{w_n}\right]} = \sqrt{\left(\frac{1}{24}\right)^2 + 0} \quad \dot{u}(0) = 0$$

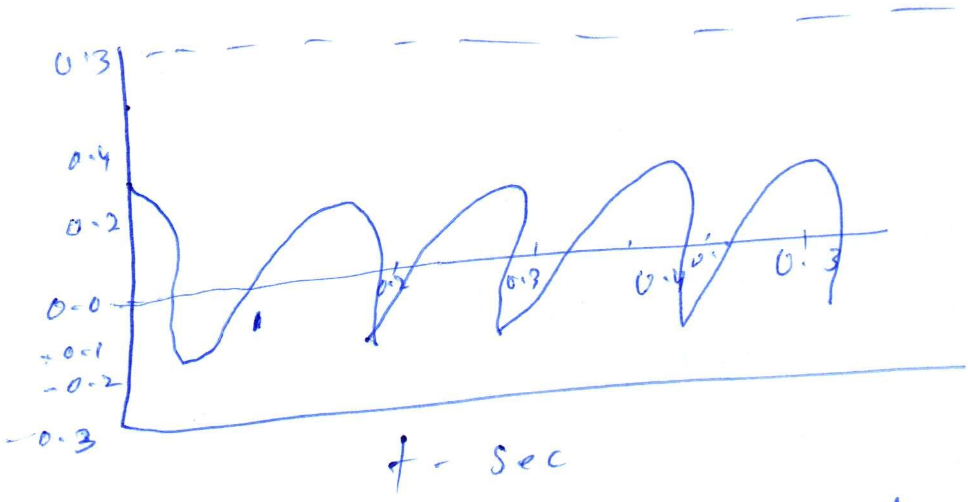
$$\boxed{u_0 = \frac{1}{24} \text{ ft.}}$$

amplitude of equivalent static force : f_{s0}

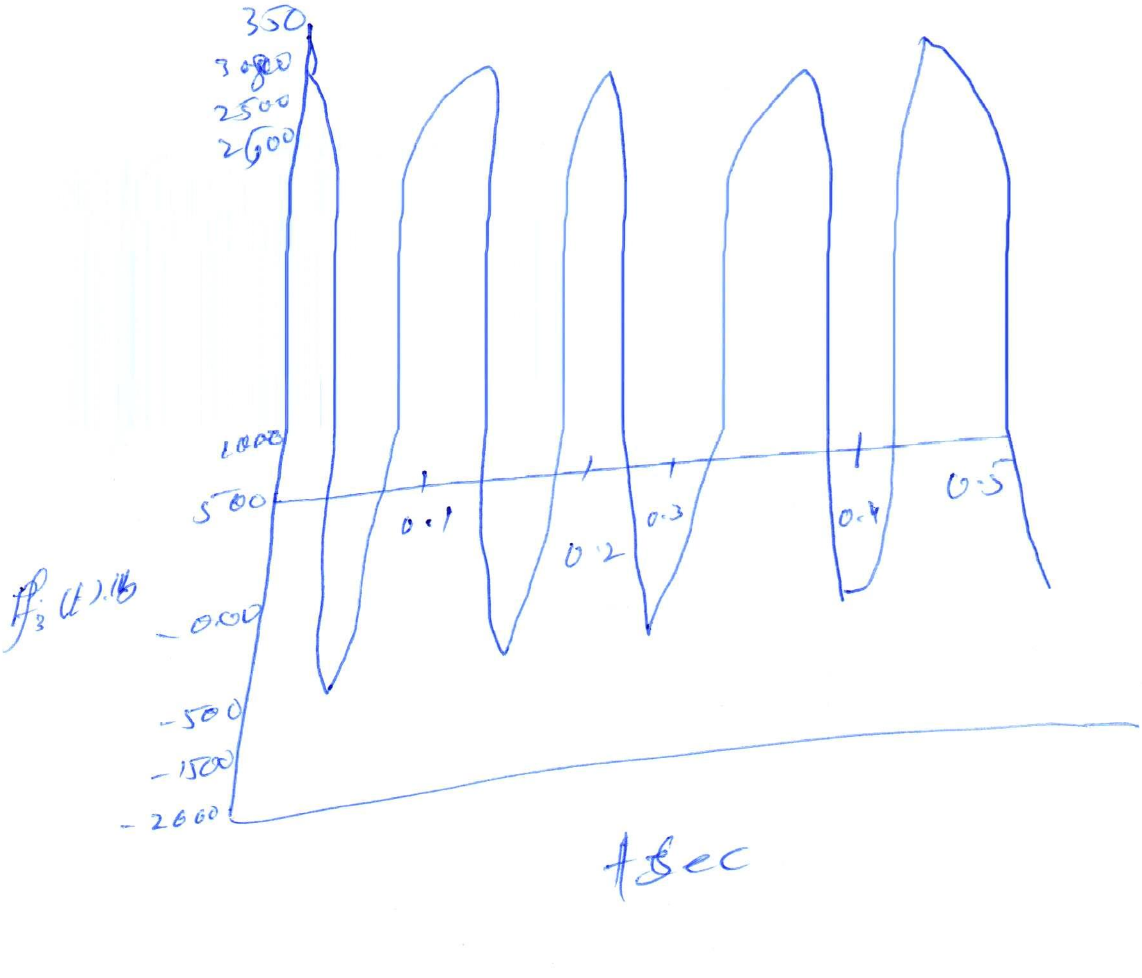
$$K u_0 = 90625 \times \frac{1}{24} =$$

$$\boxed{K u_0 = 3776 \text{ lb}}$$

undemped free vibration



undemped free vibration



(5)

~~QNO2~~ Q No #02

Given data: considerable cracking reinforce concrete

take from $\frac{1}{2}$ yied point: $\xi = 3.5\% = 3\%$

E om for demped free vibration is

$K\ddot{u} + cu + m\ddot{u} = 0$ —— (1)

from question no 1.

$K = 90625\ lb/ft$ and $m = 239.81\ lb\,sec^2/ft$.

$\omega_n = 19.43\ rd/sec$

$C = \xi \times 2 m \omega_n$

$C = (0.03) \times 2\,(239.81)(19.43)$

$C = 279.57\ lb\text{-}sec/ft$

put value in eq —— (1)

$90625 + 279.50 + 239.81 = 0$

Solation to the E om for demped free vibration is

~~$u(t) = e^{0.582t}[0.$~~

$u(t) = e^{-\xi \omega_n t}\left[u(0)\cos(\omega_D t) + \frac{1}{\omega_D}\left(\dot{u}(0) + u(0)\xi\omega_n\right)\sin\omega_D t\right.$

~~$u(t) = e^{-0.582t}[0.041\cos(19.43t) +$~~

$\omega_D = 19.43\ rd/sec$

(PTO)

(b)

$$u(t) = e^{-0.03} \times 19.43 \left(\frac{1}{24} \cos(19.43) + \frac{1}{19.43} \times (0 + \frac{1}{24} \times 0.03 \times 19.43) \times \sin(19.43t) \right)$$

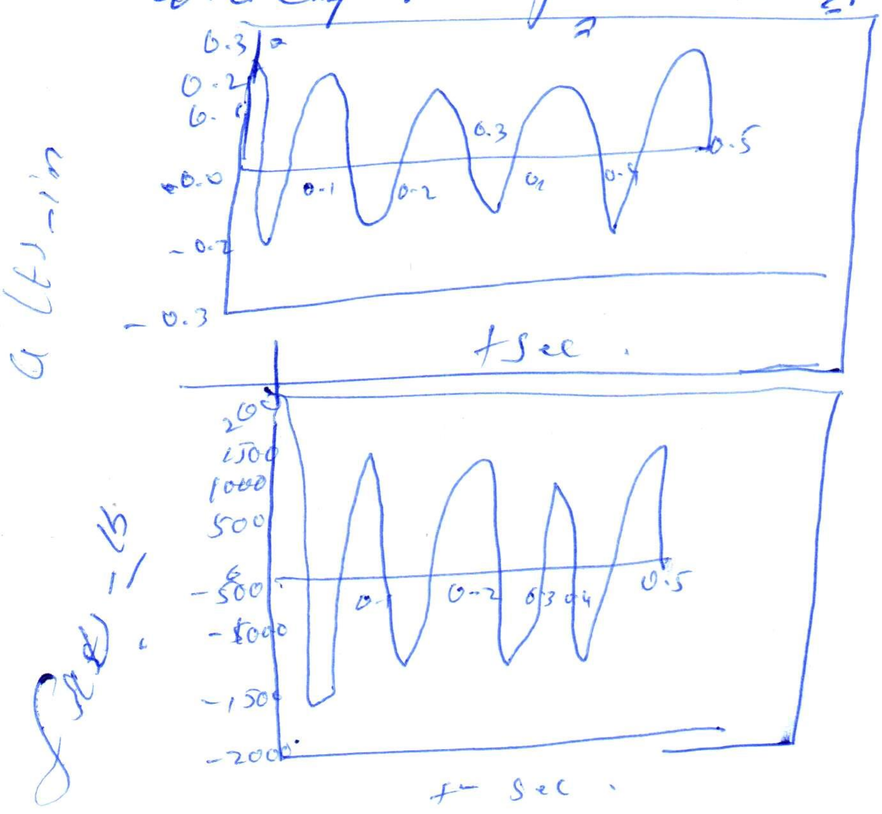
$$u(t) = e^{-0.582t} \left[0.041 \times \cos(19.43t) + 0.00125 \times \sin(19.43t) \right]$$

$$fs(t) = K.u(t) \Rightarrow 90625 \times u(t)$$

$$fs(t) = e^{-0.582t} \left[(90625 \times 0.04) \cos(19.43t) + (90625 \times 0.00125) \sin(19.43t) \right]$$

$$fs(t) = e^{-0.582t} \left(3715.69 \cos(19.43) + 113.28 \sin(19.43t) \right)$$

undamped free vibration



Q No #3

Given data: . force = 60 kips.

Cable attached displace the tank by $\left(\frac{7722}{1000}\right)$ in = 7.72 in

cycle 7 cycle. wich complet in 3.57 sec.

amplitud displacement = 2.286 cm. or 0.9 in

ignore the vertical vibration of tank ~~and~~

and compute the following.

(a) Dumping ratios.

(b) Natural period of un-damped vibration

(c) ~~Stiff~~ Stifness of Structure.

(d) Damping coffecint.

(e) weight of tank

(f) number of cycle to reduce the displacemt amplitude to 0.5".

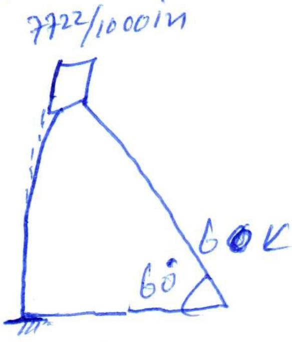


figure 2.

Solution:- As given in equation

$u = 7720.$

after $j = 7.$

$u_{j+1} = u_8 = 2.86 cm = 0.9 in$

a = ξ = Damping ratio = ?

$\xi = \frac{1}{2\pi 7} \ln\left[\frac{u}{u_{8+1}}\right]$

By putting values we get.

$\xi = \frac{1}{2\pi 7} \ln\left[\frac{7722}{0.9}\right]$

$\Upsilon = 0.0486$

$\xi = 8.643\%$

b = natural period of damped vibration

According to Que =

7 cycle of vibration Complate into 3.57 sec.

time period complete are one cycle $\frac{3.57}{7}$

To. 0.51 sec.

As we know that.

$W_0 = W_n \sqrt{(7-3)^2}$

$2\pi = 2\pi / W_n \sqrt{(1) - (3)^2}$

$\Upsilon_0 = \Upsilon_n \sqrt{(1-3)^2}$

$\Upsilon_n 2 = T_0 \sqrt{(1) - (3))^2}$

by putting values we get.

$\Upsilon_n = 0.5 \sqrt{(1 - (0.0486)}$

$T_n = 0.508n$

$\Upsilon_n = 0.508 \text{ Sec}$

Co - stiffness of structure = K_2.

$K = 60 \cos(60)$

$K = 7.72$

$K = 3.88 \text{ K/in}$

weight of tank = W_2

$\omega_n = \sqrt{\frac{k}{m}} = \sqrt{\frac{k}{W/g}} = \sqrt{\frac{k \cdot g}{W}}$

$\omega_n^2 = \frac{k \cdot g}{W^2 n}$

also $W_2 \cdot 2\pi / \tau W$

eqs = $W_2 \; kg \, (4\pi^2 / \tau_n^2)$

$W_2 = \frac{k \cdot g \times \tau_n^2}{4\pi^2}$

by puting value we get.

$W = \frac{180000 \times 32.2 \times (0.51)^2}{4\pi^2}$

$W = 38186.41 \, lb$ $\quad W = 3819 k.$

Damping coeffient : c

$\delta = \frac{c}{2 m \omega_n}$

$C = \delta \times 2 m \omega_n = \delta \times 2m \times \left(\frac{2\pi}{\tau_n}\right)$

by putting value we get.

$C = \frac{0.0486 \times 2 \times 2 \times \pi \times 38186}{0.50}$

$C = 1425.98 \, lb \cdot sec/ft$

No of cycle to reduces the displacmt amplitude to 0.5 = δ =

As we know that.

$\delta \quad j = \frac{1}{2 \cdot \pi} \ln \left(\frac{u_0}{u_{j+1}}\right)$

$j = \frac{1}{2\pi \times 0.0486} \ln \left[\frac{7.722}{0.05}\right]$

$j = 15.55$ say a cycle $j = 15.55 = 9$ cycles