Contents


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% Joel Lubinitsky - 02/11/15
% MAE 321 - HW 4.1

clear all
close all
clc
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Problem 1:

Consider the punch fixture of problem 1.82 in the book (and from the example we did in class on the handout). If the system is given an initial velocity of 15 m/s, what is the maximum displacement of the mass at the tip if the mass is 1200 kg and the bar is made of steel of length 0.25 m with a cross-sectional area of 0.01 m^2?

Unknown: x_{max}

Known

V_0, m, l, A, E_{steel}

```
vInitial         = 15;          % m/s
mass             = 1200;        % kg
lengthBar        = 0.25;        % m
areaCrossSection = 0.01;        % m^2
modulusSteel     = 2 * 10 ^ 11; % N/m^2
```

Calculations

Rod with Axial Stiffness:

$$k = \frac{EA}{l}$$

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

$$x(t) = x_0 \cos \omega_n t + \frac{v_0}{\omega_n} \sin \omega_n t$$

$$x_0 = 0, \text{ so } x(t) = \frac{v_0}{\omega_n} \sin \omega_n t$$

Max when $\sin \omega_n t = 1$, so $x_{max} = \frac{v_0}{\omega_n}$

```
stiffness = modulusSteel * areaCrossSection / lengthBar;
frequencyNatural = sqrt(stiffness / mass);
xMax = vInitial / frequencyNatural
```

```
xMax =

    0.0058
```

Results

Maximum displacement of the mass is 0.0058 m.

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