Connor McGarty, cmcgarty - HW2 P2.26 from Chapra Text

Table of Contents

File: EE254_cmcgarty_HW2_2_26.m

Date: Submitted Thursday, January 30, 2020 - 1/30/20

Problem 2.26: Figure P2.26a shows Uniform beam subject to a linearly increasing distributed load. As depicted in Fig. P2.26b, deflection y (m) can be computed with $y = \frac{w_0}{120EIL}(-x^5 + 2L^2x^3 - L^4x)$ where $E =$ the modulus of elasticity and $I =$ the moment of inertia (m^4). Employ this equation and calculus to generate MATLAB plots of the following quantities versus distance along the beam:

- displacement (y)
- slope $[\theta(x) = \frac{dy}{dx}]$
- moment $[M(x) = \frac{EId^2y}{dx^2}]$
- shear $[V(x) = \frac{EId^3y}{d^3}]$, and
- loading $[w(x) = \frac{-EId^4y}{dx^4}]$.

Use the following parameters for your computation. $L = 600cm$ $E = 50000kN/cm^2$ $I = 30000cm^4$ $w_0 = 2.5kN/cm$, and $\Delta x = 10cm$. Employ the subplot function to display all the plots vertically on the same page in order.

Parameters

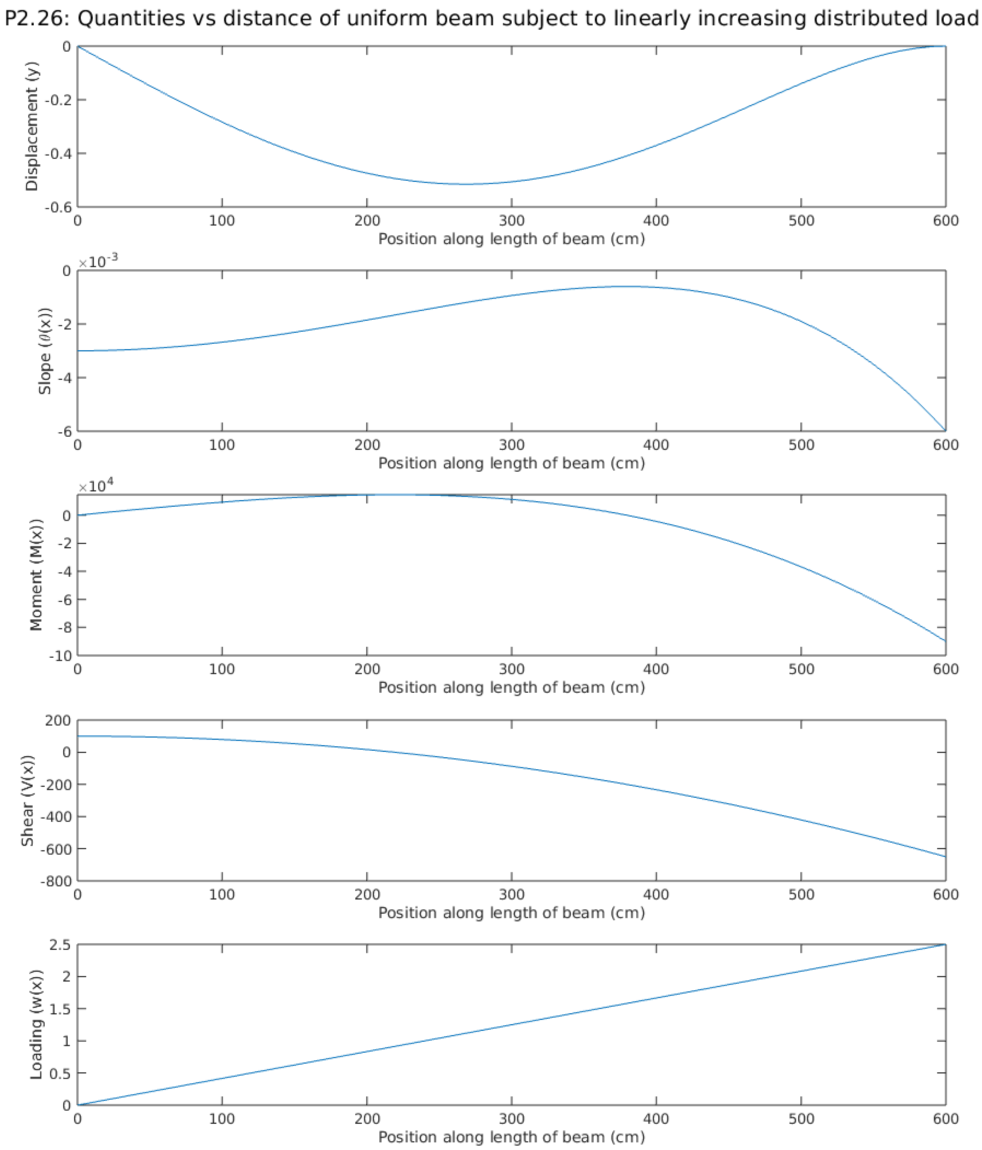
```
clear;clc;close all;
modulus_of_elasticity = 50000; % kN/cm^2
moment_of_inertia = 30000; % cm^4
length = 600; % cm
w_0 = 2.5; % kN/cm
x_delta = 10; % cm
x_init = 0;
```

Solution

```
x_vector = [x_init : x_delta : length]; % independent variable
```

```
% coefficient for all quantities
coefficient = (w_0 ./ (120 .* modulus_of_elasticity .*
 moment_of_inertia .* length));

displacement_vector = coefficient .* ((0-(x_vector.^5)) +
 (2.*(length.^2).*(x_vector.^3)) - ((length.^4).*x_vector));
% first derivative of displacement vector
slope_vector = coefficient .* ((-5.*(x_vector.^4)) +
 (2.*2.*(length.^2).*(x_vector.^2)) ...
                        - length.^4);
% first derivative of slope vector, 2nd derivative of displacement
 vector
moment_vector = (coefficient .* modulus_of_elasticity .*
 moment_of_inertia) .* ...
    ((4.*-5.*x_vector.^3) + (2.*2.*2.*(length.^2).*x_vector));
% first derivative of moment vector, 3rd derivative of displacement
 vector
% (with additional coefficient that reduces out I and E)
shear_vector = (coefficient .* modulus_of_elasticity .*
 moment_of_inertia) .* ...
    ((3.*4.*-5.*(x_vector.^2)) + (2.*2.*2.*(length.^2)));
% first derivative of shear vector, 4th derivative of displacement
 vector
% (with additional coefficient that reduces out I and E and negates as
% well)
loading_vector = -1 .* (coefficient .* modulus_of_elasticity .*
 moment_of_inertia) .* ...
    ((2.*3.*4.*-5.*x_vector));

figure(1) = figure('Position', [100, 100, 1024, 1200]);
sgtitle('P2.26: Quantities vs distance of uniform beam subject to
 linearly increasing distributed load');
subplot(5,1,1);
plot(x_vector, displacement_vector);
xlabel('Position along length of beam (cm)');
ylabel('Displacement (y)');


subplot(5,1,2);
plot(x_vector, slope_vector);
xlabel('Position along length of beam (cm)');
ylabel('Slope (\theta(x))');

subplot(5,1,3);
plot(x_vector, moment_vector);
xlabel('Position along length of beam (cm)');
ylabel('Moment (M(x))');

subplot(5,1,4);
plot(x_vector, shear_vector);
xlabel('Position along length of beam (cm)');
ylabel('Shear (V(x))');
```

```
subplot(5,1,5);
plot(x_vector, loading_vector);
xlabel('Position along length of beam (cm)');
ylabel('Loading (w(x))');

%publish('EE254_cmcgarty_HW2_2_26.m','pdf');
```



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