

Assignment 7: Basic Matlab Operations

Date Due: March 18, 2024

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Problem 1

Use Matlab to solve the problem.

A common problem in Civil Engineering is to estimate the deflection of a cantilever beam at different stations (see Figure 1).

$$y = \frac{Px^2}{6EI}(3l - x) \quad (\text{Equation 1})$$

Where:

y is the deflection at any point in the beam (inches)

x is the distance from the wall to any point on the beam (inches)

P is the load applied (lbs.)

l is the length of the beam (inches)

E is the modulus of elasticity (lb/in²)

I is the moment of inertia (in⁴)

The units in this model are all consistent.

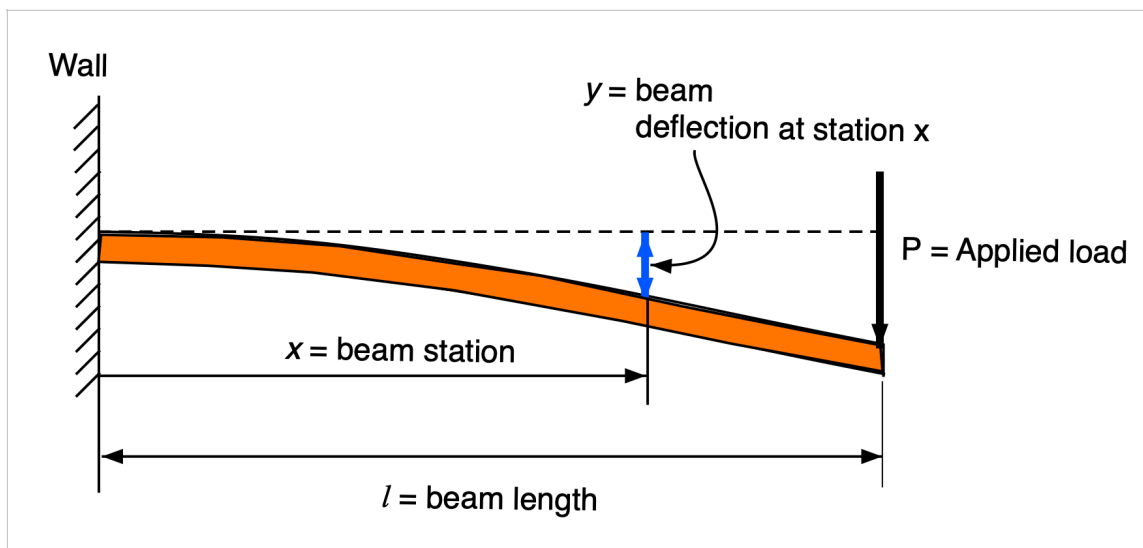


Figure 1. Cantilever Beam Subject to a Single Load (P).

A) Create a new Matlab script to estimate the estimate the beam deflection (y) given the parameters on the right hand side of Equation 1.

The values of the parameters are:

$x = 0:1:250;$ % vector of values defined in Matlab from the wall to the end of the beam (inches)

$P = 2000$ lbs.

$l = 250$ inches

$E = 2.9e7$ (in²)

$I = 200$ (in⁴)

B) Plot the deflection (y) as a function of the beam station (x).

C) Using the Matlab **max(y)** command, find the maximum deflection of the beam.

D) Modify the script created in part (A) creating another variable z where z is defined as:

$$z = \text{gradient}(y)$$

The function `gradient` takes the first derivative of the values of vector (y)

Using the “subplot” command create a new figure with two plots. Plot the values of x vs. y in the upper part of the window and x vs. z in the lower part of the same window. Change the line colors to distinguish the two views.

d) Verify that the “gradient” function is working.

Problem 2

Use the **US_dams_Units_2024.xlsx** file to work on the problem. For each problem show the Matlab code used to execute the task.

	A	B	C	D
1	Name	DamID	Longitude_deg	Latitude_deg
2	ANZALDUAS DIVERSION	TX83301	-98.334	26.137
3	DELTA LAKE UNIT NO 2 LEVEE	TX03790	-97.9367	26.43
4	FALCON	TX00024	-99.167	26.559
5	STRUCTURE 79	FL00310	-81.7126	26.7255
6	G-90	FL00440	-81.41	27.34
7	LAKE CASA BLANCA DAM	TX02267	-99.4483	27.5333
8	EXISTING STACK	FL10026	-82.38	27.87
9	EDWARD MEDARD RESERVOIR DAM	FL00434	-82.16	27.91
10	P-11	FL13003	-81.85	27.93

Figure 2. U.S. Dams.

- Use the Matlab wizard to read the all data. Let **Matlab create the code** to read the data. Save the file.
- Create individual variables for each column of data provided. Label the variables according to the headers in the Excel file.
- Plot the longitude of the dam (x -axis) versus the latitude of the dam location (y -axis) to get an idea of the locations of the dams in the US.
- Use the supplied US map to plot over the plot created in part (c). Use the Matlab ‘hold on’ command to keep the plot created in part (c) active.
- Use the string comparison command (`strcmp`) to find the dams in the state of Virginia. Create a variable with the names of the dams in Virginia. Show me the name of the first 15 dams listed in your answer.
- Add to the script to find the number of dams in Ohio.

Problem 3

Use the GPS data collected by a car data logger to do this problem. A sample of the data is shown below.

	A	B
1	Time (s)	Speed (km/h)
2	0	0.00
3	2	10.00
4	4	22.00
5	6	35.00
6	8	48.00
7	10	62.00
8	12	63.00

Figure 2. Car Speed Data.

- Read the data using Matlab.
- Plot the car speed (in y-axis) vs. time (x-axis). Observe the plot and comment on the number of stops.
- Convert the speed data into units of meters per second. Create a new variable to store the speed values in m/s.
- Convert the speed data into units of miles per hour and create a new variable.
- Estimate the acceleration of the car as a function of time using the metric data. Use the Matlab "gradient(x)" function to find the acceleration using the speed vector created in part (c). Plot the calculated acceleration vs. time recorded by the GPS data logger unit.
- Use the Max(x) command in Matlab to detect the largest speed during the journey. Find the time when the maximum speed is recorded. Display the maximum speed and the time in the Command window (use the DISP command).
- Find the average speed in meters per second of the car for the complete profile. Use the Matlab function MEAN(x) to get the average speed for all values.
- Find the number of seconds the car is traveling below 5 mph. Use the Matlab FIND function to do this part.