UNIVERSITY OF CALIFORNIA, BERKELEY College of Engineering

Introduction to Solid Mechanics (ME85/C30)

Homework8 (Due on Friday midnight March 15th)

Problem 1. (30 points)

Consider an elastic bar with Young's modulus, $E = 10$, the cross section area $A = 1$, and the length of the bar $L = 1$. The bar has a built-in boundary condition at $x = 0$, i.e. $u(0) = 0$, and at $x = L$, the internal force $R(L) = 0$ as shown in Fig. 1.

The differential equation that governs the equilibrium of the bar has been derived as follows,

$$\frac{d}{dx}\left(EA\frac{du}{dx}\right) + b(x) = 0, \quad 0 < x < L \ ,$$

where $u(x)$ is the displacement field.

The bar is subjected a distributed load along its span, i.e.

$$b(x) = p\sin\left(\frac{2\pi x}{L}\right),$$

where $p = 1$ with a unit of force per unit length.

The internal force is defined as $R(x) = \sigma A = EA\epsilon$, i.e.

$$R(x) = EA\frac{du}{dx}$$

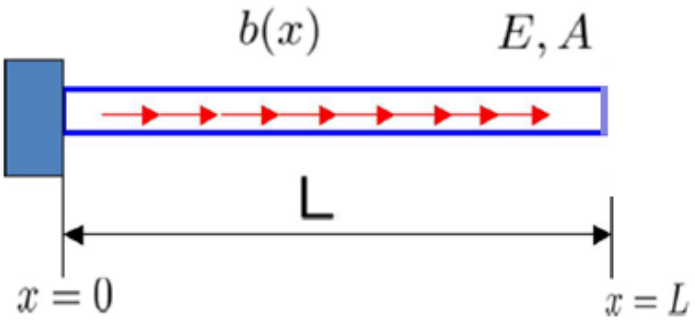

Figure 1: An elastic bar with the distributed load.

Use Matlab to find the displacement field and internal force/stress field, and compare them with the statically indeterminate system that has the same dimensions and the same material properties,

but with different boundary conditions: $u(0) = u(L) = 0$. Hint:
Go to class Bcourses website and go to the lecture folder, and then download a Matlab-P1 folder that contains the file: bar1d.m. You start your solution there. For all details, please refer to Lecture20F.pdf slide.

Problem 2. **P9.16** (10 points)

Problem 3. **P9.30** (10 points)

Problem 4. **P9.38** (10 points)

Problem 5. **P9.81** (10 points)