بسم ا الر ن الرحيم

DEPARTMENT OF CIVIL ENGINEERING - KFUPM

Numerical and Statistical Methods in Civil Engineering

CE 318-1, '11

Assignment No. 05

Subjects: Finite Differences Solution of Ordinary and Partial Differential Equations (ODE & PDE)

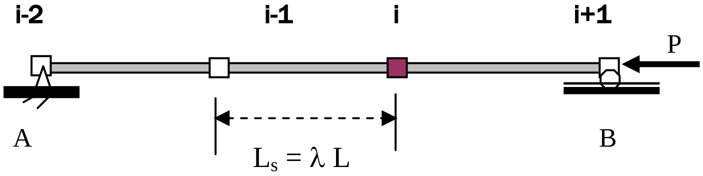
Date: **Date: Dec. 06, '11**

1. Study some basics on theory and analytical solution of column instability (bucking) as presented in the textbook pages 762-765. Then, for a uniform column AB with one end pinned and with the other end having a roller-support (as shown in Fig. P-1), determine values of the critical axial load P_{cr} for a column with L = 3 m, E = 10 GPa, and I = 1.3×10^{-5} m^4. For this:

   a. determine the analytical (exact) value of P_{cr};
   b. determine an approximate (numerical) value of P_{cr} using the method of finite differences with nodal spacing ration $\lambda_1 = 1/3$ and $\lambda_2 = 1/4$ such that $L_s = \lambda L$; and
   c. compare the results with different λ and with the analytical solution.

2. Use the method of finite difference to formulate the system of linear equations to solve problem 27.23 of the textbook page 780. Then i) determine the nodal values $u(x_i) = u_i$, and ii) plot u_i versus x_i.

Fig. P-1: mesh discretization of the column.



B.C.'s: transverse displacements at A and B are both zero.

3. The square cross section shown below) is subjected to a torque T. The stress function ϕ can be used to determine the stress at points on the cross section. The governing differential partial differential equation (*type is Poisson's Equation*) is given as

$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} + 2 = 0$$

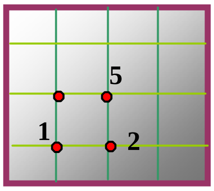
$B.C.'s:$

$$\phi = 0 \text{ at all boundary points of the cross section.}$$

Note: Assume the dimension of the cross section is 8 *cm*.

Complete the numbering scheme on the cross section, determine the values of ϕ at all *nine interior* points (numbered as: 1,2,3,4, 5 "the center point") on the cross section.

Cross -section



8 *cm*