ME 478 Homework #1

Please show your work and draw a box around your answer to receive full credit. You can refer to Appendix A in the book for a refresh your knowledge on matrix algebra for problems 2-5.

1) A concrete support shown in Figure 1 carries a load of 500 lb. Use the direct formulation method for finite elements and divide the column into five elements. Determine the deflection and average normal stress in each element ($E = 3.27 \times 10^3$ ksi). Use Matlab to solve and submit your DIARY file along with your hand-written work for the problem. Draw a box around your answers in the DIARY file.

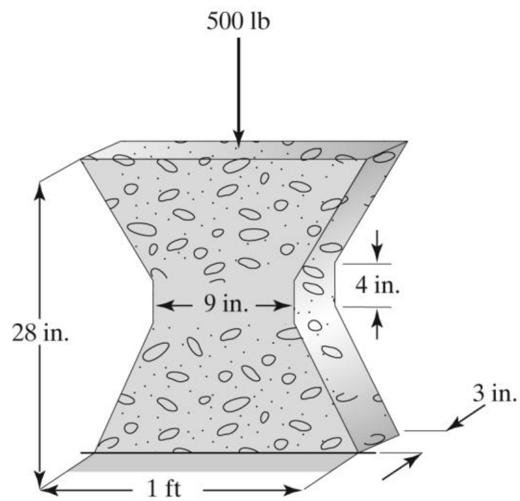

Figure 1.

2) Identify the size and type of the given matrices. Denote whether the matrix is square, column, diagonal, row, unit (identity), triangular, banded, and/or symmetric:

a. $\begin{bmatrix} 3 & 2 & 0 \\ 2 & 4 & 5 \\ 0 & 5 & 6 \end{bmatrix}$ b. $\begin{Bmatrix} x \\ x^2 \\ x^3 \\ x^4 \end{Bmatrix}$ c. $\begin{bmatrix} 4 & 0 \\ 0 & 8 \end{bmatrix}$ d. $\begin{bmatrix} 1 & y & y^2 & y^3 \end{bmatrix}$ e. $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

f. $\begin{bmatrix} 3 & -1 & 0 & 0 & 0 \\ 2 & 0 & 6 & 0 & 0 \\ 0 & 4 & 1 & 4 & 0 \\ 0 & 0 & 5 & 4 & 2 \\ 0 & 0 & 0 & 7 & 8 \end{bmatrix}$ g. $\begin{bmatrix} 1 & 2 & 2 & 2 \\ 0 & 1 & 3 & 3 \\ 0 & 0 & 1 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ h. $\begin{bmatrix} c_1 & 0 & 0 & 0 \\ 0 & c_2 & 0 & 0 \\ 0 & 0 & c_3 & 0 \\ 0 & 0 & 0 & c_4 \end{bmatrix}$

3) Given the matrices:

$$[A] = \begin{bmatrix} 1 & 4 & 2 \\ 8 & 3 & 6 \\ 7 & 1 & -2 \end{bmatrix} \qquad [B] = \begin{bmatrix} 0 & 5 & -1 \\ -3 & 1 & 7 \\ 2 & 4 & -4 \end{bmatrix}$$

Perform the following operations:

a. $[A]^T$ = ? and $[B]^T$ = ?.
b. Verify that $([A]+[B])^T = [A]^T + [B]^T$
c. Verify that $([A][B])^T = [B]^T[A]^T$

4) Given the following matrix

$$[A] = \begin{bmatrix} 0 & 5 & 0 \\ 8 & 3 & 7 \\ 9 & -2 & 9 \end{bmatrix}$$

Calculate the determinate of [A] and the determinant of $[A]^T$.

5) Solve the following set of equations (a) using the Gaussian method, (b) using the LU decomposition method, and (c) by finding the inverse of the coefficient matrix.

$$\begin{bmatrix} 1 & 1 & 1 \\ 2 & 5 & 1 \\ -3 & 1 & 5 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \end{Bmatrix} = \begin{Bmatrix} 6 \\ 15 \\ 14 \end{Bmatrix}$$