AUSTRALIAN DEFENCE FORCE ACADEMY
SCHOOL OF
AEROSPACE AND MECHANICAL ENGINEERING

Course: AMEC 3508 Mechanics of Solids 2B
AMEC 3706 Aircraft Structures 1B

Assignment #1 (30%)
Due date: Monday, September 17, 2001, 23:59

The truss in Fig.1 is made of hollow tubes with Young's modulus **E**.
The tubes have inner radius $\mathbf{R_{in}}$ and outer radius $\mathbf{R_{out}}$

The elemental stiffness matrix for 2D truss is:

$$[ke] = \frac{A \cdot E}{L}\begin{bmatrix} \cos^2\alpha & \cos\alpha\sin\alpha & -\cos^2\alpha & -\cos\alpha\sin\alpha \\ \cos\alpha\sin\alpha & \sin^2\alpha & -\cos\alpha\sin\alpha & -\sin^2\alpha \\ -\cos^2\alpha & -\cos\alpha\sin\alpha & \cos^2\alpha & \cos\alpha\sin\alpha \\ -\cos\alpha\sin\alpha & -\sin^2\alpha & \cos\alpha\sin\alpha & \sin^2\alpha \end{bmatrix}$$

A= cross section area
L= element length where $L = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$ and $\cos\alpha = \frac{x_2 - x_1}{L}$, $\sin\alpha = \frac{y_2 - y_1}{L}$

Write a MATLAB function ***A1_yourStudentID.m*** with the following declaration:
%FEM Assignment #1, Parametric Truss Analysis
function [RES]= *A1_yourStudentID* (E,Rin,Rout,h1,h2,L4,L6,L10,F,ALPHA)

Required numerical results (162 points in total):

1. (10pts) Obtain all the elemental stiffness matrices in a 4 by 4 by 11 array in **RES.KE**
2. (30pts) Obtain all the blown-up elemental stiffness matrices in a 16 by 16 by 11 array in **RES.KEB**
3. (10pts) Obtain the global stiffness matrix in a an array in **RES.KGLB**
4. Introduce the boundary conditions and obtain the reduced:
   a) (10pts) Global stiffness matrix **in RES.KGBC**
   ~~b) (10pts) Global displacement matrix in **RES.DBC**~~
   c) (10pts) Global force matrix **in RES.FBC**

5. (10pts) Use the provided "Gaussian Elimination" function to obtain all displacements in **RES.DISPS**
6. (12pts) Obtain all the reaction forces in **RES.FORCES**
7. (30pts) Obtain all axial forces in **RES.AXLF**
8. (10pts) Obtain all axial stresses in **RES.AXSTRS**
9. (5pts) Obtain the maximum tensile stress **RES.MXTSTRS** and its element number **RES.MXTLOC**

10. (5pts) Obtain the minimum tensile stress **RES.MNTSTRS** and its element number **RES.MNTLOC**

11. (5pts) Obtain the maximum compressive stress **RES.MXCSTRS** and its element number **RES.MXCLOC**

12. (5pts) Obtain the minimum compressive stress **RES.MNCSTRS** and its element number **RES.MNCLOC**

Use the following formulae in numbering the forces and displacements:

$F_x^n = F_{2n-1}$ $F_y^n = F_{2n}$ *and* $x_n = \delta_{2n-1}$ $y_n = \delta_{2n}$ where ***n*** is the node number.

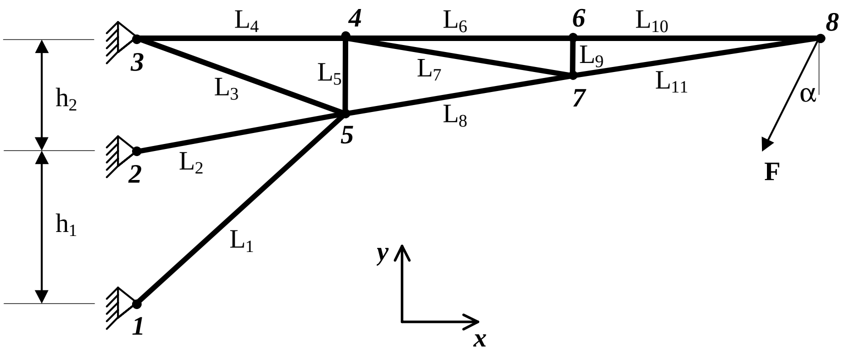

Figure 1.

<u>Hints:</u>

- L_4, L_6 and L_{10} are horizontal
- L_2, L_8 and L_{11} make up a straight line from node 2 to node 8
- Use geometric properties to calculate the rest of the dimensions and the coordinates of each node.

<u>IMPORTANT:</u>

Submission and assessment of this assignment will be done **electronically**. E-mail your MATLAB function as an attachment to m.tahtali@adfa.edu.au, with **exactly** [FEM2001-A1] in the subject field. Do not submit a function that:

- does not terminate properly
- does not return any values
- crashes
- or hangs