Ministry of Higher Education
Giza Higher Institute for Eng. & Tech.
Civil Engineering Department
Course Name: Computer Applications in Civil Eng.
Course Code : **CIV 410**

Academic Year : **2015–2016**
Semester : **Second**
Level : **4th**
Time : **3 Hours**
Date : **30 / 5 / 2016**
Examiner: ***Dr. M. Abdel-Kader***

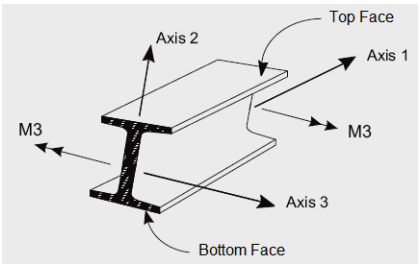
Second Semester Final Exam

- Attempt all questions.
- The Exam consists of **3** questions in **2** pages.
- Maximum grade is **60 Marks**.

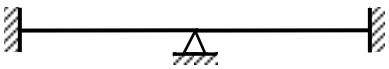
Question (1): (20 Marks)

(a) TRUE or FALSE (Put ✓ or ✗ in front of the statement number in your answer sheet)

1. The abbreviation "CAD" means Computer and Data.
2. The abbreviation "SAP" means Structural Analysis Programs.
3. The abbreviation "DOF" means Degree of Freedom.
4. The frame element is also called beam-column element.
5. In space frames, there are 6 DOF per free node, which are 3 translations and 3 rotations.
6. Bar element used in modeling trusses has two nodes at its ends, every node has 3 DOF in the element axial direction.
7. The default initial output of SAP2000 is the deformed shape of the structure.
8. If the direction of the moment M3 is as shown in the figure, the top face will be subject to a tension.



9. Structures that can be modeled with the frame element include: 3-D and planar frames – 3-D and planar trusses – Flat slabs – Raft foundation.
10. The order of the input data: Editing Supports & Assigning Frame Sections is very important.
11. Settlement of support, change in temperature and tolerance problems (fabrication errors) cause stresses in statically determinate structures, but not in statically indeterminate structures.
12. **Isotropic** means that the material properties are independent of the coordinates.
13. **Homogeneous** means that the material properties are independent of the rotation of the axes at any point in the body or structure.
14. **Seismic (Earthquake) load** is usually applied vertically on the structure.
15. The shown indeterminate beam is **1** *Kinematically Indeterminate* and **5** *Statically Indeterminate*.



(b) Choose the correct answer (**Put a, b, c or d in front of the statement number in your answer sheet**).

1. In SAP, properties of material and load combinations are considered as
   a) Results of the analysis. c) Input data.
   b) Output data. d) Always not required in the analysis.
2. The responsibility of the analytical model results lies on
   a) The structural designer who used the software. c) The input data.
   b) The company developed the software. d) The computer used.
3. Stiffness is the property of an element which is defined as
   a) Displacement per unit area. c) Force per unit mass.
   b) Displacement per unit force. d) Force per unit displacement.
4. The correct choice of modeling and analysis tools/methods depends on
   a) Importance of the structure. c) Purpose of structural analysis.
   b) Required level of response accuracy. d) All the above.
5. For plane frame in X-Z plane, the fixed support has restraints in Joint Local Directions as:

a) b) c) d)

Please turn over

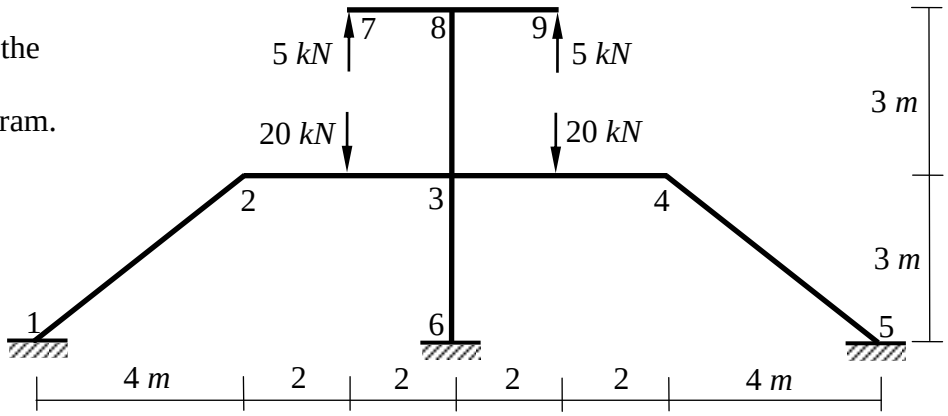
Question (2): (20 Marks)

For the shown frame, using the stiffness method:

Neglect axial deformation.

(a) Determine the displacements at the nodes due to the given load.

(b) Draw the bending moment diagram.

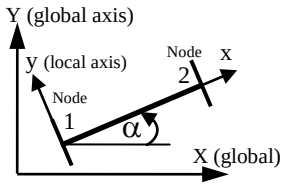


Given Data:

$E = 2.1\times10^{7}\ kN/m^2$

$I = 3.125\times10^{-3}\ m^4$

$A = 0.15\ m^2$



Frame element

$$[K_e]=\begin{bmatrix}
\left(\frac{EA}{L}\lambda^2+\frac{12EI}{L^3}\mu^2\right) & \left(\frac{EA}{L}\mu\lambda-\frac{12EI}{L^3}\mu\lambda\right) & -\frac{6EI}{L^2}\mu & \left(-\frac{EA}{L}\lambda^2-\frac{12EI}{L^3}\mu^2\right) & \left(-\frac{EA}{L}\mu\lambda+\frac{12EI}{L^3}\mu\lambda\right) & -\frac{6EI}{L^2}\mu \\
\left(\frac{EA}{L}\mu\lambda-\frac{12EI}{L^3}\mu\lambda\right) & \left(\frac{EA}{L}\mu^2+\frac{12EI}{L^3}\lambda^2\right) & \frac{6EI}{L^2}\lambda & \left(-\frac{EA}{L}\mu\lambda+\frac{12EI}{L^3}\mu\lambda\right) & \left(-\frac{EA}{L}\mu^2-\frac{12EI}{L^3}\lambda^2\right) & \frac{6EI}{L^2}\lambda \\
-\frac{6EI}{L^2}\mu & \frac{6EI}{L^2}\lambda & \frac{4EI}{L} & \frac{6EI}{L^2}\mu & -\frac{6EI}{L^2}\lambda & \frac{2EI}{L} \\
\left(-\frac{EA}{L}\lambda^2-\frac{12EI}{L^3}\mu^2\right) & \left(-\frac{EA}{L}\mu\lambda+\frac{12EI}{L^3}\mu\lambda\right) & \frac{6EI}{L^2}\mu & \left(\frac{EA}{L}\lambda^2+\frac{12EI}{L^3}\mu^2\right) & \left(\frac{EA}{L}\mu\lambda-\frac{12EI}{L^3}\mu\lambda\right) & \frac{6EI}{L^2}\mu \\
\left(-\frac{EA}{L}\mu\lambda+\frac{12EI}{L^3}\mu\lambda\right) & \left(-\frac{EA}{L}\mu^2-\frac{12EI}{L^3}\lambda^2\right) & -\frac{6EI}{L^2}\lambda & \left(\frac{EA}{L}\mu\lambda-\frac{12EI}{L^3}\mu\lambda\right) & \left(\frac{EA}{L}\mu^2+\frac{12EI}{L^3}\lambda^2\right) & -\frac{6EI}{L^2}\lambda \\
-\frac{6EI}{L^2}\mu & \frac{6EI}{L^2}\lambda & \frac{2EI}{L} & \frac{6EI}{L^2}\mu & -\frac{6EI}{L^2}\lambda & \frac{4EI}{L}
\end{bmatrix}$$

Where, $\lambda = \cos\alpha$ and $\mu = \sin\alpha$

Question (3): (20 Marks)

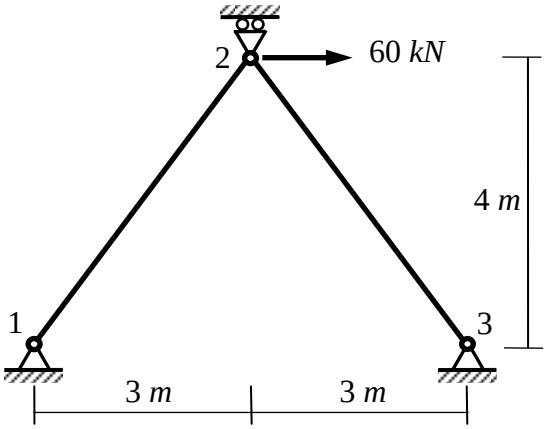
For the shown truss, using the stiffness method, determine:

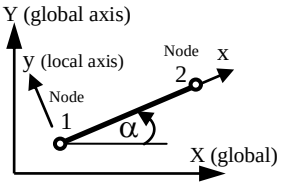
(a) The displacements at the nodes due to the given load.

(b) The reactions at the supports 1, 2 and 3.

(c) The forces in members 1-2 and 2-3.

Given Data: $E = 2.0\times10^{7}\ kN/m^2$ $A = 2.0\times10^{-4}\ m^2$





Truss (Bar) element

$$[K_e]=\begin{bmatrix}
\frac{EA}{L}\lambda^2 & \frac{EA}{L}\mu\lambda & -\frac{EA}{L}\lambda^2 & -\frac{EA}{L}\mu\lambda \\
\frac{EA}{L}\mu\lambda & \frac{EA}{L}\mu^2 & -\frac{EA}{L}\mu\lambda & -\frac{EA}{L}\mu^2 \\
-\frac{EA}{L}\lambda^2 & -\frac{EA}{L}\mu\lambda & \frac{EA}{L}\lambda^2 & \frac{EA}{L}\mu\lambda \\
-\frac{EA}{L}\mu\lambda & -\frac{EA}{L}\mu^2 & \frac{EA}{L}\mu\lambda & \frac{EA}{L}\mu^2
\end{bmatrix}$$

Where, $\lambda = \cos\alpha$ and $\mu = \sin\alpha$

With my best wishes

Dr. M. Abdel-Kader