- In section 3 we covered:

  1. section 3.1: Representation of data and functions pertinent to various FEM objects (*e.g.,* elements, nodes, and dofs).
  2. section 3.2: Steps needed from reading elements and nodes to FEM solution for node and element dof values and forces.
  3. section 3.3: Simplifications that can be employed in Matlab and description of input and output file formats.

- The term project involves:

  – Development of FEM solver for four different element types: 1. bars, 2. beams, 3. trusses, and 4. frames. The process to implement element specific routines (*e.g.,* stiffness and load vectors and well as output function) is described in course notes (section 3.3).

  – Limitations of implementation (*e.g.,* no source term and natural boundary force, same dof for all nodes, and some other are described in 3.3.

  – Input file format is provided in 3.3.

  – Beside solving the FEM problem (all steps in 3.2), the project involves Input/Output operation in accordance with the format given in section 3.3

- Deliverables are:

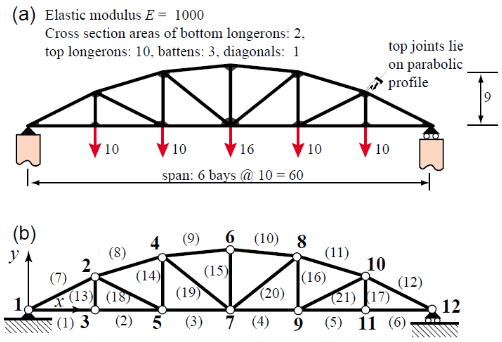
  1. **All Matlab or C++ files** should be submitted in a **zip file** with name "LastNameFEMProject.zip".
  2. The **output file** corresponding to the truss problem shown in section 3.3. RunName = Truss. Input file is shown in that section and can also be downloaded from: http://rezaabedi.com/wp-content/uploads/Courses/FEM/Truss.txt.
  3. From Reference [1]: **Input File** and **output File** for Figure 22.4 (also shown in figure 1(a)). RunName = TrussExt.
  4. From Reference [1]: **Input File** and **output File** for Exercise 22.3 (also shown in figure 1(b)). All geometry and material parameters are provided in the reference [2] page 22-12 " The SI physical units to be used are: mm for lengths, N for forces, and MPa=N/mm2 for elastic moduli. For the calculations use the following numerical data: $L = 10,000$ mm (10 m), $H = 6,000$ (6 m), $a = 500mm$ (0.5 m), $P = 4,800$ N, $E = 35,000$ MPa (high strength concrete). The member cross section area is $A = a^2$, and the flexural moment of inertia about the neutral axis is $I_{zz} = a^4/12$"

     RunName = FrameExt.
  5. From Reference [1]: Exercise 22.4 (A concept question about Exercise 22.3). The question is as follows: Do we capture the exact solution for the frame problem in figure 1(b)? Justify your answer (why we (do not) obtain the exact solution).

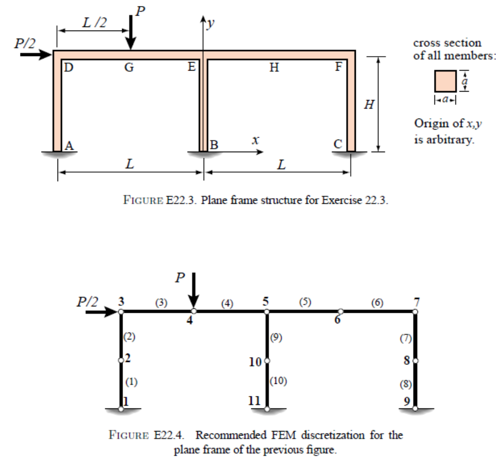
References:[1]

[1]. Introduction to Finite Element Methods (ASEN 5007), Fall 2013, Department of Aerospace Engineering Sciences, University of Colorado at Boulder: Part III: Computer Implementation of Finite Elements: Chapter 22 Index. FEM Programs for Trusses and Frames.
Course URL: http://www.colorado.edu/engineering/cas/courses.d/IFEM.d/
Chapter 22 URL: http://www.colorado.edu/engineering/cas/courses.d/IFEM.d/IFEM.Ch22.d/IFEM.Ch22.pdf

[1]Unfortunately these materials are no longer available, but the two examples are taken from a course by professor Carlos Felippa notes, U Colorado Boulder.



(a) Problem description for TrussExt



(b) Problem description for FrameExt

Figure 1: Brief description of two problems from reference [1]; for more information refer to the reference.