MAEG 5130 – 2022 Term 2

Project 1 Description

This project is to solve the truss problems using MATLAB. A PDF file (Chapter 12) for basic operation of MATLAB has been uploaded to Blackboard. ***For this project, you are required to write MATLAB scripts to solve all the following problems.*** Please note that problem 1 is a compulsory question in this project while problem 2 is a bonus question.

Problem 1 (100')

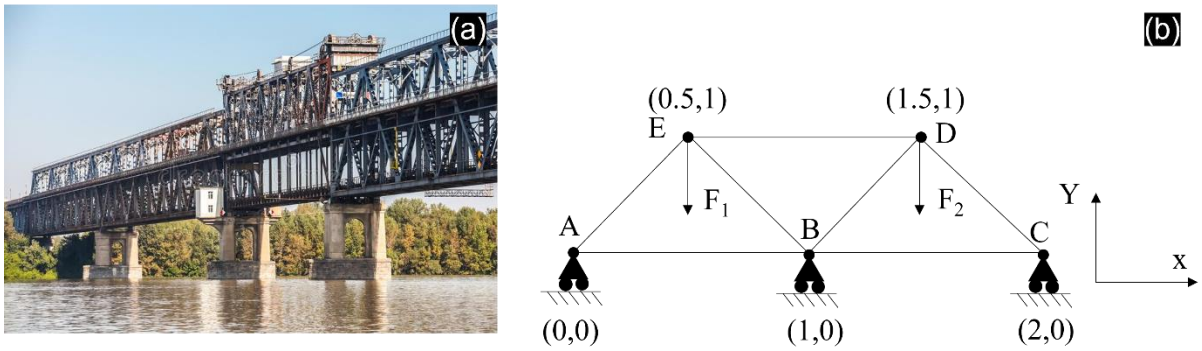

Figure 1. (a) Danube bridge [1]. (b) Schematic for the planar truss structure in problem 1.

Truss is a common engineering structure for the construction of bridges and buildings. Figure 1 (a) shows the Danube bridge constructed based on the truss. In problem 1, consider a simplified truss structure from the Danube bridge in 2D, as illustrated in the Figure 1 (b). Nodes A, B, and C are fixed in y direction. Two forces equal to 20 N act in the negative y direction at nodes D and E. Coordinates of joints are given in meters. Young's modulus is $E = 2\times10^{11}$ Pa, and the cross-sectional area for all bars is $A = 3\times10^{-2}$ m^2.

Please finish the questions from a to d.

a. Number the elements and nodes.

b. Assemble the global stiffness and force matrix.

c. Partition the system and solve for the nodal displacement.

d. Compute the stresses and reactions.

Problem 2 – Bonus problem (100')

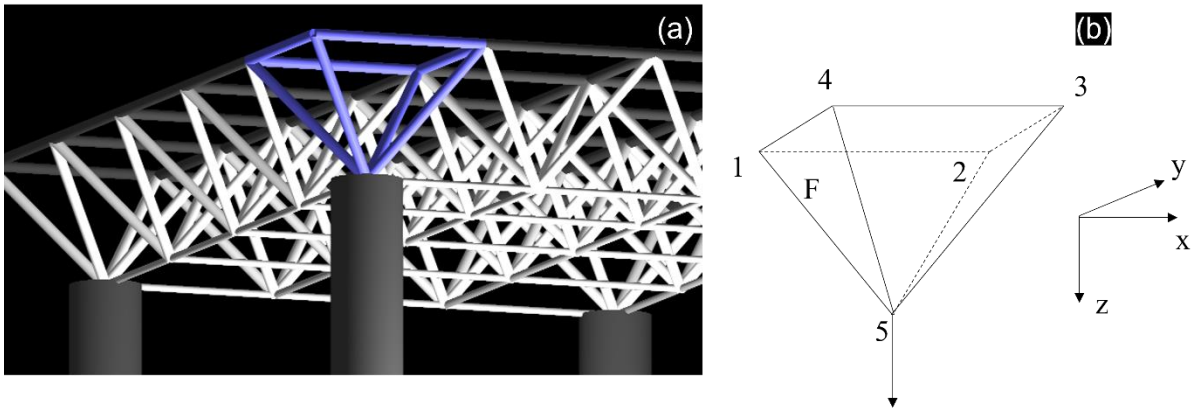

Figure 2. (a) Engineering use of the 3D truss structure [2]. (b) Schematic for the 3D truss structure in problem 2.

Figure 2 (a) shows a periodic truss structure in 3D space to support load on top surfaces. The blue beams constitute a unit cell of this structure, and the unit cell can be simplified to the structure demonstrated in Figure 2 (b). Node 1 is fixed in x, y, and z. Node 2 is fixed in y and z. Node 3 is fixed in z. Node 4 is fixed in x and z. A force, $F = 2N$, is applied along negative z direction at Node 5. The length of each bar is $L = 1m$ with cross-sectional area of $A = 3\times10^{-2}$, and Young's Modulus is $E = 2\times10^{11}$ Pa.

Please finish the questions from a to c.

a. Number the elements and nodes.

b. Calculate the nodal displacement matrix.

c. Calculate the nodal force matrix.

3 Report requirements

1) Problem 1 is the compulsory question of this project, and problem 2 is a bonus question which is optional.

2) Script which is just for calculation of matrices is acceptable, but ONLY use one script for one problem.

3) A report for how to solve this or these problems, with codes attached on the end of the report.

4) A PDF file of your report and your MATLAB scripts should be submitted to Blackboard. Do NOT zip these files in '.zip' or other formats.

5) Due date: 23:59, 22, Feb.

[1] https://cn.dreamstime.com/

[2] https://www.wikiwand.com/