

AE4ASM003 Linear Modelling Assignment 2: truss element

Due Tuesday 22 September 2020, 10:00 CET

Please upload on Brightspace under the 'assignments' tab (on top of the page). You can upload multiple times, but only the last version you upload before the deadline expires is retained and will be checked and graded. Grading will only start after the deadline has passed. Please note that the deadline in Brightspace is a hard deadline: you cannot upload any files after the deadline has passed. The plagiarism check is enabled in Brightspace. Please follow the submission guidelines on page 3 of this assignment.

The aim is to provide you with feedback and a grade two weeks after the deadline, if grading takes longer this will be announced on Brightspace. Please refrain from asking questions about grading until two weeks after the assignment deadline or the new date announced on Brightspace.

In this exercise you are asked to write a generally applicable Python or Matlab code to solve truss structures. Your code should take as input the node locations, connectivity matrix, material elastic modulus, area of each element, force vector and boundary conditions. Your code should calculate the node displacement, reaction forces, and stress and strain in each element. An example of the code with input and output defined is attached to this assignment. Please note that the current input of the code is for the example problem worked out in the lecture notes.

Hint: use as many functions as possible that you can re-use in future assignments; you should be able to re-use some of the functions from assignment 1 (for example applying boundary conditions and solving the system).

As a verification case, please use the structure shown in Figure 1 that you should build in Python/Matlab and Abaqus. The node numbers are in circles, the element numbers in squares. Note: the vertical line on the left indicates a boundary condition, there are no elements between nodes 1 and 6, or 6 and 5. This example can be seen as a scaled-down version of the support structure of the walking path in the B-17, shown in Figure 3.

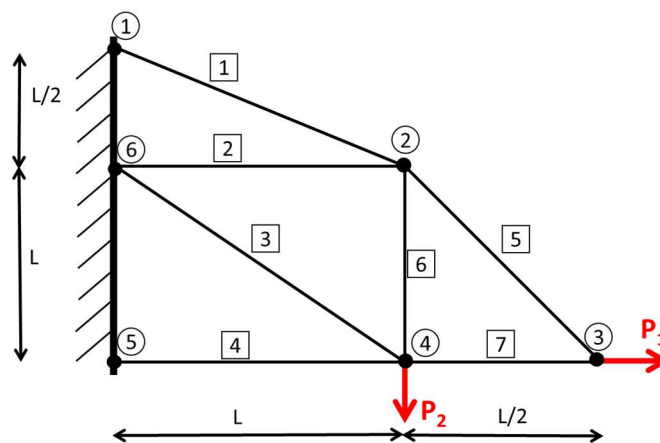


Figure 1: verification case to use for this assignment

All truss elements are made from Aluminium ($E = 70 \text{ GPa}$) with a cross section of 20 mm^2 . The length L is given to be 150 mm . The forces are $P_1 = 2 \text{ kN}$; $P_2 = 1 \text{ kN}$.

Tasks

1. Complete the code given in the assignment: change the input values to the values of the problem shown in Figure 1 and program all functions. Please do not change the names of the variables in the input file or the output printed out.
2. In the report, mention what you believe is the most important assumption (only one!) you make while solving this problem and give your reasoning.
3. In the report, show the verification you did using Abaqus.
4. In the report, answer the following question: would it make a difference if we model each truss member using two equal truss members in series (same cross sectional area and material), as shown in Figure 2? (Please answer this question using reasoning, no Abaqus or Python/Matlab output allowed in your answer)

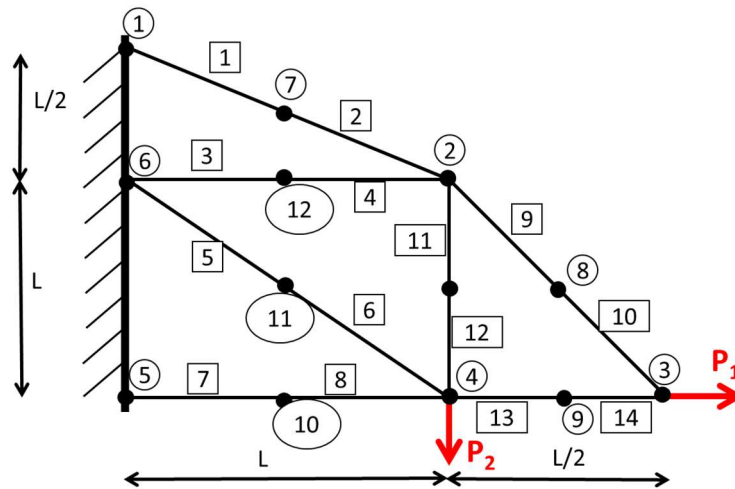


Figure 2: structure with each member halved

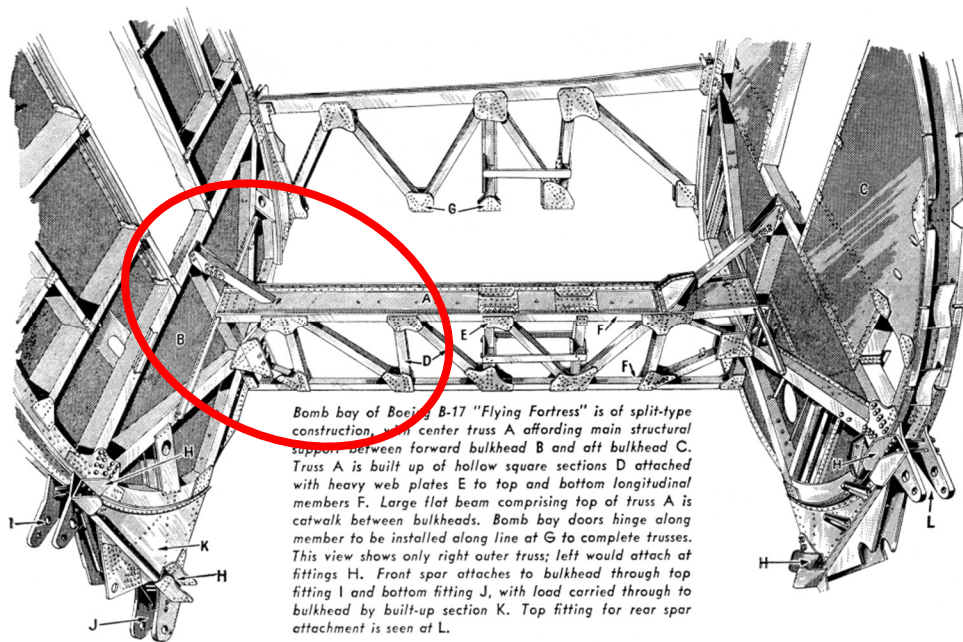


Figure 3: B-17 walking path with the support structure highlighted for reference
http://legendsintheirowntime.com/LiTOT/Content/1944/B17_Av_4406_sk_bomb-bay_p197_W.png

Submission and naming:

- submit your own Python/Matlab code and the report in pdf format using the following naming convention:
 - o LMex2_StudentNumber.pdf
 - o HW2functions_StudentNumber.py or HW2functions_StudentNumber.m
 - o HW2ForStudents_StudentNumber.py or HW2ForStudents_StudentNumber.m
 - o change StudentNumber by your student number in the naming convention
- Upload the files themselves, no external links to the files.
- Make sure you add all three files and click 'submit' (only last submission is visible for grading, so if you hit submit for each file only 1 file will be visible for grading; if you want to make a change to a file, you have to upload all three files again).
- Your submission should look like this right before submitting (check all files have been uploaded and are visible). Do not forget to click 'submit':




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Comments

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Submit Cancel

As a guideline, the report should be 1-3 pages (including figures from Abaqus)