MECHGM05/GR05/M003: Advanced Computer Applications in Engineering
Finite Element Analysis - Assignment 2

THE PROBLEM

Part 1: Write a MATLAB program to calculate the stiffness matrix of a two-dimensional plane stress using (i) three-noded and (ii) six-noded element shown in Figure 1A. Assume E=100 GPa, υ=0.3 and plate thickness is 2 mm.

Part 2: Extent your program in Part 1 to determine the displacement and strain in a thin plate, consisted of two and four (i) three-noded and (ii) six-noded triangular elements, under uniform tension (as shown in Figure 1B). Assume E=100 GPa, υ=0.3 and plate thickness of 2 mm. Do not change the dimensions in Figure 1B; increase the mesh density from two elements to four elements.

Part 3: Re-run your program in Part 2 to determine the displacement and strain, based on four six-noded triangular elements, (i) for three additional elastic modulus (ii) for three additional loading conditions i.e. changing the loading direction from θ=90°. Keep other variables constant.

See Figure 1B for a schematic of the thin plate under tension modelled with two three-noded elements. Use general shape function equations derived on slide 79 and 87 of your lecture notes.

Your report must compare/comment on the:

- displacement and strain results obtained from different elements, material properties and loading conditions
- validity of your program

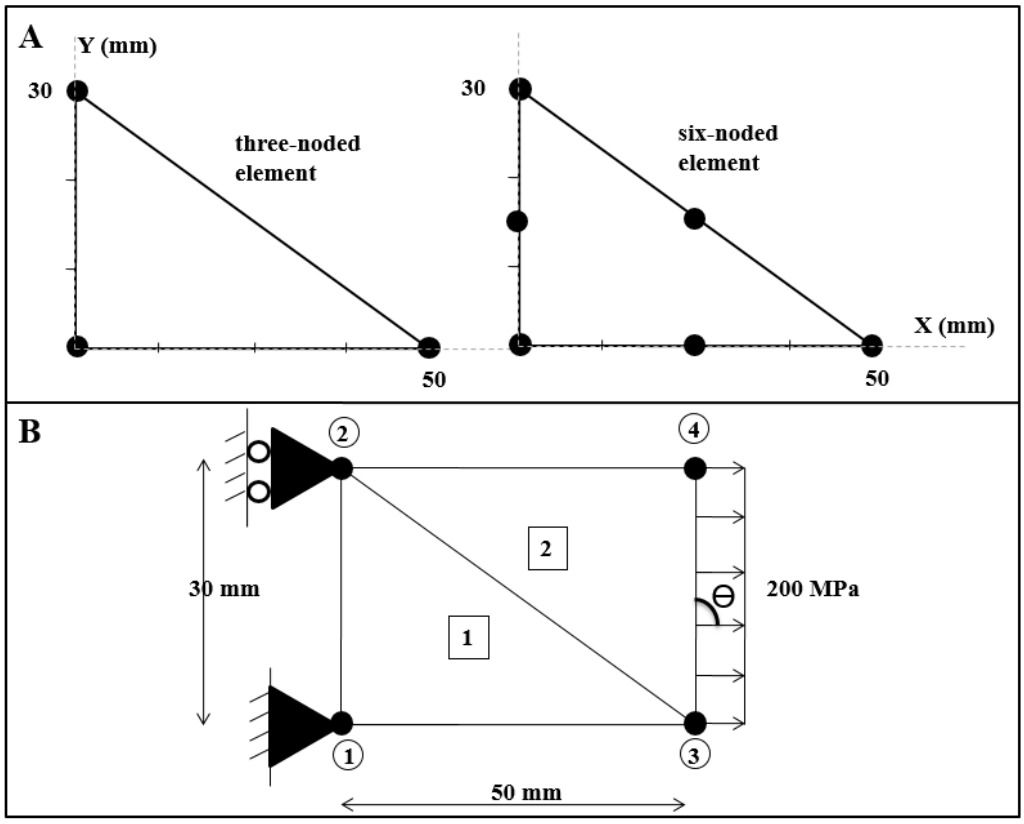

Figure 1: (A) three-noded and six noded elements; (B) thin plate under tension [1].

REPORT OUTLINE AND MARKING SCHEME

Prepare your report in the format of a journal article based on the following guidelines:

Title page

- title of report, your name, affiliation, email address and word count

Abstract ----------

Introduction ----------

- describe the problem, include a sketch/drawing of the problem; describe the aim of the study…

Materials and Methods----------

- model description; material properties; boundary conditions and loads; element type and mesh convergence; simulations, sensitivity tests and measurements (computer models & theory)...

Results ----------

- results of the simulations in the same order that mentioned in the method...

Discussion ----------

- discuss the results of each simulation in the same order as in the Results section; comparison between different models, with theory and/or experiments; comment on the validity and limitations of the model; summary/conclusion...

References

Figures and Tables

Appendix ----------

- **MATLAB code must be included here**

Presentation **[20 marks]**; technical content **[50 marks - Part 1; 10marks; Part 2; 25 marks; Part 3; 15 marks]**; discussion and critical analysis **[30 marks]**

REPORT REQUIREMENTS AND SUBMISSION DATELINE

- Your report must be submitted to the departmental office by **12 noon on 13th February 2017**. All reports need to be soft-bound (non-compliance will incur penalty points) and accompanied by signed cover-sheet (downloadable from the Student Intranet Site).
- An identical copy of your report must also be uploaded onto Moodle by the same deadline above. Penalty points will be applied if they are not identical.
- The main text (excluding title page, abstract, references, equations, tables, figure captions and appendices) must not exceed 1500 words. Word count must be included on the first page.
- Total number of Figures plus number of Tables must be less than 10.
- Do not include the Figures and Tables in the main text. Include all the Figures and Tables at the end of the text after References. Figures and Tables must be cross-referenced in the text.
- Include page and continuous line number.
- Your report including all sections (i.e. including signed cover-sheet) must not exceed 15 pages.
- Use font Arial 11, line spacing 1.15, margins 25.4 mm on all sides, continuous line and page number. The formatting does not apply to the Appendix.
- International System of Units (or SI units) must be adopted throughout the report.
- Note up to 20 marks penalty will apply if you do not follow the guidelines.
- All students are reminded of the UCL plagiarism policies given in the following webpage, viz. http://www.ucl.ac.uk/current-students/guidelines/plagiarism

REFERENCE

[1] Seshu P. Textbook of finite element analysis. PHI Learning Private Limited 2003.

Dr M Moazen
5th December 2016