Coursework
Plates and Shells: Analysis and Computation (4D9)

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Deadline: The deadline for the report and software is **11 March 2010, 5pm**

Estimated time to complete: 10 hours

Introductory lab session: 3 March 2010, 11-12

Form of submission: A typed report of at least three pages and a working MATLAB implementation. The preferred form of submission is via email to fc286@. Make sure that you submit the entire CEAKIT directory on your computer and not just the functions you implemented.

Problem description

The objective of this coursework is to implement a finite element code for static and dynamic analysis of plate structures. There is a MATLAB finite element library CEAKIT *(Computational Engineering Analysis Kit)* to be used for this coursework, which can be obtained from:
`http://www-g.eng.cam.ac.uk/csml/teaching/4d9/CEAKIT.tar.gz`

The dowloaded file CEAKIT.tar.gz can be unpacked with `tar -xzf CEAKIT.tar.gz`, which will create the CEAKIT directory containing several `*.m` files. Running the driver function `Ceakit` in MATLAB will plot a deflected plate.

Tasks to be completed

1. Study the `Ceakit.m` driver and describe with few sentences the purpose of each function called.

2. Implement a function which computes the load vector for uniform pressure loading.

3. Figure 1 shows the geometry of a plate to be analysed. The boundaries of the plate are simply supported and the plate thickness is $t = 0.2$. The Young's modulus of the material is $E = 35000$ and the Poisson's ratio is $\nu = 0.3$. The plate is loaded by uniform pressure loading of $p = 0.003$. Study the convergence of the maximal displacements for fully and selectively reduced integrated finite elements. The meshes to be used should have 4×4, 8×8, 16×16 and 32×32 elements.

4. Implement a function for computing the element mass matrix of a plate finite element and extend `Ceakit.m` for assembling the global mass matrix.

5. Implement the implicit Newmark time integration scheme.

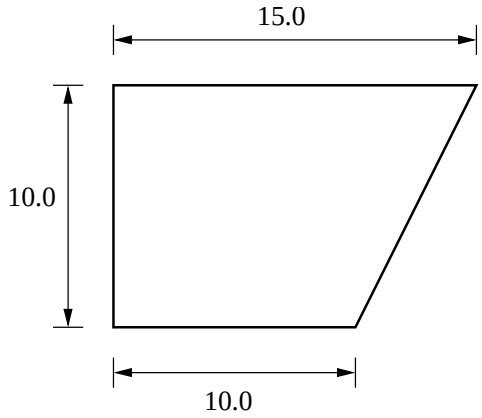

Figure 1:

6. The dynamics of the plate in Fig. 1 due to sudden uniform loading is to be studied. The mass density of the material is $\rho = 2000$. Apply a sudden uniform loading of $p = 0.003$ and plot the evolution of the maximal displacements over time.

Note, it is not sufficient just to submit a working MATLAB implementation. It is important that you submit a report, which addresses item by item each point of the previous list. Do not forget to include the requested plots and the implemented equations.