

Advanced Structural Engineering, Spring 2013

Evaluation Task 3 - Plates/shells. Prebuckling and Postbuckling

The evaluation task is a part of the examination in the course "Advanced Structural Engineering". The task deals with stability- and postbuckling analysis of a shell structure.

We consider a tubular section made of steel with a length of 14.0 m, a diameter of 4.0 m and a thickness of 30 mm. The tubular section is in both ends simply supported in the radial and tangential direction. In the axial direction it is in one of the ends supported and in the other end loaded with a uniform pressure load along the circumferential

Question 1

Calculate the analytical value of the critical pressure.

Question 2

Set up a Finite Element model in your favorite FEM program, and calculate the buckling stress.

Compare the result with the theoretical value and explain the differences.

Find the buckling stresses for the 5-10 lowest values, and comment the results.

Question 3

What difference will it make if the ends is made stiff against bending and torsion? (In wind turbine towers it is made by welding relative big flanges to the ends).

Question 4

Give the shell structure a geometric imperfection similar to the first buckling mode, and run a full non-linear geometric analysis. Illustrate the behaviour by some characteristic load-deflection curves.

Hint: The solution will converge more easily for larger imperfection levels.

Question 5

Analyse the structure for different levels of imperfections, and describe the postbuckling behaviour of the shell.