Homework assignment 4

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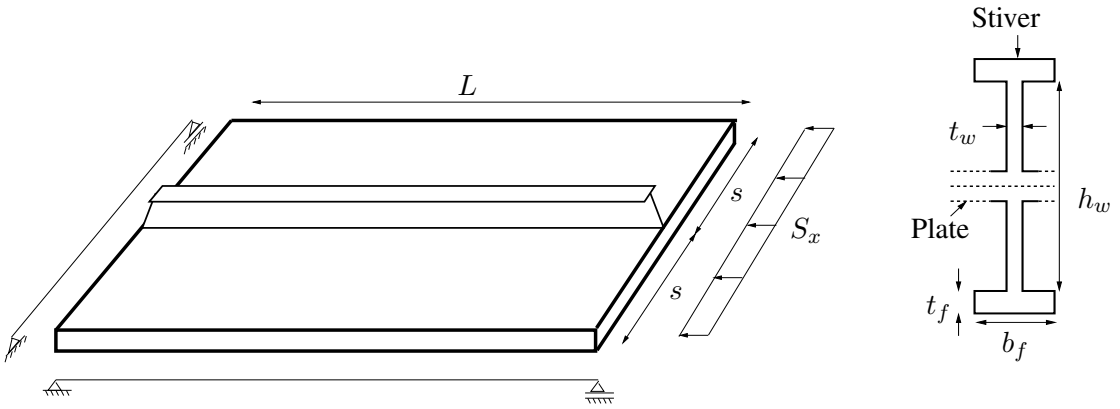
3 Exercise



Figur 1: Simply supported plate with stiffener.

Part 3.1
The plate has thickness $t = 10\,mm$, length $L = 2400\,mm$, and distance from the stiffener to the boundary parallel to the stiffener $s = 800\,mm$. The plate is simply supported and the boundaries is assumed to remain straight during deformation due to a surrounding structure. The dimensions to the symmetric stiffener is given by: $t_f = 8\,mm$, $b_f = 100\,mm$, $t_w = 10\,mm$ and $h_w = 400\,mm$. The material properties is the Young's modulus $E = 208000\,MPa$ and $\nu = 0.3$. S_x is the average stress on the boundary of the plate. The stiffener is not loaded with external loads. Use the SHELL 93 element to model the plate.

First, consider the plate without the stiffener.

a) Find the buckling load using the differential equation for a simply supported plate with length L and with s loaded axially with the stress S_x. Assume that the transverse displacement is

$$w(x,y) = a_{ij}\sin(\frac{\pi i x}{L})\sin(\frac{\pi j y}{s}) \tag{1}$$

(Find the combination of i and j giving the smallest value.)

b) Find the four smallest eigevalues of the plate using `ANSYS`, and compare to exercise a).

Part 3.2
In this part the plate with the stiffener is analyzed.

c) Find the four smallest eigenvalues using `ANSYS` and compare to exercise a).

d) Do a nonlinear analysis, using geometric nonlinearity and a linearly elastic material, the first buckling form is used as an imperfection with maximum value $s/1600$. (If this is problematic, use $s/400$ instead.)

e) Make a stress vs. transverse displacement plot.

f) Let the external stress approach the elastic buckling load and discuss the result.

g) Make a stress vs. transverse displacement plot.

h) Redo exercise c) and d) but increase the imperfections to $s/200$. Do you notice any difference in the results?

Løsning

A ANSYS input fil

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