# 2.081J/16.230J Plates and Shells

*Homework #5*
*Due date: class on Monday March 20*

**Problem 1** A long rectangular simply supported plate is compressed between two rigid blocks.


uniform thickness, $h = 10\ mm$

The following data for the considered steel are provided:

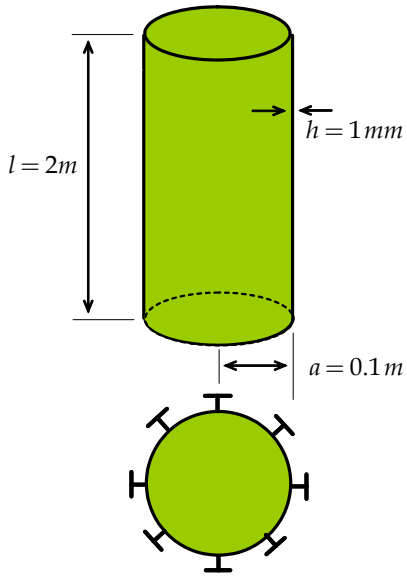
$$\sigma = \begin{cases} E\varepsilon & \text{for } \varepsilon < \varepsilon_y \\ K\varepsilon^{0.3} & \text{for } \varepsilon \geq \varepsilon_y \end{cases}$$

where

$$E = 210\ GPa; \quad \nu = 0.3$$
$$K = 2.141\ GPa$$
$$\varepsilon_y = \frac{\sigma_y}{E}; \quad \sigma_y = 300\ MPa$$

Note that $\sigma$ and $\varepsilon$ are respectively total stress and total strain.
(a) Calculate the effective width of the plate, $b_{eff}$.
(b) Assume the actual width of the plate is $b = b_{eff}/2$. Determine the plastic buckling stress $\sigma_{cr}$ and the total buckling load $P_{cr}$.
(c) Compare the solution ($\sigma_{cr}$ and $P_{cr}$) for $b = b_{eff}$ and $b = b_{eff}/2$.
(d) Plot the stress distribution in both plates, $\sigma_{xx}(y)$, at the point of buckling.

**Problem 2** A long cylindrical shell made of mild steel ($E = 210\ GPa$ and $\nu = 0.3$) is stiffened in $x$-direction by a system of eight equally spaced stringers. This shell is subjected to axial compression.




(a) Determine the buckling mode of the shell, $(\bar{m}, n)$.
(b) Calculate the corresponding half-wave length, $\lambda$.
(c) Determine the theoretical buckling stress, $\sigma_{cr}$