Elastic and Plastic Buckling of Aluminum Bars

Laboratory Assignment #5

Due date: November 25, 2002

*Present your answers in a form of a report (**at least one page long description excluding tables, figures and analytical derivations!**). Please show and present all your analytical derivations clearly. Please indicate using subsections all questions that you are answering. Follow the attached format on how to write a report. Report should be typed with 12pt font with single spacing, it should be elegant. Any writing style is acceptable. Equations should be typed in a scientific manner (e.g. equation mode in Word should be used). **Extra points will be given for a well-written report and elegant presentation of content and figures.***

Four bars made up of Al-6061T6 alloy were tested in this lab. This alloy was tested in Lab#1 and its measured material properties are:

$$\sigma_{xx} = E\varepsilon_{xx}, \varepsilon_{xx} \le \varepsilon_Y = \frac{\sigma_Y}{E}$$

$$\sigma_{xx} = A(\varepsilon_{xx})^n, \varepsilon_{xx} > \varepsilon_Y$$

where E =74 GPa, σ_Y = 240 MPa, ε_Y = 0.0032, A =420 MPa, n =0.1. The beams have rectangular cross-sections: with b=25.4mm and h=6.4mm, and different length: L_1=80mm, L_2=120mm, L_3=300mm, L_4=400mm

1. Determine from the experimental load-displacement curve the critical buckling load for each of the four beams.

2. Calculate the theoretical elastic and plastic buckling loads and compare them with the experimentally measured values. On the same graph, plot the elastic and plastic buckling stresses as a function of slenderness ratio. Plot the experimentally-measured buckling stresses on the same graph. From your results, determine which beam buckled elastically or plastically.