Aerospace Structures Pre-Laboratory
Lab 7 Column Buckling
Section 4 Group 2
Matthew Mehrtens
AER E 322 March 20, 2023 **Spring 2023**

Question 1

Review Week 9 lecture and corresponding reference book materials (Peery is available online from ISU library).

Question 2

(15 points) For the end condition of one free and one fixed (lecture note page 12), why is the effective length twice as long as the actual length? Could you come up with a simple explanation? Hint: think of "mirror"...

Question 3

(25 pts) Derive the formulas for critical load P and slenderness ratio $\frac{L}{\rho}$ of a circular rod and a rectangular bar subjected to axial loading, in terms of π, length L, modulus of elasticity E and specimen radius R (for circular rod) or cross-sectional dimensions B and/or H (for rectangular bar).

Question 4

(30 pts) Use the formulas from question three to calculate the Ps and $\frac{L}{\rho}$s for metal specimens made of stainless 304 annealed cold finish steel (elastic modulus $E = 29\,000\,\text{ksi}$ and yield strength $\sigma^Y = 35\,\text{ksi}$) and 6061-T6 aluminum ($E = 10\,000\,\text{ksi}$ and $\sigma^Y = 40\,\text{ksi}$) with the sizes and end conditions given in Table 1. What equivalent lengths will you use for the pivot-pivot and pivot-fixed end conditions? For the $0.25\,\text{in} \times 1\,\text{in}$ aluminum specimen, which dimension do you choose to calculate the slenderness ratio? Hint: see the workout example on pages 14 to 15 in lecture notes. You may want to write yourself a little computer program for these calculations. Tabulate your calculations on the Ps and $\frac{L}{\rho}$s. Also list the effective lengths you used.

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Table 1: Five column buckling test sets.

Specimen ID	Material	Cross-Section [in]	Length [in]	End Condition
I	aluminum	$\frac{3}{8}$ dia.	30	both pivot (round)
II	aluminum	0.25×1	30	both pivot (round)
III	steel	$\frac{1}{4}$ dia.	30	both pivot (round)
IV	steel	$\frac{1}{4}$ dia.	24	both pivot (round)
V	steel	$\frac{1}{4}$ dia.	27.5 (30 original)	one pivot, one fixed