Chapter 6, Problem 4

A two-member pin-connected structure supports a concentrated load $P$ at joint $B$ as shown in Figure P6.4. Calculate the largest load $P$ that may be applied with a factor of safety $n$.

Given: $n = 2.5$, $E = 210 \text{ GPa}$.
Assumption: Buckling occurs in the plane of the structure.

![Figure P6.4](image)

Chapter 6, Solution 4

$L_{BC} = 0.65 \text{ m}$ \quad $F_{AB} = \frac{5}{12} P$, \quad $F_{BC} = \frac{13}{12} P$

Bar AB

$$(F_{AB})_{cr} = \frac{\pi^2 EI}{L^2} = \frac{\pi^2 (210 \times 10^9 \text{ Nm}^2) (5 \times 10^{-3})^4}{(0.4)^2} = 6.359 \text{kN} = \frac{5}{12} P_{cr}, \quad P_{cr} = 15.26 \text{kN}$$

Bar BC

$$(F_{BC})_{cr} = \frac{\pi^2 (210 \times 10^9 \text{ Nm}^2) (7.5 \times 10^{-3})^4}{(0.65)^2} = 12.19 \text{kN} = \frac{13}{12} P_{cr}, \quad P_{cr} = 11.25 \text{kN}$$

Choose the small value, $P_{cr} = 11.25$ with $n = 2.5$. Thus

$P_{all} = \frac{P_{cr}}{n} = \frac{11.25}{2.5} = 4.5 \text{ kN}$