MECHANICS OF SOLIDS (ME F211)

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Chapter-9

Stability of Equilibrium: Buckling

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Euler's crippling load for buckling (*P*)

$$P_{cr} = \frac{\pi^2 EI}{l_e^{\,2}}$$

P_{cr} = Buckling/ crippling load

E = Modulus of elasticity

I = Moment of inertia

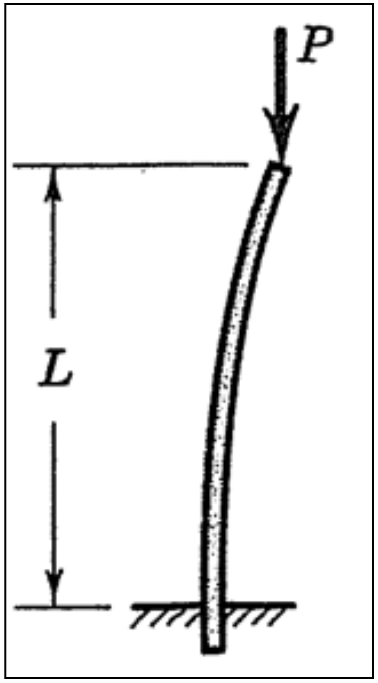
(Should be taken minimum @ the transverse axis)

l_e = Equivalent length of column/ strut. Its value depends on end conditions of the column/ strut.

Stability of Equilibrium: Buckling

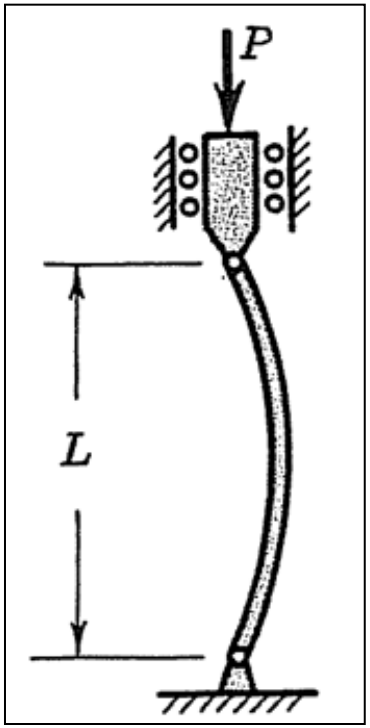
End Conditions of the Column

- One end fixed, other free



$$l_e = 2L$$

- Both ends are hinged

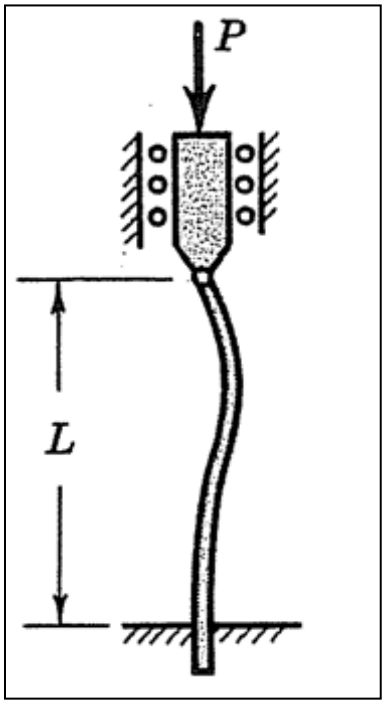


$$l_e = L$$

Stability of Equilibrium: Buckling

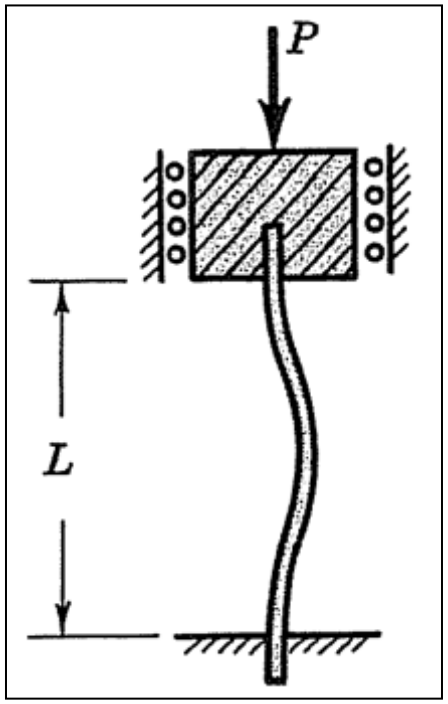
End Conditions of the Column

- One end fixed, other end is hinged/pinned



$$l_e = \frac{L}{\sqrt{2}}$$

- Both ends are fixed



$$l_e = \frac{L}{2}$$

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Problem:

A strut 2.5 m long is 60 mm in dia. One end of the strut is fixed while other end is hinged. Find the safe compressive load for the member using Euler's formula

Take FS = 3.4 and E = 200 GPa

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Problem:

A column of timber section 15 cm x 20 cm is 6 meter long and both ends are being fixed. If the young's modulus for timber is 17.5 kN/ mm^2, determine

1. Crippling load
2. Safe load for the column if factor of safety (*FS*) = 3.

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Problem:

A bar 200 mm in dia is 1.5 m long . When the bar is simply supported at its ends in the horizontal position and loaded with concentrated transverse load of 370 kN at the center, the deflection at the center of the beam is found to be 9.5 mm.

If the bar is placed vertically and loaded axially what would be the buckling load (Both ends pinned / hinged)

Find also the ratio of maximum bending stress to buckling stress.

Stability of Equilibrium: Buckling

References

1. Introduction to Mechanics of Solids by S. H. Crandall et al (In SI units), McGraw-Hill