AS3020*: Assignment 7

Module 7: Elastic Stability

Posted on 2-Nov-2024; Due at 11.59PM on 9-Nov-2024

General Instructions

1. Write this honor code and sign your name against it in the first page of your submission. Evaluation will not be done unless this is present in the submission.

   Upon my honor I state that I have received no unauthorized support and can attest that the submission reflects my understanding of the subject matter.

2. Discussions among students is permitted for this assignment. But ensure that your submission is your own. Do not write anything that you do not understand.

1 Answer in Detail

1. **(10)** Consider a simply supported beam under axial load as shown. Suppose that the effect of temperature can be modeled as an isotropic expansion leading to an increase of strain by $\alpha\Delta T$ (ΔT is the temperature change, α is some dimensional constant) in all directions such that E_{11}, E_{22}, E_{33} now contain kinematic strains and these "thermal strains".

Denote the transverse deflection as v and answer the following:

   (a) **(2)** Write down the total potential energy up to the quadratic order in deflection v.

   (b) **(2)** Invoke the principle of virtual work and derive the governing equations in v.

   (c) **(4)** What are the critical load values P_{cr} that will make the beam buckle?

   (d) **(2)** Does increase in temperature increase the likelihood of buckling under a given load or decrease it?

2. **(10)** Consider the beam with a linear spring attached to the mid-point as shown. Assume that the spring does not significantly change the buckling mode shapes such that

$$v_n = V_n \sin\left(n\frac{\pi}{\ell}X_1\right).$$

Find the value of k_T such that the first and second critical loads are identical.