ME 202 Strength of Materials

Tutorial 8

Tue 14 Mar 2023

Problem 1

- Obtain the approximate deflection curve of a simply supported beam subjected to a transverse point load at the midpoint. Use sines to approximate the deflection curve. Calculate the approximate maximum deflection and maximum bending moment and compare with the exact values.

Problem 2

- Consider a pinned-pinned beam resting on an elastic foundation of uniformly distributed stiffness (UDS) k N/m^2. The beam is subject to a uniformly distributed load (UDL) of q N/m. Obtain the approximate deflection curve of this beam. Use the orthogonality of sines to simplify the integrals.

Problem 3

- Consider a beam fixed into the wall at one end and connected to a linear spring of stiffness k N/m. The spring resists only the vertical deflection of the beam. Calculate the approximate deflection curve of the beam using only polynomials. Use a physically correct approximation for the deflection curve. Comment on how the potential energy expression and approximation function would change if at $z = 0$ the beam is connected to a pinned support through a torsion spring of stiffness β Nm/rad.

Problem 4

- A simply supported beam is loaded by a clockwise moment $M0$ at the end $z = L$. Calculate the approximate deformed shape of the beam and hence obtain the approximate maximum deflection. Use a single degree of freedom polynomial that ALSO gives zero bending moment at the unloaded end ($z = 0$) IN ADDITION to necessarily satisfying the kinematic boundary conditions.

Problem 5 (a tad mathematical)

- Consider a fixed-fixed beam subject to a UDL q. Note that this beam has zero KBCs at both ends. Show that the potential energy corresponding to the exact deflection $u(z)$ is lower than that corresponding to the approximate deflection $v(z)$ where $v(z) = u(z) + \phi(z)$. $\phi(z)$ is a function that satisfies appropriate boundary conditions i.e. show that $\Pi(u) \leq \Pi(v)$. Hint: use integration by parts to simplify a few terms.