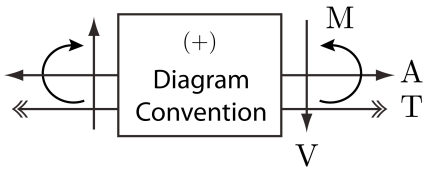
# CE 525 Exam II

November 05, 2026

*NCSU Honor Code:* I have neither given nor received any unauthorized help on this exam.

Name: _____

Signature: _____



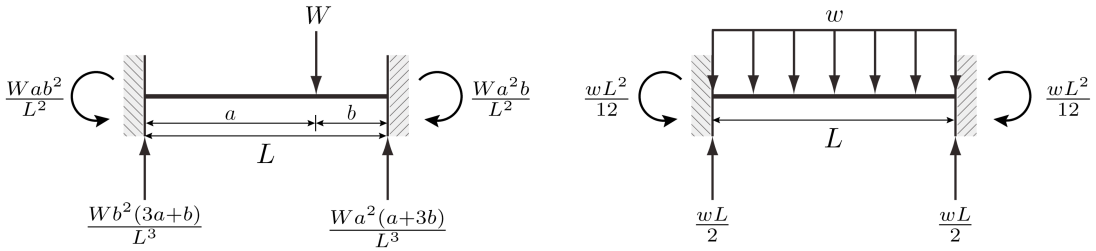

$$\left[k\right]_{beam} = \frac{EI}{L^3}\begin{bmatrix} 12 & 6L & -12 & 6L \\ 6L & 4L^2 & -6L & 2L^2 \\ -12 & -6L & 12 & -6L \\ 6L & 2L^2 & -6L & 4L^2 \end{bmatrix}$$

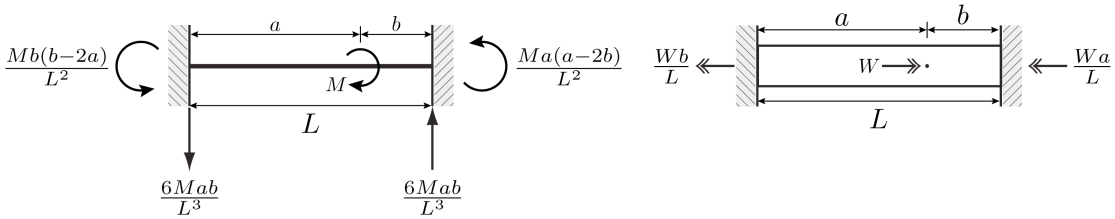
$$\left[k\right]_{FEM} = \int_V B^T E B \, dV$$

$$N_1^{beam} = 1 - 3\left(\frac{x}{L}\right)^2 + 2\left(\frac{x}{L}\right)^3 \quad N_2^{beam} = x\left(1 - \frac{x}{L}\right)^2 \quad N_3^{beam} = 3\left(\frac{x}{L}\right)^2 - 2\left(\frac{x}{L}\right)^3 \quad N_4^{beam} = \frac{x^2}{L}\left(\frac{x}{L} - 1\right) \quad \left[Q_f\right]_{FEM} = WN^T$$

$$\left[k\right]_{frame} = \begin{bmatrix} EA/L & 0 & 0 & -EA/L & 0 & 0 \\ 0 & k_{11}^{beam} & k_{12}^{beam} & 0 & k_{13}^{beam} & k_{14}^{beam} \\ 0 & k_{21}^{beam} & k_{22}^{beam} & 0 & k_{23}^{beam} & k_{24}^{beam} \\ -EA/L & 0 & 0 & EA/L & 0 & 0 \\ 0 & k_{31}^{beam} & k_{32}^{beam} & 0 & k_{33}^{beam} & k_{34}^{beam} \\ 0 & k_{41}^{beam} & k_{42}^{beam} & 0 & k_{43}^{beam} & k_{44}^{beam} \end{bmatrix} \qquad \left[T\right]_{frame} = \begin{bmatrix} c & s & 0 & 0 & 0 & 0 \\ -s & c & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & c & s & 0 \\ 0 & 0 & 0 & -s & c & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\left[k\right]_{grid} = \begin{bmatrix} k_{11}^{beam} & 0 & k_{12}^{beam} & k_{13}^{beam} & 0 & k_{14}^{beam} \\ 0 & GJ/L & 0 & 0 & -GJ/L & 0 \\ k_{21}^{beam} & 0 & k_{22}^{beam} & k_{23}^{beam} & 0 & k_{24}^{beam} \\ k_{31}^{beam} & 0 & k_{32}^{beam} & k_{33}^{beam} & 0 & k_{34}^{beam} \\ 0 & -GJ/L & 0 & 0 & GJ/L & 0 \\ k_{41}^{beam} & 0 & k_{42}^{beam} & k_{43}^{beam} & 0 & k_{44}^{beam} \end{bmatrix} \qquad \left[T\right]_{grid} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & c & s & 0 & 0 & 0 \\ 0 & -s & c & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & c & s \\ 0 & 0 & 0 & 0 & -s & c \end{bmatrix}$$




You must show all work to get credit for a problem