College of Technological Studies

Department of Civil Engineering Technology

CE 278 Structural Analysis

Tutorial (8)

Loads on Structures

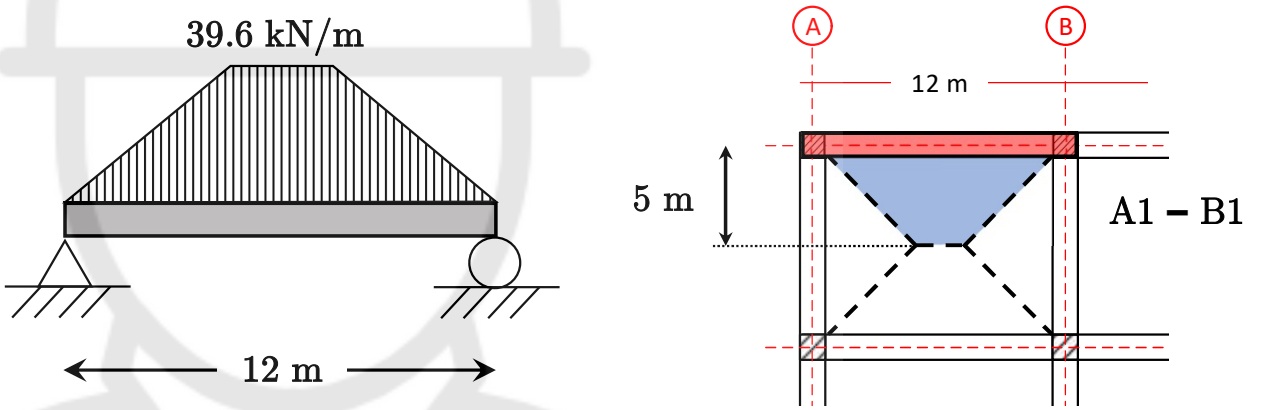
(Part II)

Example (1): Use the approximate method to convert the trapezoidal load on the beam to a uniform load.

$x = 5\,\text{m}, \qquad L = 12\,\text{m}$

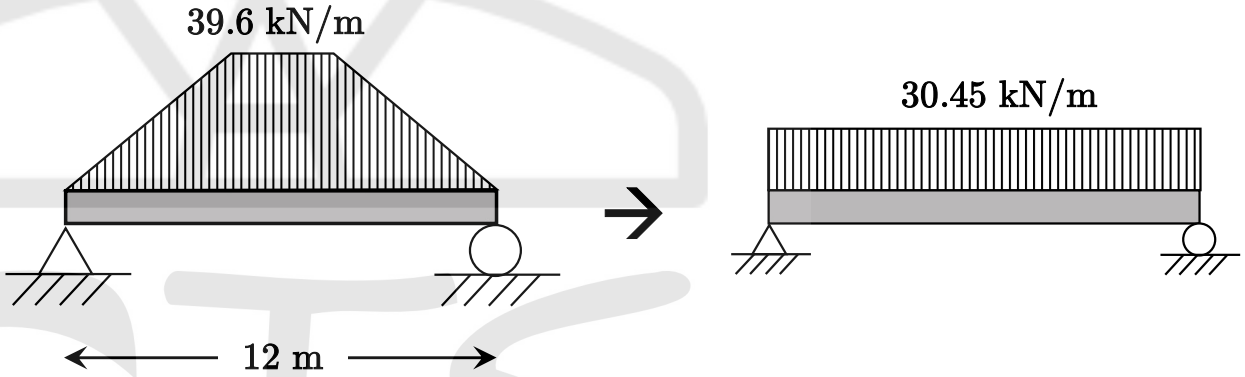
$$\alpha = 1 - \frac{1}{3}\left(\frac{2x}{L}\right)^2 = 1 - \frac{1}{3}\left(\frac{2(5\,\text{m})}{12\,\text{m}}\right)^2 = 0.769$$

$$\beta = 1 - \frac{x}{L} = 1 - \frac{5\,\text{m}}{12\,\text{m}} = 0.583$$



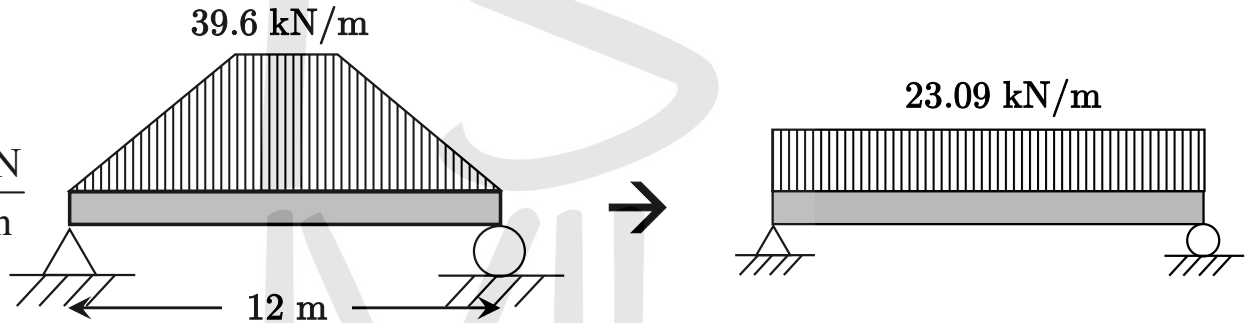
Equivalent uniform load (Bending Moment):

$$w_{eq(\text{M})} = \alpha w_u = (0.769)\left(39.6\frac{\text{kN}}{\text{m}}\right) = 30.45\frac{\text{kN}}{\text{m}}$$



Equivalent uniform load (Reactions + Shear Force):

$$w_{eq(\text{R+V})} = \beta w_u = (0.583)\left(39.6\frac{\text{kN}}{\text{m}}\right) = 23.09\frac{\text{kN}}{\text{m}}$$

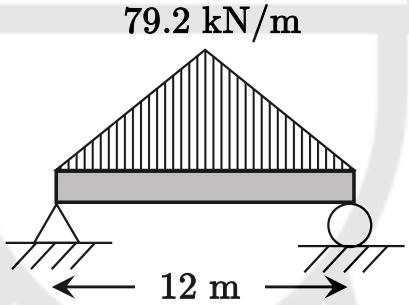


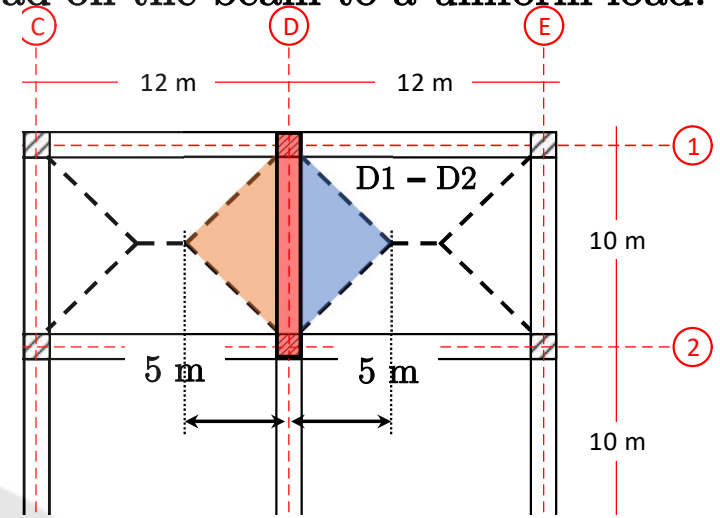
Example (2): Use the approximate method to convert the trapezoidal load on the beam to a uniform load.

$$x = 5\,\text{m}, \qquad L = 10\,\text{m}$$

$$\alpha = 1 - \frac{1}{3}\left(\frac{2x}{L}\right)^2 = 1 - \frac{1}{3}\left(\frac{2(5\,\text{m})}{10\,\text{m}}\right)^2 = 0.667$$

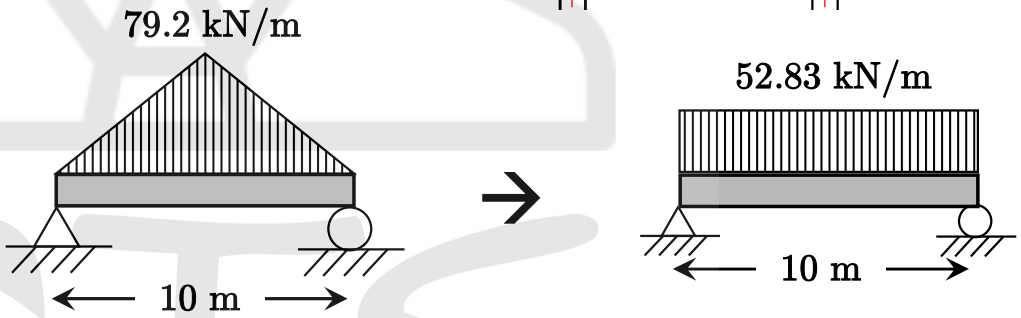
$$\beta = 1 - \frac{x}{L} = 1 - \frac{5\,\text{m}}{10\,\text{m}} = 0.50$$





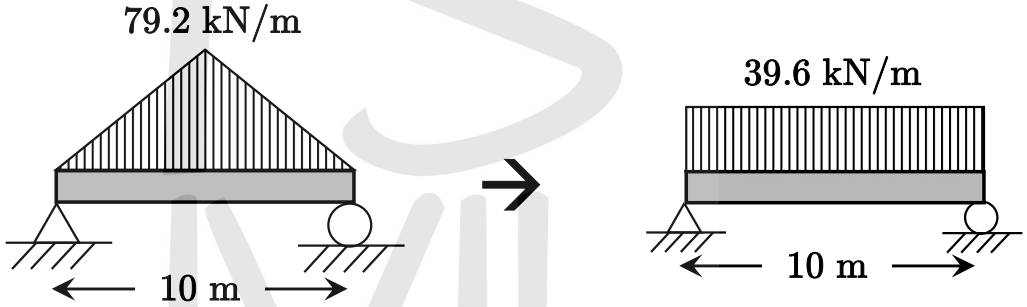
Equivalent uniform load (Bending Moment):

$$w_{eq(\text{M})} = \alpha w_u = (0.667)\left(79.2\,\frac{\text{kN}}{\text{m}}\right) = 52.83\,\frac{\text{kN}}{\text{m}}$$

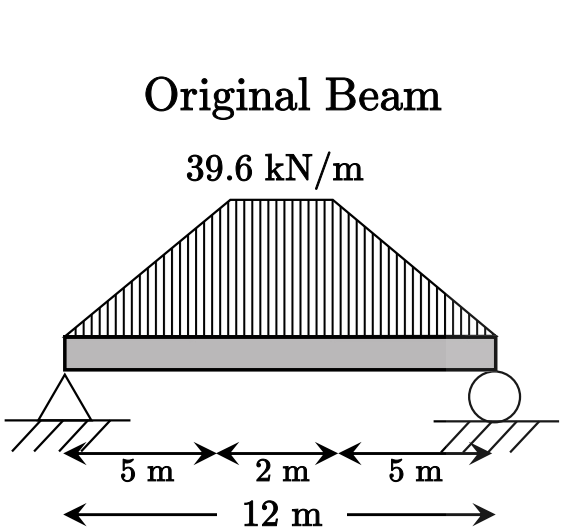


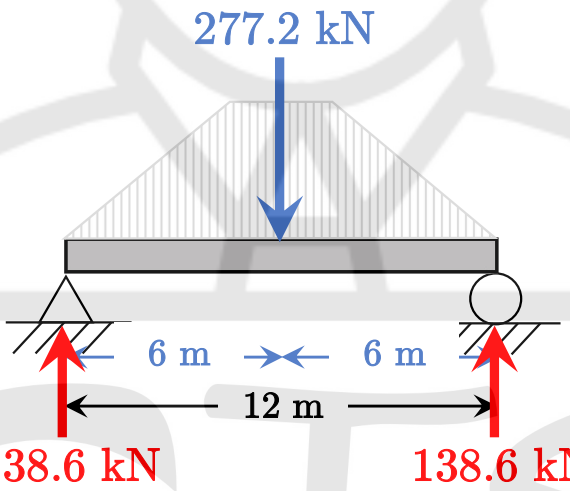
Equivalent uniform load (Reactions + Shear Force):

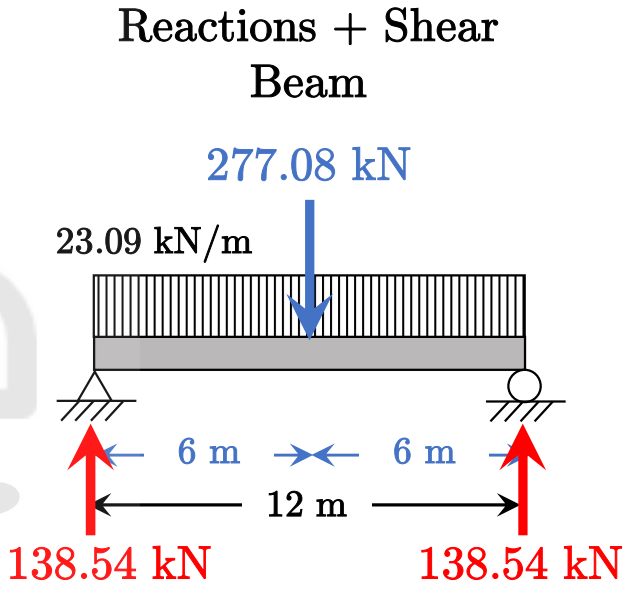
$$w_{eq(\text{R+V})} = \beta w_u = (0.50)\left(79.2\,\frac{\text{kN}}{\text{m}}\right) = 39.6\,\frac{\text{kN}}{\text{m}}$$



Does it work?!

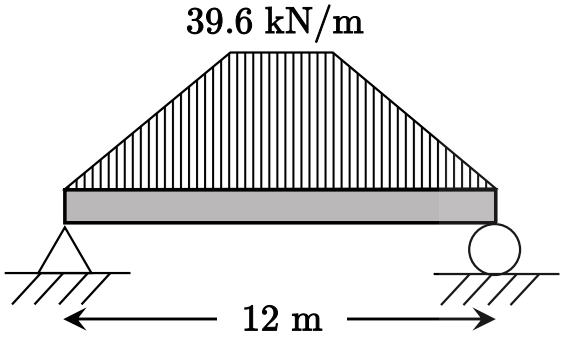

Original Beam
39.6 kN/m
5 m
2 m
5 m
12 m


277.2 kN
6 m
6 m
12 m
138.6 kN
138.6 kN

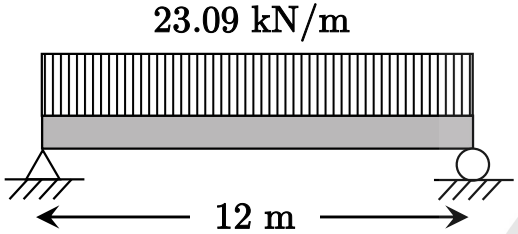

Reactions + Shear Beam
277.08 kN
23.09 kN/m
6 m
6 m
12 m
138.54 kN
138.54 kN

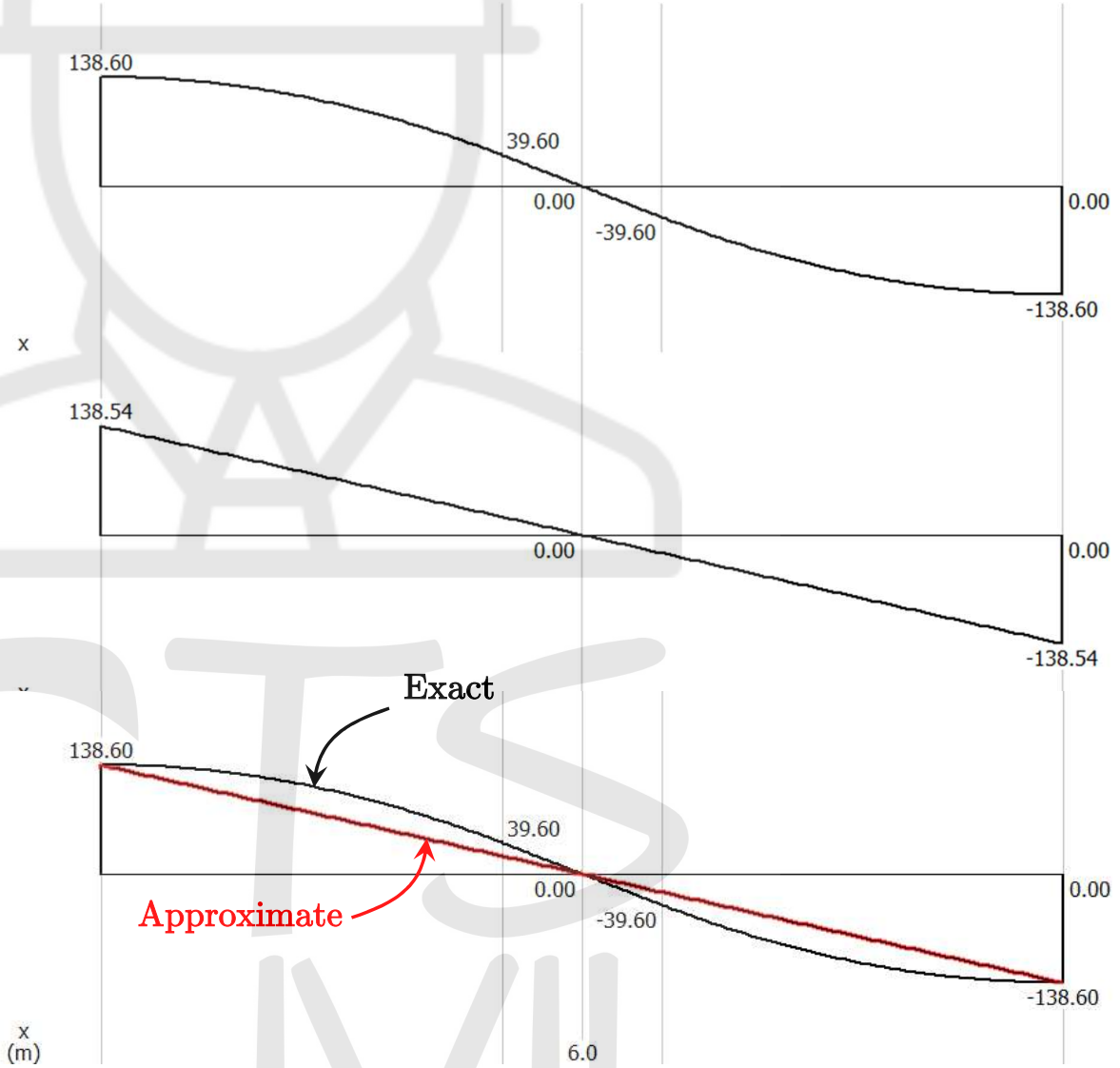
Reactions and Shear Force

Original Beam



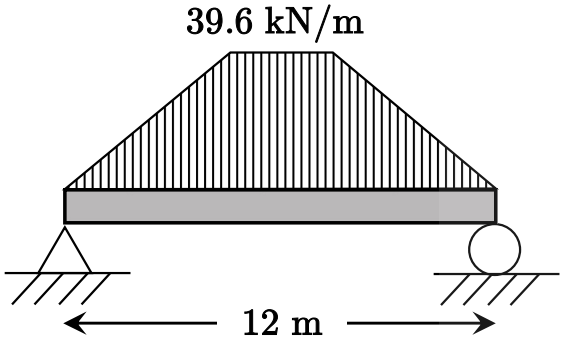
Reactions + Shear Beam



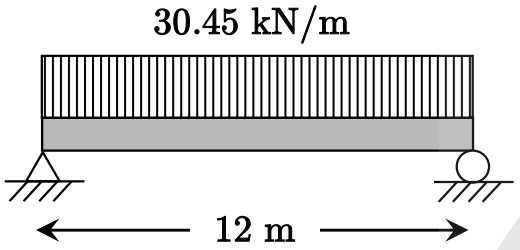


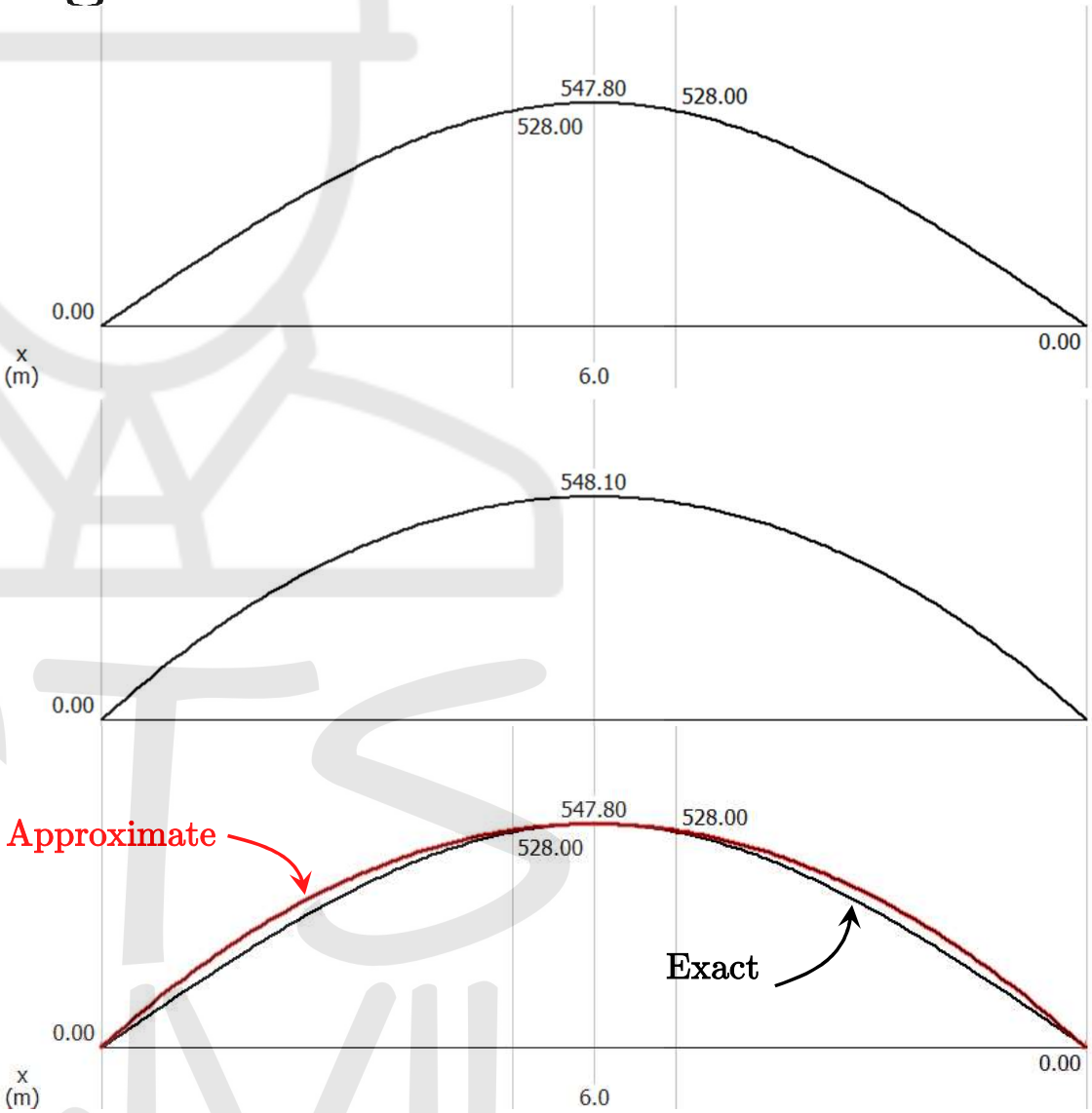
Bending Moment

Original Beam



Bending Moment Beam





Questions?