Finite Difference Method

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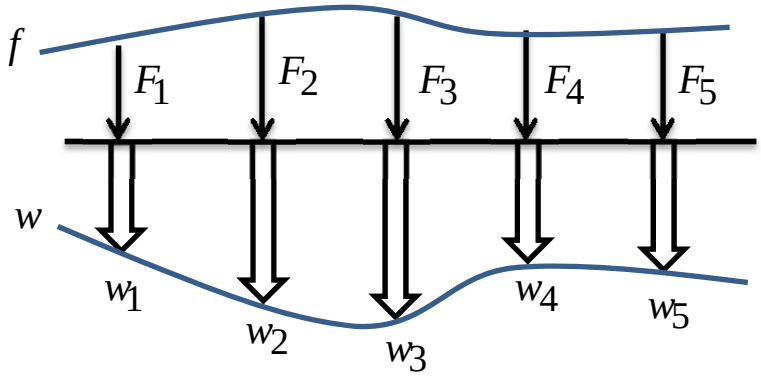


$$f = EI\, w''''$$

$$w' = \lim_{\Delta x \downarrow 0} \frac{w(x+\Delta x) - w(x)}{\Delta x} \approx \frac{w_2 - w_1}{\Delta x}$$

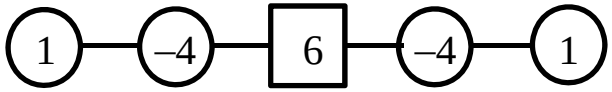
$$w'' = \lim_{\Delta x \downarrow 0} \frac{w'(x+\Delta x) - w'(x)}{\Delta x} \approx \frac{\frac{w_3 - w_2}{\Delta x} - \frac{w_2 - w_1}{\Delta x}}{\Delta x} = \frac{w_3 - 2w_2 + w_1}{\Delta x^2}$$

$$w''' = \lim_{\Delta x \downarrow 0} \frac{w''(x+\Delta x) - w''(x)}{\Delta x} \approx \frac{\frac{w_4 - 2w_3 + w_2}{\Delta x^2} - \frac{w_3 - 2w_2 + w_1}{\Delta x^2}}{\Delta x} = \frac{w_4 - 3w_3 + 3w_2 - w_1}{\Delta x^3}$$

$$w'''' = \lim_{\Delta x \downarrow 0} \frac{w'''(x+\Delta x) - w'''(x)}{\Delta x} \approx \frac{\frac{w_5 - 3w_4 + 3w_3 - w2}{\Delta x^3} - \frac{w_4 - 3w_3 + 3w_2 - w_1}{\Delta x^3}}{\Delta x} = \frac{w_5 - 4w_4 + 6w_3 - 4w_2 + w_1}{\Delta x^4}$$

$$f \approx EI\, \frac{w_5 - 4w_4 + 6w_3 - 4w_2 + w_1}{\Delta x^4}$$

beam molecule



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Solve with Excel

$$\frac{F_3}{\Delta x} \approx EI \frac{w_5 - 4w_4 + 6w_3 - 4w_2 + w_1}{\Delta x^4}$$

$$w_3 \approx \frac{\frac{F_3 \Delta x^3}{EI} - w_1 + 4w_2 + 4w_4 - w_5}{6}$$

$$w_4 \approx \frac{\frac{F_4 \Delta x^3}{EI} - w_2 + 4w_3 + 4w_5 - w_6}{6}$$

$$w_5 \approx \frac{\frac{F_5 \Delta x^3}{EI} - w_3 + 4w_4 + 4w_6 - w_7}{6}$$

et cetera

Pro: Very easy numerical solution.
Con: Extra work for edge molecules.
Pro: Also for plates loaded in plane and plates loaded perpendicularly.
Con: Plates are only easy for a rectangular grid and straight edges.