Taylor Series Expansion

Engineering Fluid Mechanics

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$$f(x+a) = f(x) + \frac{f'(x)a}{1!} + \frac{f''(x)a^2}{2!} + \frac{f'''(x)a^3}{3!} \cdots$$

VALUE OF FUNCTION f AT POINT X

Taylor Series Expansion

$f(3) = 100 \quad f'(x=3) = 75 \quad f''(3) = 50$

$f'''(3) = 25$

$f(4) = ?$

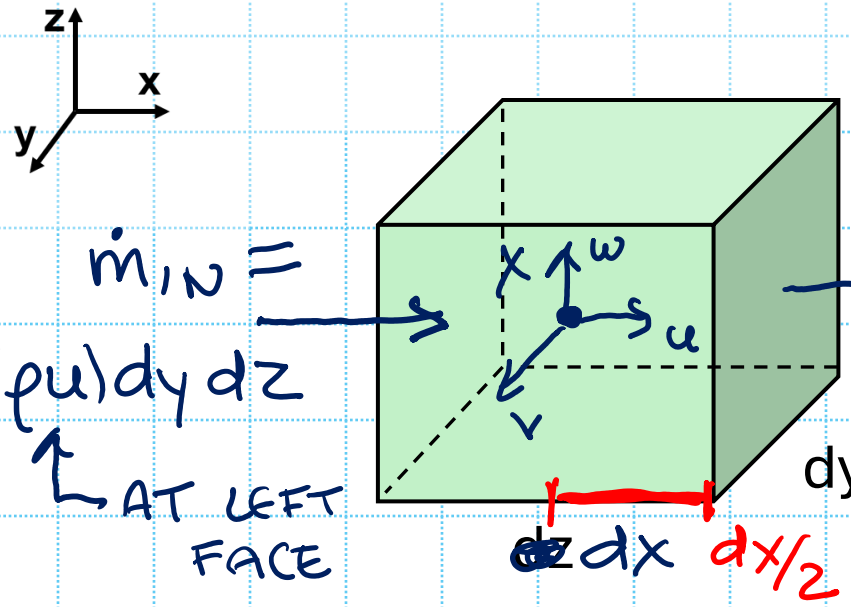
$x = 3 \quad a = 1 \quad x + a = 3 + 1 = 4$

$$f(4) = f(3) + \frac{f'(3)(1)}{1!} + \frac{f''(3)(1)^2}{2!} + \frac{f'''(3)(1)^3}{3!}$$

$$= 100 + \frac{(75)(1)}{1} + \frac{50(1)^2}{2 \cdot 1} + \frac{25(1)^3}{3 \cdot 2 \cdot 1}$$

Taylor Series example

$f(4) = 100 + 75 + 25 + 25/6 = 204.1667$



$\dot{m}_{IN} = (\rho u)\, dy\, dz$

AT LEFT FACE

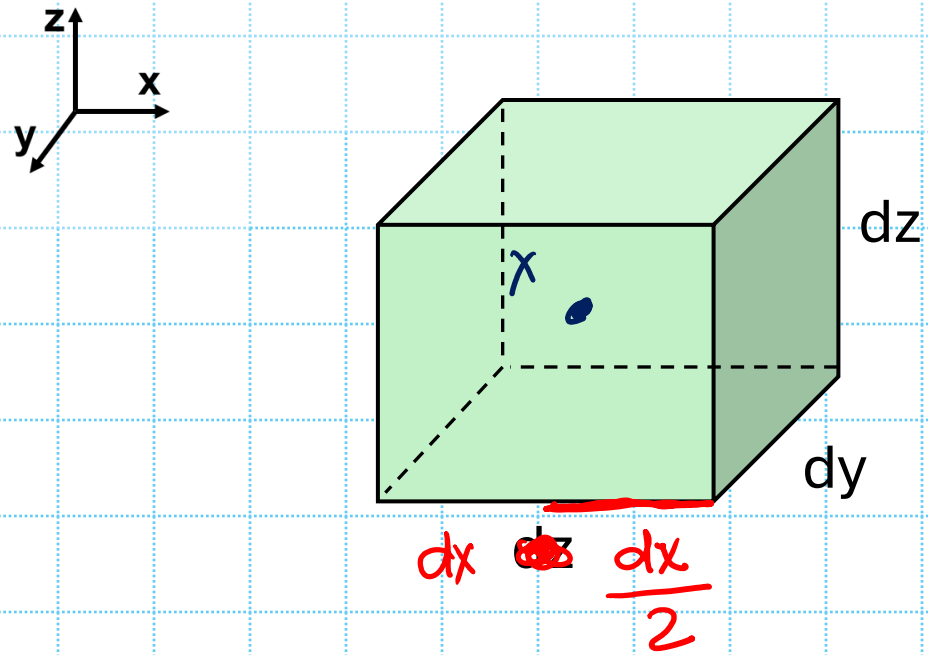
$\dot{m}_{out} = (\rho u)_{RIGHT\ FACE} \cdot dy\, dz$

AT X: DENSITY IS ρ

VELOCITY IS u, v, w

$$\dot{m} = \frac{M}{T} = \frac{M}{L^3} \cdot \frac{L^3}{T} = \rho u\, dA = \frac{M}{T} = \dot{m}$$

Sneak peek: Taylor Series application in Fluid Mechanics



$f(x+a) =$

$f(x+\frac{dx}{2}) = f(x) + \frac{f'(x)a}{1!} + \frac{f''(}{2!}$

$(\rho u)_{\text{RIGHT FACE}} = f(x+\frac{dx}{2}) = \rho u + \frac{\partial(\rho u)}{\partial x}\frac{dx}{2} + \frac{1}{2!}\frac{\partial^2(\rho u)}{\partial x}\left(\frac{dx}{2}\right)^2$

Sneak peek: Taylor Series application in Fluid Mechanics

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