

1-D ME Applications

$$-\frac{d}{dx} \left[K \frac{du}{dx} \right] + A \frac{du}{dx} + C u - Q = 0$$

The most common uses of this equation is 1) axial stresses in bars

2) torsional stresses in shafts

3) heat transfer through layered material

4) Computation Fluid Dynamics, CFD with $A \neq 0$

	Bar	Shaft	Thermal
u	axial displacement	rotation	temperature
$\frac{du}{dx}$	strain	rate of twist	gradient
	stress $\sigma = E \frac{du}{dx}$	stress $\tau = G r \frac{du}{dx}$	$q = -k \frac{du}{dx}$
Q	load per length	torque per length	heat gen/length
A FE interface must occur at the location of any discontinuity in K, A, C, Q or BC.			
	$K = \frac{EA}{L}$	$K = \frac{GJ}{L}$	$K = \frac{kA}{L}$

Example

8.2-2, 8.2-3
8.2-4

Fig 8.2-2

8.2-1
8.2-6