A short course on

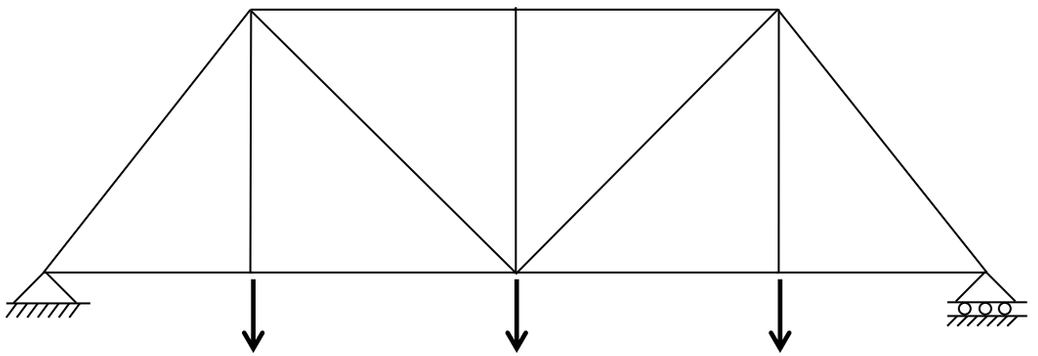
Structural Members

This video:

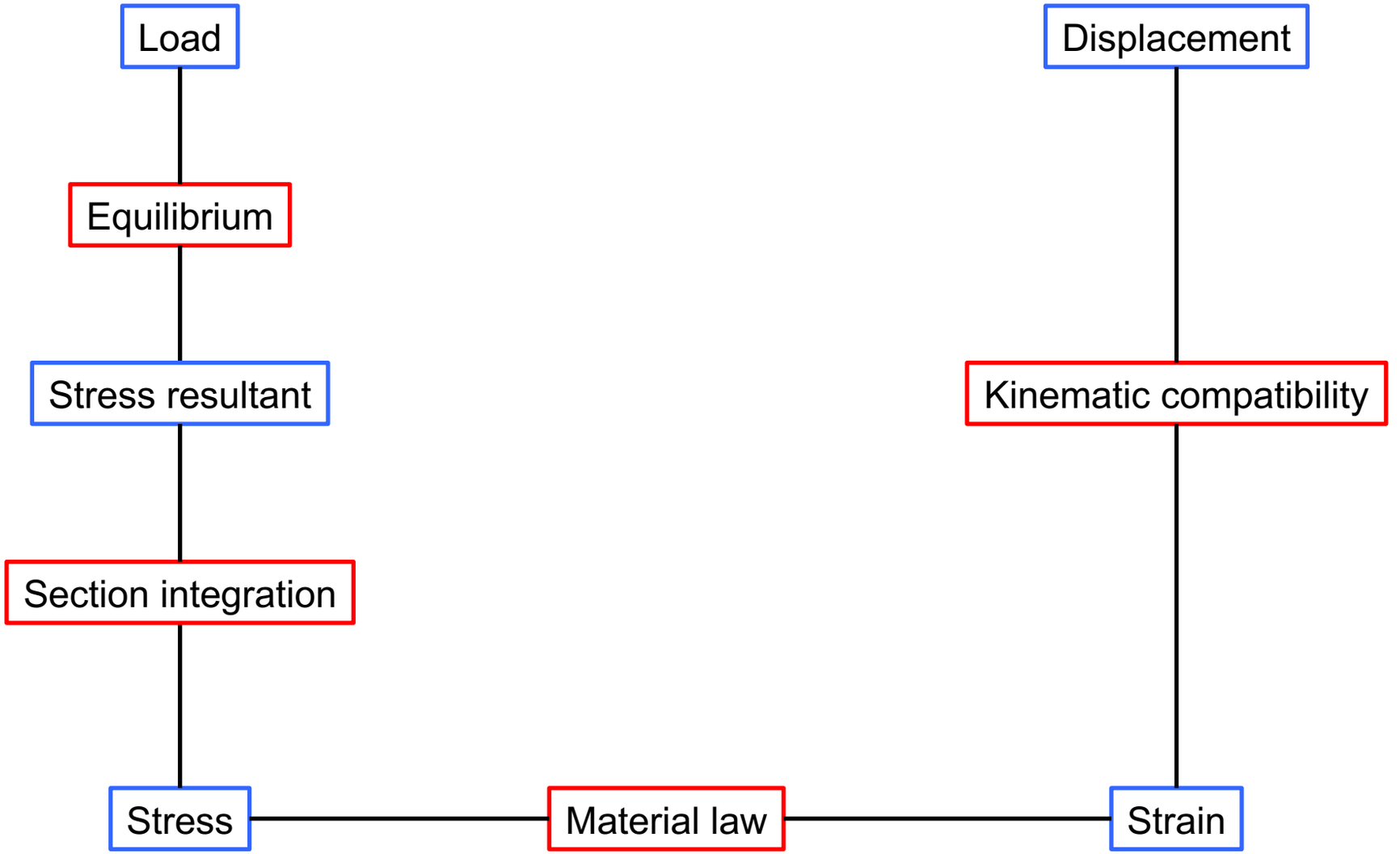
Truss Members

Terje's Toolbox is freely available at terje.civil.ubc.ca
It is created and maintained by Professor Terje Haukaas, Ph.D., P.Eng.,
Department of Civil Engineering, The University of British Columbia (UBC), Vancouver, Canada

Truss Structures



Ingredients



Notation

x = axis that runs along the member

q_x = distributed load in the x-direction

N = axial force, i.e., a stress resultant

A = cross-section area

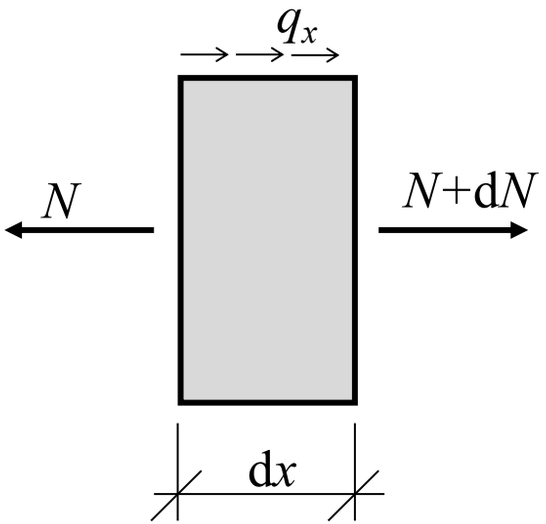
E = modulus of elasticity

σ = axial stress

ε = axial strain

u = displacement in the x-direction

Equilibrium



$$\Sigma F_x = -N + N + dN + q_x \cdot dx = 0 \quad \Rightarrow \quad q_x = -\frac{dN}{dx}$$

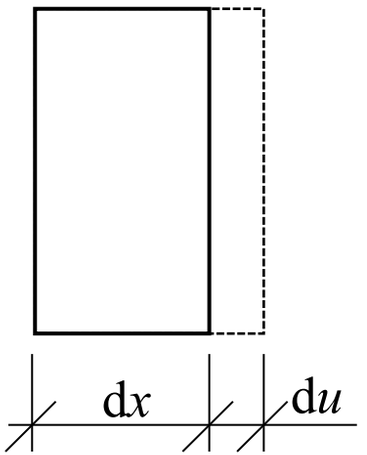
Section Integration

$$N = A \cdot \sigma$$

Material Law

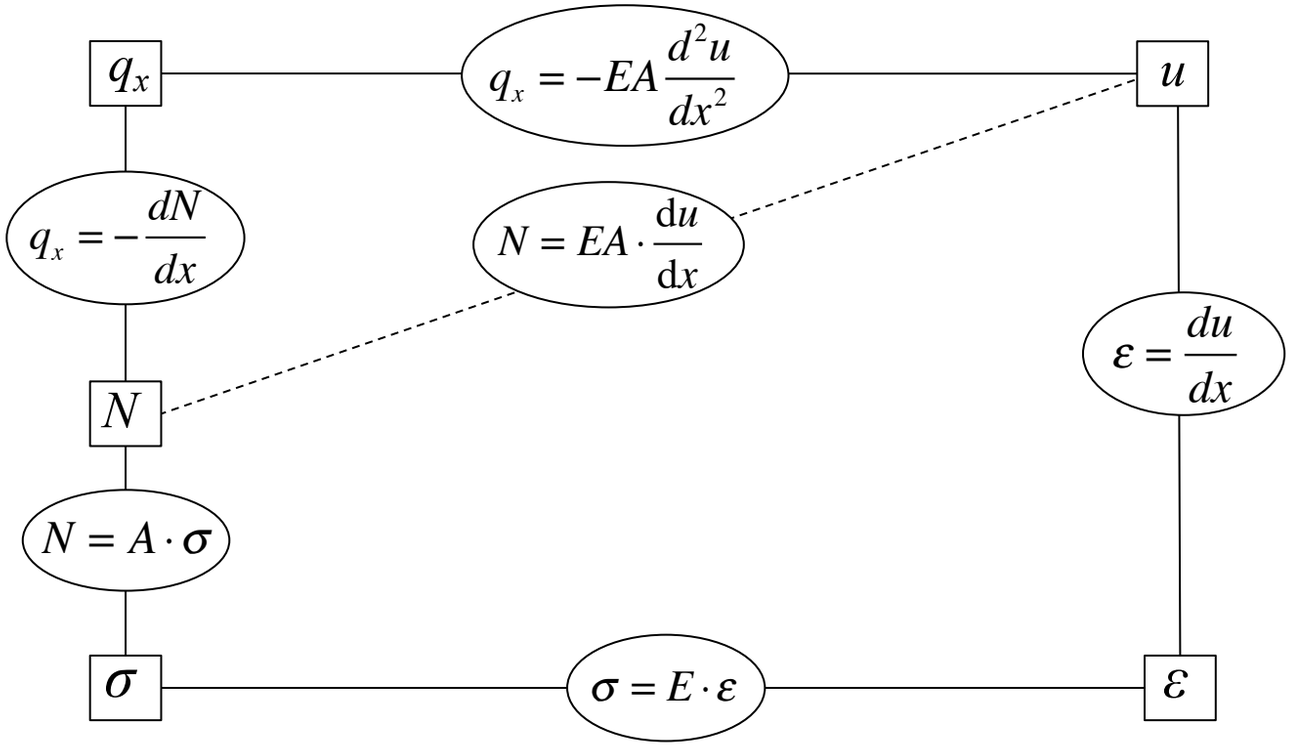
$$\sigma = E \cdot \varepsilon$$

Kinematic Compatibility



$$\varepsilon = \frac{du}{dx}$$

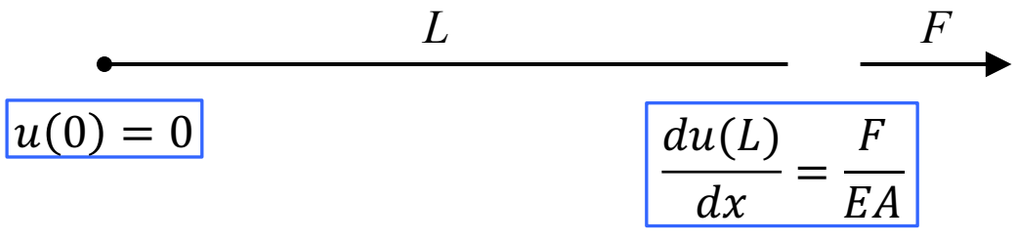
Summary


q_x
$q_x = -EA\frac{d^2u}{dx^2}$
u
$q_x = -\frac{dN}{dx}$
$N = EA \cdot \frac{\mathrm{d}u}{\mathrm{d}x}$
$\varepsilon = \frac{du}{dx}$
N
$N = A \cdot \sigma$
σ
$\sigma = E \cdot \varepsilon$
ε

General Solution

$$q_x = -EA\frac{d^2u}{dx^2}$$

$$u(x) = -\frac{q_x}{2 \cdot EA} \cdot x^2 + C_1 \cdot x + C_2$$



$$u(x) = \frac{F}{EA} \cdot x$$

More lectures:

Terje's Toobox:

terje.civil.ubc.ca