CE560 Advanced Mechanics of Solids

PURE BENDING
Summary of Bernoulli-Euler Theory

Action	Consequence
Assume plane sections before bending remain plane after bending	$\epsilon_{xx} = \frac{y}{\rho}$ y measured from NA, location unknown. ρ is radius of curvature of beam, value unknown.
Assume: $(\sigma) = \begin{pmatrix} \sigma_{xx} & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$	$\Sigma F_y = 0$, $\Sigma F_z = 0$ and $\Sigma M_x = 0$ are identically satisfied.
Assume linear elastic material.	$\sigma_{xx} = E\frac{y}{\rho}$
$\Sigma F_x = 0$	Locates NA through centroid of cross-section of beam.
$\Sigma M_z = 0$	Determines ρ so that: $\sigma_{xx} = \frac{My}{I_{zz}}$
$\Sigma M_y = 0$	y-z axes must be axes of principal 2nd moment of area. i.e. $I_{yz} = 0$
Assume: $\left\|\frac{dv}{dx}\right\| << 1.0$	$\frac{d^2v}{dx^2} = -\frac{M}{EI_{zz}}$