LaTeX 2_ε Cheat Sheet

Document classes

`book`	Default is two-sided.
`report`	No `\part` divisions.
`article`	No `\part` or `\chapter` divisions.
`letter`	Letter (?).
`slides`	Large sans-serif font.

Used at the very beginning of a document: `\documentclass{`*class*`}`. Use `\begin{document}` to start contents and `\end{document}` to end the document.

II Kinematics

Displacement:

$$\mathbf{u}(\mathrm{X},t) = \chi(\mathrm{X},t) - \mathrm{X}, \quad u_i\left(X_1,X_2,X_3\right) = \chi_i\left(X_1,X_2,X_3\right) - X_i$$

Velocity/Acceleration

$$\dot{\mathbf{u}}(\mathbf{X},t) = \frac{\partial \chi(\mathbf{X},t)}{\partial t} \quad (3.8.3)$$

$$\ddot{\mathbf{u}}(\mathbf{X},t) = \frac{\partial^2 \chi(\mathbf{X},t)}{\partial t^2} \quad (3.8.4)$$

3.2 Deformation/Displacement Gradient

$$\mathbf{F}(\mathbf{X},t) = \frac{\partial}{\partial \mathbf{X}}\chi(\mathbf{X},t), \quad F_{ij} = \frac{\partial}{\partial X_j}\chi_i\left(X_1,X_2,X_3,t\right), \quad \det \mathbf{F}(\mathbf{X},t) > 0$$

$$\mathbf{H}(\mathbf{X},t) = \frac{\partial}{\partial \mathbf{X}}\mathbf{u}(\mathbf{X},t), \quad H_{ij} = \frac{\partial}{\partial X_j}u_i\left(X_1,X_2,X_3,t\right)$$

$$\mathbf{H}(\mathbf{X},t) = \mathbf{F}(\mathbf{X},t) - 1, \quad H_{ij} = F_{ij} - \delta_{ij}$$

$$J \equiv \det\left(\frac{\partial \chi}{\partial \mathbf{X}}\right) = \det \mathbf{F} = \frac{dv}{dv_{\mathrm{R}}} \neq 0$$

3.3 Stretch & Rotation

Polar Decomposition: $\mathbf{F} = \mathbf{RU} = \mathbf{VR}$

$$\mathbf{C} = \mathbf{U}^2 = \mathbf{F}^{\mathrm{T}}\mathbf{F}, \quad C_{ij} = F_{ki}F_{kj} = \frac{\partial \chi_k}{\partial X_i}\frac{\partial \chi_k}{\partial X_j}$$

$$\mathbf{B} = \mathbf{V}^2 = \mathbf{F}\mathbf{F}^{\top}, \quad B_{ij} = F_{ik}F_{jk} = \frac{\partial \chi_i}{\partial X_k}\frac{\partial \chi_j}{\partial X_k}$$

$$\lambda \overset{\text{def}}{=} \frac{ds}{dS} = |\mathbf{U}\mathrm{e}| = \sqrt{\mathbf{e}\cdot\mathbf{C}(\mathbf{X})\mathbf{e}}$$

where $dS = |\mathrm{dX}|, ds = |\mathrm{dx}|, \mathrm{e} = \frac{d\mathrm{X}}{|d\mathrm{X}|}$

Engineering shear: $\gamma = \sin^{-1}\left[\frac{\mathbf{e}^{(1)}\cdot\mathbf{C}\mathbf{e}^{(2)}}{\lambda(\mathbf{e}^{(1)})\lambda(\mathbf{e}^{(2)})}\right]$

3.4 Strain

Green strain: $\mathrm{E} \overset{\text{def}}{=} \frac{1}{2}\left(\mathrm{F}^{\top}\mathrm{F} - 1\right) = \frac{1}{2}\left(\mathbf{H} + \mathbf{H}^{\top} + \mathbf{H}^{\top}\mathbf{H}.\right)$

Hencky's Log strain: $\ln \mathbf{U} \overset{\text{def}}{=} \sum_{i=1}^{3}\left(\ln \lambda_i\right)\mathbf{r}_i \otimes \mathbf{r}_i$

3.5.2 Infinitesimal Strain

ϵ': distortion $\epsilon_M\delta_{ij}$: dilation

$$\epsilon = \frac{1}{2}\left[\mathbf{H} + \mathbf{H}^{\top}\right], \qquad \epsilon = \epsilon^{\top}, \quad |\mathbf{H}| \ll 1$$

$$\epsilon_{ij} = \frac{1}{2}\left[\frac{\partial u_i}{\partial X_j} + \frac{\partial u_j}{\partial X_i}\right], \quad \epsilon_{ji} = \epsilon_{ij}, \left|\frac{\partial u_i}{\partial X_j}\right| \ll 1$$

3.A Linearization

$\lim \mathrm{Y}_o f(\mathbf{Y}) = f\left(\mathbf{Y}_o\right) + \left.\frac{d}{d\alpha}f\left(\mathbf{Y}_o + \alpha\left(\mathbf{Y} - \mathbf{Y}_o\right)\right)\right|_{\alpha=0}$

$\lim_0 f(\mathbf{H}) = f(0) + \left.\frac{d}{d\alpha}f(\alpha\mathbf{H})\right|_{\alpha=0}$

3.B Compatibility

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http://wch.github.io/latexsheet/