AERO 516: Quals Review

January 12, 2016

1 Basic Concepts

1.1 Properties of Composites

- Out-of-plane properties are generally very weak
- Much manufacturing variability
- Greatest specific stiffness of any material

Figure 1: Sodano's whip

1.2 Fiber Notes

- Types: glass, carbon, SiC, boron, polymer
- Tow is the number of filaments
- Carbon fiber: 225-500 GPa modulus, 3400-6400 MPa strength

2 Lamina Stress-Strain Relationships

2.1 Stress-Strain Basics

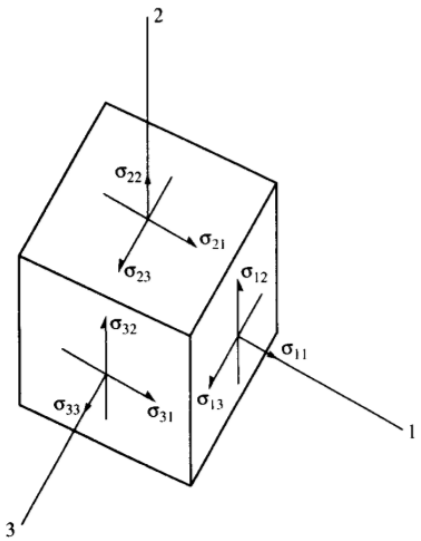

Figure 2: 3D stress representation

Table 1: Elastic coeffs

Material and coord sys	# non-zero coeffs	# ind coeffs
3D aniso	36	21
3D gen ortho (non-princ)	36	9
3D special ortho (princ)	12	9
3D transversely iso	12	5
3D iso	12	2
2D aniso	9	6
2D gen ortho	9	4
2D special ortho (princ)	5	4
2D square sym	5	3
2D iso	5	2

- $\{\boldsymbol{\sigma}\} = [\mathbf{C}]\{\boldsymbol{\epsilon}\}, C$ is the stiffness matrix
- $\{\boldsymbol{\epsilon}\} = [\mathbf{S}]\{\boldsymbol{\sigma}\}, S$ is the compliance matrix
- $\mathbf{S} = \mathbf{C}^{-1}$
- Stress and strain can be averaged over a specimen, such as:
- $\bar{\sigma_i} = \int_V \sigma_i dv/V$ and $\bar{\epsilon} = \int_V \epsilon_i dv/V$
- $\bar{\sigma_i} = C_{ij}\bar{\epsilon_j}$ and $\bar{\epsilon} = S_{ij}\bar{\sigma}$
- $W = \frac{1}{2}C_{ij}\epsilon_i\epsilon_j$
- S, the compliance matrix, contains the simpler terms in regards to engineering terms

TODO: flesh this out, include 6x6 for special cases