

## Laboratory Program (25% Credit)

- 1) Introduction
- 2) Overview of manufacturing methods
- 3) Autoclave processing and panel fabrication  
**Prof. Sadler teaches (the Above 3 sections, will be completed by Oct. 10<sup>th</sup>)**
- 4) Test methods, test plan and testing (John/ Shivakumar)  
(Oct. 21<sup>st</sup>, 23<sup>rd</sup>, 24<sup>th</sup>; Nov. 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup>)
- 5) Laboratory report ( should include Fabrication, Specimen preparation, Testing, Results and Discussion) **Due on Nov. 26<sup>th</sup>, 2003 (COB) Submit to Prof. Sadler and return to Dr. Shivakumar by Dec. 23<sup>rd</sup>)**
- 6) Group presentation (Dec. 4<sup>th</sup> & 5<sup>th</sup>) @ Fort IRC Bldg.

### Allocation of Credit

- *Sections (1)-(3): 10*
- *Lab report (due by Nov. 26<sup>th</sup>, 2003): 10*
- *Group presentation: 5*

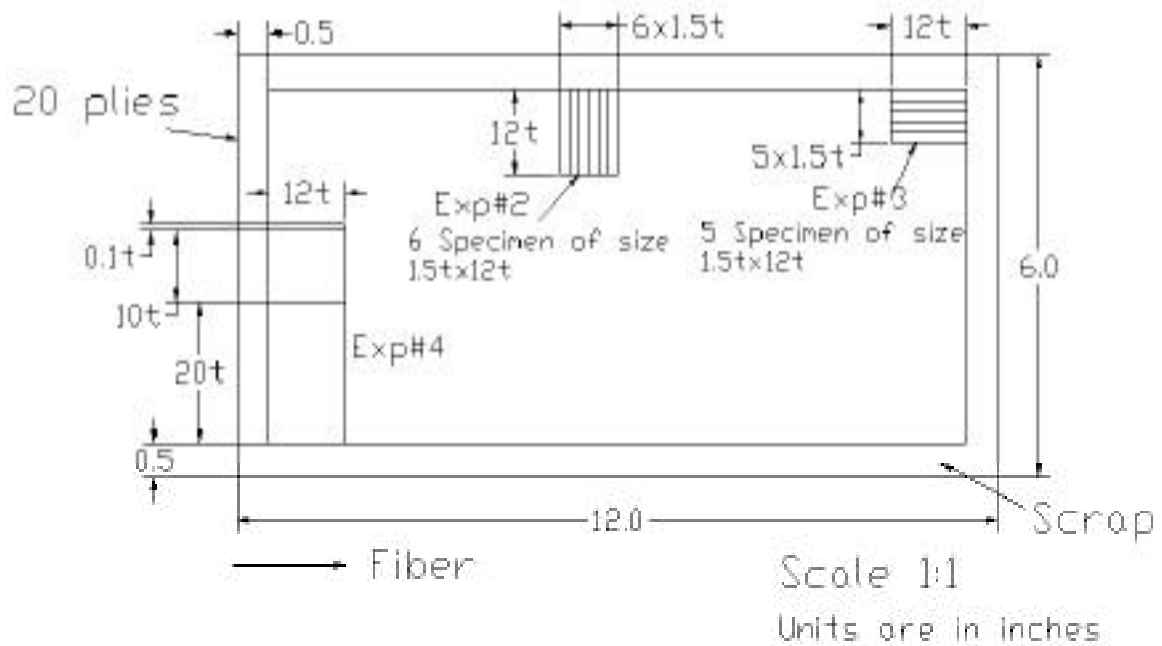
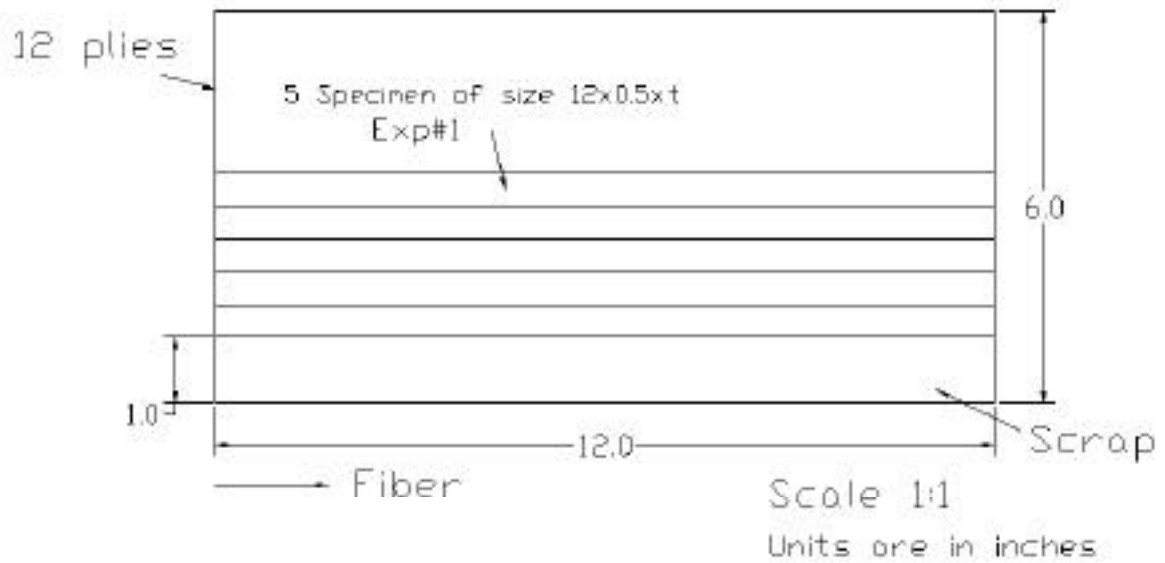
### Panel Fabrication and Testing Schedule:

- Panel fabrication- Oct 17<sup>th</sup> (Matthew Sharpe, CCMR Engineer)
- Specimen preparation and gaging- Oct. 21<sup>st</sup> & 24<sup>th</sup> (Matthew Sharpe & John Skujins)
  - Machining and Tapping- Oct. 21<sup>st</sup>
  - Strain gaging- Oct. 24<sup>th</sup>
- Review of test methods and testing- Oct. 23<sup>rd</sup> (John Skujins/Shivakumar)
- Testing Nov. 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> (Supported by John Skujins)

### Note:

1. Attendance will be taken in all lab classes.
2. Lab work duration is two hours instead of one hour as stated.

## Fabrication of Unidirectional AS4/3501-6 Composite Panel



**Panel and Specimen lay-up**

## Experiments – Material System: AS4/3501-6 Composites

### Experiment#1: Measurement of Longitudinal Properties- Axial Tension Test

- Measure density, longitudinal tensile modulus, strength, failure strain and Poisson's ratio.
- Document specific modulus, specific strength and specific failure strain. (Use transverse properties from Exp.#2 group) and compare with that of Steel and Aluminum materials.
- Longitudinal strength,  $F_{1t} = P_{ult}/bt$

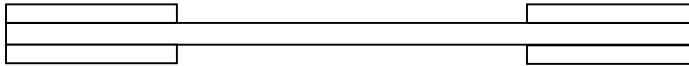
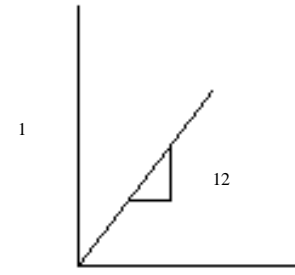
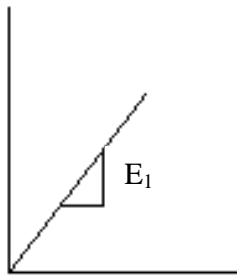


Table: Summary of test samples and data

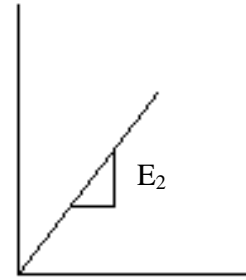
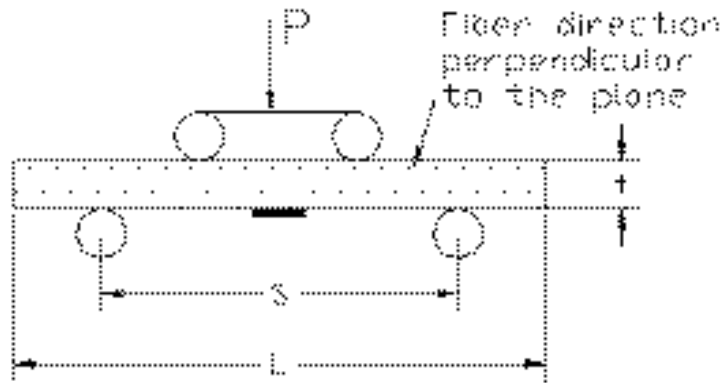
Specimen No	Width, b (in)	Thickness, t (in)	Span, S (in)	Poisson's ratio	Ultimate load, $P_{ult}$ (lbs)	Longitudinal modulus, $E_1$ (psi)	Longitudinal strength, $F_{1t}$ (psi)
1							
2							
3							
4							
5							



2

### Experiment#2: Measurement of Transverse Properties- Transverse Flexure test

- Measure transverse tensile modulus, strength and failure strain by 4-point flexure test.
- Document specific modulus, specific strength and specific failure strain. (Use longitudinal properties from Exp#1 group) and compare with that of Steel and Aluminum materials.



$S = 10t, L = 12t, \text{ Thickness} = t \text{ or } 1.5t.$

Testing and Data reduction

- No of Specimen tested- 6
- 3 Specimen with strain gage and 3 Specimen with out strain gage
- Bending stress,  $\sigma = 3PS/4bt^2$
- Transverse strength,  $F_{2t} = 3P_{ult} S/4bt^2$
- Plot  $\sigma$  vs  $\epsilon$

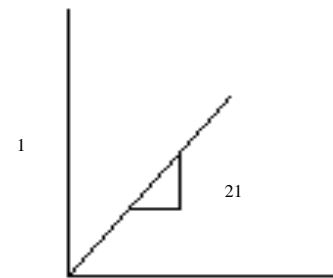
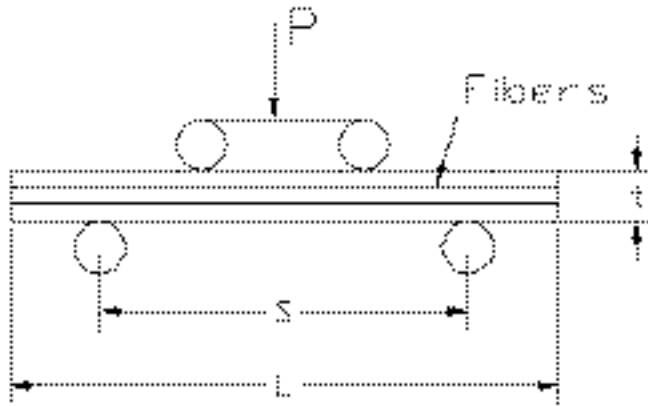


Table: Summary of test samples and data

Specimen No	Width, b (in)	Thickness, t (in)	Span, S (in)	Poisson's ratio	Ultimate load, P <sub>ult</sub> (lbs)	Transverse modulus, E <sub>2</sub> (psi)	Transverse strength, F <sub>2t</sub> (psi)
1							
2							
3							
4							
5							
6							

**Experiment#3: Measurement of Interlaminar Shear Strength**

- 4-point short beam shear test.
- 5 tests will be conducted. Measure failure load and failure mode.
- Calculate inter-laminar shear strength.  $ILSS = 3P_{ult}/4bt$



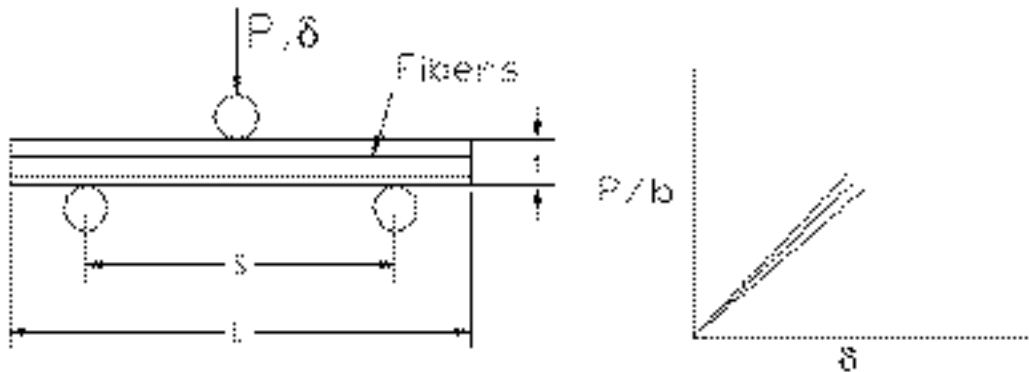
$S = 5t$ ,  $L = 7t$ , Thickness =  $t$ ,  $1.5t$ , Width,  $b = 1.5t$

Table: Summary of test samples and data

Specimen No	Width, $b$ (in)	Thickness, $t$ (in)	Span, $S$ (in)	Ultimate load, $P_{ult}$ (lbs)	ILSS, (psi)
1					
2					
3					
4					
5					

#### Experiment#4: Flexure Response of Beam and Plate (laminated)

- Conduct Flexure test on narrow and wide panels.
- Measure load versus deflection at the mid-span and plot  $(P/b)$  vs deflection ( $\delta$ )
- Use properties from Exp.# 1, 2 & 3 groups.
- Understand the response of beam versus plate (laminated).



$S = 10t$ ,  $L = 12t$ , Conduct deflection test on panels of widths,  $b = t, 5t, 10t$  and  $20t$ .