Monday, May 18, 2015
Not for Sailors Only: Sailmaking--Think High-Tech, State-of-the-Art

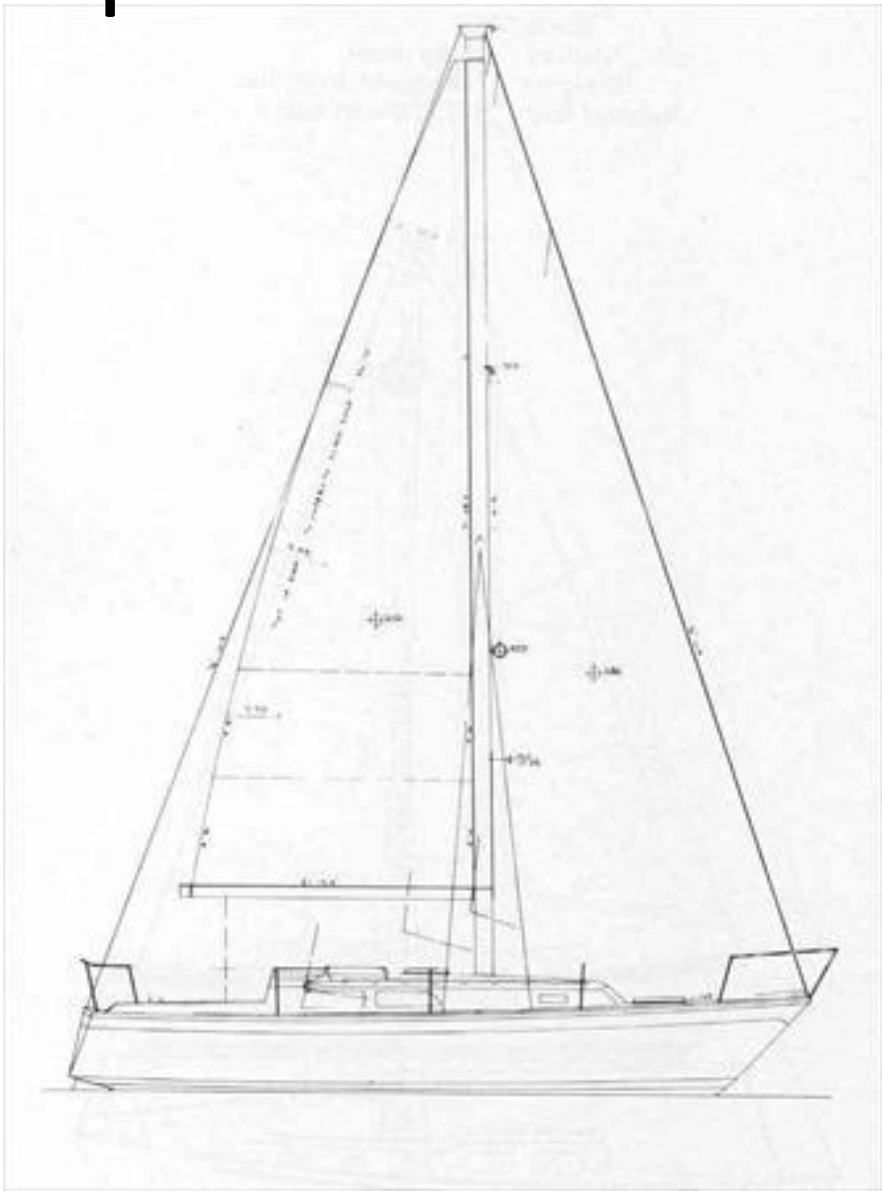
If you think sailmaking is a craft reserved for wizened old sea dogs with needles and palm-protectors, you're in for a surprise. Bary (with one r) Gately of Quantum Sails shows how sailmaking has morphed into a high-tech business, with computerized design, robot-staffed production lines, and 21st-century materials that even non-sailors will find fascinating. He'll also give us the lowdown on 10 things that captains of power-driven vessels need to know about sailboats--for their own protection as well as that of the sailors.

- Modern fibers[edit]
- The characteristics of a sail are due to design, construction and the attributes of the fibers, which are woven together to make the sail cloth. The following sections discuss the attributes of fibers assuming a good design and careful construction. There are six key factors in evaluating a fiber for suitability in weaving a sail-cloth:
- Modulus (of elasticity): elastic stretch resistance per cross sectional area of fiber, analogous to the stiffness in a spring. Higher is better for upwind sails.
- Tensile strength or tenacity: breaking strength, measured as a force per cross sectional area of fiber. Higher is better for sails.
- Creep, which describes the long term stretch of a fiber or fabric. A material with creep may have a superior modulus, but lose its shape over time.
- UV (ultra violet) Resistance: strength loss from exposure to the Sun's UV rays measured by a standardized exposure test.
- Flex Loss: Strength lost due to bending, folding, or flogging, which is frequently measured with an industry standard 50 fold test.
- Cost of the material
- There is no perfect solution since in most cases the increase of one attribute generally results in the decreased attractiveness of another. Reduced stretch generally also reduces the flexibility causing a trade-off of performance for durability. Solving both problems generally sends the price out of range for most sailors.

Sail Design

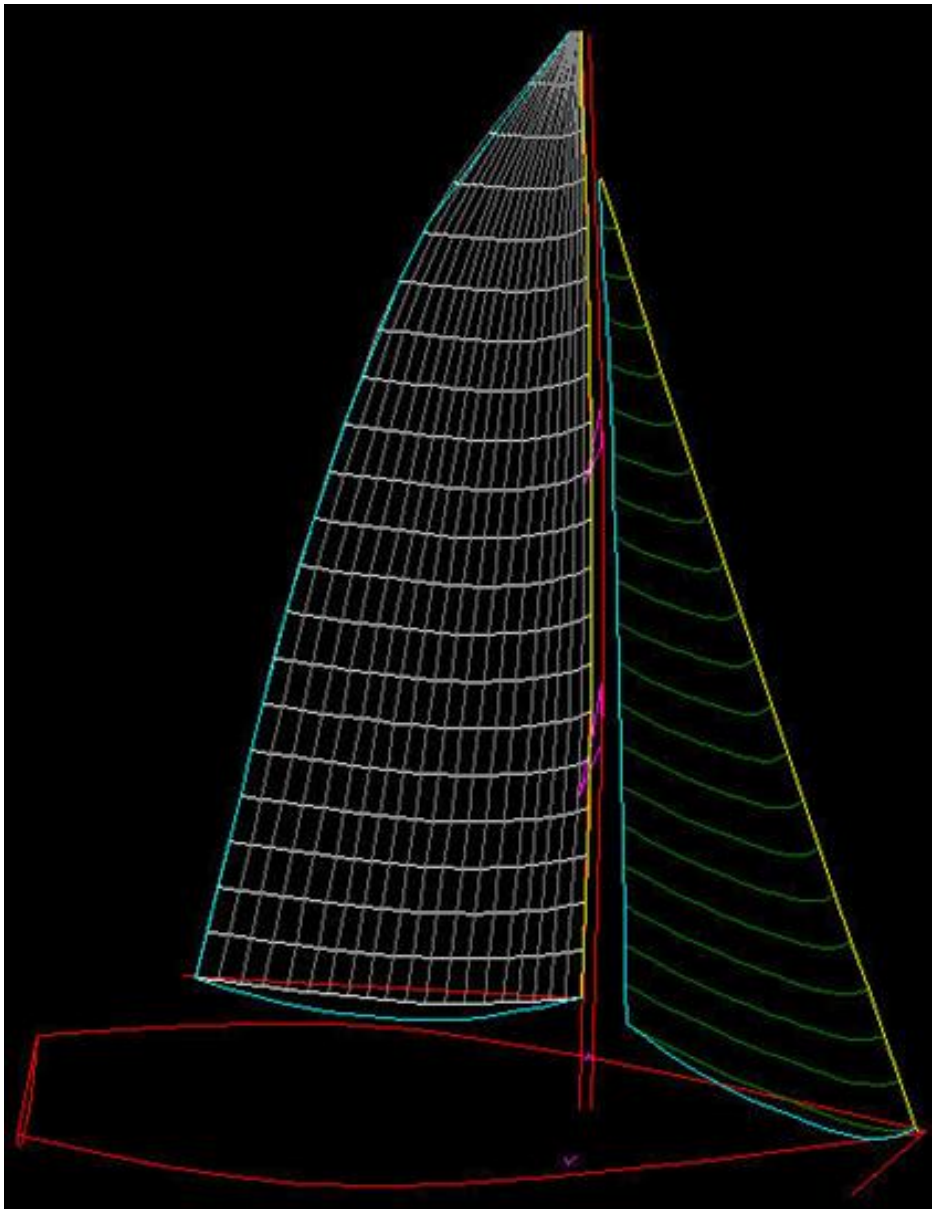
Design the Sailplan

- Line drawings are crucial to make sure the measurements taken work with the boat.
- We still use hand drawn sketches to lay down the initial design before heading to the computer.
- By sketching sailplans, we can be sure the desired sail will work with the boat's dimensions.



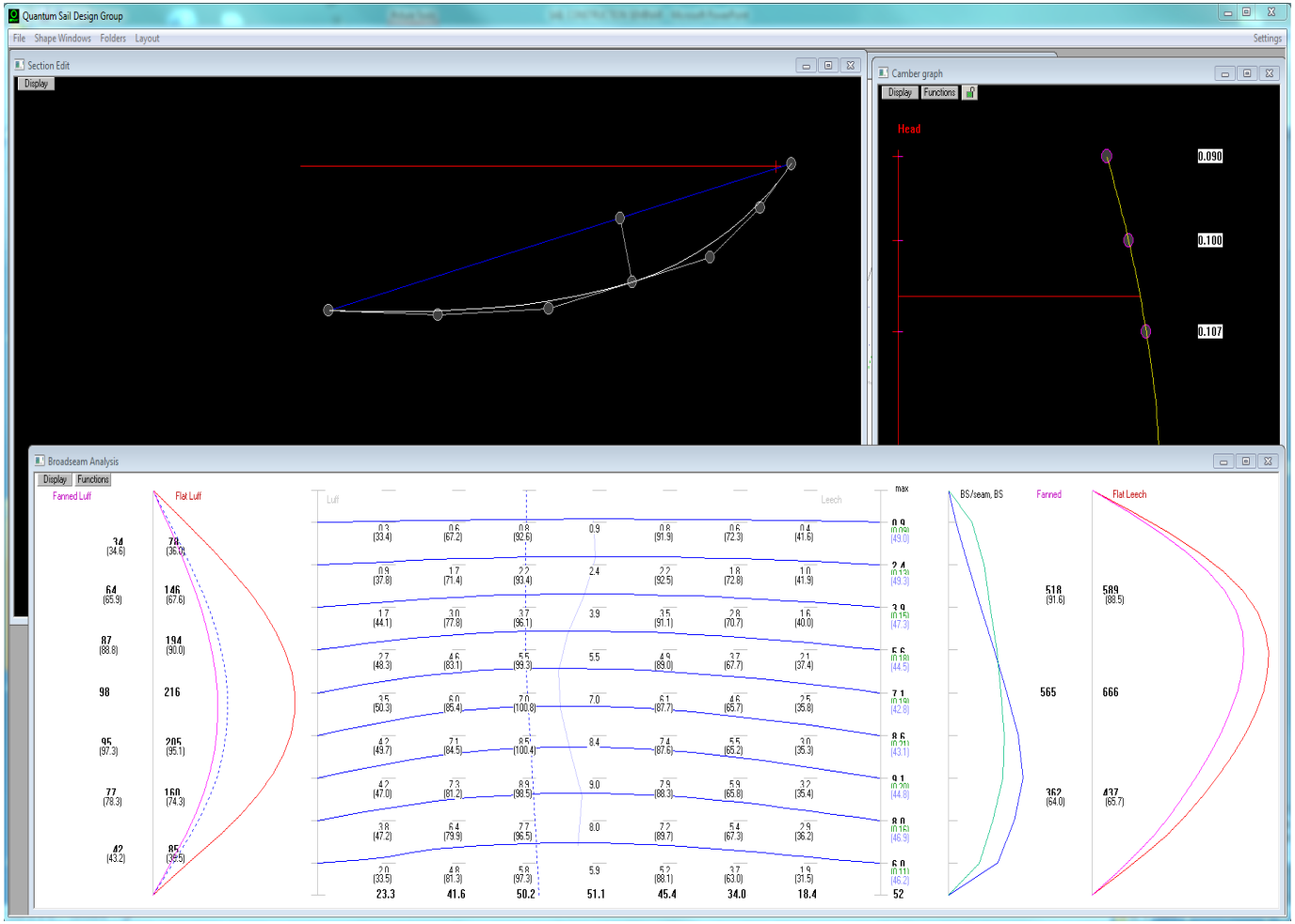
Computer Aided Design

- Sails are a three-dimensional shape.
- Using a CAD program built specifically for sails, we can design a layout that will cut a two-dimensional roll of material to produce the curved shape desired when the sail is set in a breeze.



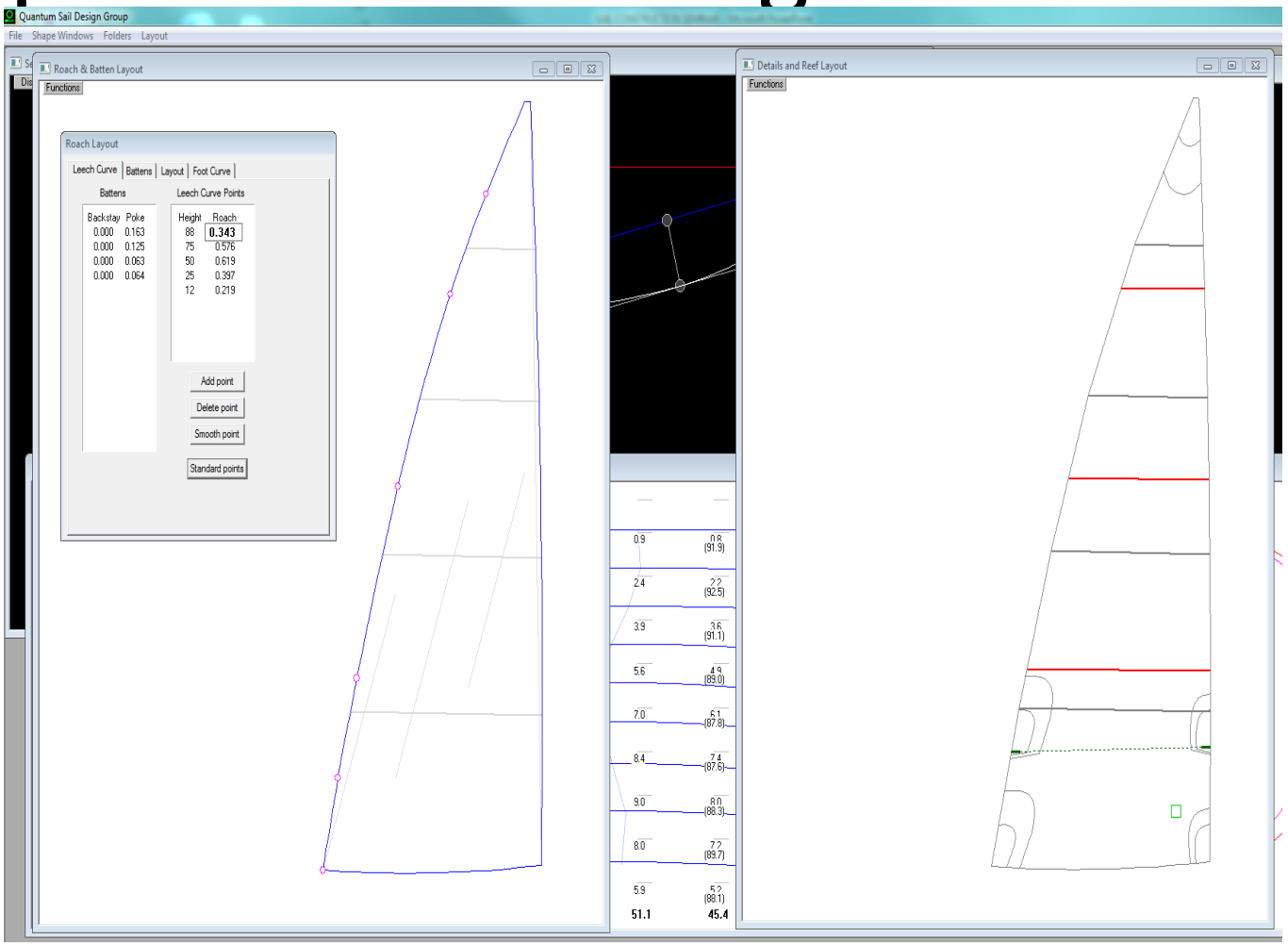
Computer Aided Design

- The design program gives us control over the minutia of the sail.
- From camber to chord, luff to leech, entry to exit, we can fine tune down to the millimeter.



Computer Aided Design

- Once the overall sail is designed, proper placement for area reefs can be discerned, corner patches built out, and even draft stripes marked.



Sail Materials and Cuts

Materials

- Dacron
- Nylon
- Laminates
- String Sails
- Taffeta Advantage

Cuts

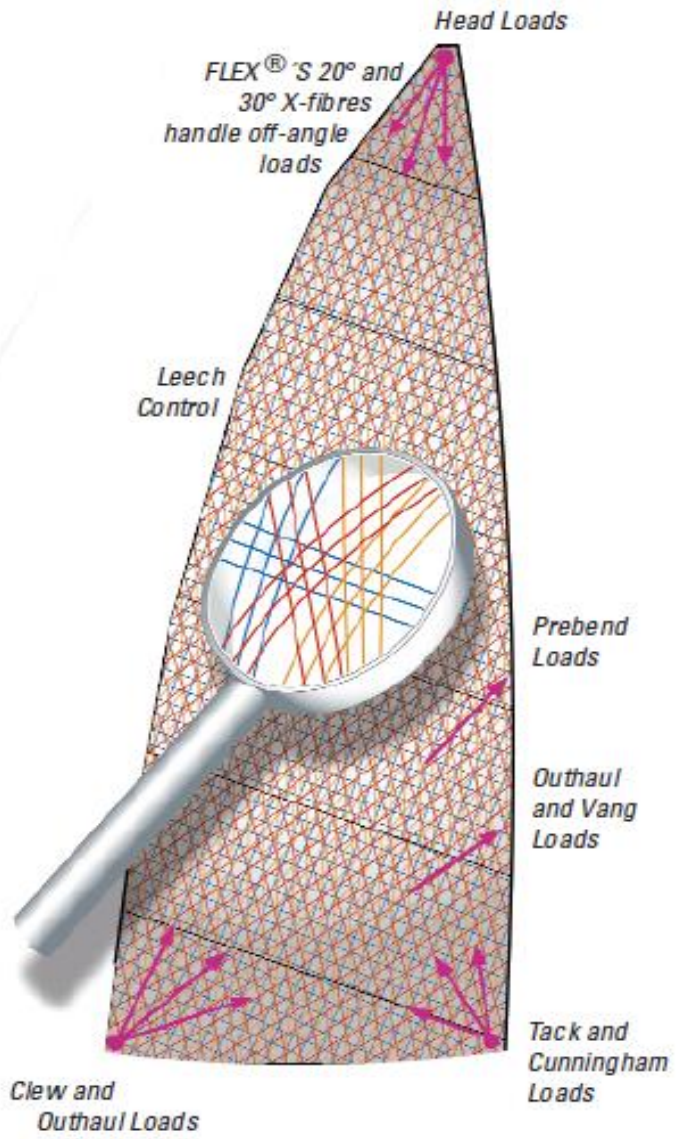
- Cross Cut
- Triradial
- String

Off the shelf / Paneled sails

44 Families of Laminates from the 4 Major Cloth Manufacturers.

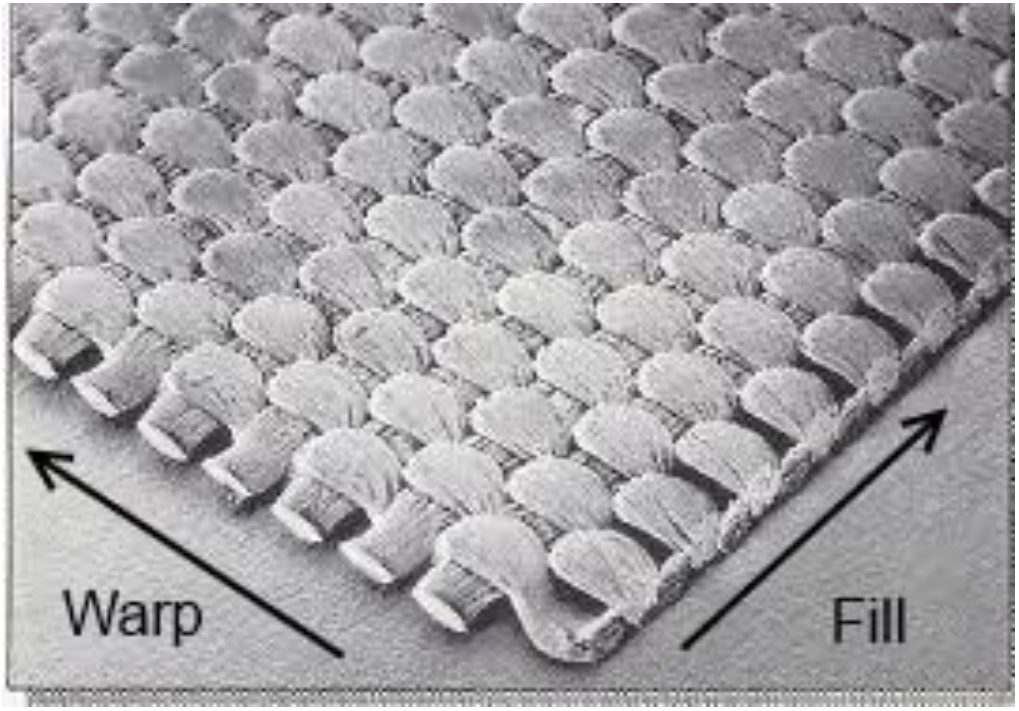
Cross Cut


4070


Head Loads
FLEX® 'S 20° and 30° X-fibres handle off-angle loads
Leech Control
Prebend Loads
Outhaul and Vang Loads
Tack and Cunningham Loads
Clew and Outhaul Loads

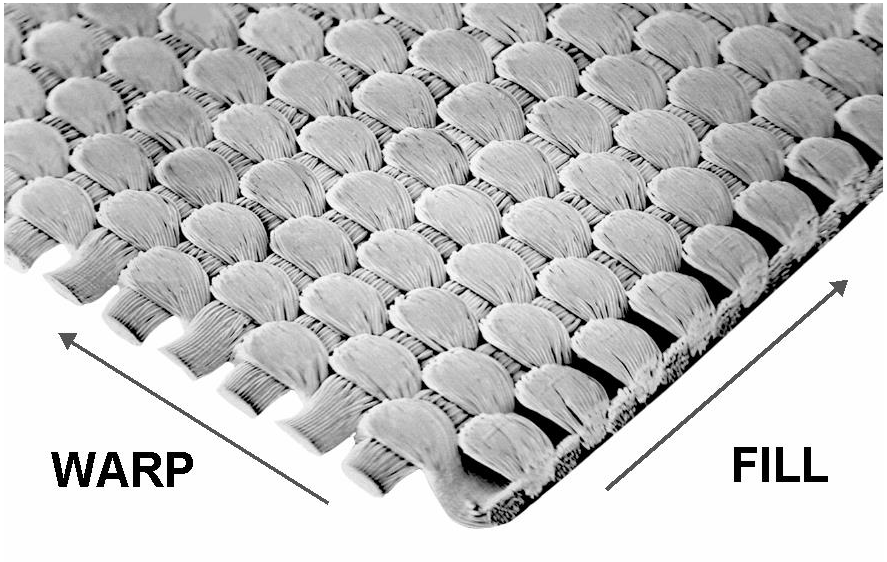
Woven

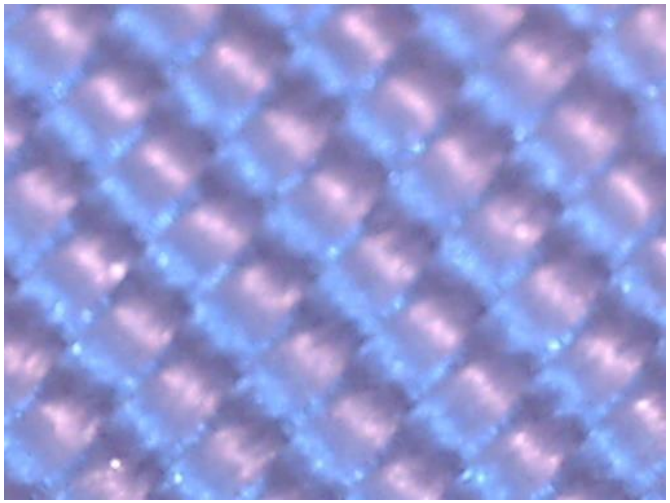
- Why is woven material Polyester or Nylon?
  - Polyester and Nylon have high shrink factors making a tight weave possible



Dacron: The Workhorse

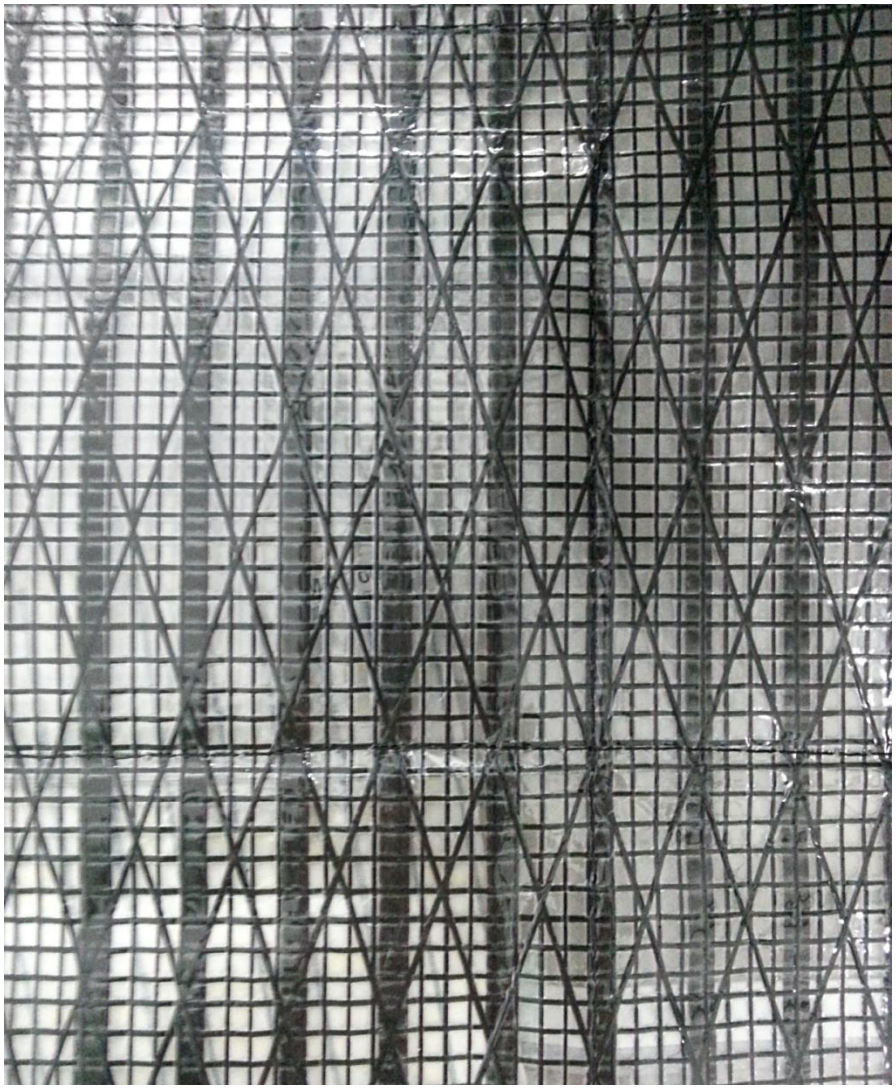
- Pros:
  - Extremely long life (10+ years)
  - Cost effective
- Cons:
  - Poor shape retention
  - Heaviest material





Photos Courtesy of Challenge Sailcloth

Triradial



Mylar: High Tech Laminates

- Pros:
  - Holds shape better than Dacron
  - Lightweight
  - UV Resistance
  - Many Options

- Cons:
  - Cost varies greatly across materials
  - Shorter lifespan
  - Possible mildew issues

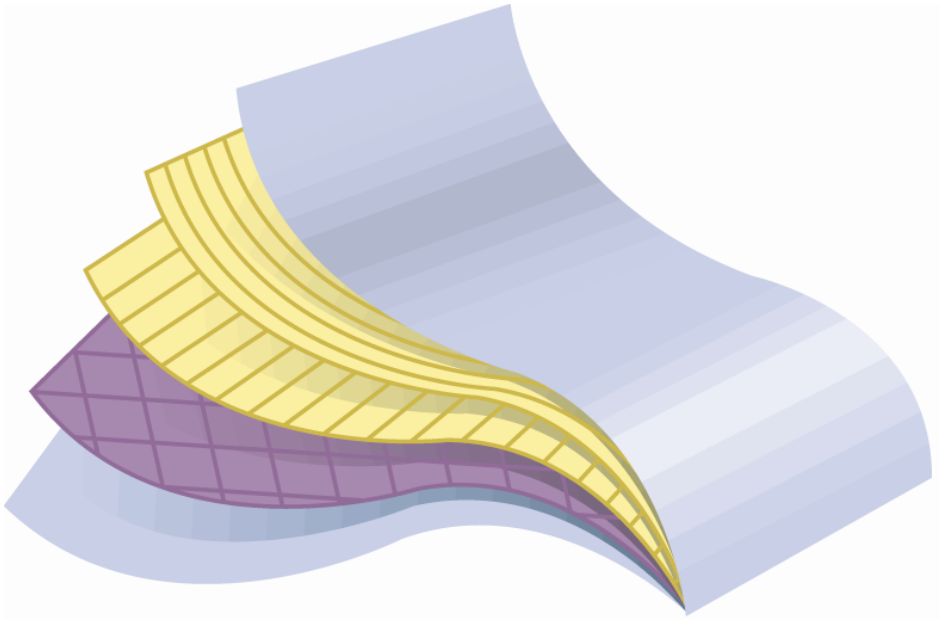
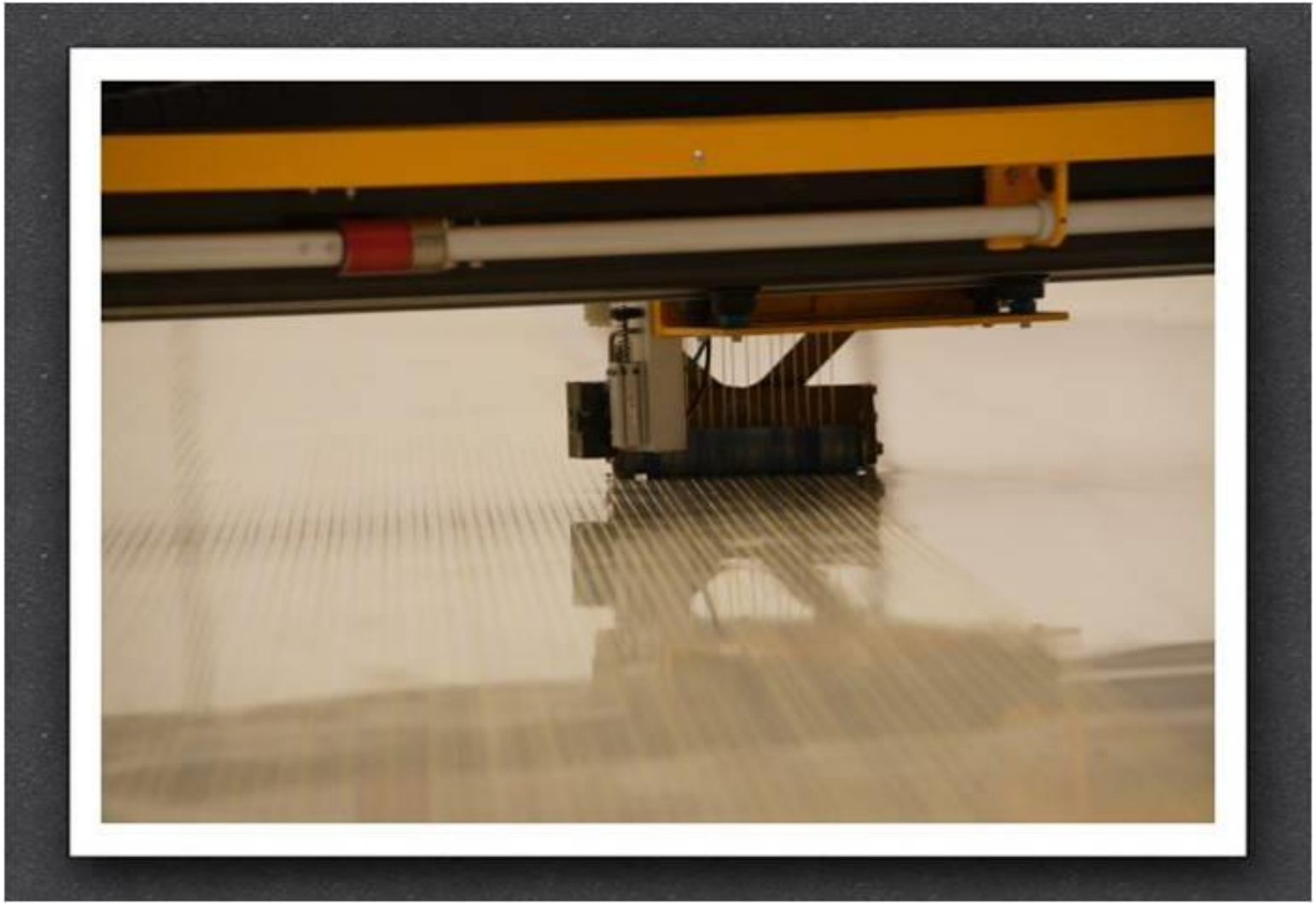
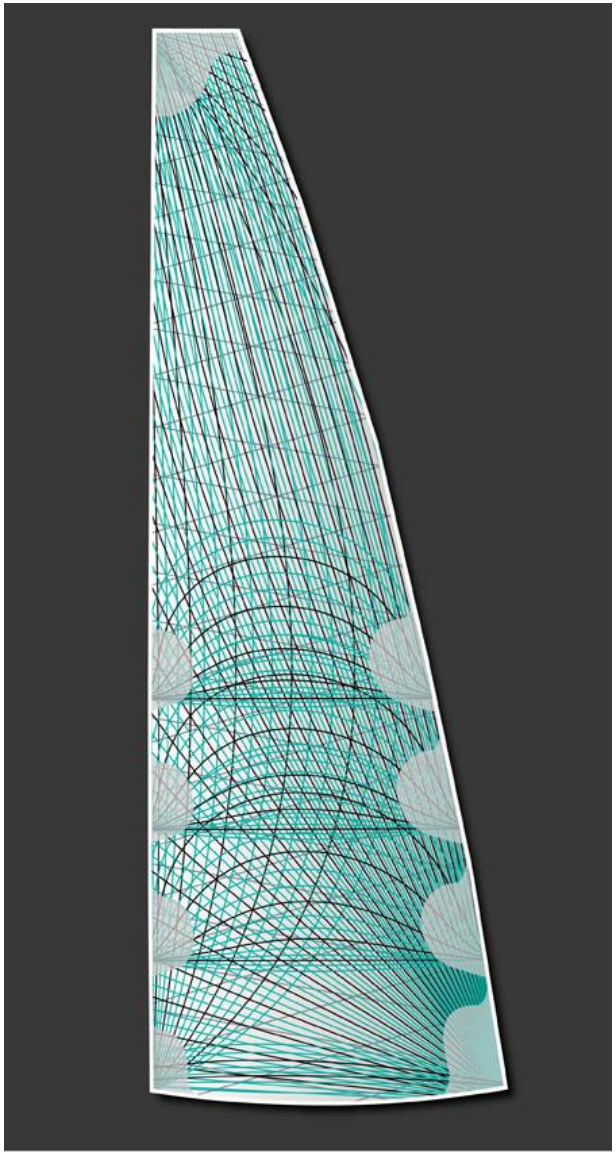


Illustration Courtesy of Dimension Polyant

Custom Laminate / Membrane

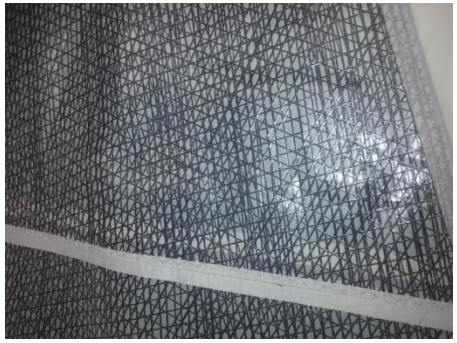


Fusion M



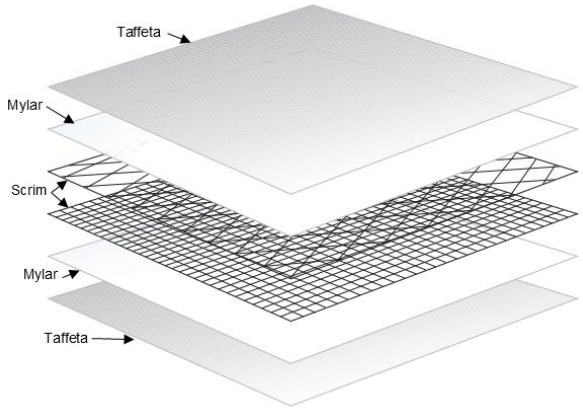
String Sails: Cutting Edge

- Pros:
  - Superior shape life an
    load bearing
  - Extremely lightweight
  - No catastrophic failur
- Cons:
  - Most expensive



Taffeta: Extending Mylar's Life

- Taffeta Backing can be used on Mylar sails and String sails to extend the life.
  - Significantly reduces breakage due to hinging
  - Adds UV protection
  - Can be either single or double sided
  - Adds weight to the (~.75 oz per side)



What had fiber advancement done for us?

- Lighter Sails
- Lighter boats
- Higher power to weight ratio (sq top Mainsails)

How Long Should A Sail Last

Challenge Sailcloth Research

- UV
- Flogging
- Exposure & Cycling – Instron Testing
- Hours of use

How Long Should A Sail Last

Woven Polyester

- Approximately 3000 Hours
- 26 Weekends Annually
- 12 Hours Per Weekend
- 312 Hours Per Year
- 9.62 Years
- Performance versus Perimeter

How Long Should A Sail Last

Fusion M

- Approximately 2000 Hours
- 26 Weekends Annually
- 12 Hours Per Weekend
- 312 Hours Per Year
- 6.41 Years
- Around The World In 83 Days

10 things that captains of power-driven vessels need to know about sailboats--for their own protection as well as that of the sailors.