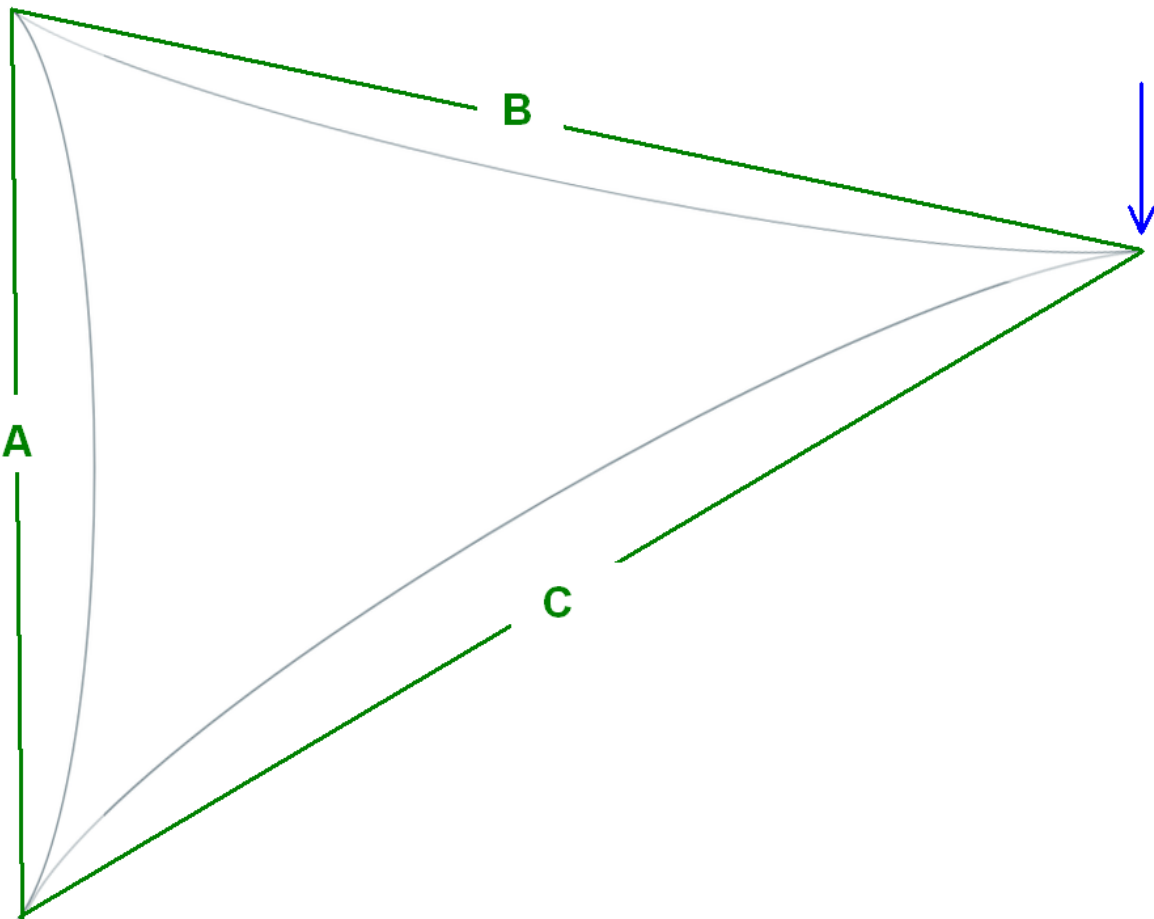




Understanding Shade Sail Geometry: Avoiding "Strappy Corners"

At BackyardCity.com, every custom shade sail is engineered with built-in inward **catenary curves** along each edge. These inward curves (where the deepest point is in the middle of the side and it is about 6% to 10% of the straight line length between the corners) are absolutely essential: When under tension, the curves try to straighten and this pulls the interior fabric tight which removes the wrinkles, minimizes sagging of the fabric and prevents waving or flapping of the fabric (which will unduly stress the fabric) under windy conditions. The curves also help distribute the surface area wind loads evenly to each corner.

On balanced shapes (like squares, rectangles or triangles where the smallest angle is about 35 degrees or larger), these curves merge cleanly right at the corner mounting points, just like the straight lines.

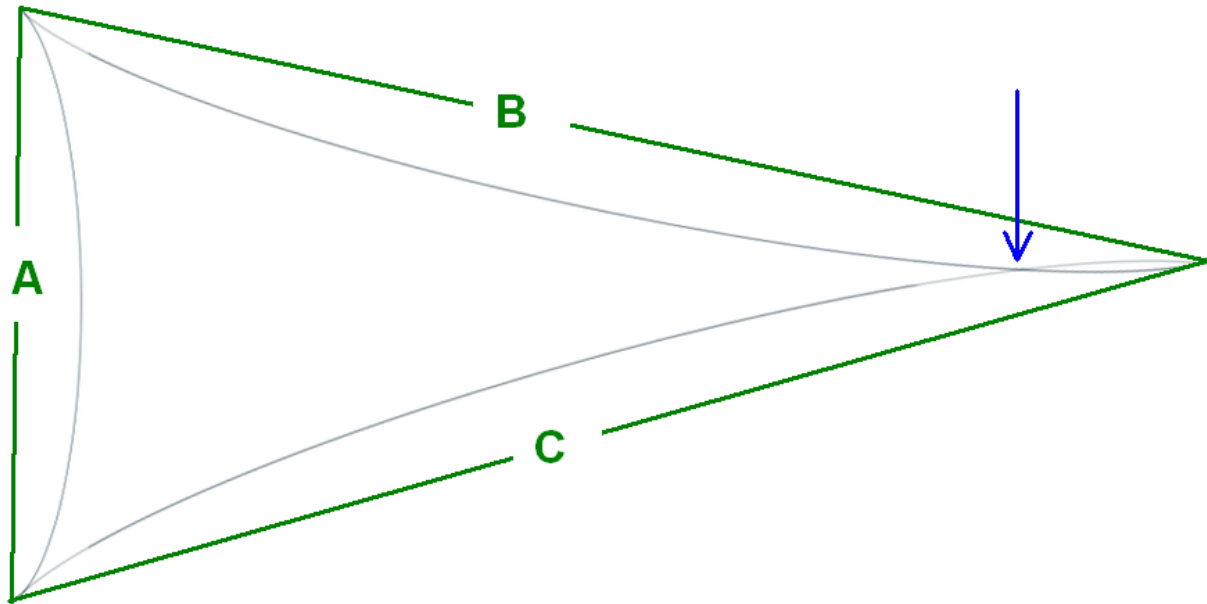


(The straight green lines between the corners represent the basic shape while gray lines represents the inward catenary curves of each side.)

But now we need to create the catenary curve on each side. The inward curves get closer together sooner than the straight lines. At smaller angles, the curved edges will intersect or meet before ending at the corner. This is just plain geometry and not a mistake. The early intersection make the

hemmed edges of the sail merge into one hemmed edge the width of a single hem which looks like a thin strap or tail. The hem width is determined by the width of the webbing or wire that runs in the perimeter edges (~1.5" to ~2").

So if the angle become too sharp. the inward curves converge sooner (blue arrow) than the straight lines. This starts to happen as the length of the two longer sides get close to twice the length of the smallest side.



To prevent tailed corners, keep all corner angles at 33° or wider.

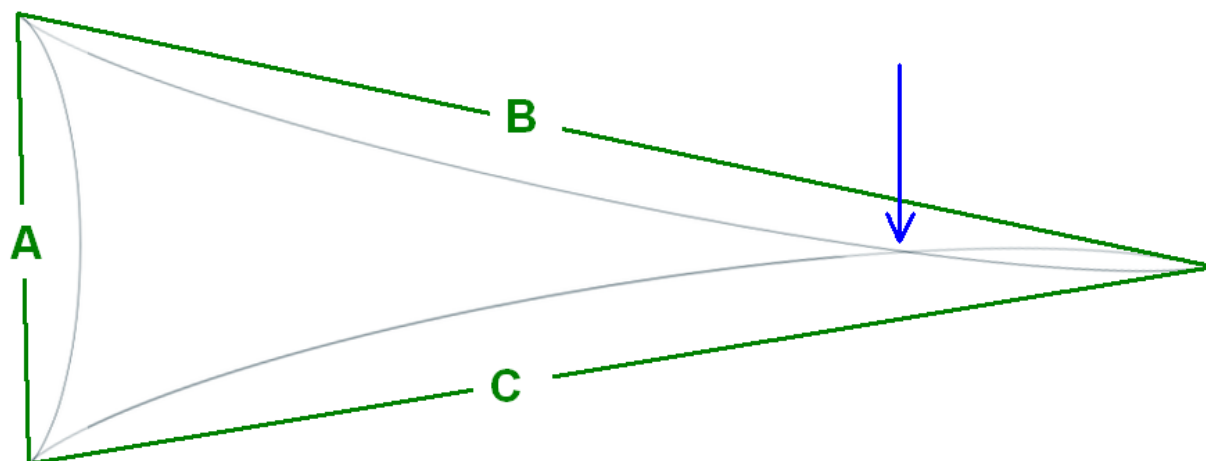
When see that we have a narrow corner, we automatically strive to flatten the inward catenary curve down to 6% on those sides to give you as much fabric as possible. Tests have shown that below 6% will not adequately tighten the fabric or transfer the wind loads to the corners. However, once a corner angle drops below 33°, the two curved edges are mathematically forced to collide earlier than the straight lines at 6%.

How do you know if your layout will cross that line?

What we have noticed is that when a triangle has at least one very long side and it will make up at least one corner that is narrow. When the angle gets to about 35 degrees or smaller that is a skinny corner even if they had straight sides. There just is not a lot of distance between the 2 straight long sides providing a decent amount of material to provide shade as the inward curves will get closer together faster than the straight lines.

As the longer side of a triangle approaches TWICE the length of the shortest side, the corner angle rapidly narrows. When their angle gets to about 33° or less, the early curve convergence is almost always guaranteed, turning the point of your sail into a strap or tail.

The convergence of the inward catenary curves arrive before the straight lines the angle gets below 33° as in this more extreme example below.



Quick Dimension Check:

- **Balanced Sail - SAFE**
 - *EX: Dimensions:* 10 ft short side × 15 ft long sides
 - *Corner Angle:* greater than 39° (Well above 33° — good fabric coverage to the corner)
- **At the Threshold (Ratio 2 : 1) — STRAPPY CORNER STARTS**
 - *Dimensions:* 10 ft short side × 20 ft long side
 - *Corner Angle:* ~ 29° (Hits the 33° threshold — curves merge into a strap/tail)
- **Extreme Triangle (Ratio 3 : 1) — LONG STRAP**
 - *Dimensions:* 10 ft short side × 30 ft long side
 - *Corner Angle:* ~ 19° (Far below 30° — produces a very long, narrow strap/tail)

While we would like to just say “No” to any angle below the 33° threshold and refuse to make these shade sails, there are many instances where this shade is used with a long strappy tail for more artistic purposes rather than for adequate shade, or there just is not a way to avoid it due to mounting point limitations at the site. Therefore, we will continue to make these skinny/strappy corner shade sails. We have cautions and warnings about the possibility of the skinny/tailed sails on our Right-Angled Triangle pages, and any custom shade sail pages of our website. You can always ask us about the angles and the probability of early curve convergence and thus a strappy tail before ordering if this is a concern.

Custom Shade Sails - Shade Sails