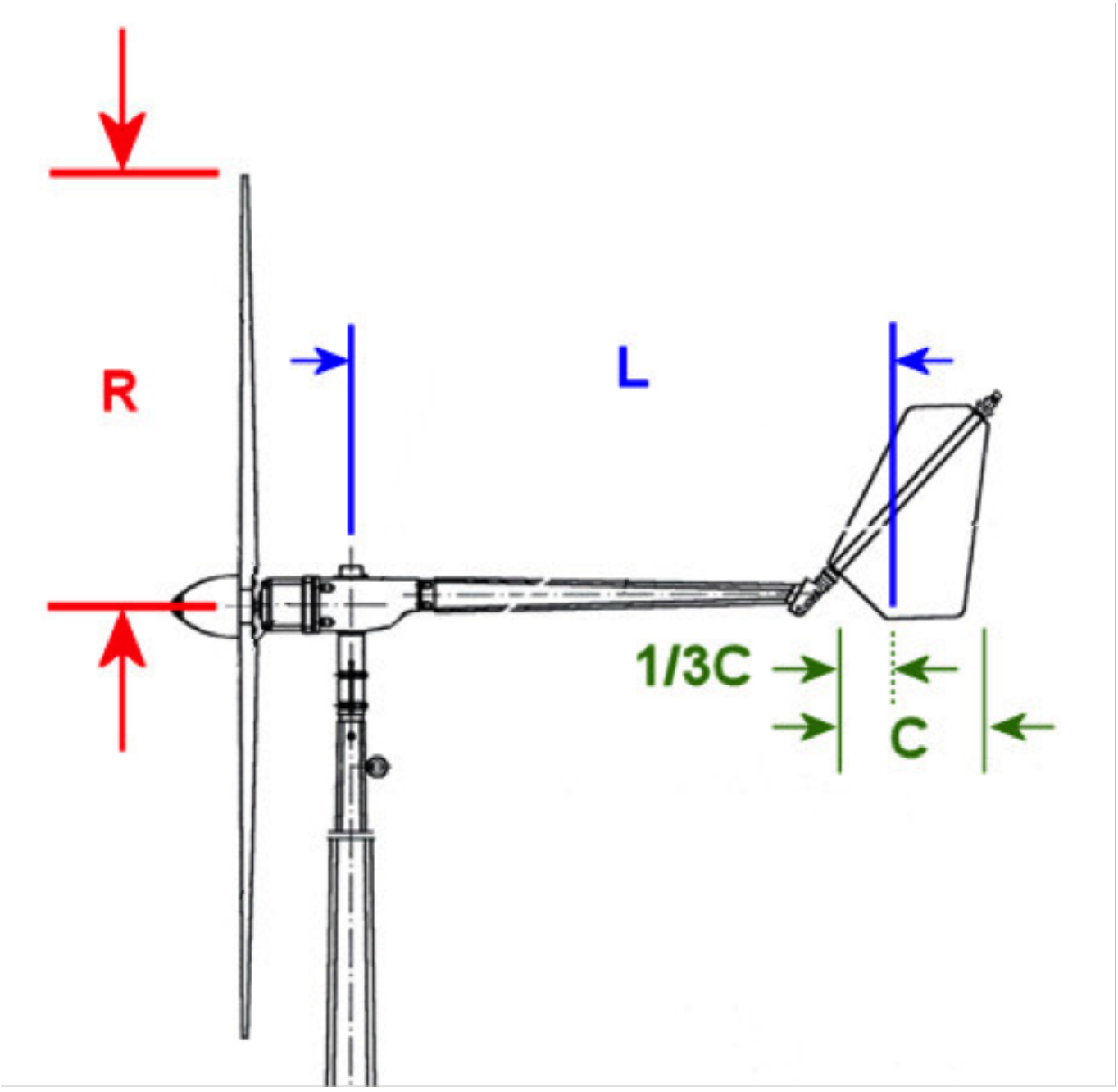
Sizing Your Wind Turbine Tail

The length of the tail-boom and the surface area of the tail vane are critical factors in having a wind turbine remain facing into the wind during normal and turbulent conditions. If not sized properly the turbine will shift away from the core wind direction causing a drop in RPM, a loss of power, and a loss of time as the turbine repositions prior to spooling-up again.



Tail Vane Area

The easiest way to establish the optimum tail vane area is to relate it to the sweep area of the turbine. The sweep area of a wind turbine simply the square of the rotor radius (R) times pi [3.1415].
Sweep Area = R^2 x ?

The rule of thumb, developed through many years of turbine design and testing, is that the tail area should be no less than 5% of the sweep area of the wind turbine's blades. The larger the tail vane area the more influence it will have on maintaining proper rotor pointing. Below is a table of tail vane area vs. rotor radius for a range of small wind turbines.

	Tail Area percentage of sweep area					
R (inches)	5%	6%	7%	8%	9%	10%
20	63	75	88	101	113	126
30	141	170	198	226	254	283
40	251	302	352	402	452	503
50	393	471	550	628	707	785
60	565	679	792	905	1018	1131

Table contains tail area square inches

Tail Vane Shapes

Should the tail vane be square, rectangular, trapezoidal, or some other shape?

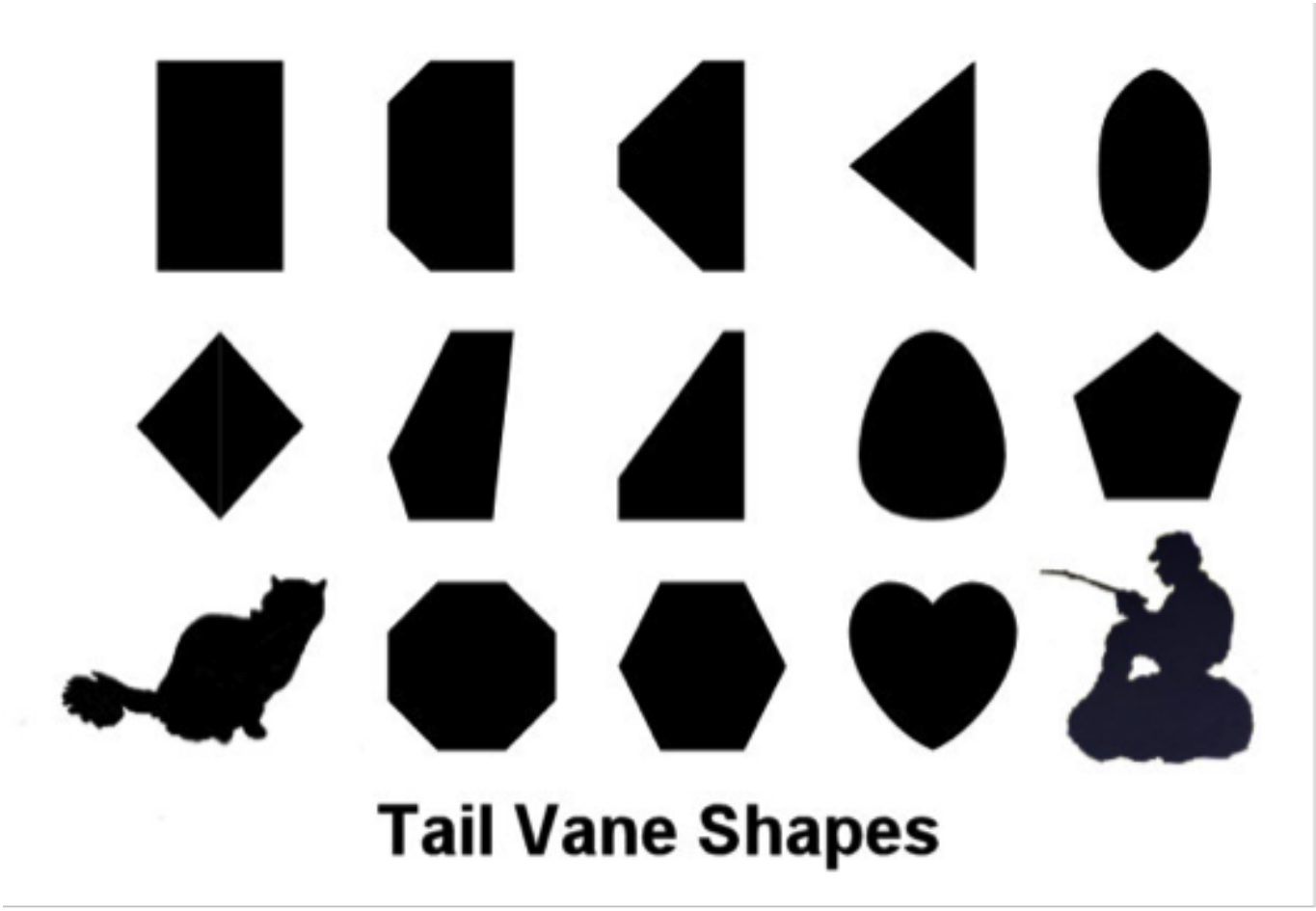
It turns out it doesn't matter a great deal as long as the surface area is within the range described above. In general, an "arrow shaped" vane with a leading edge that sweeps rearward is a bit more effective. Usually a stronger driving factor is to establish a tail vane shape that matches the overall wind turbine look that you are shooting for.

What orientation is best?

Should the tail vane be taller vs. longer? Yes, in general it is better to be taller rather than longer. The reason is that you are creating a vertical "wing" and it should take on the shape of the stubby wind. A good rule of thumb is the tail height should be approximately twice the length in order to be the most effective.

What is the most efficient alignment?

Should the tail vane be centered with the tail boom, with half the tail vane area above the boom and the other half below the boom? Ideally, yes, but it is not that critical. Again, set this based on the overall look you are shooting for.



Let's talk about Tail Boom Length

Once you have the tail area and shape designed, the next step is to position it on the tail boom at the right location.

The first graphic above shows the 2 vertical alignment points that are used. One is a vertical line through what is called the “yaw” axis. This is generally the center of the tower mounting post. It is the point where the turbine pivots left and right to align itself with the wind.

The second point is at 1/3rd of the tail length. If the tail is 12 inches in length, then the 1/3rd point is located 4 inches from the leading edge. The reason for this is tail acts like a flying surface with lifting pressure on both sides pushing the tail into position. This pressure generally is centered at about the 1/3rd length point, much like the center of gravity of a well balanced wing is at about the 1/3rd cord point.

These 2 vertical lines establish L, the **tail boom length**. The established rule of thumb is this should be equal to approximately 60% of the rotor diameter. The rotor diameter is twice the rotor radius (R). Another way to calculate it is: L = 120% x R = 1.2 x R. Therefore a rotor with a 40-inch rotor radius would have a tail boom length [L] of approximately 48-inches.

Feel free to explore variations on these themes!

Keep in mind these are general rules of thumb. They are tried and true relationships that are safe to use. You may see some very well performing turbines that have a longer tail-boom (L) and a smaller tail-area. These designers may have done this to achieve a better overall look, to reduce tail vane material costs, or they may have determined it worked better on that particular turbine.

Likewise there are undersized tail-booms on turbines with oversized tail vanes. Again, each designer is making trade-offs for stability, weight, cost, packaging, and overall look. The guidelines above will at least get you in the

ballpark if you are designing your own turbine, or it can help you determine how to modify a turbine that is not staying positioned as well as you'd like.

- Wind Turbine Tail Fin [1]

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