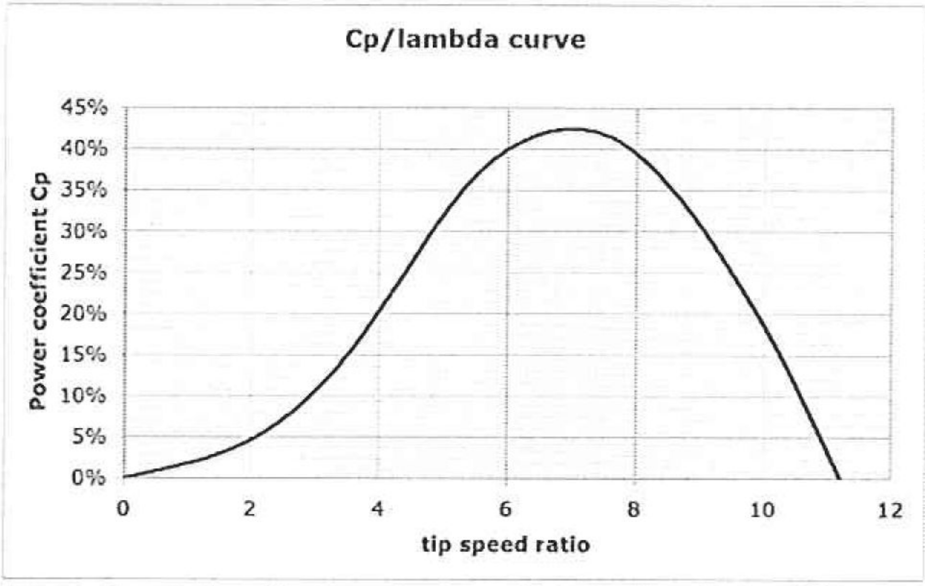
The actual power coefficient of the blades depends on the operating tip speed ratio. Here is a chart showing how it might vary (theoretically) for a blade rotor designed for λ = 7.



Cp peaks at the design tip speed ratio but it is still useful at lower and higher ratios, from about 5 to 9.

Below tip speed ratio 5 the blades literally stall. The wind strikes the leading edge at a coarse angle and fails to follow the back curve but separates instead and creates a lot of turbulence and drag.

Above tip speed ratio 9 the blades generate a lot of drag due to excessive speed and the wind now hits the blades at a too fine angle of attack.

When using an alternator connected simply via a rectifier to a battery it is not possible to keep the blades at the ideal tip speed ratio over the full range of windspeeds. The battery will hold the speed relatively constant. The best option is to compromise and cut in at a higher rpm than the ideal, so that the tip speed ratio becomes optimal in a mid-range windspeed, and does not rises high enough in stronger winds when the blades would like to be running quite fast but the alternator speed is holding them back.

When designing an alternator to match blades that prefer to run at tip speed ratio 7, I actually try to set the alternator speed so that the blades are running at tip speed ratio 8.5 or more when they cut in at 3 m/s windspeed. At around this point the wind is just strong enough to overcome the friction in the bearings and so forth.