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Vertical Solar Collector Façade Positioning Guide

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In our present time, there is an incredible emphasis and trend on sustainable buildings. We've recently realized that we cannot keep treating the earth the way we have been treating it, both our lifestyles and our buildings. One of the biggest components in sustainable technology is sustainable energy. In short, this means we can replenish the energy as fast as we utilize it if not faster. There are many different types of these, water-powered, wind-powered, but I would like to focus in on perhaps the one that can be applied most easily to any home: solar power. The sun has been around for billions of years and since the sun won't be exploding for another fifteen billion years or so, there are almost no downsides to solar energy (except maybe if you count the carbon that it takes to produce these panels). In this paper I will be giving you a crash course on all the things you should take into consideration when designing a solar façade, such as, sunlight exposure, location, strategies for minimizing shade and how to use that shade so that it will be advantageous to your building design.

Let us start with the broadest topic, location. When we refer to location, we are actually referring to the longitude of your location. Longitude is how high or low you sit on the Earth with respect to the equator. This in turn determines the angle that the sun sits on the horizon at your location. The angle is sometimes referred to as the Azimuth. When dealing with solar panels and how efficient they collect, you want the panels to be more or less perpendicular to the Azimuth. If you're dealing with shade, you can sacrifice ~2% efficiency for adjusting the panel 10 degrees (in either direction), any more than that will have a more detrimental effect to your efficiency. You always need to keep the shade in mind, because at this point in time the best commercial/residential panels hold about a 21.5% efficiency rate. Sure there are panels that get about 44.7% but they're *extremely* expensive and are reserved for crazy rich corporations like NASA. Anyway, once you know your latitude, there's a bunch of online calculators you can use to give you your sun horizon angle. Typically, these calculators will also ask for the day of the year. Why? That is because depending on the time of the year, the sun angle gets higher or lower in the sky, the sun is higher in the sky during the summer and sits lower during the winter. During the spring and fall it's somewhere in the middle of those two. You should usually calculate your panel angles for the winter, summer and spring/autumn solstice because those are when the sun is at its highest, lowest and dead center. Just to give an example, in New York the sun sits on the horizon at about 31 degrees, so that means the plane your panel is on needs to create a 59 degree angle with the ground for it to perpendicular (optimal efficiency).

Let's talk panel efficiency. One of the best ways to get your panels at optimal efficiency is to have them rigged to some kind of mechanical system that moves them both on the horizontal and vertical axis. The vertical axis would adjust them every few months to take into account the changing of seasons, and the heightening or lowering of the sun's angle on the horizon. The horizontal axis would adjust them at set intervals everyday depending on where the sun is in the sky. The sun rises in the east and sets in the west so the horizontal axis tracker could hypothetically adjust every hour of the day, slowly tilting east to west to match the sun's path (with your location taken into account of course). When the night comes, the panels would move back to their original position in the east and then once the sun has fully risen it would start the cycle over again. The next way to keep your panels efficient is to have some kind of water cooling system mounted behind them. Having the sun projected at a glass-like surface from sunrise to sunset can make them quite hot. After a certain temperature threshold has been reached, these panels will begin to lose efficiency; you really can't afford to have that happen. The most common way to do this is to mount a few PVX plastic tubes to the back of each panel and run cold water through them. It would be ideal to give each group of panels their own set of piping so that by the time the water reaches the last panel, it's not already extremely hot. To make it a multifunctional system, you may want to consider having the hot water feed into some kind of boiler that can be purified (if needed) and be reused by the house in some way.

The final topic I would like to touch on is shading. By now you can understand that if you can prevent any loss in efficiency, you need to. But how do you overcome the issue of shade? I'll start off with the most obvious, make sure you keep all trees and vegetation clear of the panels, even though trees and such don't create 'hard' shade, they do create 'soft' shade, which can drastically decrease your panel output. However, most of the time you will be dealing with shade from panels above casting their shadow onto panels below. More often than not, you will have several panels positioned onto a wall so that the panels are above each other; the panels above will cast shade onto the ones below. I have three methods of counteracting this. One way that this can be resolved is through you mount the highest panel onto the wall, then you extend the panel below it so that even at a 45 degree angle, the panel above is not touching the panel below if you were to look at it in an elevation/sectional view. You keep extending the panels further and further as you place more. However, this isn't terribly space efficient as it wastes a lot of space placing rack bars and other pieces to allow the panels to extend. A method that I'm very proud of mounts the panels onto a stretched semicircle that can sustain the weight of the panels and equipment. These semicircles can be made of wood or steel or even PVC piping, as long as they can sustain the weight. The semicircles should extend the full height of the building, connecting where the building tops out, to allow for the whole height of the façade to be utilized efficiently. This system is most comparable to a louver system, except instead of the pieces being placed between the channels, they are placed on top as to allow for the vertical and horizontal tracking mentioned above. The best thing about this system is that it can use the shade created by the system in an extremely advantageous way: it shades the area behind the louver system! This can allow for a shade deck space or even an awning depending on how densely the panels are packed onto the louver system. The last method of combating shade I would like to touch on is mirrors. You've probably had your watch on and bounced incoming sunlight off it at one point or another; you can take the same idea and apply it to solar panels. If you have a panel that's shaded and you place a mirror perpendicular to the angle the panel is at, you can more or less bounce the incoming sunlight directly onto the panel.

A vertical solar collector façade requires a lot of careful planning and thought to obtain optimal output but it really is worth it. You need to give a lot of consideration to your location, surrounding objects, time of day and keeping your panels cool. You should give special consideration to placement of the panels due to shading issues but all in all if you follow the steps I outlined above you will be well on your wall to designing an efficient vertical solar collector façade!