Hydroponic Living Walls – Irrigation

Lately the requests for information about setting up irrigation for hydroponic walls have flooded my email. Over the past 5 years I have seen more green wall companies popping up all fighting for a small piece of an infant market. More companies equate to more inexperience, some media based, some hydroponics. If you haven’t read the archive “Hydroponic Living Walls – DIY – Really?” you should start there to understand the dynamics of media-less horticulture and hydroponic living walls. Because of the popularity and frankly the ease of hanging felt, foam, coco husk or scrub pads this type of living wall has gained momentum. I can’t blame anyone for wanting to utilize this technique it’s quite easy to install, lightweight and easy to transport but keeping the plants alive is another task. Even with media based wall systems it is critical to have the correct lighting, moisture and nutritional needs. Over my experience the single most important factor beyond light and nutrition is the need for oxygen exchange at the root level. If you have already read the archived article you will know that this is the single most critical variable to prevent disease. This is where the majority of hydroponic walls fail, plant loss due to anaerobic activity and it is primarily due to the material used as the hydroponic build up and this is coupled with poorly devised irrigation systems and inexperience with fertilizers, nutrition and microorganisms. The layers of materials literally suffocate the roots. I equate the situation to being able to build a computer but not having the software to make it run. In previous articles I talked about the materials, coincidentally we have some of the newest technology being released in the next few weeks that prevents root rot and increases aerobic activity and nutrient uptake by 300%. Our current experience we are able to utilize our patented technology with both media and hydroponic applications because there are no layers to suffocate the roots, accept my apology in advance because of the competition I’m not going to reveal what we use in our hydro walls however you can enjoy the great work of Greg Lee via 1st Look Exteriors who has mastered the use of our technology specific for hydroponic use however the principles of irrigating hydroponic living walls is relatively the same.

Irrigation is the delivery of water and nutrients to the plant roots and one of the key components to hydroponic living walls. Start with the visual and dynamic of a hydroponic living wall realizing that unlike horizontal growing we have to consider the vertical alignment and gravity.

Because of gravity the calculation of water is somewhat of a guessing game for the novice. Gravity will pull water through the wall to the bottom; this result is a system that will dry out at the top long before the bottom becomes dry with a tendency to overwater. The best advice without disclosing the calculations is to utilize multiple zones; the more zones the more control you have over the water volume and frequency.
Typical horizontal hydroponics designed as ebb and flow system, referencing the relation to the rhythm of the tidal changes, requires a tray. The tray is segmented and elevates the grow blocks or containers so they are not sitting in water, a reservoir and a pump. The tray design is important; you can’t use just any tray. The bottom of the tray has to have raised areas to keep the roots from being submerged or sitting in water. This is exactly the same principle with the popular built up hydroponic walls! No aerobic activity equals disease and root rot. Typically the pump is on a timer moving water to flood the tray with fertilizer directly to the plant root zone and then through an overflow the water drains back into the reservoir for reuse. A hydroponic living wall will not require a tray. This is an important part to the success of a hydroponic living wall. There needs to be aerobic activity at the root level, the layers of material sandwich the plant roots creating an anaerobic environment. In a horizontal set up the tray allows for air flow and the roots can breathe never being submerged in water for more than a few seconds taking up nutrients as the water recedes back to the reservoir.

Hydroponic tray shown with channels that allows water and nutrients to flood the tray and recede back to the reservoir. The plant roots literally sit up and out of the water that is left in the tray preventing root rot due to anaerobic activity.
Typical Ebb and Flow Cycle for Horizontal Hydroponic Applications

The above diagram shows the water flow cycle flooding the root area with nutrients and then receding back to the reservoir. This action alone adds oxygen to the water and avoids sitting water. An additional air stone may also be required in the reservoir to oxygenate the water.

When water is not oxygenated disease is imminent, root rot is caused by *Phytophthora*. Spores will also contaminate other plants if there is adequate water. The figure to the left displays classic root rot (top plant) and the onset of the disease shown in
the lower plant. The roots are sandwiched between two wet surfaces never allow a reprieve from the constant moisture.

Living walls pose a challenge to meet a fine line and balance between having enough moisture without being excessive, causing root rot. Looking at various types of hydroponic living walls, one is the felt or layered materials like the one Patrick Blanc made famous and modular systems using various rooting materials from rock wool to coco husk. I started this article to describe the how to process of irrigating hydroponic living walls and as you can see just by the types of materials there will be just as many irrigation configurations not to mention the new living wall technology application coming soon that will pretty much do away with 99% of water all together as if the industry is not confused enough.

Figure 1 & 3 display a felt layered hydroponic living wall while Figure 2 shows a bagged system with coco husk. Both materials will require an irrigation system that is different and specific to the application of the system and the materials used. The felt in Fig. 1 will always be wet or if it is allowed to dry out of the fabric will shed water instead of absorb it. Coco husk shown in Figure 2 holds no water and in fact allows 99% of the water to simply run through. These are two extremes where clearly one system will have too much water and the second not enough making the irrigation system difficult to design around. Also with the felt there will always be more water at the lower portion of the wall making the calculation of the water use very difficult. The result may be too much water, not enough water and an imbalance of nutrients. Unlike the ebb and flow there is no rhythm to the flow of water and nutrients and no constant measurement, this also makes it difficult to monitor nutrient use and may cause over or under fertilizing. It's also not uncommon to include a highly technical monitoring system to alarm the technician of changes in pH, moisture levels, temperatures, nutrition, quantity and frequency or the water application.

The best advice I have for the novice living wall technician is to simple monitor the wall and collect data on a weekly basis to determine the rates and applications of water and nutrients throughout the first year. Even if the living wall is indoors the plants will go through some seasonal changes. Throughout the yearly cycle the technician must be acute enough to adjust the irrigation as needed. After the first year the data log will reveal a predicted cycle.
Which irrigation system do I use for my living wall?

There are two common options. There is a potable water connection or a reservoir. The reservoir is typical of the ebb and flow hydroponic system with fertilizer already mixed into the water which is continuously reused until one or more of the variables such as temperature, pH, aeration, disease etcetera are altered forcing the disposal and cleansing of the holding tank. The potable water source is a direct connection to a city or water supply not recycled and will have a fertilizer injector. This type of connection removes many of the variables in hydroponics however are subject to water purification additives like fluoride and chlorine. Too many parts per million of chlorine will hinder plant growth and kill off beneficial bacteria. To improve the quality of water it is simply a matter of adding a specialized filter to turn potable water into distilled removing the harmful additives.

Both types of irrigation systems will require specialized equipment, fertilizer and beneficial bacteria (GLTi has bioSoil Link [http://agreenroof.com/glti-biosoil-superior-green-roof-living-wall-media/]). The
question you have to ask yourself is: Do I want a reservoir or do I want to use potable water source. Once you decided on what the source of irrigation water will be the next step is to calculate how many zones and in what configuration the wall will need. I have been glad to explain how to connect from the water source to the drip lines, how you configure the drip line is up to you, frankly this is one of our trade secrets and I’m not willing to disclose the exact how to part.

We have already discussed that all irrigation systems start with the water source or supply also known as the POC or point of connection. An ebb and flow system will contain a water reservoir with fertilizer already premixed. The second option is to connect directly to potable water. Irrigation is relatively simple process, the water moves through a supply line from the POC into a fertilizer source through a valve and filters and then to the specified watering “zone” controlled by the “zone valves”. The zone is a defined area of the wall in which water is applied. The number of zones is dependent on the size of the wall. Depending on the location of the zone the frequency and quantity of the water is controlled by a timer, monitoring system or both.

Here is the critical part of experience. Rhetorically speaking, how do I know how many zones, how much water should I calculate? This is where I stop; sorry irrigation is one of the critical components to the success of living walls. I will elaborate enough to help you experiment. There are key variables that impact each and every living wall. Elevation (North, South, East, West), geographic location, seasonal changes, impacting surroundings (other buildings or trees), interior applications, height, length, plant type... just to name a few! The one piece of advice I will disclose is to use like minded plants. This means use plants in the application that require the same type of water needs, this will make calculating the irrigation much easier, you won’t have to try and decipher multiple zones and various plant requirements. Second remember gravity is a part of the living wall irrigation design. I have seen inexperience designers and manufacturers for that fact unable to properly design irrigation systems for living walls. Water flows down, this means the calculations for water needs based on the multiple variables has to account for the fact the upper part of the wall will dry out faster than that at the bottom. Two additional pieces of advice: Put plants that like more water at the bottom and calculate the water volume for two different cycles, one that will saturate the entire wall and the second that will supply only the upper portion.

There are two types of applications for hydroponic irrigation. One has a reservoir the other is potable water. Both will require a fertilizer source, both should include a biological additive like bioSoil. The decision is simply based on preference. The success comes from the ability to adjust the system as needed to meet the plants needs according to many variables.
1. Point of Connection (POC)
2. Zone Valve with Filter
3. Fertilizer Injection
4. Automated Timer

The picture to the left depicts the reservoir used to irrigate this living wall. This is the “Source” for this irrigation system.