

Reasons and Remedies to the Dying Plant Walls

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Sustainability in construction has been increasingly popular and detrimental with the state of the planet and climate change. One of the more popular solutions is the addition of plant façades to a building, which are plants that are put on the vertical of a building. The benefits that come with plant façades include and are not limited to: Reduction of the urban heat island effect, improved air quality, local job creation, improved energy efficiency, building structure protection, noise reduction, increased biodiversity, urban agriculture. These benefits are not reaching their full potential because these plant façades keep dying creating a bigger waste than if not installed at all. The main purpose of this paper is to look at what goes into keeping a plant façade alive and why they keep dying. With the addition of interviews from current landscape architects, we can conclude whether or not newly proposed ideologies such as integrating landscape architects earlier in the design process or biocurtains will help remedy this problem. These newly inputted opinions and facts may ultimately lead to a lot more green covered buildings and a reduction in greenhouse gases, while also increasing funding and research on the subject.

Key Words: Landscape architecture, Design, Sustainable, Integration, Green Façade

Introduction

Though not common in most commercial/industrial settings, plants offer many benefits when placed on the side of buildings. However, a big problem with plant façades is they are an afterthought and once they are included on a project they often come without a plan on how to maintain them (Rentokil, 2021). Frequently, these plants end up dying creating a bigger waste than not having them at all. The more knowledge about this rising trend will diminish waste and will lead to new technologies on watering techniques or replacements to what plants are currently in place. Proposing ideas that seem unpopular or new may open doors up for more improvement and innovation to help remedy this issue that continues to have problems. The addition of more plants onto buildings will help further guide the industry into a greener building since our generation is more for ecofriendly practices and the reduction of our carbon footprint.

Literature Review

Green façades were patented back in 1938 but publicized by Patrick Blanc a French botanist in 1986. Blanc's vertical garden system (Mur Végétal) is what we use today with slight variation. It involves a metal frame attached to the building, a layer of PVC, and a thin polyamide felt. The research and evolution of this system has not gone far since then since it has only gained popularity in the 21st century (Bianchini, 2019).

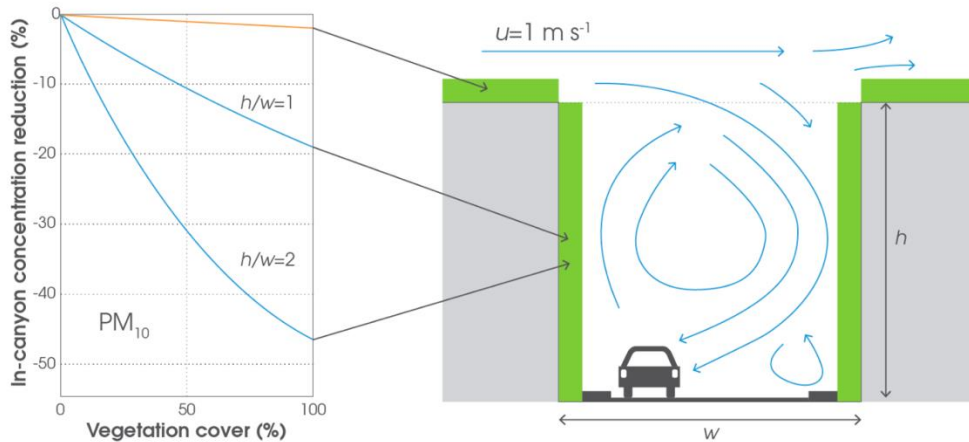


Figure 1: Effectiveness of Green Infrastructure for Improvement of Air Quality In Urban Street Canyons (Pugh, 2012)

In cities there is a reduction of moisture and the increase of reflective surfaces due to all the concrete and buildings. This with the combination of global warming has made the urban island heating effect a prevalent issue. Ultimately this leads to uncomfortable weather and increased use of cooling, which in turn contributes to the toxins in the atmosphere. The benefits of these green walls aim to fix these issues. The reintroduction of vegetation into urban environments promotes the occurrence of natural cooling processes, such as photosynthesis and evapotranspiration (Greenroofs, 2015). These plants can help trap toxins and help lower extreme heat. In figure 1, you can see the concentration of trapped pollutants reduce as the vegetation increases. Heat can also damage building facades and plants can help add an additional insulated layer to aid in the temperature fluctuations. In additions, Greenroofs states, “Green walls can help mitigate the loss of biodiversity due to the effects of urbanization, help sustain a variety of plants, pollinators and invertebrates, and provide habitat and nesting places for various bird species.” All these environmental positives and there is still the benefit of visual beauty. These walls add character and green to an otherwise industrial city.

There are many reasons why plants are not living as long as they should. When adding plants to a building there is a lot of research and effort that is involved in order to be on a path of success. The reasons why plants aren't surviving have to do with: wrong plant species selection, mismatched design with site needs and climate, inadequate irrigation and drainage, maintenance needs, not having experts in elevated horticulture care (Tensile, 2019).

Currently what is in place right now to take care of green walls is a mixture of two things: replacement and irrigation. For replacement, there are many buildings that will have plants that only last around 1-5 years on the building and have them replaced due to overgrowth in roots or dying (Rentokil, 2021). The second treatment involved is a hidden irrigation systems on the building. This usually involves hidden pipes that have a watering system that is connected to the building. This however can lead to poor drainage and death in the plants or damage to the building.

In order to have success with thriving plants a landscape architect and botanist should be present during the whole process. With both parties involved, their knowledge of plant care will improve the

chances of those plants surviving by knowing what plants thrive in certain atmospheres and the required maintenance to keep them alive (Mustonen, 2017). Further, in order to have a higher rate of survival, plants must be picked native to where the building is. Not only does the plant have to do well in that environment, it also has to be suitable to thrive in a vertical atmosphere. What also comes into play is the aspects of micro climates that being in a city creates. The shading of buildings, the intense heat, gusts of wind; These all vary in the city depending on the buildings surrounding it.

Proposed Solutions

These proposed solutions I have generated through the knowledge I have obtained at Cal Poly along with the many new ideas that are being tested out in order to reduce CO₂. Through further research I found that these aspects could be useful when it comes to extend the life of living walls on a building. I will then propose these new solution to industry professionals in order to get their opinion and input on the matter.

Integration

In the design process Landscape architects are brought on at the end of the project and are viewed more as an afterthought. By having the landscape designers brought in early in the design process there can be more collaborative work that can lead to longer lasting plant walls. When plants are put on a building after it has been constructed it will be attached via a metal structure or straight on the building. These are often times accompanied by the irrigation systems that help keep them alive, but this can result in rot or corrosion from the leaks or nutrients of the plants. The systems that are attached to the building can also cause damage to the outside because of the weight of the plants and when plants are placed directly on the building it can cause damage to the outside of the building.

Having landscape architects on early on the project can help bring new and innovative ways to incorporate plants . Landscape architects knowledge in plants and construction gives them an advantage when it comes to how plants should be maintained and the drainage necessary. Much like design-build, this style of design can help mitigate mistakes and help save money in the long run. Landscape architects can also help choose façades of the building that best support the cultivation of plants on the outside.

Biocurtains

There has been a newly proposed way of cutting down the carbon dioxide (CO₂) and it has to do with microalgae put into plastic curtains. Algae is a phototrophic organism which means it obtains what it needs from the sun and atmosphere; this allows it to absorb the things in the atmosphere such as CO₂. In addition to CO₂, because Algae has higher photosynthetic efficiencies it allows it to absorb nitrogen dioxide (NO₂) and sulfur dioxide (SO₂) – gasses that are harmful to our ecosystems. Algae creates around 71% of the worlds oxygen, which is a lot more than any terrestrial plant; This is why these organisms could reduce the pollution optimizing the space it occupies. (Malinska, 2010).

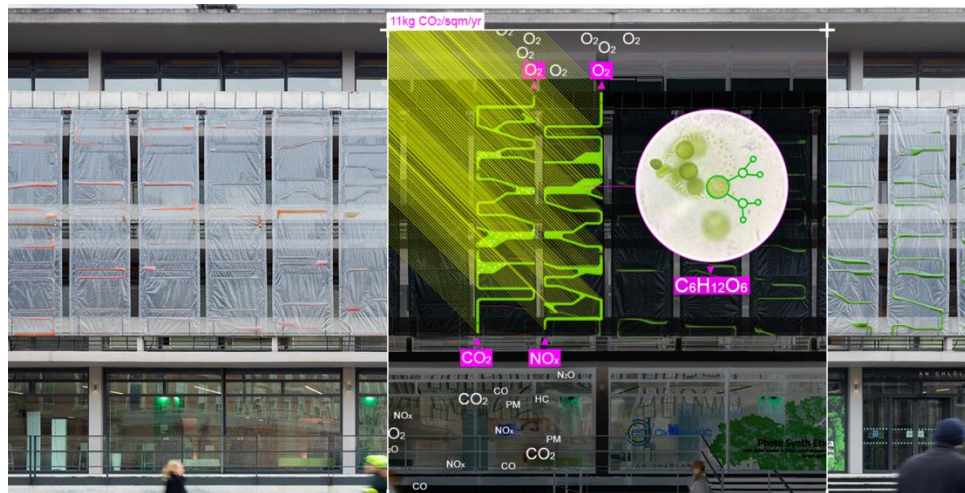


Figure 2: Air Pollutant Filtration (EcoLogicStudio, 2018)

The creation of these biocurtains by EcoLogicStudio has made it a possibility to be placed as a façade on buildings in the city. Currently, there is only a prototype available, but with the right resources and production of these curtains could take away the need for constant maintenance of the green walls with most of the same benefits (EcoLogicStudio, 2018). As seen in figure 2, the toxins in the atmosphere are picked up from the bottom of the curtain and oxygen is then released through the top of the curtain.

These organisms require very low maintenance. There are certain nutrients that these algae need along with the sun and atmosphere, but it is far less than what is required with terrestrial plants. There is no worry of over grown roots, irrigation system, or dying. Algae reproduces asexually or sexually in the plastic curtains and creates adaptations to harsh conditions when necessary (Parker, 2019). The problems with attaching these plants are also eliminated. Algae weighs a fraction of what plants weigh and their support systems can be placed on most facades with no damage. The cost benefit of the algae is another enticing aspect to consider. The cost to upkeep these algae is a fraction of what it takes to keep plants alive. With the water consumption problem our world faces this is a very ecofriendly solution because of the little water to no water needs.

There are some things that will be loss due to the dramatic differences of the types of plants. Algae does not have the same visual affect as terrestrial plants along with the ability to reduce noise. The very low maintenance of these organisms also means there won't be the creation of more jobs. All these things are in exchange for a higher chance of carbon neutrality and cost efficiency.

Methodology

I will be using quantitative research for my topic of solutions to dying plant facades. For my data collection methodology, I will be using interviews to 3 current landscape architects. This would be the most effective method for my project because it is theoretical and professionals in this field would help greatly with their input. I will be asking the landscape architects about their experience when it comes to the design process and what things they would do if they had to chance to be early in the design process. I will also get their personal opinion on the other proposed ways on my solutions to

the dying plant facades. It is important that these landscape architects come from different firms so that the data sample is more varied.

The objectives of this analytical research are as follows:

- Knowledge of the current field
- Get a very perspective, rounded answers that concludes the proposed solutions
- Opinions on the potential of the proposed solutions

Questions

1. Have you worked on any projects with a green façade? If so, what is the process your firm took to mitigate all the issues that come with having a green façade?
2. Do you know what practices are in place currently to help keep green facades alive? If so which ones?
3. Do you think that green facades are worth the time, money, and effort that goes into having them on buildings?
4. Do you think it would be beneficial if landscape architects were involved earlier in on the design process in order to help keep these green facades from dying?
5. Bio curtains are a new discovery that places algae in these curtains that are hung on the outside of buildings to help convert the CO2 to oxygen. They help clean the air in compact cities while being relatively low maintenance. Do you think that bio curtains are a good replacement for green facades or do you think that green facades add something more to a city than just helping clean the air?
6. Do you have any other radical ideas that you think will help keep green facades from dying?

Results

Nick Wong – LandCreative Inc.

At LandCreative Nick has assisted in the installation of a couple of live walls. Nick feels green walls are going to be featured on design in the future. There is a lot of enthusiasm and optimism around green walls for our generation and thinks the popularity will definitely increase in these upcoming years. He thinks the current problem is just the time and investment needed to properly maintain a functioning green wall. The biggest negative against green walls has been the level of investment. Many clients not willing to invest in green walls; Most clients try and cut costs in design and one of the first item they cut is the green wall. He does believe green walls will be more prevalent in the future. He thinks that having landscape architects on early goes hand in hand with having more investment, but could be beneficial. He doesn't know much about the biocurtains, but it sounds like an interesting concept and sounds like it could reduce the cost of maintenance.

Anh Thy Tobin – LPA Inc.

Anh Thy thinks that when brought in early, landscape architects can provide information to the client at the schematic design (SD) and design development (DD) phase. A 3rd party estimator can then provide a cost estimate at SD and DD to see if project design aligns with the clients budget and goals, especially maintenance cost. Since the wall is a living structure, continue maintenance is needed for the life of the wall. LPA, her company, has designed a living green wall on the outside of Edwards Lifescience Parking Structure in Irvine, CA, and inside her former office. She thinks that biocurtains

sound like an interesting solution, however she states that living green walls bring nature into our environment. Studies have shown that nature objects and images help with mental wellness and promotes wellness. She thinks AC condensation can be captured and used to water living green walls. Most AC units are placed on the building's roof. Condensations can collect in a cistern on the roof, then using gravity to water the plants through drip tubing. Most of the time a pump is needed to boost the water to the top of the wall. This would eliminate a pump and water. More living roof gardens and vertical green screens with vines are good alternatives. Overall, Anh Thy thinks that green walls are beneficial because they allow more plants on earth which reduce CO₂ and convert into O₂, especially in urban environments when ground planting is minimal. Cost and maintenance are probably the two top reasons why living walls and roofs are not installed on more projects.

Trevor Gorman – Hapa Landscaping

Trevor has not been in the business long, but has been involved in an installation and design of a live wall. He says a lot of research goes into the selection of the correct living wall system based on the design, project budget, and maintenance. He finds it highly valuable to present different options based on these criteria to the client. These systems are not cheap. For the living walls to be successful, his firm recommends the client hires a maintenance company that specializes and have an understanding of the system. Lack of maintenance and not setting aside appropriate annual maintenance budget are the top reasons why these systems fail. Automatic irrigation systems help keep the living green wall alive, however some plants do need to be replaced now and then. A good substrate backing support and water proofing is importance to make sure the building is not damage. Also the system needs a drainage system to collect excess irrigation water. By having landscape architects earlier in the process the drainage system can maybe be incorporated into the design of the building or they can have the façade be compatible with these plant systems. Trevor has never heard of Biocurtains but sounds like it can have a positive impact on our air quality if produced properly.

Conclusion

The objective of this project was to minimize the amount of dying plant facades so that plants that cover buildings have a positive and not a negative impact in the long run. This may ultimately lead to a lot more green covered buildings and a reduction in greenhouse gases. After talking to different professionals from different firms I have concluded that what the number one issue is investment. Investment in evolving living walls and to have living walls is something that is missing, but very necessary in order to get anywhere in the future. The importance of health and well-being of the planet is very low compared to the cost of a building. If there is a choice between a one-time payment of a wall versus a wall that cost more to install and maintain, the client chooses the cheaper option. All of the landscape architects agree that there are issues with the current plant walls and there is room for improvement. With the addition of landscape architects early in the design process, there was no disagreement and they could not see what the downside of being on early on. The biocurtains from EcoLogicStudio are very new and not well known, however talking to the architects this can overall benefit the community if funded and produced correctly. With the research I found on algae, it would reduce more toxins in the atmosphere and more efficiently. All the landscape architects feel that with the addition to plants it well help reduce the toxins in the air and help reduce the urban island heating effect only leading to benefits for the community. Both proposed solutions can be possible ways to reduce the dying plant walls, but cannot be executed without the right funding. Construction constitutes a significant source of environmental concerns and this would be a great way to help reduce the pollution that it makes.

Future Research

With the data gathered, it would be beneficial if there was more time and money spent on these systems. As the industry professionals said, people aren't willing to spend the money on something that is not important now. Since this subject is so important for our future I think that the funding will be easier to obtain as the new generation comes into the field. Based off the studies that show the issues that come with global warming, this could help reduce the toxins and heating in urban cities. New and innovative ways can also be discovered and executed with such investment, such as using condensation from AC units to water the surrounding plants mentioned by Anh Thy. This could be a pivotal in the production of living walls.

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