

Green Facades: Ecologically Designed Vertical Vegetation Helps Create a Cleaner Environment

Green facades are self-sufficient vertical gardens that are attached to a structure built along a building's exterior. The facades differ from other green walls in that the plants are rooted in soil adjacent to the building rather than fastened to the wall itself. The plants receive water and nutrients from ground soil or hanging planter boxes. The concept of the green facade dates back to the Hanging Gardens of Babylon in 600 BC. Green facades have many uses and are considered an ecological technology. Once established, green facades need little maintenance and can grow as tall and as wide as its supporting trellis system will allow, depending on the plant species used.

Green Facades are a Smart Solution for Economic and Ecological Problems

Green facades offer many benefits to their surrounding environment including buffering building temperatures, cooling the local air temperature, providing air filtration, reducing stormwater runoff, ameliorating noise pollution, removing carbon from the air, providing shade, and creating habitats for plants and animals. In many cases, green facades are intended to be aesthetically pleasing. Research shows this biophilic aesthetic makes people more relaxed, productive, studious and mentally healthy.

Green facades can potentially reduce energy consumption. Plants on the facade shade a structure's surface, as well as cool the surroundings through the process of evapotranspiration. Green facades reduce wall surface temperatures by as much as 25°F (14°C) compared with exposed wall surfaces.⁶

During an experiment based in Maryland, green facades cooled exterior wall temperatures by an average of 13°F (7.1°C) in the summer months.⁶ Green facades can also reduce heat transfer to a structures' interior.⁶ With cooler interior temperatures, demand for air conditioning in warmer months declines, reducing energy consumption and greenhouse gas emissions and increasing energy savings.

Reducing surface temperatures of existing structures, as well as ambient air temperature, can also mitigate the urban heat island effect. An urban heat island is a metropolitan area that is much warmer than its surrounding rural area. Higher temperatures can lead to negative health impacts, reduced air and water quality, and increased energy demand.

One reason urban areas become comparatively warmer is that building surfaces absorb a significant amount of the sun's rays, which is released as heat and increases the temperature of the surrounding climate. Green walls lower exterior wall and ambient air temperatures. A Maryland study showed green facades cooled ambient air temperatures by an average of 2.5 to 3.2°F (1.4 to 1.8°C) in June, July and August. Another study in Hong Kong predicted a maximum decrease of 15.1°F (8.4°C) in an urban canyon if both walls and roofs were covered by vegetation.³

Green facades have many ecological benefits, making them an excellent example of ecological technology. The addition of new habitats in urban

environments, for example, can benefit species affected by habitat destruction and fragmentation.

In particular, birds and insects may benefit from the façade plants. Green facades also benefit the environment by improving water and air quality. Façade plants use and slow stormwater flow before it joins urban runoff, Air quality is improved when façade plants capture particulate matter and take up air pollutants such as CO₂, NO_x, and SO₂.⁵

Green facades create an appealing natural façade, adding aesthetic value to a building and positively affect the mental and physical wellbeing of those around it. Studies show that green structures and landscapes are associated with faster patient recovery time, reduced stress, and improved mood.^{4,7,8}

Vegetation Grows on a Frame in Green Facades

The height of green facades is only limited by how high plants can grow since trellis systems can span significant heights. There are two types of green facades:

- Modular trellis systems are installed vertically and can be placed directly onto an existing structure's wall, or constructed as a freestanding structure.
- Cable systems are potentially more complicated since they must be assembled on-site (figure 1).

Cable Systems Must be Attached Directly to the Wall, and Can Cover Large Areas

Installation of green facades requires skilled carpentry or masonry. Some installations necessitate construction and maintenance of planter boxes. Green façade cable systems most often are attached to the outside of a building and require cables held in tension with a series of connectors at each intersection between vertical cables and horizontal rods (figure 2). These cables are usually made of stainless steel, which ensures durability. Anchors are bolted into the building façade, onto which cables are

attached. This provides the permanent framework for the remaining system of cables to attach.

Figure 1. Rod and cable trellis systems are installed vertically



Care should be taken in both the planning and installation of a green façade cable system, as proper anchoring and cable spacing are vital to sustained welfare of the trellis.

Figure 2. Cables systems use connectors at each intersection between vertical cables and horizontal rods



What Types of Plants Can be Used?

1. Native vines are best suited for Maryland's climate (water needs, sensitivity to drought, temperature tolerance, soil type, solar exposure, and wind tolerance), will require little maintenance, and promote local biodiversity.
2. Twining vines, such as coral honeysuckle, grow by winding their stems around vertical supports to grow properly, and will grow successfully on wires (figure 3).
3. Grapes are an example of vines with tendrils which have thin stems that wrap around a vertical structure in need of support (figure 4).

Figure 3. Twining vines wrap around vertical supports



4. Aesthetically pleasing vines provide visual appeal. When selecting vines, consider vine leaf size, flower color, flowering season, fruiting potential, nitrogen fixation, attachment mechanism, seasonal persistence of the leaves. There are many food producing vines.⁹

5. Nitrogen-fixing vines, such as American groundnut (*Apios americana*) produces an edible

Figure 4: Grapes are an example of a vine with tendrils



tuber that tastes like a cross between a peanut and a potato, and fixes nitrogen for self-fertilization.

Recommended Vines for the Mid-Atlantic U.S.

- American bittersweet (*Celastrus scandens*)
- American groundnut (*Apios americana*)
- Coral honeysuckle (*Lonicera sempervirens*)
- Crossvine (*Bignonia capreolata*)
- Wild grapes (*Vitis riparia* or *V. rupestris*)
- Leather flower (*Clematis viorna*)
- Virgin's bower (*Clematis virginiana*)
- Passion flower (*Passiflora incarnata*)
- Yellow jasmine (*Gelsemium sempervirens*)¹⁰

There are Plants that Should Not Be Used

Vines that attach to walls and other flat surfaces using small rootlets along stems, should be avoided because they can damage building surfaces. These

clinging vines are poor choices for a green façade because their creeping tendency can widen cracks in mortar and damage brick walls. Clinging vines also collect moisture and can lead to wood decay. Examples of potentially damaging vines include English Ivy (*Hedera helix*), Morning glory (*Ipomoea spp.*), Boston Ivy (*Parthenocissus tricuspidata*), Hedge bindweed (*Calystegia sepium*), Virginia Creeper (*Parthenocissus quinquefolia*) and Poison Ivy (*Toxicodendron radicans*).

Non-native vines, such as English Ivy, do not support local biodiversity so they should be avoided. English Ivy is a non-native plant in the United States. It is invasive and can damage buildings and facade structures. English Ivy can take over other vines to exclude them from the facade and grow beyond the trellis to areas on the building not intended to be covered. It may also out-compete native species which will reduce biodiversity.

Trellis Materials and Installation Labor are Main Costs of Green Facades

If possible, facades should be incorporated into existing structures to lessen or eliminate additional costs related to support of the façade. Miscellaneous expenses for shipping, fasteners, plants, soil preparation and irrigation systems should also be included when planning a façade system.

During the design of green façade systems, the composition of the existing structure should be assessed to determine the types of fasteners and attachments needed for the system. Loads on the façade also should be determined during the design stage to account for snow, ice and wind. Potential loads on the façade, as well as thermal expansion and contraction may dictate the material needed to construct a physically secure system.

Figure 5. Virginia creeper, English Ivy and other vines with aerial roots can grow into cracks and damage buildings



Building codes related to a façade system may affect the cost of a system. Zoning codes and the necessary construction permits and zoning codes should be investigated prior to planning to ensure the project will not be halted by regulations. Considering the different types of systems, manufacturer and regional labor rates, a general fixed cost or even range of cost for green facades can be difficult to formulate.

There are multiple manufacturers that sell trellis materials for green facades in the United States.

With Proper Planning and Installation, Maintenance of Green Façades Can be Minimal, Requiring Only Periodic Checks of Systems

A maintenance plan should be developed during the design stage of the façade system to minimize expensive upkeep. The main maintenance requirements for a trellis system are inspection of the fasteners, cables, anchors and existing building material for potential issues. Storm drains and gutters in close proximity to façade systems should be monitored for blockage by plant debris. If needed, snow and other weather related debris should be removed from the façade system to reduce potential damage to the structure and/or associated plants. When irrigation systems are installed for facades, they should also be periodically monitored for leaks to ensure water is used efficiently and is reaching the intended areas for irrigation.

In urban areas, salt toxicity from snow removal can play a role in façade health when the system is in close proximity to roads.¹² An irrigation system may be necessary in areas where drought conditions occur.

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