To Our Reader:

In our new series of green roof project assessments, Green Roof Technology intends to analyze extensive green roofs all across the world and relate them to the market in which they are located. Extensive green roofing has become increasingly localized, where local policies dictate market conditions and create unique environments for constructing green roofs. In the following assessment we set aim on the Toronto green roof market.

We believe the Podium Roof Garden acts as a highly visible example of a green roof designed and constructed in a mistaken fashion. The aim of any green roof, or any other kind of BMP, is to create a sustainable, low-maintenance environment in the most cost-effective way possible. Whether a green roof stormwater management program is established as a requirement, an incentive, or a tax, all parties involved—the regulators or the regulated—must understand the technical properties of green roofs and how they are designed and constructed in the most cost-effective manner. The confusion in the industry can be traced to its history.

The green roof industry in North America is still very new, little more than a decade old. During the industry’s infancy, many systems and technologies were created by a variety of companies, each with differing experiences, specializations, and varying degrees of green roofing knowledge. The result has been a patchwork of green roofing systems—some experimental or antiquated, others well-established and proven to work for decades in Europe. This has led to a continent full of beautiful, well-functioning green roofs but also a continent rife with under-performing and failing green roofs.

Toronto must remain a progressive city, rewarding its citizens with a safe, healthy, and beautiful place to live. The green roof program is an essential aspect of Toronto’s long-term goals. What is required of the city, and of any other city in North America, is to establish a clear consumer-oriented guideline for the best-practice in green roof construction. An industry wide effort must be made to reduce the market price of designing and installing green roofs. The result will benefit the multitude over the few in the decades to come.

Sincerely,

Jörg Breuning
The Podium Roof Garden at Toronto City Hall

An Assessment

By

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**ABSTRACT:**

On 29 May 2010 the Podium Roof Garden at Toronto City Hall was opened to the public during Doors Open Toronto, a yearly celebration of the city’s heritage buildings. Over two days, multiple ceremonies and events were held commemorating the opening and celebrating the beautification of a landmark square. The 3400 m² Podium Roof Garden was designed by Toronto based Plant Architect Inc., in collaboration with the firms Shore Tilbe Irwin & Partners (now Shore Tilbe Perkins+Will) and Hoerr Schaudt. The green roof is comprised of a 4 – 6 inch LiveRoof tray system and was installed by Gardens in the Sky, a division of Flynn Canada. The reported cost of the green roof was $2.3 million. This total cost is equal to $675.00/m² or $60.00/ft².

The Podium Roof Garden is an award winning design, the product of several talented architectural and landscape architectural firms. The complexity and intricacies of the design are apparent when viewing any of the pre-production renderings (See Figure 1). Style and individuality are the hallmarks of any design firm; however, during the course of any project certain design and economic factors must be taken into consideration. The Podium Roof Garden provides an excellent case study of the psychology of green roof expectations and their economic costs.

Two key factors led to the writing of this study: an independent inspection of the site on November 2011 and the subsequent investigation into the project, which was highlighted by the discovery of the exceptionally high cost per square foot (See Appendix I). In the following sections Green Roof Technology (GRT) will report that the landscape architect’s design for the green roof led to higher installation costs and higher future maintenance costs, which were not been included in the total cost of the green roof.

The Podium Roof Garden has fallen victim to a psychology of unobtainable and opportunistic design expectations and the consequences have been expensive. By not employing the most economical approach to green roof design and construction, the City of Toronto missed an opportunity to either reduce costs by more than 50% or install another green roof of similar type and even greater area.

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2. The average CAD – USD exchange rate for Jan 2010 to May 2010 was .96818. If the reported cost was 2.3 m CAD then there is a 1.99 USD/ft² reduction in cost, or 3% overall.
3. Agora·Theatre won a 2007 Toronto Urban Design Award and a Canadian Architect Award of Excellence.
INTRODUCTION:

Green roofs and roof top gardens are a nascent field of design in North America and only beginning to rise along their exponential growth curves. Architectural and design firms all across the continent have been quick to join the market.

It is important to remind new designers and the public at large that the modern green roofing technologies necessary for a successful vegetated roof have been in production and in practice for over 40 years in Germany and other European countries (See Figure 2). In the last decade, the North American market has been flooded with a variety of green roof technologies in a wild attempt to secure a market share. Many of these technologies have been produced by companies completely inexperienced in the green roof industry. They have spent considerable time and money to advertise their products as superior when in fact they are inadequate and antiquated. The North American market has suffered from these tactics and consequently has not seen any dramatic reduction in the market price of constructing a green roof and remains five to ten times more expensive than its equivalent in Europe.

It is important to highlight the importance of maintaining a fine balance between design desires and feasible execution. Landscape designers should be encouraged to never force their green roof design, keep it simple, and allow a natural evolution to unfold within the space. Green roofs are a unique microclimate and the plant species that populate them successfully are often uncommon or unknown to many landscape architects. Green roofs and roof top gardens are a very specialized field within a broader discipline and require an engineer’s ingenuity combined with a horticulturalist’s experienced touch.
DESIGN & EFFECT:

The designers at Plant Architects created a green roof highly characterized by its right-angled geometry. It is likely this Tetris-like approach to green roof design influenced their decision to use a modular tray system. The Tetris motif was achieved by using pre-vegetated mono-cultured/mono-colored trays. These types of growth patterns are unnatural and are only seen in nurseries. LiveRoof described the Podium Roof Garden as, “installed in a pre-determined ‘random’ pattern on the roof.” This oxymoronic statement only further solidifies our belief that the Podium Roof Garden is the first taxpayer funded nursery on a roof.

By utilizing a pre-vegetated tray system, the designers of the Podium Roof Garden were able to create intricate patterns of color, texture and vertical height. And while the initial ‘wow effect’ was present, in less than two years many plants have migrated, some have died, and others continue to thrive and colonize all over. There are strong signs that significant portions of the green roof are evolving into a grassy and herbaceous meadow. Typically this occurs when the sedum-patches become colonized and dominated by taller grasses and wildflowers (See Figure 4). The sedum specie in Figure 4 is S. album, which is characteristically planted to provide rapid covering while other slower growing species can mature. The sedum is known to be easily dominated and will migrate to areas of less competition, such as cracks in the sidewalk, within three years.

The Podium Roof Garden was also designed with an irrigation system. It is often difficult to justify the need for an irrigation system when soil depths are six inches or shallower. Sedums, other low growing succulent species, many grasses, and herbaceous plants require no irrigation. A proper selection of plants will contribute as much as 40% of the roof’s capacity to store stormwater and can conserve water with equal effectiveness when quantities are in low supply. Needless to say, an irrigation system wastes potable water on plants that do not need it. This excess water only serves to promote the growth of unwanted plants from foreign origins. Another telltale sign that excess irrigation is occurring is the prolific growth of moss around the drains. The existence of significant moss growth shows that the drains are a prime area for vegetative growth and many other plants will attempt to colonize there. Vegetative growth in or around the drains will quickly lead to drain blockage, water logging, and root rot (See Figures 5). Not only is the irrigation system unnecessary, it is an expensive project addition that does more harm than good and causes more intensive maintenance requirements in the future.

It is safe to say that the Podium Roof Garden is designed to be of an extensive green roof depth but requires an intensive amount of maintenance. By forcing plants to live within unnatural delineated spaces, the roof will never achieve a natural balance and mature into a low maintenance ecosystem (See Figure 6).

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vi Additionally, it is worth noting that the firm Hoerr Schaudt had previously designed a similar geometric shaped green roof on 900 North Michigan Avenue in Chicago, which also utilizes a LiveRoof tray system (See Figure 3). http://www.greenroofs.com/projects/pview.php?id=778.


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The Podium Roof Garden is also noteworthy due to a couple peculiar design features. During GRT’s independent inspection an area of exposed drainage board was discovered (See Figure 7). Modular tray systems are designed to have all the drainage requirements contained within the module itself and do not require any additional drainage components. By laying the modular trays on top of a drainage board, the City of Toronto essentially paid for two drainage components. Considering plastic drainage boards are known to be the money making component of the entire system, they have the highest mark-ups, it is no wonder the roof cost so much.

Upon further investigation, GRT uncovered an article in the Daily Commercial News that reported contractors were surprised to find a 0% slope on the roof when it was documented to be 1%. Mary Tremain, of Plant Architect, was quoted in the article. “We had to redesign the insulation thickness, and that meant the whole sandwich (membrane, insulation and high-performance bedding) that we ended up putting on the roof brought the level of the paving up higher.” Consequently, “this became a building code issue, and the team had to heighten an existing guardrail, built around the podium perimeter when regulations were more lax. That, in turn, had heritage and cost implications’, Tremain says. ‘It was kind of snowball effect.”

There is no doubt that working with a modular tray system tied the architects’ and contractors’ hands and made engineering decisions difficult and solutions expensive.

Working with rigid, plastic green roof trays is like building with square Lego pieces. When problems arise and creative fixes are necessary, it can seem like you are trying to build the Oval Office out of Legos. Any biological system that is to be created must be malleable and adaptable to unforeseen challenges. In this case, GRT would not have needed to make any slope changes in the roof and worked with the 0% slope. The drain is always the lowest point on the roof and water will drain towards it. Inconsistencies in the roof can be dealt with by creating temporary retention ponds (See Figures 8).

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THE ECONOMICS:

How much money could the City of Toronto have saved? A similar monolithic, seamless semi-intensive / extensive meadow styled green roof can be installed for less than $30/ft². A significant portion of the cost reduction occurs in the cost of the plant material, which can be reduced over 80% by using seeds and cuttings. Overall, there is a potential savings of $1,202,090, which is more than half the cost of the final Podium Roof Garden.

It is also worthwhile to note that with $1,202,090 you can install 3723 m², or 40,070 ft², of a similar meadow style green roof or even more area of a less expensive sedum meadow type. This additional green roof area is equal to a potential annual stormwater holding capacity of 2,328,737 L or 614,295 gallons. The total potential stormwater retention is roughly equal to the volume of an Olympic sized swimming pool.

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viii Stormwater calculations are based on an 834 mm/year precipitation.

CONCLUSION:

In the previous sections the question of the designer’s intentions and the project’s execution were brought into focus. GRT believes the Podium Roof Garden acts as a highly visible example of a green roof designed and constructed in a mistaken fashion. The aim of any green roof is to create a sustainable, low-maintenance environment in the most cost-effective way possible. During the course of a green roof design, decisions are made that greatly affect the final construction cost as well as future maintenance costs. Special considerations must always be made to keep project costs down and future maintenance costs minimal. Practical designing and resourceful engineering can have a dramatic impact on reducing the average market price of constructing a green roof.

This brings us to our final question: When using public funds to finance green roof projects, do officials have an obligation to construct their green roofs, or other best management practice, in the most economical way possible? Or, are they to be allowed to spend more than is technically necessary to install a luxurious, pre-vegetated green roof so the first press event looks its best?
APPENDIX I:

The inflated cost per square foot of the Podium Roof Garden may not solely be the fault of the designer’s creative intentions. Whenever taxpayer money is used to fund a public beautification project there is a high potential for media exposure for all parties involved. Naturally, sponsoring politicians and government officials will attempt to capitalize on their investment to the highest degree possible, especially during an election year. They therefore only fund projects that will deliver the greatest immediate ‘wow effect’ during the first video broadcast or photo-opt. Architects and designers are well aware of this situation and design accordingly. This game between designers and government officials has an effect of significantly driving up the cost of a green roof.
APPENDIX II:

FIGURE 1: 🔗

- A pre-production rendering of the Podium roof garden shows the intention of the designer to create a complex geometric design highlighted by an intricate color pattern.
Over three decades of trial and error research in Germany has determined the built-up, monolithic green roof system to be the superior extensive green roofing system.

The built-up extensive green roofing system has proven to be the most cost efficient extensive green roofing system available.

The system is 100% recyclable.

The system is easily deconstructed, moved to another location and reconstructed if necessary. No handles requires.

A built-up extensive system eliminates or minimizes its use of plastic components.

Utilizing Electric Field Vector Mapping with the built-up extensive green roof system creates pinpoint leak detection accuracy.
FIGURE 3: Photo by Hoerr Schaudt

- 900 North Michigan Avenue in Chicago by Hoerr Schaudt & LiveRoof.

FIGURE 4: Photo by Green Roof Technology

- Sedum-patches will be colonized and dominated by taller grasses and wildflowers in the absence of intensive maintenance.
Moss growth on open-drains indicates over-irrigation and can lead to drain blockages, water logging, and root rot.
Sedum patches have begun to deteriorate and intensive maintenance will be required to alleviate the die-back.

Poor craftsmanship exposes the additional drainage board and irrigation hose.
Temporary retention ponds are an engineering solution to 0% sloped roofs and roof inconsistencies. Ponds also increase potential biodiversity.