

Green Roofs 101

Introduction

There is a growing trend in Canada towards the promotion and implementation of sustainable technologies and energy conservation projects. This “green” momentum has led to the development of a new sector of the economy to support these new initiatives (new laws, code changes, associations, certification agencies, suppliers, specialty contractors, consultants, etc). This article highlights one item of this paradigm shift in policies and design practices, generally referred to as “green roofs”.

Green Roofs

What is a Green Roof?

In its simplest form, a green roof is a living roof on top of a structural “dead” roof that supports the load of the vegetation. They are also known as roof gardens, eco-roofs or landscaped roofs.

The living roof promotes the growth of vegetation, and provides additional benefits such as air purification, habitat creation, reduction of the heat island effect and reduced storm water runoff. They also help to lower building energy costs by absorbing and/or deflecting the solar radiation, causing a reduction in heat on the roof. On a hot summer day, a gravel roof can achieve very high temperatures. A green roof could keep temperatures within the ambient range.

Types of green roofs:

There are two common types of green roofs with the following characteristics:

Extensive Green Roof

This type of roof system is typically 2-6 inches in depth with a weight of approximately 15-35 pounds per square foot (psf). Due to the shallowness of the growing medium and the hot microclimate on roofs, plants must be low and hardy, typically alpine, dry land or indigenous. The plants are watered and fertilized only until they are established. There is no irrigation with this system and the plants are moss, sedum herbs and grasses. Generally there is no public access to this type of roof. It serves as an ecological protection layer. Maintenance consists of a couple of visits per year for weeding and inspections.

Intensive Green Roof

This type of roof system is typically 8-24 inches in depth with a weight of approximately 60-200 psf. Some of the plant loading is localized and the structural capacity of the roof must take this into consideration. There is a regular irrigation system and typical vegetation includes lawn plants, perennials, shrubs and trees. This type of roof is a park-like garden with walkways and seating areas. It provides for a higher diversity of plants and habitats with excellent insulation properties and storm water retention capabilities.

Some literature references other types of green roofs, but they are variations to the ones noted above, which are the most common.

Components of a green roof

Above the structural roof the green roof system consists of insulation, a waterproof membrane, root barrier, drainage layer, filter cloth and the planting medium. The thickness varies depending on the type of roof chosen.

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In terms of roof loading, the extensive roof could replace the weight of the ballast commonly used in flat roofs. Therefore the additional loading, if any, may be minimal. For intensive roofs, the loading pattern can become very complex. In either case, the structural capacity of the roof should be verified by a design professional.

Costs

Life cycle costing indicates that green roofs cost about the same as a traditional roof but provide a number of social, environmental and economic benefits. The actual construction costs will vary depending on whether it is new construction or a retrofit. Accessibility, area labour rates, type of roof, irrigation system and other factors will impact the final cost. Also, the larger the roof, the more economy of scale can be achieved.

Major Benefits of a green roof:

1-Energy Savings

The extent of the energy savings will depend on the size of the building, the area of roof exposure, its location, the depth of the growing medium, and the type of plants chosen. In one to two-storey complexes where the roof area is large, the cooling energy savings can be substantial.

2-Roof Membrane Protection

Green roofs help to protect the roofing membranes from the extreme temperature fluctuations and the impact of ultraviolet radiation.

3-Sound Insulation

Green roofs also insulate for sound with the growing medium blocking lower frequencies and the plants blocking higher frequencies. This may be a priority consideration where airline flight paths are an issue.

4-Fire Resistance

Due to the potential drying of the plants and the related fire hazard, the integration of firebreaks is recommended. These breaks would be made of non-combustible material such as concrete pavers. We also recommend using 'fire retardant plants' such as sedums that have a high water content. A sprinkler irrigation system connected to the fire alarm should also be considered.

5-Storm Water Retention

A heavily vegetated green roof with 8-16 inches of growing medium can hold between 4-6 inches of water. Over many acres of roof in a municipality, the demand on the outflows can be impacted significantly.

6-Other Benefits

School boards can use the green roof as a teaching classroom and health care facilities can use them as part of patient therapy. In addition, green roofs filter out fine airborne particulate matter and the rain washes it into the growing medium below. Plants also absorb gaseous pollutants and hold them in their leaves, which later become humus.

7-Considerations

Before any construction begins, it is prudent to include the following considerations in the planning and design phase. At a minimum, we recommend:

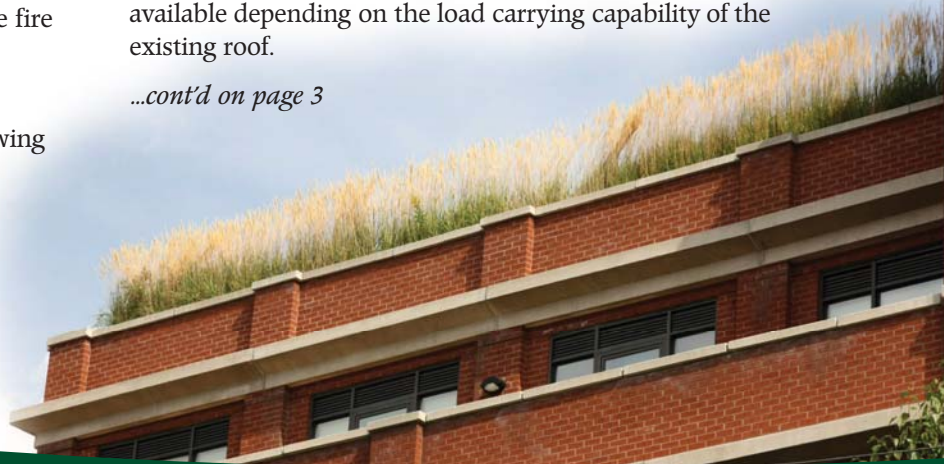
- An analysis of location, climate and roof orientation for the selection of plants and trees and growing conditions
- Confirming exposure to wind and wind gusts to resist uplift and wind blown debris control
- Completion of a roof flood test prior to the construction of the green roof – this should be a mandatory requirement of any contract and the results certified by the contractor
- Checking the weight of the saturated soil – this may be a large part of the dead load the roof needs to support
- Checking snow loading and drifting live loads as per the building code
- A review of the green roof plan with the fire and emergency response departments

In addition, you should check:

- Freeze/thaw considerations
- Roof occupancy and building code compliance with lighting, exits, guardrails, and barrier-free access
- Roof drainage and waterproofing
- Root size for selected vegetation
- Accident prevention for the maintenance personnel

For new buildings, the architect – in conjunction with the structural engineer – can easily incorporate a green roof design since the entire infrastructure can be included in the construction. For existing buildings, a structural consultant and landscape specialist should be retained to ascertain the options available depending on the load carrying capability of the existing roof.

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Winter Maintenance – Are you prepared?

Municipalities are mandated to provide safe roads for the travelling public during the winter season. To meet this mandate, municipalities undertake a number of activities, such as plowing, salting and sanding to ensure that winter road surfaces remain clear and safe. Controlling snow and ice is a key part of any winter maintenance program.

Winter Season Preparation

Well ahead of the winter season, public works departments begin their preparations. This usually includes:

- 1) Ordering salt and sand
- 2) Readying equipment by mounting plows, wings, brine tanks, sanding boxes and other equipment onto vehicles
- 3) Recalibrating equipment
- 4) Conducting pre-season meetings with staff and contractors to explain service levels, route familiarization
- 5) Training new staff in service levels and equipment

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Integrating Rooftop Turbines

In the eagerness to contribute to our environment, some owners are also considering the inclusion of rooftop turbines for power generation. This in itself is a separate subject but for the purposes of this article the following considerations should be noted:

1. High rooftops do not have laminar wind flow and because it is highly turbulent, the noise and vibrations can ripple through the building's structural frame.
2. For a turbine to produce sufficient power for tall buildings, the size of the turbine and its integration with the structure will need specialized input.

Conclusion:

Green roofs are not only economical – they can provide added value to a formerly stark roof, and are practical and environmentally responsible. It's easy to see why green roofing is gaining momentum in Canada, and there will be many future opportunities to incorporate these into new and existing buildings.

Professionals who can incorporate all the various factors that influence the cost should provide a green roof design. We also recommend you consider some of the points we have listed above before the construction phase to ensure you maximize the benefits a green roof can provide, and minimize any potential future issues.

Do Your Winter Season Preparations Include Reviewing Your Documents?

Here are some key issues to consider:

- Do supervisors review last year's records to determine whether they are being fully and accurately completed by every employee?
- Do they look for inconsistencies between the sanding sheets and the patrol and dispatch records?
- Do they determine when notations are made – at the time or after the fact?
- Do they determine whether or not operators are following patrollers' instructions?
- Do the operators stay on the prescribed route?
- Do they change routes when advised to?

Do Your Records Clearly Indicate?

- a) Trigger response for plows to be deployed
- b) Date and time the response was triggered
- c) Time the plow operator booked in for work
- d) Operations performed during his shift
- e) Time the operator stopped working
- f) Reason the operator stopped working
- g) Operational instructions were followed

Balance of Probabilities

A civil trial may be brought against a municipality if a motorist is injured and feels the accident was caused by a non-repair of roadway. The case will be decided based upon "the balance of probabilities". The Plaintiff must prove, on a balance of probabilities, that the condition of non-repair existed and that the non-repair caused the damages. The Municipality must prove, on a balance of probabilities, that the non-repair did not exist and that the damage was not caused by the alleged non-repair. Documentation provides the evidence that the municipality met its duty of care. It provides the evidence that: (1) standardized policies or procedures existed and were followed; and (2) regular inspections were conducted and necessary maintenance performed.

Do your records tip the balance of probabilities in your favour?

Terrain Parks

When moguls and half-pipes started to become too tame for snowboarders and skiers, commercial ski hills responded by developing more challenging courses. Known as "Terrain Parks", these areas within a ski resort feature 'jibs', which can be any fixed object that can be slid on, jumped from or bounced off of. These provide an exhilarating run as participants spin, jump, slide and 'bonk' their way down the course.

While some ski resorts offer these terrain parks, they come at an additional cost, and some terrain park enthusiasts may not want to pay a fee. They may instead approach their local municipality requesting such a park be built on a large and steep municipal sledding hill.

Before you agree to build a terrain park, here are some issues to consider.

Course Design

- Who will design the course?
- Who will construct the course and jibs?
- Will "air" time be limited?
- Will there be sufficient exit/entrance space between elements?
- Will there be a mechanical lift system? T-bar?
- Will the park have controlled access points for entry (single entrance point)?
- Will the park be closed during 'off hours' and 'off season' times?
- Will the park include sections for beginners? Spectators?
- Will the park be closed during warm spells in winter months, or will snow be made to keep an adequate base?
- Will the park operate at night (lights)?
- How will you separate tobogganing from the terrain area?
- Remember to enter into contracts with all designers and contractors

Course Maintenance/Inspection

- Inspections will need to occur throughout the day while the park is in operation as a change in weather will impact snow quality
- All home-made elements should be removed from the course site immediately
- All documentation should be retained and reviewed
 - This will include inspection checklists, work-orders, proof of work completion, contracts, etc

Supervision

- Will there be trained spotters at every element? At the lifts?
- Will personnel be trained in first aid and have the capability to contact emergency services (police, fire, ambulance)?
- Will the park be used by skiers and snowboarders only, or will toboggans and sleds be allowed to access any features?
- How will users know the parks rules?
- Will helmets be required? How will users be reminded to "wear the gear"?
- How will the rules be enforced?
- Will there be a minimum age/height for using the park?
- Will users be required to sign waivers?
 - Parents or guardians will need to sign on behalf of minors
- Will there be a registration or admission fee? Seasonal pass?
- Will lessons be given?
- Could the park be rented out for birthday parties or corporate events? Will there be a charge for this?
- The municipality's alcohol plan (MAP) should be updated to reference the park as an alcohol prohibited area

Although terrain parks have many unique features, they do have one element that all municipalities are familiar with. By using municipal land for such a park, the municipality will become an 'occupier' and will be subject to the laws of negligence and Occupiers Liability as per provincial law.



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