Risk Management Considerations for Green Roofs

There is a growing trend in Canada to promote and implement sustainable technologies and energy conservation projects. This “green” momentum has led to the development of a new sector of the economy which supports these new initiatives (new laws, code changes, associations, certification agencies, suppliers, specialty contractors, consultants, etc).

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 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 micro- climate 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 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.

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

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.

Roof Membrane Protection

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

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.

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.

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.

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.

Considerations

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

- Analyzing location, climate, roof orientation 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 that 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 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.

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:

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.

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 just economical, they can provide added value to stark roof and are environmentally responsible. It's easy to see why green roofing is gaining momentum in Canada.

intact public entities