SECTION  – vegetated tray roofing assembly

1. General
   1. SUMMARY
      1. This Section includes requirements for supply and installation of a vegetated roofing assembly, consisting of the following:
         1. Root barrier.
         2. Pre-grown vegetated module of sedum mat complete with growing medium.
         3. Edging.
         4. Irrigation.
      2. Provide specified system with labour, materials, and equipment required to install vegetated roofing assembly including accessories, and retention grid as necessary for a complete installation.
      3. Related Requirements:
         1. Section 05 50 00 – Metal Fabrications.
         2. Section 06 10 00 – Rough Carpentry.
         3. Section 07 55 56.13 – Hot-Applied Rubberized Asphalt Protected Membrane Roofing.
         4. Section 07 62 00 – Sheet Metal Flashing and Trim.
         5. Section 07 72 33 – Roof Hatches and Accessories.
         6. Section 07 92 00 – Joint Sealants.
   2. definitions
      1. Conventional Roof Membrane Assembly: Installation of roof membrane on top of insulation and ballasted or left exposed.
      2. Protected Roof Membrane Assembly: Also known as an inverted roof, this roof system installs the roof membrane directly onto the roof deck and is then covered with extruded foam insulation and ballasted with stone or pavers.
      3. Extensive Vegetated Roof: Light weight, low cost, low maintenance, typically designed to be more self-sustaining vegetation system.
      4. Semi-Intensive Vegetated Roof: A variety of grasses, herbaceous plants, and wild shrubs can be integrated in a semi-intensive vegetated roof system. System weight and cost are between extensive and intensive vegetated roof system.
      5. Intensive Vegetated Roof: A greater depth of soil, allowing for a variety of vegetation within the vegetation layer, such as shrubs, grassed areas, plant plugs, and select trees.
      6. Root Barrier: A water impermeable, flexible layer below the vegetated roof assembly that serves as protection against root encroachment into the underlying roof membrane system components.
      7. Edging: L-Shaped profile with vertical slots to provide positive drainage.
      8. Inspection Chamber: Drain boxes with hinged lids and vertical slots to provide positive drainage.
      9. Growing Medium: An engineered growing medium composed of mineral and organic materials that support a variety of landscape design and vegetation growth.
      10. Pre-Grown Tray System: A module consisting of growing medium and vegetation which has been planted and grown prior to shipment to site. Modules remain after installation of the vegetated roofing assembly.
      11. Pre-Vegetated Mat: A combination of plant material and growing medium within a vegetation carrier. Pre-vegetated mats are harvested and delivered to site in rolls and sheets.
      12. Pre-Vegetated Grass Mat: A section of grass-covered surface soil held together by matted roots. Pre-vegetated Grass mats are harvested and delivered to site in rolls.
      13. Plant Plugs: Small potted plants that have been established in a nursery and are ready for planting on rooftops.
   3. reference standards
      1. Specification American Society for Testing and Materials (ASTM):
         1. ASTM E 2397-11, Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems
         2. ASTM E 2399-11, Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems.
      2. City of Toronto Green Roof Bylaw, May 2009:
         1. Municipal Code Chapter 492, Green Roof.
      3. Toronto Green Roof Construction Standard:
         1. Article IV, Green Roof Bylaw.
      4. Guidelines for the Planning, Execution and Upkeep of Green-Roof Sites, January 2010:
         1. FLL - Roof Greening Guideline
   4. SUBMITTALS
      1. Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
      2. Action Submittals: Provide the following submittals before starting any work of this Section:
         1. Product Data:
            1. Systems, materials, and methods of installation proposed for use, showing system and each component. Certify compliance of each component with applicable standards.
            2. Submit cold weather construction procedures and methods of protection which will be initiated, installed, and maintained when ambient temperature falls below 0 deg C.
         2. Shop Drawings: Submit shop drawings of vegetated roofing assembly components, substrate materials, planting layout, corner, and edge details, drain details, anchorage details, and accessories to the Consultant for review.
            1. Delegated Design Submittals:

Furnish approved design calculations indicating structural load bearing capacity of substructure, bearing the seal of a Professional Engineer registered in the Place of the Work. Factor in weight of vegetated roof assembly when fully saturated to determine the system depth prior to ordering.

Furnish approved design calculations and drawings indicating wind uplift, bearing the seal of a Professional Engineer registered in the Place of the Work, and determine amount of vegetation-free zone around the perimeter of the roof.

Once there is any change to the design, furnish a new approved design calculations indicating the following:

Structural load bearing capacity of substructure, bearing the seal of a Professional Engineer registered in the Place of the Work.

Factor in weight of vegetated roof assembly when fully saturated to determine the system depth prior to ordering.

Drawings indicating wind uplift, bearing the seal of a Professional Engineer registered in the Place of the Work, and determine amount of vegetation-free zone around the perimeter of the roof.

* + - 1. Samples:
         1. Planting module complete with type of planting mix required.
         2. Metal edging.
      2. No work of this Section shall be purchased until shop drawings and all other related submittals, documentation, and samples as required by this Section, have been reviewed by the Consultant.
      3. Manufacturer's Maintenance Manuals: Submit two (2) copies of manufacturer's maintenance manual.
  1. quality assurance
     1. Installer Qualifications: Perform Work of this Section by a company specializing in installing and planting of vegetated roof systems with a minimum of five (5) years proven acceptable experience on installations of similar complexity and scope.
     2. Nursery Qualifications: Company specializing in growing and cultivating of plants with a minimum ten (10) years of documented experience, approved by Consultant.
     3. Maintenance Services: Perennial and groundcover maintenance must be performed by a certified horticulturalist.
     4. Verification of Structural Capacity: Prior to ordering products obtain written confirmation from owner-mandated professional engineer certifying that structure is capable of bearing additional load of green roof system.
     5. Vegetation guarantee: Provide written statement from manufacturer guaranteeing a minimum of 95% vegetated coverage at time of installation pre-planted ten (10) weeks prior to installation on roof.
     6. Pre-installation meetings: Arrange meeting on Site to be attended by Consultant, Contractor, and roofing manufacturer's representative to inspect substrates, and to review installation procedures 48 hours in advance of installation.
  2. MOCK-UPS
     1. Mock-ups: Construct mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution in accordance with Section 01 45 00 – Quality Control for mock-ups and as follows:
        1. Build mock-up of typical vegetated roofing assembly, incorporating root barrier, vegetated module system, edging, and corner anchoring clips.
     2. Notify Consultant a minimum seven (7) days prior to mock-up construction.
     3. Review and acceptance of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Consultant specifically notes such deviations in writing.
     4. Once reviewed by Consultant, acceptable mock-up can form a permanent part of the Work and will form the basis for acceptance for the remainder of the project.
     5. Remove and replace materials found not acceptable at no additional cost to Owner.
  3. delivery, storage, and handling
     1. Pre-cultivated plant material shall be delivered in such a manner as to preserve quality of plants (e.g. refrigerated container).
     2. Upon arrival to site, modules shall be immediately removed from delivery truck and utilized on roof on same day. If roof is not sufficiently prepared for installation of module, then prepare holding area to store modules without being stacked.
     3. Non-living components (root barrier, drainage, and fleece) can be stored on site, but must be protected from the elements by covering with a water-resistant tarpaulin.
  4. warranty
     1. Submit an extended written warranty for pre-grown roof modules in accordance with the General Conditions, except that warranty period is extended to two (2) years from date of Substantial Performance of the Work.
     2. Plants shall be in healthy growing condition by end of warranty period. Plants with dead or dying branches, which in the opinion of the Consultant are sufficient to detract from the character and form of the plant, will not be accepted.
     3. Replacements required during warranty period shall be plants of the same kind and size as shown on the plant list and on the Drawings, furnished and planted as specified in the Contract Documents. The cost of replacement shall be the responsibility of the Contractor.

1. Products
   1. manufacturers
      1. Compatibility: Verify that pre-grown module system and vegetated roofing components identified in this Section are provided by a single manufacturer to ensure compatibility. Multiple manufacturers providing vegetated roofing assembly components on this project will not be accepted, unless manufacturer of the pre-grown module accepts responsibility of all vegetated roofing components under their warranty.
      2. Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis of Design Materials, manufacturers offering products that may be incorporated into the Work include but are not limited to, the following:
         1. LiveRoof LLC: LiveRoof Standard System.
   2. MATERIALS
      1. Modules: 305 mm x 610 mm x 75 mm (12" x 24" x 3") high x 100 mil. thick recycled polypropylene pans complete with 89 mm (3-1/2") tall x 16 mil. thick removable insert collar to allow for growing soil above container edge. Saturated weight with mature vegetation shall be approximately 27-29 lb. per square ft.
      2. Growing medium: Engineered blend of inorganic and organic components.
      3. Vegetation: All plants will be No. 1 grade nursery stock grown and supplied in accordance with current standards as adopted by the Canadian Nursery Trades Association. Refer to Landscape Drawings for planting schedule and module planting mixes.
         1. Plants shall be healthy, vigorous, and grown in a recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae and defects.
         2. Plants shall be in full accordance with Drawings.
         3. Ensure coordination of planting of individual modules with the overall planting plan.
      4. Metal edging: Non-fastened co-engineered aluminum slotted edging in clear anodized finish.
         1. Provide linear pieces and 90-degree corner pieces as need to contain areas as indicated on Drawings.
         2. Fasteners: As recommended by vegetated roofing manufacturer.
         3. Basis of Design Materials: Permaloc by Liveroof LLC.
   3. irrigation system
      1. PVC pipes: SCH 40 PVC (Polyvinyl Chloride Plastic) subterranean pipe for irrigation lines with SCH 80 solvent weld PVC fittings. MP Rotator or equivalent irrigation head recommended.
      2. Function: fully automatic or manual.
      3. Controls:
         1. Automatic rain sensor optional.
         2. Irrigation controller shall be outdoor type.
         3. All sprinklers will have matched precipitation on the same zone.
      4. Piping:
         1. Subterranean irrigation using a v-shaped hoe to dig a trench into the soil at the Moisture Portals. Lay the irrigation pipe in the trench and fill in soil and plants over pipe.
         2. Alternately, lay subterranean irrigation lines between modules. Space modules to accommodate fittings and irrigation head. Cut drainage board with a minimum flow rate of 174 liters per minute per lineal meter into strips and lay under irrigation pipe. Use a chalk line to ensure straight rows. Lay filter fabric over pipe assembly and cut to height of adjacent modules. Cut holes in filter fabric as needed to fit over irrigation heads. Fill with LiveRoof Engineered growing medium or stone ballast. Remove Soil Elevators unless otherwise indicated.
         3. For subterranean irrigation against a parapet or building wall, place irrigation lines between modules and parapet or wall. Lay filter fabric over pipe assembly and cut to height of modules. Cut holes in filter fabric as needed to fit over irrigation heads. Fill with Engineered growing medium or stone ballast. Remove soil elevators unless advised that they are biodegradable.
         4. Surface applied irrigation pipe and fittings must be UV resistant, preferably painted green to blend in with the plants.
      5. Valves:
         1. A master valve shall be installed on the mainline after the backflow device.
         2. All valves to be covered by a 150 mm valve box.
         3. All wire connections to be waterproof, UL approved.
         4. To be a manual drain type. Install automatic freeze protection drain valves on all main and lateral piping.
2. Execution
   1. examination
      1. Verification of Conditions:
         1. Examine substrates to receive work and surrounding adjacent surfaces for conditions affecting installation. Coordinate with related sections to ensure proper installation sequence is maintained.
         2. Ensure substrate components have been installed and tested according to roof membrane manufacturer's requirements. Flood test or leak detection shall be concluded and any holes shall be patched prior to installation of materials indicated in this Section.
         3. Roof structure shall not have any areas of ponding water greater then 5 mm (3/16").
         4. Verify hose bib has been installed on roof and is in working order prior to installation of vegetated roofing system.
         5. Maintain roof membrane integrity during installation of materials indicated in this Section.
         6. When moving materials on roofs or installing vegetated roof systems, protect exposed work surfaces to avoid damage. Use sturdy panelling to erect rooftop footpaths so as to cover materials installed and permit foot traffic and movement of new materials. The contracted installer is fully responsible for any damage.
      2. Notify Contractor in writing of any conditions that are not acceptable.
         1. Proceed with installation after verification and correction of surface conditions acceptable to manufacturer.
   2. INSTALLATION - ROOT BARRIER
      1. Protected Roof Membrane Assembly:
         1. Loose lay the root barrier onto the roof membrane.
      2. Overlapping side and end laps minimum 305 mm (12") in a shingle fashion, to facilitate water flow towards drains.
      3. Make cut outs for roof penetrations and extend root barrier beneath non-vegetation areas and up parapet to ensure roof membrane is protected from lateral root penetration.
   3. INSTALLATION - VEGETATED MODULE
      1. Pre-grown module system installation to commence only once curbs and edging have been installed.
      2. Install modules over root barrier in accordance with manufacturers' written recommendations.
      3. Uniformly distribute range of planting mix modules over total area of work as indicated on Drawings.
      4. Water modules promptly after installation to thoroughly moisten media from top to bottom. Water shall be of suitable quality for plant growth.
      5. Roof Edges, Drains and other Penetrations.
         1. Maintain a distance as indicated on Drawings.
         2. Cut modules to conform to plan layout.
   4. INSTALLATION - IRRIGATION SYSTEM
      1. Install irrigation system in accordance with manufacturers' written recommendations.
   5. MAINTENANCE DURING CONSTRUCTION
      1. Contractor shall be responsible for interim maintenance of plant material up to point of final acceptance and client maintenance take-over and such maintenance shall be considered part of installation.
      2. Contractor must immediately replace all dead or dying plants as required by Consultant. Replacement of plants only at end of warranty period will not be acceptable.
      3. Interim maintenance for new planting shall consist of:
         1. Pruning, watering, fertilizing, cultivating, weeding, mulching, resetting plants to proper grades or upright position, restoration of planting beds, furnishing and application of such sprays and protective barriers as are necessary to keep plants free of insects, rodents, diseases, and such maintenance as required at direction of Consultant.
         2. Keeping planting beds free of weeds; do not cultivate areas where groundcover is becoming established. Do not use herbicides or pesticides.
   6. MAINTENANCE DURING ESTABLISHMENT PERIOD
      1. Maintenance must be provided by green roof Contractor during the establishment period.
      2. Maintenance shall comprise weekly inspections, and application of watering, fertilizing, weeding and infill plantings, as required to keep vegetation vigorous and healthy.
      3. Contractor shall submit monthly reports, including list of all operations completed, including photographs.
   7. FIELD QUALITY CONTROL
      1. Notify Consultant 72 hours prior to completion of green roof system and arrange for job site inspection in presence of Consultant.
      2. Contractor to schedule inspection by technical representative of green roof system to ensure system has been installed as per product specifications.

END OF SECTION