SECTION  – vegetated mat roofing assembly

1. General
   1. SUMMARY
      1. This Section includes requirements for supply and installation of a vegetated roofing assembly, complete with root barrier, edging, drainage layer, water retention layer, growing medium, pre-vegetated mat, plant plugs and stone ballast.
      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. Build-Up Roof Assembly: A roof system that is made of successive layers of asphalt and roofing felts.
      4. Extensive Vegetated Roof: Light weight, low cost, low maintenance, typically designed to be more self-sustaining vegetation system.
      5. 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.
      6. 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.
      7. 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.
      8. Filter Fabric: A layer of materials that helps contain particulates and prevent them from clogging the drainage path.
      9. Drainage Panel: A layer of panels that creates sufficient space below the vegetated roofing assembly to permit unrestricted movement of excess water to roof drains while restricting particulates from clogging the drainage path.
      10. Water Retention Fleece: A layer of fleece that helps to contain particulate materials, and retain water for plant use and increases water retention capacity of the vegetated roofing assembly.
      11. Edging: L-Shaped profile with vertical slots to provide positive drainage.
      12. Stone Ballast: Round washed stones with diameter between 16mm and 32mm (5/8" and 1-1/4").
      13. Inspection Chamber: Drain boxes with hinged lids and vertical slots to provide positive drainage.
      14. Growing Medium: An engineered growing medium composed of mineral and organic materials that support a variety of landscape design and vegetation growth.
      15. 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.
      16. 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.
      17. 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. ADMINISTRATIVE REQUIREMENTS
      1. Coordination: Coordinate the Work of this Section with the installation of roof membrane and insulation:
         1. Sequence work of this Section so that installation of insulation coincides with completion of root barrier installation on protected membrane application, without causing delay to the Work. Supply root barrier to roof membrane installer to sequence material installation with protective membrane application.
      2. Pre-Construction Conference: Arrange a site meeting attended by the Contractor, the Subcontractor, the Consultant, materials supplier(s), and other relevant personnel before commencement of work for this Section as indicated in Section 01 31 19 – Project Meetings.
         1. Review methods and procedures related to installation, including manufacturer's written instructions.
         2. Examine substrate conditions for compliance with manufacturers installation requirements.
         3. Review temporary protection measures required during and after installation.
   5. 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: Submit manufacturer's data sheets covering the care and recommended maintenance procedures for incorporation into maintenance manuals.
         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. Submit a 305 mm x 305 mm (12" x 12") sample of pre-vegetated mat, showing plant life for Consultant's approval.
       2. Submit samples of plant plugs indicating colours for Consultant's approval.
       3. Submit 305 mm (12") samples of accessories as requested by Consultant.
    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. CLOSEOUT SUBMITTALS
     1. Operation and Maintenance Data: Submit manufacturer's written instructions for maintenance procedures, include name of original installer and contact information in accordance with Section 01 77 19 – Closeout Requirements.
  2. quality assurance
     1. Qualifications: Provide proof of qualifications when requested by Consultant:
        1. Manufacturer / Supplier: Obtain vegetated roofing materials from one source with resources to provide products for each contiguous area of consistent quality in appearance and physical properties.
        2. Installers: Execute Work of this Section using qualified personnel skilled in installation of work of this Section, having a minimum of three (3) years proven experience of installations similar in material, design, and extent to that indicated for this project.
        3. Manufacturer's Representative: Vegetated roof materials manufacturer shall delegate a representative to visit the jobsite at commencement of work, and/or during critical installation periods determined by the manufacturer. Facilitate access to jobsite and roof in which vegetated roofing assembly is scheduled to be installed.
  3. 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, filter fabric, drainage panel, water retention fleece, edging, growing medium, vegetation, and anchoring.
     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.
  4. delivery, storage, and handling
     1. Delivery:
        1. Deliver plant plugs and pre-vegetated mats in a manner as to preserve quality of the plants and protect from temperature or wind damage.
        2. Transportation time less than 24 hours: Use of a climate-controlled trailer or flat deck transport truck is permitted.
        3. Transportation time greater than 24 hours: Use of a climate-controlled trailer is required.
        4. At the time of delivery, immediately off-load vegetation and install within 12 hours.
        5. Remove damaged and dead plant materials from the site immediately.
     2. Storage:
        1. Store vegetation materials in accordance with manufacturer's written instructions.
        2. Store non-living (accessories) components dry, raised off the ground and protected from the elements by weatherproof flame-resistant sheeting or tarpaulin.
        3. Handling: Material shall be handled in accordance with sound material handling practices and in accordance with manufacturer's written instructions.
  5. site conditions
     1. Site Measurements: Verify dimensions by field measurements prior to ordering and indicate measurements on Shop Drawings where vegetated mats and/or plant plugs are indicated to be installed.
     2. Establish dimensions and proceed with ordering vegetated mats and/or plant plugs where field measurements cannot be made without delaying the work; allow for site trimming and fitting.
     3. Ambient Conditions: Install materials outlined in this Section after completion of work by other Sections is complete, and within manufacturer's recommended temperature guidelines. Water vegetation thoroughly during hot, humid weather to avoid severe stress to the root system.
  6. warranty
     1. Warrant work of this section in accordance with manufacturer's warranty that the vegetation shall be sufficiently pre-established to provide a minimum of 70% vegetation coverage at the time of installation.
     2. Submit an extended written vegetation warranty in accordance with the General Conditions, except that warranty period is extended to two (2) years from date of Substantial Performance of the Work.
     3. 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.
     4. 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 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 supplying growing medium, and vegetation 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. Next Level Stormwater Management.
   2. MATERIALS - VEGETATED ROOFING ASSEMBLY
      1. Root Barrier:
         1. 18 mil, low density polyethylene sheet.
      2. Filter Fabric:
         1. One (1) layer of flexible, non-woven entangled polymeric filaments with a geo-textile filter fabric bonded to underside.
      3. Water Retention Fleece:
         1. Blend of recycled polymeric fibre with a water-saturated weight of approximately 7 kg/m² (1.41 lb/ft²), complete with a water retention capacity of 6.2 L/m² (0.02ft³/ft²), unless otherwise indicated on Landscape Drawings.
      4. Growing Medium:
         1. A proprietary mixture high in mineral based materials and low in premium organic matter formulated for vegetated roofing assembly planting, meeting the requirements in the FLL Guidelines for the Planting, Execution and Upkeep of Green-Roof Sites. Water retention capacity: 950-1200 kg/m³ (2,720-3,440 lb/y³).
      5. Pre-Vegetated Mats:
         1. A textile-based vegetation carrier of polymer entanglements bonded to a geo-textile fabric, filled with growing medium and mature vegetation. Saturated Weight: 29.70 kg/m² (6.0 lb/ft²).
      6. Pre-Vegetated Grass Mats:
         1. A surface layer of earth containing meadow plants with matted roots. Saturated Weight: 29.30 kg/m² (6.0 lb/ft²).
            1. Grass Type: As indicated on the Landscape Drawings.
         2. Plant Plugs: Plants supplied as plugs in pots.
            1. Plant Type: As indicated on the Landscape Drawings.
   3. ACCESSORIES
      1. Edging:
         1. L-shaped profile used to contain growing medium and separate non-vegetated area from vegetation. Height of profile is dependent on depth of vegetated roofing assembly.
            1. Galvanized steel.
      2. Stone Ballast:
         1. Round washed stone with diameter between 16 mm and 32 mm (5/8" and 1-1/4").
      3. Inspection Chamber:
         1. Drainage boxes, used to protect and separate drains from vegetated roof components.
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 - FILTER FABRIC
      1. Protected Roof Membrane Assembly:
         1. Install filter fabric of on top of insulation.
      2. Cut to fit along roof edge and around penetrations, overlapping end seams 100 mm (4").
      3. Extend filter protection layer to edging, or if no edging is present, extend under vegetation-free zone composed of stone ballast. Do not install under walkway pavers.
   4. INSTALLATION - WATER RETENTION FLEECE
      1. Install water retention fleece overtop of drainage layer, overlapping edge seams 50 mm (2").
      2. Cut to fit along the vegetated free zones.
   5. INSTALLATION - EDGING
      1. Protected Roof Membrane Assembly:
         1. Install L-shaped metal edging on top of filter fabric or underneath the filter fabric to separate the vegetated area and non-vegetated boarder area.
      2. Install edging pointing towards vegetated area such that weight of vegetated roof system will hold edging in place.
      3. Join edging together by connection pieces.
   6. INSTALLATION - STONE BALLAST
      1. Install stone ballast around the perimeter of the roof and above the vegetated roofing assembly, see shop drawing for detail of the vegetation-free zone.
      2. Install stone ballast around all drains a minimum of 305 mm (12").
      3. When required, evenly distribute washed round stone over the vegetated mat at a rate of 24-34 kg/m² (5 - 7lb/ft²).
   7. INSTALLATION - INSPECTION CHAMBER
      1. Install inspection chamber directly over centre of the drain. Secure inspection chamber lid once installed.
   8. INSTALLATION - GROWING MEDIUM
      1. Install a layer of filter fabric before installing the growing medium.
      2. Spread growing medium onto filter fabric.
      3. Distribute growing medium evenly by the wooden rake without tines.
      4. Compact the growing medium by using garden roller.
      5. The allowable compaction rate falls between 15% œ 25% in volume depending on the growing medium.
      6. The minimum depth of the medium must be calculated and measured after compaction.
      7. Do not place large amount of growing medium on one area of the roof to avoid overloading the roof structure.
   9. INSTALLATION - PRE-VEGETATED MAT
      1. Prior to installation of vegetated mat, fully saturate accessories with water.
      2. Unroll pre-vegetated mats onto, tightly abutting each roll, leaving no gaps. Offset adjacent rolls by half the length of the roll to avoid alignment of end seams across rows.
      3. Add growing medium to low spots once installation of vegetated mats is complete.
      4. Thoroughly water pre-vegetated mat immediately after installation.
   10. INSTALLATION - PRE-VEGETATED GRASS MAT
       1. Prior to installation of pre-vegetated grass mat, fully saturate accessories with water.
       2. Unroll pre-vegetated mats onto water retention fleece **[and] [growing medium]**, tightly abutting each roll, leaving no gaps. Offset adjacent rolls by half the length of the roll to avoid alignment of end seams across rows.
       3. Add growing medium to low spots once installation of vegetated mats is complete.
       4. Thoroughly water pre-vegetated grass mat after installation.
   11. INSTALLATION - PLANT PLUGS
       1. Loosen plug from pot and loosen the planting substrate slightly and spread-out roots.
       2. Dig a hole slightly deeper and wider than pot in growing medium. Place plug and replace growing medium to same level as surrounding growing medium.
       3. Thoroughly water plugs once installed to assist with settling of individual components and support recovery and establishment of the vegetation.
   12. CLEANING AND REPLACEMENT
       1. Progress Cleaning: Leave work area clean at the end of each workday, ensuring safe movement of passing pedestrians.
       2. Final Cleaning: At completion of installation, clean all surfaces so they are free of foreign matter using cleaners recommended by vegetated roofing assembly manufacturer.
       3. Waste Management: Co-ordinate recycling of waste materials and packaging at appropriate facility, diverting waste from landfill. Certified installer shall be responsible for ensuring waste management efforts are practiced.
   13. MAINTENANCE - FIRST YEAR
       1. Provide full maintenance and call-back service on the entire vegetated roofing assembly described herein for a period of one year from the date of installation.
       2. Call-backs during normal working hours shall be included as part of the maintenance service, except for calls resulting from vandalism, abuse, or other reasons beyond the normal control of the maintenance provider.
       3. Employ competent personnel to handle call-back service and have qualified personnel available at such places to insure the fulfillment of this service without unreasonable loss of time in reaching the job site.
       4. This maintenance service shall be performed solely by the vegetated roofing assembly manufacturer and shall not be assigned or transferred to any agent or subcontractor.
       5. Intensive Vegetated Roof System or Sloped Greater than 5 degrees: Maintenance includes but is not limited to:
          1. Weekly maintenance visit for first three (3) months, watering once per week until saturated, removing weeds and garbage, and adding growing medium and mat clipping where required to encourage growth.
          2. One visit per month from month four until frost, and beginning again the following spring, watering vegetation, cleaning drains, weed and garbage removal, and adding growing medium and mat clipping where required to encourage growth.
          3. Fertilize in spring with organic slow-release fertilizer.

END OF SECTION