

## **SECTION 07 55 63.03**

### **FLUID APPLIED ROOFING & MODULE VEGETATIVE ROOF ASSEMBLY**

SPEC NOTE: This Guide Specification includes materials and methods for the application of a Henry Vegetated Roof Assembly (VRA) [790-11EV] [790-11] Hot Applied Rubberized Asphalt Roofing/Waterproofing System with the **AVRS Modular Tray**. Includes double interlocking trays, connectors, regionally-engineered growing media, vegetation, stainless steel trim elements, and integrated irrigation system. Growing media can be stacked above level of interlocking trays for thicker beds because of interlocking design. Drainage system is designed to control flow of water and bottom of trays are designed to reduce wind uplift. This specification should be adapted to suit the requirements of individual projects. It is prepared in CSC / NMS three part format and should be included as a separate section under Division 7 - Thermal and Moisture Protection.

#### **PART 1: GENERAL**

##### **1.1 GENERAL REQUIREMENTS**

- .1 The General Conditions, Supplementary Conditions, Instructions to Bidders and Division One General Requirements shall be read in conjunction with and govern this section.
- .2 The Specification shall be read as a whole by all parties concerned. Each Section may contain more or less than the complete work of any trade. The Contractor is solely responsible to make clear to the Subcontractors the extent of their work.

##### **1.2 VEGETATIVE ROOF ASSEMBLY DESCRIPTIONS**

- .1 Vegetative Assembly Design & Performance
  - .1 The Modular Vegetated System shall consist of plastic trays, growing medium, and plant materials for installation over roofing system, including [flashings,] [irrigation,] and [other systems by manufacturer] as required for complete installation. [xx] inches (refer to ballast dead load requirements) of growing media installed over root barrier.
  - .2 The vegetative roof assembly shall be designed for the climate conditions of the project site with supplemental irrigation measure to be determined necessary by the landscape professional.
  - .3 This vegetative roof assembly shall be compatible with pedestrian access and integration with patio and walkway elements.
  - .4 The vegetative roof assembly shall:
    - a. Support a perennial vegetative ground cover,
    - b. Provide efficient drainage of moisture in excess of that required for the growth of vegetation,
    - c. Protect the roof waterproofing materials from damage caused by physical abuse and temperature fluctuations.
- .2 Henry Extensive Vegetative Roof Assembly: Supply labor, materials, plant, tools and equipment to complete the Work as shown on the Drawings and as specified herein including, but not limited to the following:
  - .1 Concrete deck, plywood or sheathing board mechanically fastened to metal deck,
  - .2 Adhesive, Primer & 2 ply Hot Applied Rubberized Asphalt Waterproofing and Protection Course,
  - .3 Flood Test or Electric Filled Vector Mapping (EFVM) Quality Assurance Program,
  - .4 Root Barrier, Rigid Insulation, Water Retention / Drainage Board and Filter Fabric,
  - .5 Extensive - Modular Vegetated System with Growing Media Blend 100 - 150 mm (4 - 6 inches) and Plant Material.
- .3 Henry Semi-Intensive Vegetative Roof Assembly: Supply labor, materials, plant, tools and equipment to complete the Work as shown on the Drawings and as specified herein including, but not limited to the following:
  - .1 Concrete deck, plywood or sheathing board mechanically fastened to metal deck,
  - .2 Primer & 2 ply Hot Applied Rubberized Asphalt Waterproofing Membrane and Protection Course,
  - .3 Flood Test or Electric Filled Vector Mapping (EFVM) Quality Assurance Program,
  - .4 Root Barrier, Rigid Insulation, Water Retention / Drainage Board and Filter Fabric,
  - .5 Semi-Intensive Growing Media Blend 150 - 225 mm (6 - 9 inches) depth and Plant Material.

##### **1.3 PERFORMANCE DESIGN CRITERIA**

- .1 Roof Load Criteria: Following roof load requirements are regionally dependent and may vary by specific installation.
- .2 Post, Sedum Tiles, Hydro-Planted AVRS 135 mm (5.25 inch) Growing Media
  - .1 Fully Saturated Weight: 127 kg/m<sup>2</sup> (26 psf)
  - .2 Field Moisture Capacity Weight: 100 kg/m<sup>2</sup> (20.5 psf)
- .3 Pre-planted AVRS 120 mm (4.625 inch) Growing Media
  - .1 Fully Saturated Weight: 112 kg/m<sup>2</sup> (23 psf)
  - .2 Field Moisture Capacity Weight: 88 kg/m<sup>2</sup> (18 psf)
- .4 Max-Lite AVRS 135 mm (5.25 inch) Growing Media
  - .1 Fully Saturated Weight: 90 kg/m<sup>2</sup> (18.5 psf)
  - .2 Field Moisture Capacity Weight: 61 kg/m<sup>2</sup> (12.5 psf)
- .5 Max-Lite AVRS 120 mm (4.625 inch) Growing Media
  - .1 Fully Saturated Weight: 81 kg/m<sup>2</sup> (16.5 psf)
  - .2 Field Moisture Capacity Weight: 54 kg/m<sup>2</sup> (11 psf)

#### 1.4 RELATED WORK

- .1 LEED Requirements Section [XXXXX]
- .2 Concrete: Section [XXXXX]
- .3 Rough Carpentry: Section [XXXXX]
- .4 Metal Flashing and Trim: Section [XXXXX]
- .5 Sealants: Section [XXXXX]
- .6 Masonry: Section [XXXXX]
- .7 Insulation: Section [XXXXX]
- .8 Roof Drains and Vents: Section [XXXXX]
- .9 Irrigation and Plantings Section [XXXXX]

#### 1.5 REFERENCES

- .1 The following standards are applicable to this section:
  - .1 ASTM D41M-11: Asphalt Primer used in Roofing, Dampproofing, and Waterproofing.
  - .2 ASTM D92-12: Standard Test Method for Flash and Fire Points by Cleveland Open Cup.
  - .3 ASTM D5329-09: Standard Test Method for Sealants and Fillers, Hot-Applied for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements.
  - .4 ASTM E96: Water Vapor Transmission of Materials.
  - .5 CGSB 37-GP-50M: Hot Applied, Rubberized Asphalt for Roofing and Waterproofing.
  - .6 US Green Building Council (USGBC), Leadership in Energy and Environmental Design (LEED) - LEED Reference Guide, Version 3.0, and USGBC Project Calculation Spreadsheet. Web Site <http://www.usgbc.org>.
  - .7 UL Inc.: Class A Classification for use in Ballasted Systems.
  - .8 ANSI/SPRI VF- 1 External Fire Design Standard for Vegetative Roofs.
  - .9 ANSI/SPRI RP-14 Wind Design Standard for Vegetative Roofing Systems.
  - .10 ASTM E2396-11 - Standard Test Method for Saturated Water Permeability of Granular Drainage Media [Falling-Head Method] for Vegetative (Green) Roof Systems.
  - .11 ASTM E2397-11 - Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems.
  - .12 ASTM E2398-11 - Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Vegetative (Green) Roof Systems.
  - .13 ASTM E2399-11 - Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems.
  - .14 ASTM E2400-06 - Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems.
  - .15 ASTM D3776-96 - Standard Test Methods for Mass per Unit Area (Weight) of Fabric
  - .16 ASTM D4355-02 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon
  - .17 ASTM D4716-08 - Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
  - .18 ASTM D5035 - Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
  - .19 ASTM D5493-06 - Standard Test Method for Permittivity of Geotextiles Under Load
  - .20 ASTM D5736 - Standard Test Method for Thickness of Highloft Nonwoven Fabrics.

#### 1.6 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section [XXXXX] - [XXXXX].

#### 1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery of Materials:
  - .1 Materials shall be delivered to the jobsite in undamaged and clearly marked containers indicating the name of manufacturer and product and shall have UL markings.
- .2 Storage of Materials:
  - .1 Hot rubberized asphalt should be stored in closed containers outdoors.
  - .2 Store adhesives and primers at temperatures of 5°C (40°F) and above to facilitate handling. Keep solvent away from open flame or excessive heat.
  - .3 Store roll materials on end.
- .3 Handling of Materials:
  - .1 Adhesives and Primer contains solvent and is flammable. Do not use near open flame.
  - .2 Melting equipment shall consist of a doubled jacketed kettle indirectly air heated or containing a high flash point heat transfer oil and mechanical agitator.
  - .3 Avoid overheating of hot rubberized asphalt. Recommended application temperature is 180°C to 200°C (356°F to 395°F). Do not heat above 215°C (419°F).
  - .4 Pallets shall be shrink wrapped and secured prior to being lifted onto roof.
  - .5 Conduct roof top delivery, assembly, and storage of each component of vegetated roof under direction of manufacturer's authorized installer.
  - .6 Maintain health of plant material as recommended by system supplier's guidelines prior to rooftop installation.
  - .7 Take measures to spread loads in a manner to not exceed the load bearing capacity of the roof deck.
  - .8 Store empty materials over plywood panels or protective sheathing and do not allow products, growing media, debris, and pedestrian traffic on unprotected roofing membrane.
  - .9 Provide water source for irrigation of and maintenance of plants until permanent drip irrigation system is in place.

#### 1.8 PROJECT/SITE CONDITIONS

- .1 Environmental Requirements: No installation work shall be performed during rainy or inclement weather and on frost or wet covered surfaces.
- .2 Membrane protection:
  - .1 Provide temporary protection of the membrane to prevent mechanical damage or damage from spillage of oil or solvents until such time as permanent protection is provided.
  - .2 Do not permit traffic of any kind over unprotected waterproof membranes. Apply protection sheet as soon as possible after installation of membrane.
- .3 Ensure all preparation work is complete prior to installing waterproofing membrane.
- .4 Ambient Air Temperature: Install plant materials preferably between April 1 and November 1 (at northern latitudes) at temperatures between 5°C and 35°C (40° F and 95° F), except as otherwise instructed by manufacturer. Do not install if extended freezing temperatures are expected or if ambient growing media temperature is expected to remain below 10°C (50° F).

#### 1.9 SUBMITTALS

- .1 Submit document stating that the applicator of the primary membranes specified in this Section are recognized by the manufacturer as suitable for the execution of the Work.
- .2 Copies of manufacturers' current ISO certification. Membrane, primers, sealants, adhesives and associated auxiliary materials shall be included.
- .3 References clearly indicating that the membrane manufacturer has successfully completed projects on an annual basis of similar scope and nature for a minimum of fifteen years. Submit references for a minimum of three projects.
- .4 Manufacturers' complete set of standard details for the roofing membrane system.
- .5 Certify that waterproofing components are supplied and warranted by single source manufacturer.
- .6 Samples
  - .1 Submit 70 x 90 mm samples of sheet products
  - .2 170g (6 oz) samples of loose materials
  - .3 300 x 600mm (12 inch x 24inch) sample of vegetated sedum mats
  - .4 150 mm (6 inch) length of metal edging

- .7 Conform to Section 018113 for documentation of LEED Credits contributing to Certification of Project under USGBC LEED-NC 2.2 Green Building Rating System for sustainable building requirements

#### 1.10 QUALITY ASSURANCE

- .1 Single-Source Responsibility:
  - .1 Obtain waterproofing and vegetative roof assembly components and materials from a single manufacturer regularly engaged in the manufacturing and supply of the specified products.
  - .2 Contractor to verify product compliance with federal, state and local regulations controlling use of Volatile Organic Compounds (VOC).
- .2 Installer:
  - .1 Submit copies of manufacturers' current ISO certification. Membrane, primers, sealants, and adhesives shall be manufactured in an ISO registered facility.
  - .2 Perform work in accordance with the printed requirements of the waterproofing membrane manufacturer and the requirements of this specification.
  - .3 Maintain one copy of manufacturer's instructions on site.
  - .4 At the beginning of the work and at all times during the execution of the work, allow access to work site by the waterproofing membrane manufacturer's representative.
  - .5 Mock-Ups: Where directed, construct typical assembly incorporating substrate, primer and waterproofing membrane. Allow 24 hours for inspection of mock-up before proceeding. Mock-up may remain as part of the work.
- .3 All components used in this section shall be furnished by one manufacturer, including primary membrane, liquid sealants, primers, mastics, and adhesives. Primary membrane shall meet CGSB 37-GP-50-M89.
- .4 The rubberized asphalt membrane product shall be resistant to acids (fertilizers, building washes and acid rain).

#### 1.11 MEMBRANE MANUFACTURER QUALIFICATIONS

- .1 Manufacturer shall demonstrate qualifications to supply materials of this section by certifying the following:
  - .1 Membrane Manufacturer must show evidence that the specified rubberized asphalt has been manufactured by the same source for fifteen (15) years and installed on a yearly basis for a minimum of fifteen (15) years on projects of similar scope and complexity.
  - .2 Membrane Manufacturer must not issue warranties for terms longer than they have been manufacturing their hot fluid rubberized asphalt membrane.

#### 1.12 PRECONSTRUCTION CONFERENCE

- .1 With prior notice, manufacturers of the waterproofing/roofing membrane will meet with the necessary parties at the jobsite to review and discuss project conditions as it relates to the integrity of the waterproofing and vegetated assembly.
  - .1 Review construction schedule and confirm growing and delivery time of plantings for project expectations.
  - .2 Coordination of required flood testing or installation of electric field vector testing.
  - .3 Placement of insulation and temporary ballast,
  - .4 Coordination of the placement of vegetative roof components, irrigation connections, system and controls, and plant materials
  - .5 Verify equipment location, placement and lifting requirements based on vegetative component weights, and
  - .6 Coordination of job site visits by membrane manufacture and verify status of warranty documents
- .2 Following installation of garden roof system and plantings, meet at site with installer/maintenance contractor to review procedures and opening day owner expectations.

#### 1.13 MANUFACTURER'S PROJECT ACCEPTANCE

- .1 Prior to contracting the prime roofing/waterproofing contractor and vegetative roof assembly installer, provide a letter from the Membrane Manufacturer stating acceptance of the project specifications and the terms of the specified warranty.

#### 1.14 WATERPROOFING MEMBRANE WARRANTY

SPEC NOTE: There are three warranty configurations available from Henry. Choose 1.13.A, 1.13.B or 1.13.C from the following. Note that charges apply to certain warranties and scope of coverage varies. Contact Henry for complete details.

- .1 Manufacturer's Material Warranty:
    - .1 Contractor hereby warrants that the waterproofing membrane and membrane flashings will stay in place and remain leak proof, for two years.
    - .2 Waterproofing membrane manufacturer hereby warrants the membrane and membrane flashings for leak coverage as a result of faulty materials for a period of [5 years] [10 years] [15 years] [20 years] years from the date of substantial completion.
  - .2 Manufacturer's Single Source System Warranty:
    - .1 Contractor hereby warrants that the waterproofing membrane and membrane flashings for leak coverage, for two years.
    - .2 Waterproofing membrane manufacturer hereby warrants the membrane and membrane flashings for leak coverage as a result of faulty materials for a period of [5 years] [10 years] [15 years] [20 years] from the date of substantial completion.
  - .3 Manufacturer's Single Source Gold Seal Warranty:
    - .1 Contractor hereby warrants that the waterproofing membrane and membrane flashings leak coverage, for two years.
    - .2 Waterproofing membrane manufacturer warrants that the membrane and membrane flashings for leak coverage as a result of faulty materials or workmanship for a period of [5 years] [10 years] [15 years] [20 years] from the date of substantial completion.
- CONTACT HENRY FOR WARRANTY TERMS AND CONDITIONS DETAILS --**

## **PART 2: MATERIALS**

### **2.1 MANUFACTURER**

- .1 Components and membrane materials must be obtained as a single-source from the membrane manufacturer to ensure total system compatibility and integrity.
  - .1 Acceptable Manufacturer: Henry Company Canada  
15 Wallsend Drive  
Toronto, ON  
M1E 3X6  
[www.Henry.com](http://www.Henry.com)

SPEC NOTE: Henry manufactures two types of 790-11 waterproofing system. 790-11 is the standard offering; 790-11 EV is the Environmental grade and contains 25% cost-consumer recycled content. Choose from the following.

### **2.2 PRIMARY WATERPROOFING MEMBRANE (Basis-of-Design)**

- .1 Primary waterproofing membrane shall be 790-11EV manufactured by Henry, an SBS modified hot applied rubberized asphalt composed of a specially selected blend of refined asphalts, synthetic rubber and mineral stabilizers, and having the following physical properties:
  - .1 Solids Content: 100%;
  - .2 Low Temperature Flexibility and Adhesion: No cracking, delamination or loss of adhesion @ -25°C (-13 degrees F) in accordance with CGSB 37-GP-50-M89;
  - .3 Flow: 3mm (1/8inch) film on 75% angle for 5 hours @ 60°C (140 degrees F): No flow in accordance with ASTM D5329;
  - .4 Cone Penetration: More than 10 @ 0°C (32 degrees F), less than 110 @ 25°C (77 degrees F), less than 200 @ 50°C (122 degrees F) in accordance with ASTM D5329;
  - .5 Water Absorption: Gain of 0.09g in accordance with CGSB 37-GP-50-M89;
  - .6 Flash Point (Open Cup): 310°C (590 degrees F) in accordance with ASTM D92;
  - .7 Water Vapour Permeance (3mm Film): 0.6 ng/Pa.m<sup>2</sup>.s (0.01 perms) in accordance with ASTM E96 Procedure A and 1.0 ng/Pa.m<sup>2</sup>.s (0.016 perms) in accordance with ASTM E96 Procedure E.
  - .8 Ratio of Toughness to Peak Load: 0.04 min. in accordance with CGSB 37-GP-50-M89.
  - .9 Toughness: 9.2J in accordance with CGSB 37-GP-50-M89.C
  - .10 Crack Bridging Capability: No cracking, splitting or loss of adhesion in accordance with CGSB 37-GP-50-M89.

- .11 Heat Stability: 5 hours @ 200°C (390 degrees F): Meets flow, penetration and low temperature flexibility in accordance with CGSB 37-GP-50-M89.
  - .12 Recycled content: Minimum 25%.
- .2 Primary waterproofing membrane shall be 790-11 manufactured by Henry, a hot-applied rubberized asphalt composed of a specially selected blend of refined asphalts, synthetic rubber and mineral stabilizers, and having the following physical properties:
- .1 Solids Content: 100%;
  - .2 Low Temperature Flexibility and Adhesion: No cracking, delamination or loss of adhesion @ -25°C (-13 degrees F) in accordance with CGSB 37-GP-50-M89;
  - .3 Flow: 3mm (1/8inch) film on 75° angle for 5 hours @ 60°C (140 degrees F): No flow in accordance with ASTM D5329;
  - .4 Cone Penetration: More than 10 @ 0°C (32 degrees F), less than 110 @ 25°C (77 degrees F), less than 200 @ 50°C (122 degrees F) in accordance with ASTM D5329;
  - .5 Water Absorption: Gain of 0.09g in accordance with CGSB 37-GP-50-M89;
  - .6 Flash Point (Open Cup): 285°C (545 degrees F) in accordance with ASTM D92;
  - .7 Water Vapour Permeance (3mm Film): 0.01 perms in accordance with ASTM E96 Procedure A and 0.02 perms in accordance with ASTM E96 Procedure E;
  - .8 Ratio of Toughness to Peak Load: 0.04 min. in accordance with CGSB 37-GP-50-M89.
  - .9 Toughness: 9.2J in accordance with CGSB 37-GP-50-M89;
  - .10 Crack Bridging Capability: No cracking, splitting or loss of adhesion in accordance with CGSB 37-GP-50-M89;
  - .11 Heat Stability: 5 hours @ 200°C (390 degrees F): Meets flow, penetration and low temperature flexibility in accordance with CGSB 37-GP-50-M89.1;
  - .12 Recycled content: 11% minimum for standard membrane.

SPEC NOTE: Henry offers two options for enhancing the bond of the 790-11 waterproofing system. 910-01 is a standard asphaltic primer while 930-18 is a polymer modified adhesive. Significantly improved adhesion can be achieved using 930-18. Choose from the following.

- .2 Surface Conditioning
- .1 Asphalt Primer:  
Henry 910-01 Asphalt Penetrating Asphalt Primer conforming to CAN/CGSB 37.9 and ASTM D41-M11.
  - .2 Polymer Modified Adhesive:
    - a. Synthetic rubber based adhesive shall be 930-18 Poly-Tac Rubberized Adhesive manufactured by Henry.

SPEC NOTE: There are options for exposed flashing membranes. For maximum warranty term lengths, Henry recommends the use of SBS modified bitumen flashing membranes in place of standard neoprene sheets. For exposed flashings choose 2.2.3.1. For exposure conditions up to 10 years neoprene flashing (2.2.3.2) can be considered.

- .3 Cap Flashing Membranes:
- .1 Granule surfaced cap flashing membrane shall be modifiedPLUS® NP180gM4 manufactured by Henry, an SBS modified bitumen membrane having a polyethylene lower surface and a ceramic granule top surface, reinforced with a non-woven polyester reinforcement, designed specifically for hot mop applications, and having the following physical properties in accordance with CGSB 37GP56M Type 1 class A Grade 2 and ASTM D6164 Type 1, Grade G:
    - .1 Thickness: 3.5 mm (0.140 inches 140 mils);
    - .2 Tensile strength @ -18°C (0 °F): 113 lbf per inch (md), 100 lbf per inch (xd);
    - .3 Elongation @ 0 degrees F: 40% (md & xd);
    - .4 Low temperature flexibility: -30°C (-22°F);
  - .2 Exposed flashings and expansion joint membrane shall be Neoflash and Neoflash Adhesive manufactured by Henry. Neoprene type, uncured and having a minimum thickness of 1.5 mm (60mils).

SPEC NOTE: For concealed flashing, crack treatment, reinforcement & slip sheet membranes, SBS modified bitumen membranes may be either applied in 790-11 or self-adhered. The specifier may allow the contractor to choose or may select *modifiedPLUS*®NP180s/s for applications set in 790-11, *modifiedPLUS*®

G100s/s for self-adhered applications and Blueskin® WP200 for waterproofing transition membranes.

- .4 Concealed Flashing, Crack Treatment, Reinforcement & Self Adhered Sheet Membranes:
  - .1 Mop grade membrane shall be modifiedPLUS® NP180s/s manufactured by Henry, an SBS modified bitumen membrane having a minimum thickness of 2mm (80 mils) and a non-woven polyester reinforcement of 180 g/m<sup>2</sup> meeting ASTM D6164 Type 1, Grade S. The upper and lower surface shall be sanded and be fully compatible with the primary membrane.
  - .2 Self-Adhering waterproofing transition membrane for vertical walls shall be Blueskin® WP 200 manufactured by Henry, a 1.5mm (60 mils) thick SBS modified bitumen, self-adhering sheet membrane with a cross-laminated polyethylene film, and having a tensile film strength of 5000psi (34.5 MPa) to ASTM D882 and Elongation of 300% to ASTM D412.
- .5 Fabric Reinforcement:
  - .1 Polyester Fabric reinforcement sheet as supplied by Henry, an inorganic spun bonded polyester fabric sheet with sufficient porosity to allow good interply bonding between layers of waterproofing membrane.
- .6 Protection Course
  - .1 modifiedPLUS® G100s/s, an SBS modified bitumen membrane having a minimum thickness of 80 mils and a fiber glass reinforcement of 100 g/m<sup>2</sup> meeting ASTM D6163, Type 1, Grade S.. The upper and lower surface shall be sanded and be fully compatible with the primary membrane.
- .7 Termination Sealant:
  - .1 Termination Sealant shall be HE925 BES Sealant manufactured by Henry; a moisture cure, medium modulus polymer modified sealing compound having the following physical properties:
    - .1 Compatible with roofing and waterproofing membranes and substrate,
    - .2 Complies with Fed. Spec. TT-S-00230C, Type II, Class A,
    - .3 Complies with ASTM C 920, Type S, Grade NS, Class 25,
    - .4 Elongation: 450 – 550%,
    - .5 Remains flexible with aging,
    - .6 Seals construction joints up to 25mm (1 inch) wide.
- .8 Securement Bars (By Others):
  - .1 Securement bars shall be continuous aluminium, stainless steel or galvanized metal, 3mm x 25mm (1/8 inch x 1 inch) in size and shall be pre-drilled for non-corrosive screw attachment on a maximum of 200mm (8 inches) centres.

SPEC NOTE: WATERPROOFING MEMBRANE INTEGRITY TEST. As a requirement for meeting warranty conditions, the waterproofing membrane must be tested for leaks. The completed waterproofing system may be tested by either flood testing the area or Electric Vector Testing.

- 2.3 ELECTRIC FIELD VECTOR TESTING QUALITY ASSURANCE COMPONENTS (Optional alternative to Flood Testing)
  - .1 Provide electrical wiring, and other components necessary for a testing agency to perform integrity testing of waterproofing membrane.
- 2.4 ROOT BARRIER
  - .1 Root barrier shall be Root Bloc 20 supplied by Henry, a 0.4mm (15 mil) thick polyethylene composite geo-membrane sheet specially designed to prevent root penetration.
- 2.5 SEALANT
  - .1 Sealant shall be HE925 BES Sealant manufactured by Henry; a moisture cure, medium modulus polymer modified sealing compound having the following physical properties:
    - .1 Compatible with waterproofing membranes and substrate;
    - .2 Complies with Fed. Spec. TT-S-00230C, Type II, Class A;
    - .3 Complies with ASTM C 920, Type S, Grade NS, Class 25
    - .4 Elongation: 450 – 550%
    - .5 Remains flexible with aging
    - .6 Seals construction joints up to 25mm (1 inch) wide.
- 2.6 EXTRUDED POLYSTYRENE INSULATION

- .1 Supplied by Henry Company and meeting ASTM C578-87a, Type [XX], to thickness indicated on drawings and having the following properties:
  - .1 Minimum water absorption by volume per ASTM C-272 of 0.1%
  - .2 Minimum compressive strength to ASTM C-1621 shall be 275 kPa [40 psi], 415 kPa [60] or 690 kPa [100] psi.

## 2.7 GEOTEXTILE FILTER FABRIC

- .1 Henry Filter Fabric No 4, a non-biodegradable non-woven geotextile made of polypropylene fibres, resistant to most soil chemicals and alkali with a pH range of 3 to 12.

SPEC NOTE: Where a thinner profile is desired, contact Henry Representative for the Low Profile Multilayer system.

## 2.8 AVRS TRAYS: DETAIN AND RETAIN RAIN AND IRRIGATION WATER (Basis-of-Design)

- .1 Performance / Design Criteria: Engineered to
  - .1 Retain and meter rain and drip irrigation water.
  - .2 Allow hydration of plants and prevent root rot.
  - .3 Allow phytoremediation (removal of contaminates) from soil and water at bottom of trays.
  - .4 De-energize wind flow under trays reducing chance of wind uplift.
  - .5 Eliminate need for additional drainage material, root barriers, and filter fabric.
- .2 Tray Size: 600 x 600 x 117mm (2 ft x 2ft x 4-5/8") deep
- .3 Injection moulded, 2.5mm (100 mil) polypropylene, 100 percent post-industrial recycled content.
  - .1 Water-Retention Ridges and Troughs: Eleven 20 x 16 mm (3/4 inch wide by 5/8 inch high) troughs and corresponding troughs
  - .2 Molded Drain Holes: 9mm (3/8 inch) diameter. Nine holes located at tops of water-retention ridges and one at each trough.
  - .3 Interlocks: Two flat and two overlapping top edges designed to connect and hold adjacent trays together.
  - .4 Sides: Sloped at 5 degree angle from top to bottom.
  - .5 Clearance: 16mm (5/8 inch) above underlying roof membrane to allow water to flow freely under and around trays.
  - .6 Connection Holes and Fasteners:
    - .1 Four 9mm (3/8 inch) holes, aligned and centered in each vertical side panel.
    - .2 Quick-lock fasteners.
    - .3 Hook and quick-lock fastener for drip irrigation system.
- .4 Weight
  - .1 Unloaded Tray Weight: 1.6kg (3.6 pounds).
  - .2 Loaded with Mature Plants and Fully Saturated: 112 to 127 kg/m<sup>2</sup> (23 to 26 pounds per square foot),
  - .3 Moisture Content Weight: 88 to 98 kg/m<sup>2</sup> (18 to 20 pounds per square foot), fully saturated.

## 2.9 GROWING MEDIA

- .1 Growing Media: Based on German FLL Greenroof Guidelines and supplied by Henry Company.
  - .1 Produced from organic recycled material and inorganic by-products for use as a light weight growing media for hardy long lasting succulent or phytoremediation plants that are beneficial in a green roof environment.
  - .2 Pre-blended regionally and delivered to site for application in bulk or minimum in 1.1 to 1.5 m<sup>3</sup> (1.5 or 2.0 cubic yard) super totes when possible.

SPEC NOTE: VEGETATION: Choose between (or a combination of) the options listed below - Sedum Tiles, Sedum mats, Plugs, cuttings.

## 2.10 VEGETATION

- .1 Conform to project landscape design requirements, recommendations of local horticulturists, where possible, and requirements of authorities having jurisdiction,



- including Fire Marshal, for specific recommendations and regulations based on German FLL Greenroof Guidelines
- .2 Design mix of vegetation, capable of thriving in rooftop environment for project location. Selections conforming to USDA hardiness zone classification and regional horticulturalist recommendation, as accepted by Architect and supplied by Henry Company.
- .3 Planting Method: [Sedum Tiles], [Sedum Mats], [Sedum Tiles], [Plugs 72/flat], [Un-rooted Cuttings] as specified by Architect.
  - .1 Plug Size: Minimum 38mm [1.5] inch wide
  - .2 Plug Spacing: 150, 200, 300, 450 mm[6, 8, 12, 18] inches on center
  - .3 Sedum Tiles: Plant following placement and full saturation of growing media.
  - .4 Sedum Mats: Plant following placement and full saturation of growing media.
  - .5 Un-rooted Cuttings: Plant at a minimum rate of 113 kg [250] lbs. /92.9 m<sup>2</sup> (1000 sf.) following placement of growing media.

#### 2.11 ACCESSORIES

- .1 DRIP IRRIGATION SYSTEM COMPONENTS
  - .1 Low-pressure 0.7kPa (15 psi) agricultural-grade line.
  - .2 Water source connectors.
  - .3 Patented AVRS irrigation line retention hook and quick-lock fastener.
  - .4 Provide connections to sub-main, valves, timers and manifold components at tray under work of [Division 22]
- .2 DRAIN INSPECTION CHAMBER WITH COVER
  - .1 Roof Drain Inspection Chamber with Cap. 20 gauge Stainless Steel 304b to be supplied by Henry Company
  - .2 Roof Drain Inspection Chamber with Cap. Aluminum Mill Finish to be supplied by the Henry Company.
- .3 METAL EDGING
  - .1 Aluminum Straight Edge Restraint Slotted for drainage. H32 5052 Grade .375" supplied by Henry Company.
  - .2 Stainless Steel Straight Edge Restraint Slotted for drainage. 16 gauge 304B supplied by Henry Company.

#### 2.12 ROOF BALLAST

- .1 PLAZA DECK PAVERS - Precast Plaza Deck Pavers: Heavyweight, hydraulically pressed, concrete units, square edged, factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C78 and as follows:
  - .1 Size: 600 x 600 x 50 mm (24 x 24 x 2 inches).
  - .2 Compressive Strength: 50 mPa 7500 psi, minimum ASTM C 140
  - .3 Colors and Textures as selected by architect
  - .4 Available Manufacturers:
    - .1 Hanover Architectural Products, Inc.
    - .2 Wausau Tile, Inc. Terra-Paving Div.
    - .3 Westile
- .2 Pedestal Supports: Pedestal supports for pavers shall be in accordance with the paver manufacturers' recommendations.
- .3 Stone Ballast: Well screened and washed stone gravel meeting ASTM D-448-80, gradations #57, 2, 4 or 5.

### PART 3: EXECUTION

#### 3.1 EXAMINATION

- .1 Acceptable substrates are cast-in-place and precast concrete and plywood. Metal pan decks to which concrete is poured must be venting type. Recommend cure time for normal weight structural concrete to be 28 days, 14 days minimum prior to application of the membrane system.
- .2 Lightweight concrete is an acceptable substrate provided:
  - .1 The recommended minimum compressive strength of the lightweight concrete is 17mPa (2500 psi) at 28 days.
  - .2 The density of lightweight concrete topping is minimum 1842 kg/m<sup>3</sup> (115 pcf).
  - .3 The deck is vented from the underside to facilitate drying. For composite steel deck construction, allow concrete to cure sixty (60) days.

- .4 The membrane is applied in a two-coat fabric reinforced system. Pin-holing of the membrane is expected to occur in the first coat over lightweight structural concrete.
- .3 Verify that surfaces and conditions are ready to accept the work of this section. Commencement of the work or any parts thereof shall mean acceptance of the substrate.

### 3.2 PREPARATION

- .1 All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar, frost or other contaminants. Fill spalled areas in substrate to provide an even plane and remove scaling or laitant concrete. Remove curing compounds or any foreign matter detrimental to the adhesion of the primary waterproofing membrane or membrane flashings.
- .2 New concrete should be cured for a minimum of 14 days and must be dry before waterproofing membranes are applied. Concrete in vented metal pan decks must be cured a minimum of 28 days.
- .3 Concrete shall have a broom finish. Steel float finishes are too smooth and compromise the adhesion of the waterproofing system. Decks with a steel float finish must be sandblasted or equivalent prior to the application of the waterproofing system.
- .4 Prefabricated expansion joint assemblies should be in place prior to the application of the primary waterproofing assembly.
- .5 Substrate Preparation For Sheathing over Metal Deck or Wood Blocking
  - .1 Mechanically secure sheathing with type and sufficient quantity as recommended by the sheathing manufacturer and to meet maintain structure integrity and applicable code.
  - .2 Lay sheathing with butted joints at right angles to flute direction. Joints occurring along the widths of the sheathing are to be continuously supported on a top flange of the deck.
  - .3 Install sheathing such that all edge and end joints are supported by metal deck ribs and/or appropriate blocking. Stagger end joints of adjacent boards.
  - .4 Prepare joints with either minimum 300mm (12 inches) wide Polyfab or 150mm (six inch) modifiedPlus set in 3mm (1/8") thick hot rubberized asphalt.
  - .5 The contractor shall review all surfaces to receive the membrane and report any discrepancies prior to installing the waterproofing system.

### 3.3 INSTALLATION OF WATERPROOFING MEMBRANE

- .1 Surface conditioning:
  - .1 Apply primer or adhesive as recommended by manufacturer and allow to dry prior to the application of the primary waterproofing membrane or membrane flashings.
- .2 Joint Treatment For Precast Concrete Deck:
  - .1 Reinforce joints along length and width of units with a strip of 300mm (12 inches) wide Polyester Fabric set in a 450mm (18 inches) wide, 3mm (1/8 inch) thick coat of membrane.
- .3 Deck to Vertical Junctures:
  - .1 Apply hot rubberized asphalt membrane to provide a thickness of approximately 3mm (1/8 inch) to the vertical faces and extend a minimum of 100mm (4 inches) out onto the horizontal surface.
  - .2 Embed flashing sheet in the hot rubberized asphalt membrane, avoiding any wrinkles or fishmouths, extending a minimum of 75mm (3 inches) out onto the horizontal surface.
  - .3 Mechanically attach the flashing sheet to vertical surfaces with metal securement bar where height of flashing exceeds 300mm (12 inches). Lap flashing sheet minimum 75mm (3 inches) on ends.
  - .4 At monolithic pour, use fabric reinforcement as option to flashing sheet.
- .4 Expansion Joints (Neoprene):
  - .1 Expansion joint membrane can be applied in a bed of primary waterproofing membrane or adhered to substrate with expansion joint adhesive. Place expansion joint membrane into expansion joint adhesive as recommended by manufacturers' written instructions.
  - .2 Loop expansion joint membrane down into expansion joint, embedded into a 3mm (1/8 inch) thick layer of hot rubberized asphalt membrane. Ensure that the depth of loop is a minimum 1-1/2 X the joint width.
  - .3 Extend expansion joint membrane minimum of 75mm (3 inches) on each side of joint. Seal end joints a minimum of 150mm (6 inches) and seal with a 3mm (1/8 inch) coat of membrane. Fill loop with membrane as required.

- .4 Secure top of expansion joint membrane with continuous fixing bar at vertical wall.
- .5 Crack Treatment:
  - .1 Seal cracks and joints over 1.5mm (1/16 inch) but less than 6mm (1/4 inch) in width with a 300mm (12 inches) wide, 3mm (1/8 inch) thick coat of hot rubberized asphalt membrane and a 150mm (6 inch) wide strip of fabric reinforcement, centered over joint.
  - .2 Seal cracks and joints 3mm (1/8 inch) to 6mm (1/4 inch) in width with a 300mm (12 inch) wide, 3mm (1/8 inch) thick coat of hot rubberized asphalt membrane and a 150mm (6 inch) wide strip of crack treatment or expansion joint membrane, centered over joint.
- .6 Membrane Flashing At Drains:
  - .1 Coat areas around the drains with hot rubberized asphalt membrane at a thickness of 3mm (1/8 inch).
  - .2 Place flashing sheet over the coated drain flange and extending a minimum 150mm (6 inches) around the flange.
  - .3 Apply a second coat of hot rubberized asphalt membrane over the flashing sheet at a thickness of 3mm (1/8 inch).
  - .4 Apply clamping ring exerting sufficient pressure to affect a seal between clamping ring and membrane. Temporarily block all drains during the application of ballast, or other materials that might block the drains. Remove blocking when work is not in progress and upon completion.
- .7 Membrane Flashing At Protrusions:
  - .1 At mechanical vent, protrusions and pipe penetrations provide flashing sheet set into 1/8 inch layer of hot rubberized asphalt membrane. Overcoat and seal with membrane. Install clamps as required.
  - .2 At pitch pockets, place pan on top of a 3mm (1/8 inch) layer of membrane and attach into roof deck. Set flashing sheet into 3mm (1/8 inch) hot rubberized asphalt membrane over top of flange. Fill pitch pocket with rubberized asphalt or rubber asphalt sealer in order to shed water.
- .8 Non-Exposed Membrane Flashing At Vertical Junctures (Self-Adhering Membrane):
  - .1 Apply self-adhering waterproofing membrane to prepared substrate in lengths of 6 feet or less.
  - .2 Horizontal to vertical inside corner transition areas are to be pre-treated with a fillet bead of termination sealant extending 20mm (3/4 inch) vertically and horizontally from the corner. Apply a minimum 250mm (10 inches) wide strip of waterproofing membrane centred at the joint.
  - .3 All outside corners are to be pre-treated with a minimum 250mm (10 inches) strip of waterproofing membrane centred at the joint.
  - .4 Where three or more planes come into contact reinforce with cut sections of waterproofing membrane reinforcing sheet as per manufacturer's instructions.
  - .5 Provide 65mm (2-1/2 inches) laps at both sides and ends. Position for alignment and remove protective film. Press firmly into place. Promptly roll all laps with a counter top roller to effect seal. If more than one length is required on a vertical surface, apply in a shingle fashion.
  - .6 Terminate membrane using termination sealant and counter flashing as indicated.
  - .7 All laps within 300mm (12 inches) of a 90 degree change in plane are to be sealed with termination sealant.
- .9 Application of Hot Rubberized Asphalt Membrane:
  - .1 Ensure deck is ready to receive hot applied rubberized asphalt membrane. Where torch applied flashing membranes have been used, ensure top polyfilm has been scorched away prior to application of the membrane.
  - .2 Apply membrane smooth, free from air pockets, wrinkles, or tears and to manufacturer's Instructions. Ensure full bond of membrane to substrate.
  - .3 Apply first layer of hot rubberized asphalt membrane evenly to a minimum thickness of 2mm (90 mils) to form a continuous monolithic coating over horizontal and vertical surfaces including previously reinforced areas.
  - .4 Apply fabric reinforcing sheet and firmly press into first layer of hot membrane. Overlap fabric approximately 6mm (1/4 inch) ensuring that a layer of membrane is present between overlaps. Apply second layer of membrane over the fabric to a minimum thickness of 3mm (1/8 inches, 125 mils) providing a total thickness of 5mm 215 mils.
- .10 Installation of Protection Course

- .1 Protection course shall be rolled onto hot applied rubberized asphalt membrane while still warm and tacky.
- .2 Lap protection course 75mm (3 inches) on side laps and 6 inches on end laps.
- .3 Starting at the low points or drains lay the protection course membrane in full continuous sheets in a shingle pattern. Stager all end laps.

SPEC NOTE: WATERPROOFING MEMBRANE INTEGRITY TEST. As a requirement for meeting warranty conditions, the waterproofing membrane must be tested for leaks. The completed waterproofing system may be tested by either flood testing the area or Electric Field Vector Testing. Henry Company recommends Electronic Vector Testing in lieu of flood testing

- .11 Flood Test
  - .1 Upon the completion of the Primary Waterproofing Membrane, Protection Course and all associated terminations the contractor shall flood test the system.
  - .2 Provide temporary stops and plugs for the roof drains within the test area.
  - .3 Flood test with minimum 50mm (2 inches) of water for no less than 24 hours.
  - .4 Repair and retest the system for no less than 24 hours, report all deficiencies to the Architect or Consultant.
  - .5 Remove temporary stops and plugs.
  - .6 No other Work is to proceed with out prior direction from the Consultant.
- 3.4 ELECTRIC VECTOR TESTING (EFVM) (Alternate to Flood Test)
  - .1 EFVM to be completed in conjunction with the completion of waterproofing and prior to placement of root barrier or any other overburden.
  - .2 Contact pre-approved test provider several weeks in advance to coordinate schedule.
  - .3 In the event of a breach of the membrane, repair and retest the system for no less than 24 hours,
  - .4 Report results of testing to the Consultant & Henry Technical Representative. Remove temporary stops and plugs.
  - .5 No other Work is to proceed with out prior direction from the Architect or Consultant.
- 3.5 INSTALLATION OF ROOT BARRIER
  - .1 Install Root Barrier membrane as directed by landscape professional:
    - .1 Lap the root barrier sheet 600mm (24 inches) and seal with 12mm (½") bead of 925 BES Sealant sealant.
    - .2 Extend Root barrier sheet up vertical surfaces to the upper level of the growing medium and protect the waterproofing membrane.
    - .3 Provide temporary ballasting over root barrier membrane where required until permanent covering material is installed.
- 3.6 INSULATION APPLICATION
  - .1 Install insulation loose over the root barrier, firmly butting each insulation board to surrounding board.
  - .2 Stagger the end joints of the insulation..
  - .3 Cut the insulation to fit closely to all cants, protrusions and obstructions.
  - .4 When installing multiple layers of insulation, the thickest layer is to be installed first. Install the second layer with joints staggered with the layer below.
- 3.7 FILTER FABRIC APPLICATION
  - .1 Install filter fabric over the drainage/water retention fabric. Overlap side and ends lap 150mm (six inches). Do not use lengths of less than 2m (6 feet).
  - .2 At all penetrations and roof drains cut and fit filter fabric to surround the penetration or drain, Slit fabric to fit tightly over penetrations, cut out around roof drains and other openings.
  - .3 Extend material above the anticipated media level. After installation of the growing media, trim fabric down to the level of the soil.
  - .4 Provide temporary ballasting over Filter Fabric as required preventing displacement until permanent covering material installed.
- 3.8 TRAYS
  - .1 Place trays directly over protection cover provided under roofing work of Section

[075323].

- .2 Positioned bottom troughs of trays perpendicular to roof slope, except minor crickets.
- .3 Orient edges to interlock and hold trays in place.
- .4 Attach trays in place with manufacturer's standard quick-lock fastener through aligned holes in tray sidewalls.
- .5 Secure trays together with quick-lock fasteners and install edge flashing in place.
- .6 Promptly after placing trays on roof, install growth medium or ballast as necessary to prevent movement of trays due to weather and construction activities.

### 3.9 IRRIGATION SYSTEM

- .1 Lay out and secure irrigation lines to trays using manufacturer's irrigation hook and quick-lock fastener system [, conforming to Section 328413].
- .2 Make connections of irrigation lines to water supply provided under work of other Sections, including sub-mains, valves, and manifold system.
- .3 Install regulator to govern pressures exceeding 100kPa (15 psi).
- .4 Conduct testing procedures to verify performance prior to installing growing medium.

### 3.10 GROWING MEDIA

- .1 Transport bulk growing media to roof on pallets of trays using stabilized hoisting equipment or cranes in [1.5 or 2.0] cubic yard totes or 22 to 30 kg (50 to 70 pound) sacks.
- .2 Distribute growing media evenly throughout tray.
- .3 Fill to specified depth allowing for compaction

SPEC NOTE: EROSION CONTROL MAT. Recommended when using plugs. Not required when sedum mats or sedum tile are installed.

### 3.11 EROSION CONTROL FABRIC.

- .1 Install the erosion control mat directly over the growing media. Roll out flat, even and smooth without stretching the material. Abut side and end laps with adjacent layer and secure with common row of anchors.

SPEC NOTE: VEGETATION INSTALLATION: Choose between (or a combination of) the options listed below.

### 3.12 VEGETATION INSTALLATION

- .1 Sedum Mats or Sedum Tile
  - .1 Thoroughly wet the media before overlaying with sedum mats or tile.
  - .2 Install sedum mats or tile directly over freshly moistened growing media.
  - .3 Lay sedum mats or tile smoothly over the growing media, maintaining good overall contact with the media layer.
  - .4 Place sedum mats or tile close together, avoiding air gaps between them.
  - .5 Immediately and thoroughly water the newly installed sedum mats or tile.
- .2 Plugs
  - .1 If growing media is very dry, moisten it to the point where dust is not generated when disturbed before planting the plugs.
  - .2 Install erosion control blanket if required.
  - .3 Install plugs to a depth where the top of the plug root ball corresponds to the surface of the growing media.
  - .4 Install plugs at the specified spacing of [xx] inches on center in staggered rows (to resemble a "5" as on dice).
  - .5 Distribute varieties as shown on landscape plan.
  - .6 Immediately and thoroughly water the newly installed plugs.
- .3 Sedum Cuttings
  - .1 Moisten growing media to point where dust is not generated when disturbed before planting the cuttings.
  - .2 Hand sow cuttings at a rate of (kg/m<sup>2</sup>); [xx] pounds per 100 sq.ft.
  - .3 Distribute varieties as shown on landscape plan.
  - .4 Cover the cuttings with a temporary mulch.

### 3.13 EDGE FLASHING

- .1 Conform to manufacturer's details and provisions of Section 076000 for interconnections

of flashing systems.

- .2 Install trim flashing to conceal tray sides [and to lock into metal counter flashing at building perimeter flashing systems as specified by Section 076000].
- .3 Install interlocking metal anchor flashing at openings between trays and perimeter roof edges to anchor trays, building perimeter flashings and counter flashings together.

### 3.14 SHEET METAL FASTENERS

- .1 Concrete Walls: Fasten at 300 mm (12 inch) on centre using a 6mm (1/4 inch) lead drive pins.
- .2 Wood Parapet Walls: Install interlocking metal anchor flashing fastened with minimum 12 stainless steel fasteners at 300mm (12 inch) on center.
- .3 Gypsum Sheathing and Other Low Strength Materials: Install 18 gauge by 100mm (4 inch) galvanized steel strip installed at structural framing at fastener locations. Fasten with minimum 12 stainless steel fasteners at 300mm (12 inch) on center.

### 3.15 CONCRETE PAVERS AND GRAVEL BALLAST

- .1 Installation of concrete pavers and gravel ballast to be completed after placement of curbs details as indicated on drawings.
- .2 Spread gravel ballast uniformly over the installed filter fabric according to insulation manufacturer's recommendations.
- .3 Place concrete pavers, where indicated, on pedestals, accurately aligned, and leveled with upper surface of pavers in plane with adjacent units. Cut pavers to fit irregularly shaped areas and around protrusions. Install according to manufacturer's instructions.

### 3.16 FIELD QUALITY CONTROL

- .1 Final Inspection and Approval:
  - .1 Final inspection of completed work shall be carried out by the owner's representative, the contractor and Henry.

### 3.17 CLEAN-UP

- .1 Promptly as the work proceeds and on completion, clean up and remove from the premises all rubbish and surplus materials resulting from the foregoing work.
- .2 Clean to the consultant's approval, soiled surfaces, spatters, and damage caused by work of this Section.
- .3 Check area drains to ensure cleanliness and proper function, and remove debris, equipment and excess material from the site.

END THIS SECTION