

VEGETATED ROOF COVERING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install a extensive vegetated roof covering complete as shown on the Drawings and as specified herein.
- B. Section Includes:
 - 1. Moisture retention/ protection fabric
 - 2. Drainage layer
 - 3. Separation fabric.
 - 4. Growing media and vegetation
 - 5. Border units
 - 6. Drainage access chambers
 - 7. Accessories and components as necessary for a complete installation of the vegetated roof covering.

1.02 RELATED WORK

- A. Vegetation for roof covering shall be as shown on the Drawings.
- B. Roofing system under vegetated roof covering.

1.03 SUBMITTALS

- A. Submit detailed information on system provider's technical literature for proposed materials and installation methods.
- B. Statement of existing conditions that must be achieved and provided to begin installation of the vegetated roof covering system.
- C. Statement of method for protecting the surface from wind disturbances until the foliage layer is established.
- D. Shop Drawings: Submit Shop Drawings showing:
 - 1. Details of installation with conditions at terminations, transitions, and penetrations;
 - 2. Fabrication details or System Provider's information for drain access chambers.
 - a. System Provider shall coordinate with Roofing Membrane Provider the details for roof drains, scuppers and overflows, including accurate dimensions and geometric configurations. Verify that standard drain access chambers, deck drains and scuppers conform to System Provider's written recommendations.

E. Samples: Submit samples as follows:

1. 4 by 4-in square of moisture retention/ protection fabric, synthetic sheet components, including fabrics, sheet drains, reinforcing materials, and wind protection materials.
2. 1 pound sample of growth media as delivered for each 100 cubic yards for verification.

F. Plant list: Identify species, size, and source for each type of plant. Indicate growing and planting method, planting density, and quantity conditions for care during the establishment period and provide source for all plant materials. All plants shall be non-invasive.

G. Certifications:

1. System Provider's statement indicating that:
 - a. Proposed use is appropriate for each product, material and component.
 - b. System Provider has reviewed and approved the details for the associated Roofing Membrane system, including deck drains, flashings, penetrations, and coping.
 - c. System Installer is approved by System Provider.
 - d. Proposed system is eligible for the specified warranty required of the System Provider.
2. The System Installer has documented at least 200,000 sq ft of successful un-irrigated green roof installations of similar design that are at least five years of age.
3. Certified laboratory results showing compliance of the soil growing media with the specifications. Test shall be conducted by an independent laboratory with the experience and capability to conduct the tests indicated: Agricultural Analytical Services Laboratory, Penn State University.
4. The System Provider shall submit warranty documentation that will describe Single-Source Responsibility for installation and services for the vegetated roof covering system components and vegetation. The submittal shall be a comprehensive 'single source' warranty to the Owner that includes both the waterproofing and the vegetated cover system as described herein.

H. Closeout Submittals:

1. Warranty.
2. Proposed maintenance program for establishment and long term annual maintenance program for Owner use.

1.04 REFERENCES

A. ASTM International (ASTM)

1. ASTM D3786 - Standard Test Method for Bursting Strength of Textile Fabrics- Diaphragm Bursting Strength Tester Method
2. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity

3. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
 4. ASTM D4716 - Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
 5. ASTM D4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
 6. ASTM D5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
 7. ASTM D5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles
 8. ASTM E2114 - Standard Terminology for Sustainability Relative to the Performance of Buildings
 9. ASTM E2399 - Standard Test Method for Maximum Media Density for Dead Load Analysis of Green Roof Systems
 10. ASTM E2400 - Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems
 11. ASTM E 2396 – 05: Standard Test Method for Saturated Water Permeability of Granular Drainage Media [Falling-Head Method] for Green Roof Systems
 12. ASTM E 2397 – 05: Standard Practice for Determination of Dead Loads and Live Loads associated with Green Roof Systems
 13. ASTM E 2398 – 05: Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Green Roof Systems
 14. The Landscape and Landscape Development Research Society, E.V. FLL, January 2002 edition: Guideline for the Planning, Execution and Upkeep of Green-Roof Sites
- B. Agricultural Analytical Services Laboratory
Penn State University
Tower Road
University Park, PA 16802
814-863-0841
- C. American Society of Agronomy
1. MSA - Methods of Soil Analysis
- D. Recommended Chemical Soil Testing Procedures, North Central Region Publication #221 (RCSTP)
- E. Test Methods for the Examination of Composting and Compost (TMECC)

1.05 DEFINITIONS

- A. Definitions pertaining to sustainable development: As defined in ASTM E2114.
- B. Drain Access Chamber: Open-ended box or cylinder that covers drains and/or scuppers. The chamber must be designed to admit water freely at the base. It must also have a removable lid to prevent debris from entering the chamber.

- C. Growth Media Layer: An engineered soil-like material designed to retain moisture, manage plant nutrients, and support vigorous growth of the foliage.
- D. EFVM (Electric Field Vector Mapping): A leak location technique that relies on the electrical conductivity of the cover material (moist media) and electrical insulating properties of the waterproofing membrane. The compatibility of EFVM with a specific waterproofing system must be established in advance by the EFVM service provider.
- E. Manning formula for conveyance (ft³/s): $K = (1.49 \times A \times R^{(2/3)})/n$; A=area (ft²), R=hydraulic radius (ft), n=Manning's roughness coefficient (dimensionless).
- F. System Installer: Entity approved by System Provider to install vegetated roof covering system.
- G. System Provider: Entity that provides and certifies all materials required for installation of the vegetated roof covering system and offers long-term support and warranty protections for the completed green roof assembly.
- G. Roofing Membrane Provider: Entity that provides all materials required for installation of the waterproofing or roofing system below the vegetated roof covering.

1.06 SYSTEM DESCRIPTION

A. Design Requirements:

1. The vegetated cover for semi-intensive green roof system shall be a multi-layer system, consisting of a 2 ½ inch growth media layer installed over a layers of protection fabric, drainage sheet, & separation fabric designed to promote drainage and distribute moisture.
2. The weight of this system at Maximum Water Capacity as per ASTM E2399 and with rainfall runoff occurring, shall be less than or equal to 15 pounds per square foot.
3. The system dead load, measured according to ASTM D2397, when added to the weight of the roofing membrane system, shall not exceed the maximum allowable dead load for the roof.

B. Performance Requirements

1. The vegetated roof covering system shall support a perennial vegetated ground cover and provide efficient drainage of moisture that is in excess of that required for the vigorous growth of the installed vegetation. It shall also protect roof waterproofing materials from damage caused by exposure to ultraviolet radiation, physical abuse and rapid temperature fluctuations.
2. The wet dead weight of this system shall not exceed 15 pounds per square foot (ASTM E-2397).
3. The system will continue to perform as designed for the duration of the warranty period, without a requirement to amend or refresh the media.

1.07 QUALITY ASSURANCE

- A. Single-Source Responsibility: Installation of the vegetated roof covering system components and vegetation, shall be coordinated by a single-source System Provider that shall be required to offer a comprehensive 'single source' warranty to the Owner that includes both the

waterproofing and the vegetated cover system. The System Provider shall coordinate warranty documentation and services.

1. Moisture retention/ protection fabric
2. Drainage sheet
3. Separation fabric.
4. Growing media and vegetation
5. Border units
6. Drainage access chambers

B. Roofing Inspection:

1. The System Provider shall furnish a quality control specialist to observe critical aspects of the installation and testing of the work.

C. Pre-Construction Meeting: After award of Contract and prior to the commencement of the Work of this Section, schedule and conduct meeting to discuss the Work of this Section and to coordinate with related Work.

1. Notify all attendees at least two weeks prior to the conference.
2. Require attendance of parties directly affecting Work of this Section, including, but not limited to:
 - a. Owner,
 - b. Contractor,
 - c. Engineer,
 - d. System Provider,
 - e. System Installer,
 - f. Roofing Membrane Provider,
 - g. Roofing Membrane Installer, and
 - h. Mechanical and Plumbing Installers.

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate the Work with installation of associated roofing, waterproofing, flashings, and roof accessories specified under other sections as the Work of this Section proceeds.
- B. Sequence the Work with attention to preventing deterioration of installed roofing by minimizing the use of newly constructed roof deck for storage, walking surface, and equipment.

1.09 WARRANTY

- A. Green Roof System Components: Provide a warranty signed by System Provider against failure of components in vegetated roof covering system, including vegetation. Warranty shall include repair of flaws which impair the functioning of the green roof system, provided the flaws originate from errors in design, material defects, improper assembly, incompatibility between components, or deterioration. Failure of components shall include:
 1. Loss or dislocation of media due to wind scour (during the establishment period).
 2. Persistent ponding of water after rainfalls.
 3. Anaerobic conditions developed in the media due to inadequate drainage.

4. Cracking or deterioration of drain access chambers and border units, clogging of roof drains or scuppers.
- B. Green Roof System Vegetation: Provide a warranty signed by System Provider and Installer against failure of vegetation in vegetated roof covering system, including but not limited to failure of the plants to thrive due to compression or decomposition of the media. Warranty shall provide for the following:
1. Supplement or replacement of potted plant materials after 24 months if the surface coverage rate is less than 80 percent.
 2. Emendation of media, if required to provide a viable growing medium for the vegetation.
- C. Warranties shall include cost of labor and materials to inspect, repair, remove, and replace components in vegetated roof covering system without financial limit.
1. Warranties shall include removing and replacing vegetated roof covering to access and repair waterproofing/roofing below vegetated roof covering.
 2. Warranties shall run concurrently with roofing system and shall be a single-source warranty.
- D. Warranty Period:
1. Green Roof System Components: 20 years.
 2. Green Roof System Vegetation: 2 years, with option for another 18 years with maintenance agreement with certified green roof installer.

1.10 MAINTENANCE

- A. System Installer and Provider shall execute with Owner a 2-year establishment period maintenance contract for plantings from time of provisional acceptance.
- B. Maintenance up to provisional acceptance and after the time of provisional acceptance shall include cultivation, weeding, disease and insect pest control. Procedures shall be consistent with good horticultural practices necessary to ensure vigorous, healthy growth of plant material.
1. Provide hand weeding, watering, and organic fertilization media supplement and replacement as required to maintain the health and vigor of the plants.
 2. Clean up: During course of maintenance, excess and waste materials shall be promptly removed at end of each workday.
- C. Maintenance schedule of activities:
1. Schedule: Shall include a minimum of 4 maintenance working visits per year with a total of 8 visits during the two year establishment period.
 2. Provide Owner with long term written annual maintenance program prior to provisional acceptance. Consideration will be given to system components including growing media plantings, watering, weeding, and fertilization at a minimum.
- D. Maintenance reports:

1. Provide reports to Owner summarizing activities, observations, necessary corrections, and recommended changes to maintenance routine, if any.

PART 2 PRODUCTS

2.01 GREEN ROOF SYSTEM COMPONENTS

A. MOISTURE PROTECTION and DRAINAGE COMPONENT

1. **Protection Mat SSM 45 by ZinCo USA:** High-quality fiber mat made of polypropylene, with fleece backing.

Color: black

Thickness: ca. 0.15 in (ca. 3.8 mm)

Weight: ca. 0.11 lb/sq ft (ca. 543 g/m²)

CBR Puncture (according to ASTM D6241): ca. 1050 lbs (ca. 4673 N)

Grab Tensile Strength (according to ASTM D4632): ca. 380 lbs (ca. 1691 N)

Elongation (according to ASTM D4632): 50 %

Water Flow Rate (according to ASTM D4491): ca. 50 gpm/ft² (ca. 2037 l/min/m²)

Dimensions: EDP No. 21204500 ca. 7.50 ft x 150.00 ft (ca. 2.30 m x 46.00 m)

2. **Fixodrain XD-20 drainage layer by Zinco.** The composite shall satisfy the following specifications:

Material: HD-PE (REC) (Polyethylene (REC))

Color: black / grey

Height: ca. 0.80 in (ca. 20 mm)

Weight: ca. 0.20 lb/sq ft (ca. 1.00 kg/m²)

Water storage capacity: ca. 0.07 gal/sq ft (ca. 3 l/m²)

Max. compressive strength: 7.25 psi (50 kN/m²)

Waterflow rate in element level: with 1 % slope: ca. 1.75 gpm/ft (ca. 0.36 l/(s·m))

with 2 % slope: ca. 2.50 gpm/ft (ca. 0.52 l/(s·m))

with 3 % slope ca. 3.15 gpm/ft (ca. 0.65 l/(s·m²))

Dimensions: rolls ca. 3.30 ft x 65.60 ft (1.00 m x 20.00 m)

- 2 Separation Fabric/ Filter Fabric: **Thermally strengthened filter sheet of polypropylene.**
ZinCo Filter Sheet SF

Color: black

Thickness: ca. 0.04 in (ca. 1.14 mm)

Weight: ca. 0.02 lb/sq ft (ca. 109 g/m²)

CBR Puncture (according to ASTM D6241): ca. 220 lbs (ca. 979 N)

Grab Tensile Strength (according to ASTM D4632): ca. 80 lbs (ca. 356 N)

Elongation (according to ASTM D4632): 50 %

Water Flow Rate (according to ASTM D4491): ca. 160 gpm/ft² (ca. 6519 l/min/m²)

B. GROWING MEDIA LAYER

1. Stancils light-weight growth media.

Parameters Guiding Values * Guiding Values (metric) *

Proportion of silting components: ≤ 15 mass %

Volume weight apparent density

max. water capacity: 56 lb/cu ft

Total pore volume: approx. 50 Vol. %

Max. water capacity: approx. 40 Vol. %

Water permeability, mod Kr: 0.024–2.40 in/min 0.001–0.10 cm/s

pH-Value: 6.50–8.00

Salt content (water extract): ≤ 2.50 g/l

Organic content: ≤ 65 g/l

- a. Non-capillary Pore Space Ratio at Field Capacity, 0.333 bar (TMECC 03.01, A) ≥ 10% (vol)
- b. Moisture Content at Field Capacity (TMECC 03.01, A) ≥ 15% (vol)
- c. Non-Capillary Pore Space Ratio at Maximum Water Capacity ≥ 6% (ASTM-E2399)
- d. Maximum Water Capacity ≥ 40% (vol) (ASTM-E2399-05)
- e. Density at Maximum Water Capacity ≤ 85 lb/ft³ (ASTM-E2399-05)
- f. Water Permeability ≥ 0.05 in/min (ASTM-E2399-05)
- g. Alkalinity, Ca CO₃ equivalents (MSA) ≤ 2.5%
- h. Total Organic Matter (TOM), by loss on ignition ≤ 3-8% (dry wt.) (MSA)
- i. pH (RCSTP) 6.5-8.0
- j. Soluble Salts (DTPA saturated media extraction) (RCSTP) ≤ 6 mmhos/cm
- k. Organic Supplements (compost, peat moss, etc.) ≤ 1 mg CO₂/g TOM/d combined respiration rate (TMECC 05.08, B)
- l. Cation exchange capacity (MSA) ≥ 10 meq/100g
- m. Grain-size distribution of the mineral fraction (ASTM-D422)
 - (1) Clay fraction (2 micron) ≤ 3%
 - (2) Pct. Passing US#200 sieve (i.e., silt fraction) 5-15%
 - (3) Pct. Passing US#60 sieve 10-25%
 - (4) Pct. Passing US#18 sieve 20 - 50%

- (5) Pct. Passing 1/8-inch sieve 55 - 95%
- (6) Pct. Passing 3/8-inch sieve 90 -100%

n. Chemical Analysis

- (1) Nitrogen, NO₃ (RCSP) 25-100 ppm
- (2) Phosphorus, P₂O₅ (RCSP) 20-200 ppm
- (3) Potassium, K₂O (RCSP) ≥ 150 ppm
- (4) Other macro- and micro-nutrients shall be incorporated in the formulation in initial proportions suitable for support the specified planting.

- 2. Thoroughly blend at a batch facility. Moisten, as required, to prevent separation and excessive ‘dusting’ during installation.

C. WIND PROTECTION

- 1. Woven coconut coir fibers. Opening to be 0.75” x 0.5”, weight to be 600 g/SM.

D. BORDER UNITS

- 1. To allow free flow across edges, these units should be installed on top of strips of sheet drain.

A. Edge Elements

- (1) These are used to separate gravel margins from the green roof proper. Edge elements shall be Permaloc or equal aluminum perforated cantilever (i.e., ‘L-shaped’) border units conforming to the following dimensions:

Height: ≥ 0.25 inch higher than the top of the growth media layer

Base Length: greater of 6 inches, or 1.5 times the height of the element

B. Stone

- (1) Pea Stone for walkway and river rock ballast stone for borders.

E. DRAIN ACCESS CHAMBERS

- 1.. These are designed to enclose roof drains and scuppers. They prevent intrusion of media and protect the drains from clogging by wind-blown paper, leaves, etc. Drain access chambers are typically 12 inches square (or 12 inches in diameter).

2.02 VEGETATION

A. Plants: Provide plants in accordance with ASTM E2400 and as follows:

- 1. Provide vegetation that minimizes or eliminates irrigation requirements after establishment as approved by Engineer and Owner.

2. Plant materials shall be as shown Green Roof Plan. Substitutions shall be indigenous plant species. However, substitutions providing a plant community that can provide a dense groundcover capable of withstanding climatic conditions, holding the growth medium in place, minimize weed potential, and provide desirable aromatic characteristics is the primary goal.
3. The plant list shall be as shown on plan and include a minimum of 5 species with a record of success in similar installations and conditions.
4. Plants selected for the green roof shall be generally low-growing groundcovers and perennials, with an occasional ornamental grass (maximum height 48”) for semi-intensive installations as approved by Engineer and Owner.
5. Water for irrigation and plant establishment purposes shall be potable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions under which roofing will be applied, with System Installer and Roofing Membrane Installer present, for compliance with requirements
 1. Correct any deficiencies to the satisfaction of the System Installer.
 2. Do not proceed with installation until unsatisfactory conditions have been corrected.
 3. For the record, prepare a written report, endorsed by the Roofing Applicator and the Vegetated Roof System Installer, listing conditions as appropriate that may be detrimental to the performance of the work. Proceed only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare Surface:
 1. Clean surface of the Roofing Membrane as recommended by Roofing Membrane Provider/Installer and by System Provider.
- B. Protect Roofing Membrane:
 1. Until the protection fabric course is installed, traffic over the working area shall be strictly controlled and limited to essential personnel only.
 2. Protect heavily traveled areas, including but not limited to corridors for transporting media to the working areas, as recommended by the Roofing Membrane Provider.
 3. Protect lay down areas using ½-inch plywood or particle board over 1-inch sheets of expanded polystyrene (EPS), or similar sheathing material.
- C. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

3.03 INSTALLATION

- A. Install vegetated roof covering system according to System Provider's written instructions, applicable regulations, approved shop drawings, and as specified.
- B. Install moisture retention/ protection fabric:
 - 1. Layout moisture retention/ protection fabric on top of the completed waterproofing system by overlapping adjoining sheets by a minimum of 6-inches. Allow slack to accommodate contraction during cold weather.
- C. Install Drainage layer:
 - 1. Assemble the internal drainage conduit according to the layout provided by the System Provider.
 - 2. Cover the assembled conduit using separation fabric.
 - 3. The conduit shall be completely concealed below the top of the granular drainage aggregate when properly installed.
- D. Install drain access chambers and border units:
 - 1. Assemble border units directly on top of the drainage panel. Cover the edge elements and sheet drain with separation fabric to prevent intrusion of media.
 - 2. Layout drain access boxes. Wrap drain access chambers with separation fabric to prevent intrusion of media.
 - 3. Immediately place granular aggregate to stabilize the border units and separation fabric.
- E. Install walkways:
 - 1. Install a second layer of drainage panel at areas to receive walkways.
 - 2. Locate as shown in the drawings.
 - 3. Edge the walkways with separation fabric.
- F. Install growing media
 - 1. Place the growing media onto the roof in a manner that will not suddenly increase the load to the roof. It shall be immediately spread to the specified thickness, plus 10 percent, after moderate compaction. Unless otherwise approved, compaction shall be using a 4-ft wide lawn roller with a total load of not less than 100 lbs per linear foot and not more than 200 lbs.
 - 2. Upon completion of compaction, install tackifier emulsion at a rate approved by System Provider. Furnish and schedule a minimum of 2 applications at different times to secure finished grades of growing media.
 - 3. Upon completion of compaction, thoroughly soak with water using a hand sprayer or sprinkler in a manner as approved by the System Provider.
- G. Install vegetation:

1. Plant installation shall occur April 30 through June 1, and August 15 through October 30, unless otherwise approved by the System Provider.
2. Plants shall be well established according to the System Provider's recommendations.
3. Thoroughly soak the growing media prior to commencing planting.
4. Install plants into the growing media to their full depth and press firmly around each installed plant. At the end of each day, soak those areas that have been newly planted.
5. Install watering practices and wind protection measures immediately upon completion of each planting area and as recommended by the System Provider.
6. Enfield: Install plants at a density of 2.2 plants per square foot from 72 cell trays.
7. Springfield: Install plants at a density of 3 plants per square foot from 36 cell trays.

3.04 2-YEAR MAINTENANCE SERVICE

The green roof installer shall offer a two-year maintenance service. This service will include:

- A. Hand weeding and/or chemical weeding and fertilization, as required to maintain the health and vigor of the plants.
- B. The installer shall guarantee an 80 percent cover rate at the end of 24 months. As necessary, plants shall be replanted to achieve this requirement.

END OF SECTION

Apex Green Roofs and SKANSKA USA BUILDING INC. for Green Roof

Submittals Transmittals

- A. Technical Literature**
- B. Statement of Conditions prior to Install**
- C. Statement of Method for protection from Wind**
- D. Shop Drawings**
- E. Samples**
- F. Plant List**
- G. Certifications**
- H. Closeout Submittals**

A. Technical Literature

1.1

Protection Mat SSM 45 by ZinCo USA: High-quality fiber mat made of polypropylene, with fleece backing. Water and nutrient storage mat.

Color: black

Thickness: ca. 0.15 in (ca. 3.8 mm)

Weight: ca. 0.11 lb/sq ft (ca. 543 g/m²)

CBR Puncture (according to ASTM D6241): ca. 1050 lbs (ca. 4673 N)


Grab Tensile Strength (according to ASTM D4632): ca. 380 lbs (ca. 1691 N)

Elongation (according to ASTM D4632): 50 %

Water Flow Rate (according to ASTM D4491): ca. 50 gpm/ft² (ca. 2037 l/min/m²)

Dimensions: EDP No. 21204500 ca. 7.50 ft x 150.00 ft (ca. 2.30 m x 46.00 m)

PRODUCT DATA SHEET
Protection Mat SSM 45




Water and nutrient storage mat of synthetic fibres, for the application as a protection layer under green roofs, gravel fills, slab pavings, etc.

Features

- resistant to mechanical stress
- high quality protection layer
- water and nutrient storage
- non-rotting
- biologically neutral
- bitumen and polystyrene compatible
- made of recycled fibres
- quick and easy installation

Technical Data

Protection Mat SSM 45 / EDP No. 2045 / 2046
 High-quality fibre mat made of polypropylene, with fleece backing.

Colour:	brown (varies)	
Thickness:	ca. 0.2 in	(ca. 5 mm)
Weight:	ca. 0.1 lb/sq ft	(ca. 470 g/m ²)
Water storage capacity:	ca. 0.1 gal/sq ft	(ca. 5 l/m ²)
Strength class:	3	
Tensile strength lengthwise:	> 570 lb/ft	> 8.5 kN/m
Extension lengthwise:	> 90 %	
Dimensions:		
EDP No. 2045: rolls, ca. 1076 sqft (100 m ²)	6.6 ft x 164.0 ft	(2.0 m x 50.0 m)
EDP No. 2046: ca. 215 sqft (ca. 20 m ²), folded	ca. 6.6 ft x ca. 32.8 ft	(ca. 2.0 m x 10.0 m)

Health and Safety

This product does not require a material safety data sheet (MSDS) according to the OSHA Hazard Communication Standard (29 CFR 1910.1200). When used as recommended or under ordinary conditions, it should not present a health and safety hazard. However, an MSDS can be provided as a courtesy in response to a customer request.

Installation Instructions

Install the Protection Mat SSM 45 above a waterproofing or root barrier with an overlap of 4 inch. The Protection Mat has to be taken above the growing medium along edges and at roof penetrations. Cut the Protection Mat in situ at roof penetrations. Consider an allowance for overlap and wastage of ca. 10 – 15 %.

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Subject to technical alterations and printing errors; First edition: 01/07, revised: 01/09
 Authorized by ZinCo GmbH

1.2

Fixodrain XD-20 drainage layer by Zinco. The composite shall satisfy the following specifications:

Material: HD-PE (REC) (Polyethylene (REC))

Color: black / grey

Height: ca. 0.80 in (ca. 20 mm)

Weight: ca. 0.20 lb/sq ft (ca. 1.00 kg/m²)

Water storage capacity: ca. 0.07 gal/sq ft (ca. 3 l/m²)

Max. compressive strength: 7.25 psi (50 kN/m²)

Waterflow rate in element level: with 1 % slope: ca. 1.75 gpm/ft (ca. 0.36 l/(s•m))


with 2 % slope: ca. 2.50 gpm/ft (ca. 0.52 l/(s•m))

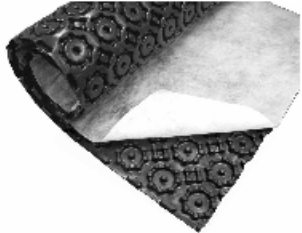
with 3 % slope ca. 3.15 gpm/ft (ca. 0.65 l/(s•m²))

Dimensions: rolls ca. 3.30 ft x 65.60 ft (1.00 m x 20.00 m)

PRODUCT DATA SHEET

Fixodrain® XD 20





Features

- no need for additional protection layer due to connectible interlocking studs
- tested and proven drainage capacity
- water retention within the element
- quick and easy installation
- 100 % Polypropylene

Economic, multi-functional Drainage Mat for use as alternative to single layered extensive green roof build-ups.

Technical Data

Fixodrain® XD 20 / EDP No. 3020
 Drainage Mat with attached Filter Sheet, connecting lengthwise on interlocking studs.

Material:		Polypropylene	
Color:		grey / white	
Height:		ca. 0.8 in	(ca. 20 mm)
Weight:		ca. 0.2 lb/sq ft	(ca. 1.0 kg/m ²)
Water storage capacity:		ca. 0.07 gal/sq ft	(ca. 3 l/m ²)
Max. compressive strength:		> 7.25 psi	(> 50 kN/m ²)
Waterflow rate in element level:	with 1 % slope:	ca. 1.75 gpm/ft	(ca. 0.36 l/(s-m))
	with 2 % slope:	ca. 2.50 gpm/ft	(ca. 0.52 l/(s-m))
	with 3 % slope:	ca. 3.15 gpm/ft	(ca. 0.65 l/(s-m ²))
Dimensions:	rolls	ca. 3.3 ft x 65.6 ft	(1.0 m x 20.0 m)

Health and Safety

This product does not require a material safety data sheet (MSDS) according to the OSHA Hazard Communication Standard (29 CFR 1910.1200). When used as recommended or under ordinary conditions, it should not present a health and safety hazard. However, an MSDS can be provided as a courtesy in response to a customer request.

Installation Instructions

Install the Drainage Mat Fixodrain®XD 20 on the roof resistant and waterproof roof construction. The Fixodrain®XD 20 mats are to be connected by interlocking studs lengthwise. Cut the Fixodrain®XD 20 mat in situ at roof penetrations. Ensure that pre-attached filter sheet overlaps completely at joints. Consider ca. 3 % allowance for wastage.
 Note: At roof edge and upstands the waterproofing has to be protected by a protection layer which has to be taken up above the finished surface in accordance with guidelines.

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2.0

- Aluminum GeoEdge:** Long Base aluminum restraint for media and vegetated assembly
- Height:** 3” x 3.25”
- Weight:** 4lbs (per 8’ length)
- Thickness:** 0.210 inch thick exposed top lip
- Connection Method:** Spliced together with horizontal 0.060 inch thick x 1 inch wide x 2-3/4” aluminum sliding connector
- Anchors:** Anchor as specified
- Finish:** Natural Mill Aluminum

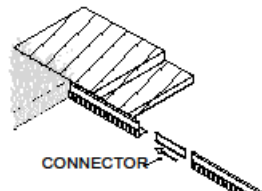
geoeedge™

PERMALOC CORPORATION, 13505 BARRY STREET HOLLAND, MI 49424
(800) 356-9660 PHONE: (616) 399-9600 FAX: (616) 399-9770 WWW.PERMALOC.COM

ARCHITECT NOTE: CHECK OFF APPLICABLE SIZE & FINISH DESIRED

SIZE: ALL 8" (2.44M) LENGTHS w/ 0.250" (6.35MM) THICK EXPOSED TOP LIP

<input type="checkbox"/> 3" x 3.25" (76MM x 83MM)	<input type="checkbox"/> MF	<input type="checkbox"/> BL
<input type="checkbox"/> 3.5" x 4.5" (89MM x 114MM)	<input type="checkbox"/> MF	<input type="checkbox"/> BL
<input type="checkbox"/> 4" x 3.25" (102MM x 83MM)	<input type="checkbox"/> MF	<input type="checkbox"/> BL
<input type="checkbox"/> 4.25" x 3.25" (108MM x 83MM)	<input type="checkbox"/> MF	<input type="checkbox"/> BL
<input type="checkbox"/> 4.5" x 3.25" (114MM x 83MM)	<input type="checkbox"/> MF	<input type="checkbox"/> BL
<input type="checkbox"/> 4.5" x 4.5" (114MM x 114MM)	<input type="checkbox"/> MF	<input type="checkbox"/> BL
<input type="checkbox"/> 5.5" x 8.5" (140MM x 165MM)	<input type="checkbox"/> MF	<input type="checkbox"/> BL
<input type="checkbox"/> 6.5" x 5.5" (165MM x 140MM)	<input type="checkbox"/> MF	<input type="checkbox"/> BL
<input type="checkbox"/> 7.5" x 8.5" (191MM x 216MM)	<input type="checkbox"/> MF	<input type="checkbox"/> BL
<input type="checkbox"/> 8.5" x 7.5" (216MM x 191MM)	<input type="checkbox"/> MF	<input type="checkbox"/> BL



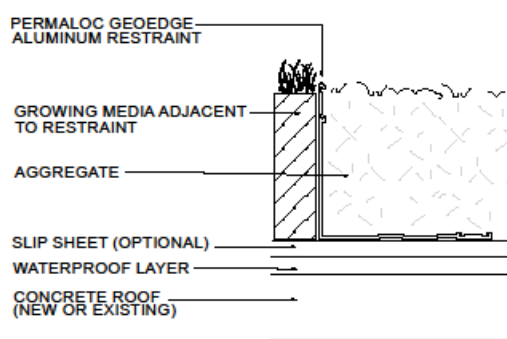
CONNECTOR

ISOMETRIC VIEW
NTS

FINISH LEGEND:
(MF) MILL FINISH-NATURAL ALUMINUM
(BL) BLACK DURAFLEX-ELECTROSTATICALLY APPLIED BAKED ON PAINT, MEETS AAMA 2603

NOTES:

1. INSTALLATION PER MANUFACTURER'S RECOMMENDED "INSTALLATION GUIDELINES" IN ACCORDANCE WITH DESIGNER'S INSTRUCTIONS.*
2. 8'-0" (2.44M) SECTIONS CONNECTED WITH 2 - 2.75" (70MM) SLIDING CONNECTORS.
3. CORNERS: REMOVE BASE TABS AND FORM A CONTINUOUS CORNER.
4. PERMALOC GEOEDGE AS MANUFACTURED BY PERMALOC CORPORATION, HOLLAND MI. (800) 356-9660 (616) 399-9800
5. CONTRACTOR'S NOTE: FOR PRODUCT AND PURCHASING INFORMATION VISIT: WWW.PERMALOC.COM



PERMALOC GEOEDGE ALUMINUM RESTRAINT

GROWING MEDIA ADJACENT TO RESTRAINT

AGGREGATE

SLIP SHEET (OPTIONAL)

WATERPROOF LAYER

CONCRETE ROOF (NEW OR EXISTING)

*DESIGNER MAINTAINS ULTIMATE RESPONSIBILITY FOR VALIDITY AND SAFETY OF THE INSTALLATION.

ALTERNATE INSTALLATION: GEOEDGE BASE MAY BE INSTALLED UNDER THE GROWING MEDIA

EDGING FOR GREENROOF WITH AGGREGATE
SCALE: 3"=1'-0"

GE2.dwg

3.0

Stancils light-weight growth media.

Parameters Guiding Values * Guiding Values (metric) *

Proportion of silting components: 15 mass %

Volume weight apparent density

max. water capacity: 68.74 lb/cu ft

Total pore volume: approx. 60 Vol. %

Max. water capacity: approx. 50 Vol. %

Water permeability, mod Kf: 0.024–2.40 in/min 0.001–0.10 cm/s

pH-Value: 6.50–8.00

Salt content (water extract): □ 2.50 g/l

Organic content: □ 65 g/l

- a. Non-capillary Pore Space Ratio at Field Capacity, 0.333 bar (TMECC 03.01, A) □ 10% (vol)
- b. Moisture Content at Field Capacity (TMECC 03.01, A) □ 15% (vol)
- c. Non-Capillary Pore Space Ratio at Maximum Water Capacity □ 6% (ASTME2399)
- d. Maximum Water Capacity □ 40% (vol) (ASTM-E2399-05)
- e. Density at Maximum Water Capacity □ 68.74 lb/ft³, not to exceed 15 lb./SF at design depth.
- f. Water Permeability □ 0.05 in/min (ASTM-E2399-05)
- g. Alkalinity, Ca CO₃ equivalents (MSA) □ 2.5%
- h. Total Organic Matter (TOM), by loss on ignition □ 3-9% (dry wt.) (MSA)
- i. pH (RCSTP) 6.5-8.0
- j. Soluble Salts (DTPA saturated media extraction) (RCSTP) □ 6 mmhos/cm
- k. Organic Supplements (compost, peat moss, etc.) □ 1 mg CO₂/g TOM/d combined respiration rate (TMECC 05.08, B)
- l. Cation exchange capacity (MSA) □ 10 meq/100g
- m. Grain-size distribution of the mineral fraction (ASTM-D422)
 - 1) Clay fraction (2 micron) □ □ 3%
 - 2) Pct. Passing US#200 sieve (i.e., silt fraction) 5-15%
 - 3) Pct. Passing US#60 sieve 10-25%
 - 4) Pct. Passing US#18 sieve 20 - 50%
 - 5) Pct. Passing 1/8-inch sieve 55 - 95%
 - 6) Pct. Passing 3/8-inch sieve 90 -100%
- n. Chemical Analysis
 - 1) Nitrogen, NO₃ (RCSP) 25-100 ppm
 - 2) Phosphorus, P₂O₅ (RCSP) 20-200 ppm
 - 3) Potassium, K₂O (RCSP) □ 150 ppm

4.0

Inspection Chamber KS 8: Designed to enclose roof drains and prevent intrusion of media or other debris.

Height: ca. 3.1 in (ca. 80 mm)

Aperture: ca. 9.8 x 9.8 in (ca. 250 x 250 mm)

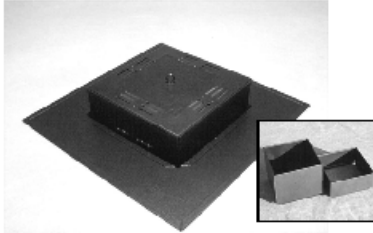
Flange: ca. 19.7 x 19.7 in (ca. 500 x 500 mm)

Slot width: ca. 0.1 in (ca. 3 mm)

Weight: ca. 7.05 lb (ca. 3.20 kg)

PRODUCT DATA SHEET

Inspection Chamber KS 8



Inspection chambers for protection and inspection of roof outlets for extensive green roofs and gravel roofs.

Features

- fits all outlets, $d < 10$ in
- frost proof due to insulated cover
- walkable
- corrosion-resistant
- overflow function via the cover, in case of flooding
- elevation with additional extension pieces KSA

Technical Data

Inspection Chamber KS 8 / EDP No. 4286

Made of galvanized, plastic-coated steel with lateral slots for water passage. Detachable and walkable cover, with thermally insulating expanded polystyrene inlay and drainage slots according to German FLL-Guidelines.

Height:	ca. 3.1 in	(ca. 80 mm)
Aperture:	ca. 9.8 x 9.8 in	(ca. 250 x 250 mm)
Flange:	ca. 19.7 x 19.7 in	(ca. 500 x 500 mm)
Slot width:	ca. 0.1 in	(ca. 3 mm)
Weight:	ca. 7.05 lb	(ca. 3.20 kg)
Colour:	"oldsilver-antique"	

Accessories:

Extension Piece KSA 10 / EDP No. 4249	ca. 3.9 in	ca. 100 mm
Extension Piece KSA 20 / EDP No. 4250	ca. 7.9 in	ca. 200 mm

Health and Safety

This product does not require a material safety data sheet (MSDS) according to the OSHA Hazard Communication Standard (29 CFR 1910.1200).

When used as recommended or under ordinary conditions, it should not present a health and safety hazard. However, an MSDS can be provided as a courtesy in response to a customer request.

Installation Instructions

Install the Inspection Chamber KS 8 on the drainage element above the drain. Install the Filter Sheet on top of the flange of the Inspection Chamber.

ZinCo USA, Inc. • Paragon Towers • 233 Needham Street • Newton MA 02464-1502
T 866 766 3155 • F 866 766 3955 • www.zinco-usa.com • info@zinco-usa.com

Subject to technical alterations and printing errors; First edition: 01/07
Authorized by ZinCo GmbH

EXHIBIT “M”
 Apex Green Roofs and SKANSKA USA BUILDING INC. for Green Roof

DATE:

MATERIAL STATUS LOG – ATTACHMENT NO. 1

SUBCONTRACTOR: Apex Green Roofs

Location:									
Bid Package No. and Description:									
Item	Manufacturer/Supplier	Purchase Order		Shop drawing release date	Fabrication date		Delivery Date		
		Number	Date		Start	Complete	Scheduled	Promised	Actual
(1.1)	Zinco – Protection Mat						June		
(1.2)	Zinco – Drainage layer						June		
(2.0)	Permaloc – Edging						June		
(3.0)	Stancill – Roof Media						June		
(4.0)	Zinco – Inspection Chamber								

EXHIBIT “M”

Apex Green Roofs and SKANSKA USA BUILDING INC. for Green Roof

SUBMITTAL SCHEDULE – ATTACHMENT NO. 2

SUBCONTRACTOR: **Apex Green Roofs**

LOCATION:									
Submittal no.	Spec Section	Spec Paragraph	Description of Item	Shop Drawing	Brochure	Sample	Date Item will be Submitted	Date Approval is Req'd By	Remarks
1.1			Protection fabric	SKA-018		SSM-45			
1.2			Drainage	SKA-018		XD-20			
2.0			Aluminum Edge	SKA-018		GeoEdge Permaloc			
3.0			Growth Media	SKA-018		Stancill			
4.0			Inspection Chamber	SKA-021		KS 8			

B.

For a vegetated roof to be successfully installed existing conditions must be as follows:

EFVM Testing to be performed by the roofer with a representative of Apex Green Roofs present as well as a representative from Sika Sarnafil. Testing is to be completed within two weeks of Apex's mobilization for construction.

The general contractor must confirm in writing to Apex Green Roofs Inc. that no trades or personnel will be permitted on the roof from the time of EFVM test to commencement of green roof construction.

Roof surface is to be clean, swept of all construction debris.

C.

Wind Protection:

Immediately after plant installation Apex Green Roofs will install a liquid applied tackifier to protect against wind scour.

An additional application will be applied in the fall maintenance visit as needed.

D. Shop Drawings:

E. Samples:

1. 4 by 4-in square of moisture retention/ protection fabric, synthetic sheet components, including fabrics, sheet drains, reinforcing materials, and wind protection materials.
2. 1 pound sample of growth media as delivered for each 100 cubic yards for verification. With mixture analysis per 2.1.B.1.

F. Plant list: The plant list shall be as shown on plan and include a minimum of 7 species with a record of success in similar installations and conditions. Max. concentration of 300 plugs of one species.

Phedimus
Delosperma
Sedum album
Sedum acre
S kamschaticum "Weihenstephaner's gold"
S sichotense
S rupestre "angelina"
S reflexum "blue spruce"
S pachyclados
S sichotense
S sexangulare
S spurium roseum
S spurium fuldaglut
S spurium var album
S spurium "John Creech"
S spurium "voodoo"

G. Certifications –

System provider indicates that each product, material and component will be used in accordance to each items appropriate use. Details in association with Roofing Membrane system, deck drain, flashings, penetrations and coping have been reviewed and approved. System installer

is approved by Sika Sarnafil. Proposed system is eligible for a single-source warranty through the waterproofing manufacturer Sika Sarnafil

Certified laboratory results show compliance of the soil growing media with the specifications. Tests have been performed by Penn State University Agricultural Analytical Services Laboratory. See attached document 3.0

Warranty documentation describing Single Source Responsibility for installation and services for the vegetated roof will be provided and attached.

- I. Closeout Submittals – Warranty & Maintenance –
See attached warranty



Sedum Master Inc.
746645 Township Rd. #4
Princeton, ON, N0J 1V0
T: 519-458-4061
F: 519-458-8883

Sedum Master SMRM5 Blankets

Size: 3.28' x 3.28' (L x W) or 6.56' x 3.28 (L x W)
(Soil thickness approximately 2cm to 2.5cm)

Material: **SMRM5** is a geometric patterned core, blanket designed to reinforce soil for green roof vegetation. It consists of a matrix of tangled monofilaments. The monofilaments are heat welded at the junctions to form a resilient structure that utilizes a removable Non Woven Spun bound Polyester.

Weight Vegetated: **Approximately 6-7 lbs./sq. ft. fully saturated**

Features & Benefits:

- Excellent for flexibility and compressibility.
- Fire Resistant - Class A fire rated product for roofing.
- Easy to handle.
- Easy to cut for installation around roof vents and equipment.
- Non-biodegradable fibers.
- Non-woven root penetrating backing.
- Fast installation reducing labour cost.

Soil Media: Organic and inorganic Sedum Master pre-engineered growing medium enables fast root penetration from SMRM5 blankets to the substrate below. Blanket substrate is for production only

Drainage: Combination of fibrous material and porous growing media provides drainage to avoid root rot.





Sedum Master Inc.
746645 Township Rd. #4
Princeton, ON, N0J 1V0
T: 519-458-4061
F: 519-458-8883

Plants:

The sedum species in our vegetative blankets varies from one to another, therefore exact percentages or varieties cannot be determined. Listed below are our most common species and are subject to change (custom grown are also welcome).

- Sedum Acre
- Sedum Album
- Sedum Ellacombianum
- Sedum Sexangulare
- Sedum Reflexum
- Sedum Spurium Dragons Blood
- Sedum Pulchellum
- Moss

Irrigation System: Not typically needed, however, we recommend that it be possible to water during an extended drought.

Growing

Lead Time: For a 75% - 85% blanket coverage, an 18 - 20 month lead time is required for all custom grown orders.

Sedum Mat Care: Upon receipt of your Sedum Master Vegetative Blankets unpack immediately to avoid plant spoilage.

Installation:

- Removing the backing is optional. With backing removed, root to soil contact is increased and the blanket performance will be increased.
- Sedum Master recommends that newly installed plants be watered thoroughly and continually until well established.
- A long term maintenance plan is advisable.





Sedum Master Inc.
746645 Township Rd. #4
Princeton, ON, N0J 1V0
T: 519-458-4061
F: 519-458-8883

Sedum Master SMUL6 Blankets

Size: 3.28' x 3.28' (L x W) or 6.56' x 3.28' (L x W)
(soil thickness approximately 2cm – 2.5cm)

Material: **SMUL6** is a geometric patterned core blanket designed to reinforce soil for green roof vegetation. It consists of a matrix of tangled monofilaments. The monofilaments are heat welded at the junctions to form a resilient structure that utilizes a removable Non Woven Spun bound Polyester filter fabric.

Weight

Vegetated: Approximately 1.75 -2.25 lbs./sq. ft. fully saturated.

Features & Benefits:

- Excellent for flexibility and compressibility.
- Fire Resistant - Class A fire rated product for roofing.
- Ultra lightweight & easy to handle.
- Easy to cut for installation around roof vents and equipment.
- Non-biodegradable fibers.
- Non-woven root penetrating backing.
- Fast installation reducing labour cost.

Soil Media: Organic and inorganic Sedum Master pre-engineered growing medium enables fast root penetration to the substrate below the SMUL6 blankets. Blanket substrate is for production only.

	Dry Density	Moisture Content	Air Space	Water Retention	Coarse Fiber > 10 mesh	Medium Fiber 10 - 18 mesh	Fine Fiber 18-50 mesh	Extra Fine < 50 mesh
	g/l	%		x dry weight	%			
Average	79.9	53.9	15.1	9.9	23	21.7	39.3	16.2



Sedum Master Inc.
746645 Township Rd. #4
Princeton, ON, N0J 1V0
T: 519-458-4061
F: 519-458-8883

Drainage: Combination of fibrous material and porous growing media provides ample drainage.

Irrigation System: Not typically needed, however, we recommend that it be possible to water during an extended drought.

Growing Lead Time: For a 75% - 85% blanket coverage, an 18 - 20 month lead time is required for all custom grown orders.

Sedum Mat Care: Upon receipt of your Sedum Master Vegetative Blankets unpack immediately to avoid plant spoilage.

Installation: Sedum Master recommends that newly installed plants be watered thoroughly upon installation and continued until established.

Plants: In our vegetative blankets we use Mix 1 and Mix 2 varieties. Due to seed availability and germination however, not all the species may be present. Blankets will vary.

