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Details



Roof Garden System

June 2010

PART I GENERAL

1.01 DESCRIPTION

The Carlisle Roof Garden System incorporates an adhered membrane waterproofing system with one of three types of Roof Garden Assemblies installed above.

The waterproofing system utilizes one of Carlisle's adhered roofing assemblies; EPDM, TPO, PVC, FleeceBACK or AFX products installed over a structural deck or tapered insulation and cover board.

Above the waterproofing system is one of three types of Roof Garden Assemblies utilizing various components including Root Barrier, Polystyrene Insulation, MiraDRAIN G4 Drainage Composite, Carlisle Engineered Growth Media and Carlisle Vegetation. These components are installed above the membrane dependant on desired planting schedule, allowable loads and the climatic region of the project.

As an alternative to the traditional, planted-in-place Roof Garden system, Carlisle offers the modular Green Grid tray system, which incorporates a protection fabric and pre-planted modules over the adhered waterproofing system.

1.02 Roof Garden Definitions

A. Shallow (Ultra-Extensive) Roof Garden System

Shallow Roof Garden System (growth media depth 2.5" to 4") is ideally suited for areas likely to receive little maintenance. Recommended plants include sedums, herbs and grasses. The anticipated weight above the membrane assembly is generally between 4.8 and 6 pounds per square foot, per inch of system depth, in a saturated state.

B. Medium Depth (Extensive) Roof Garden System

Medium Depth Roof Garden System (growth media depth of 5" to 8") includes plants such as sedums, herbs, grasses and other vegetation, which can grow in this depth of media. Un-irrigated systems can be provided without difficulty; however, drip, mist or spray irrigation systems may be required to support more diverse plant types or for installations in semi-arid climates. The anticipated saturated weight above the membrane assembly is less than 50 pounds per square foot.

C. Deep (Intensive) Roof Garden System

Deep Roof Gardens typically incorporate a planting system requiring greater growth media depth (exceeding 8") that requires regular maintenance, such as watering, fertilizing and mowing/weeding. A variety of plants are available including turf grass, annual or perennial flowers, shrubs and even small trees. This system typically requires a structural concrete roof deck to support the larger dead load. An irrigation system should be utilized in these assemblies. The anticipated weight above the membrane assembly is generally greater than 50 pounds per square foot.

1.03 DESIGN GUIDELINES

The Roof Garden Waterproofing assemblies will incorporate a minimum 60-mil thick Sure-Seal EPDM, Sure-Flex PVC or Sure-Weld TPO membrane, 115 FleeceBACK (EPDM or TPO) membrane, Sure-Seal AFX-Plus EPDM or 135 Sure-Weld AFX TPO membranes. Membrane will be adhered with appropriate adhesive to either a slope structural concrete deck or tapered insulation with an acceptable cover board. To facilitate drainage, a minimum roof slope of 1/4" in 12" must be provided at the waterproofing membrane level. Refer to Garden Roof (GR) Details included at the end of this specification for the various assembly options available.

Refer to **Roof Garden Attachment I** for Roof Garden options based on depth of engineered growth media, membrane type, and possible warranties.

1.04 QUALITY ASSURANCE

- A. This Roof Garden Waterproofing System must be installed by a Carlisle Authorized Roofing Applicator in compliance with shop drawings as approved by Carlisle. There must be no deviations made from Carlisle's specifications or the approved shop drawings without the **PRIOR APPROVAL** of Carlisle.
- B. A **pre-installation meeting** should be coordinated by the specifier and attended by the roofing applicator, membrane manufacturer's representative and other trades working on the roof system both before and after membrane installation. The purpose of this meeting is to discuss the necessity of ensuring proper membrane protection during all phases of installation and to review other applicable requirements or unusual field conditions.
- C. Upon request by the Authorized Applicator, an inspection will be conducted by a Field Service Representative of Carlisle to ascertain that the membrane roofing system has been installed according to Carlisle's specifications and details. This **inspection** shall be coordinated **prior to installing the "above membrane roof garden components"** so access to the membrane is not impaired.
- D. Flood testing, electronic testing or other leak detection means is **required** to check the waterproof integrity of the membrane prior to installing any above membrane components.
- E. An in-progress inspection may be scheduled after the initial inspection (after the membrane installation is completed) to ensure proper protection procedures are being followed to prevent possible damage to the membrane during the installation of Roof Garden components.

Note: The roofing applicator must notify Carlisle at least 3 weeks in advance of the applicable inspection dates for coordination purposes.

1.05 SUBMITTALS

- A. To ensure compliance with Carlisle's warranty requirements, **all projects should be forwarded to Carlisle for review** prior to installation.
- B. A dimensioned layout of all field splices shall be included along with the project submittals (shop drawing and Request for Warranty).
- C. For all projects, prior to project inspection by Carlisle, a final shop drawing must be approved by Carlisle.

1.06 WARRANTY

- A. A **10, 15 or 20-year** System Warranty is available for a charge on commercial buildings and applies only to **products manufactured or marketed by Carlisle SynTec Incorporated**. The membrane system is defined as membrane, flashings, adhesives, sealants and other Carlisle brand

products utilized in this installation. For a complete description of these products, refer to the "Products Section" or the applicable "Attachment" in the Carlisle specifications.

When Carlisle Roof Garden components are specified and installed, for a nominal charge, a 10, 15 or 20-year Overburden Warranty can be added. The warranty covers all Carlisle Roof Garden components above the membrane limited to the protection fabric, polystyrene, drainage products, moisture retention mat, growth media, and Carlisle Roof Garden Plants. In the event of a leak, Carlisle is responsible for overburden removal, roof repair, and replacement of the overburden.

If a 20-year **No Dollar Limit** warranty including overburden is desired, a Sustainable Roofing Alliance Consultant must be utilized on the project during the design and construction phases. The SRA consultant shall be on site to monitor the installation.

B. Access for warranty service

If a 10, 15 or 20-year Overburden Warranty is not obtained or if the owner chooses to use overburden by others, it shall be the owner's responsibility to expose the waterproofing membrane assembly in the event warranty service or investigation is necessary.

- C. The formation or presence of mold or fungi in a building is dependent upon a broad range of factors including, but not limited to, the presence of spores and nutrient sources, moisture, temperatures, climatic conditions, relative humidity, and heating/ventilating systems and their maintenance and operating capabilities. These factors are beyond the control of Carlisle and Carlisle shall not be responsible for any claims, repairs, restoration or damages relating to the presence of any irritants, contaminants, vapors, fumes, molds, fungi, bacteria, spores, mycotoxins, or the like in any building or in the air, land, or water serving the building.

1.07 JOB CONDITIONS

Material Safety Data Sheets (MSDS) must be on location at all times during transportation, storage, and application of materials. The applicator shall follow all safety regulation as recommended by OSHA and other agencies having jurisdiction.

- A. Coordination between various trades is essential to avoid unnecessary rooftop traffic over sections of the roof and to prevent damage to the membrane. Heavily traveled areas must be protected by placing temporary protection courses to prevent damage to the membrane.
- B. The use of a vapor retarder to protect insulation and reduce moisture accumulation within an insulated roofing assembly should be investigated by the specifier. Consult the latest publications by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) and NRCA (National Roofing Contractors Association) for specific information.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in the original, unopened containers labeled with the manufacturer's name, brand name and installation instructions.
- B. Job site storage temperatures in excess of 90° F (32° C) may affect shelf life of curable materials (i.e., sealants, cleaners, primers, adhesives, SecurTAPE, Pourable Sealer, Pressure-Sensitive Flashing and uncured flashing).
- C. When liquid adhesives and sealants are exposed to lower temperatures, restore to a minimum of 60° F (16° C) before use. Do not store containers with opened lids due to loss of solvent that will occur from flash off.
- D. Sure-Seal and Sure-Weld FleeceBACK and AFX Membrane, when specified, should be stored in its original plastic wrap or be covered to protect from moisture. Any moisture absorbed by the fleece backing must be removed by using a wet-vac system, prior to membrane application.

- E. Store Sure-Weld TPO or Sure-Flex PVC membranes (when applicable) in the original undisturbed plastic wrap in a cool, shaded area and cover with light-colored breathable tarpaulins.
- F. Membranes that have been exposed to the elements for approximately 7 days must be prepared with Weathered Membrane Cleaner prior to hot air welding. Refer to Carlisle's Sure-Weld Specifications, Part II, Application, for applicable requirements.
- G. Insulation, Dens Deck Prime, Securock, and base sheets, when specified, must be stored so they are kept dry and are protected from the elements. Store insulation, Dens Deck Prime, and Securock on a skid and completely cover with a breathable material such as tarp or canvas. If the insulation is lightweight, it should be weighted to prevent possible wind damage.
- H. Carlisle Engineered Growth Media should be stored under cover whenever possible to avoid direct sunlight exposure to the SuperSacks in which the material is delivered and excessive moisture absorption. Care should be taken not to damage the packaging to avoid leakage when hoisted to the rooftop.
- I. Carlisle Roof Garden Plants, when specified, should be planted promptly after delivery to the jobsite. Sedum cuttings should be used within 12 hours of arrival. Plugs should be unpacked immediately upon arrival and planted within three (3) days. Vegetated Sedum Tiles and Mats should be unpacked and installed within 36 hours. Unused plugs and tiles should be stored in an outdoor location with access to at least four (4) hours per day of direct sunlight.

PART II PRODUCTS

2.01 GENERAL

The components of this roofing system are to be products of Carlisle. The installation, performance or integrity of products by others is not the responsibility of Carlisle and is expressly disclaimed by the Carlisle Warranty.

2.02 MEMBRANE

Sure-Seal® (black) EPDM, Sure-Seal® AFX-Plus, FleeceBACK® EPDM or Sure-Weld® TPO membrane can be used with this system. Refer to Paragraph 1.03, Design Guidelines for required membrane thickness that is dependent upon the type of Roof Garden and warranty selected. For membrane physical properties, refer to the appropriate Carlisle Technical Data Bulletins or Product Data Sheets.

2.03 RELATED CARLISLE MATERIALS FOR WATERPROOFING

A. Sure-Seal Products

Sure-Seal Bonding Adhesive, Low VOC Bonding Adhesive, FAST Adhesive, Cold Applied Adhesive, AquaBASE 120 Adhesive, SecurTAPE, HP-250 Primer, Low VOC EPDM Primer, Splicing Cement, In-Seam Sealant™, Lap Sealant, Universal Single-Ply Sealant, Weathered Membrane Cleaner, Cured EPDM Flashing, Cured Cover Strip, Pressure-Sensitive Overlayment Strip, Elastoform Flashing, Termination Bars, Fasteners/Plates Water Cut-Off Mastic, Pourable Sealer, Walkway Pads/Rolls, Pre-Molded Pipe Seals, and Pressure-Sensitive Inside/Outside Corners are used depending on the waterproofing assembly.

B. Sure-Weld Products

Sure-Weld Flashing, Sure-Weld Bonding Adhesive, Low VOC Bonding Adhesive, FAST Adhesive, Cold Applied Adhesive, AquaBASE 120 Adhesive, Cut-Edge Sealant, Water Cut-Off Mastic, Universal Single-Ply Sealant, TPO Molded Pocket Sealant, Weathered Membrane Cleaner, Pressure-Sensitive Cover Strip,

Coated Metal, Heat Weldable Walkway Rolls, Pre-Molded Accessories, TPO Primer, Low VOC TPO Primer, Termination Bars, and Fasteners/Plates are used depending on the waterproofing assembly.

C. Sure-Flex Products

Sure-Flex PVC Bonding Adhesive, Sure-Flex PVC non-reinforced Flashing, Sure-Flex PVC "T" Joint Cover, Sure-Flex PVC Cut-Edge Sealant, Water Cut-Off Mastic, Universal Single-Ply Sealant, PVC One-Part Pourable Sealer, Foil Grip Aluminum Tape, PVC Membrane Cleaner, Sure-Flex PVC Coated Metal, Sure-Flex PVC Heat Weldable Walkway Rolls, Sure-Flex PVC Inside/Outside Corners and Sure-Flex Pre-Molded accessories are used depending on the waterproofing assembly.

D. Other Carlisle products, such as insulation and edgings/copings, are also required when such components are to be included as part of the System Warranty.

2.04 CARLISLE ROOF GARDEN COMPONENTS

A. **MiraDRAIN G4 Drainage Composite** consists of a high impact polystyrene core with "cups" and high-flow overflow drains. A non-woven 100% post-consumer recycled polyester combination filter fabric and green moisture retention mat is bonded to the retention side of the molded core to prevent passage of particles into the water reservoirs. Designed to filter and retain water in all Roof Gardens while allowing excess water to quickly reach the drainage system. Drainage composite is 1.21" thick and holds up to 0.32" of rainfall (0.2 Gallons) per square foot. Packaged in 4' x 50' rolls weighing 70 pounds.

B. **Carlisle Engineered Growth Media** - A lightweight FLL-approved growth media used for roof garden applications. Applied at the specified depth on Carlisle Roof Garden assemblies. Refer to **Roof Garden Attachment II**.

C. Carlisle Roof Garden Plants

1. **Plugs** - Carlisle plant plugs are available in 10" X 20" flats/trays containing either twenty-four (24) 2.5" diameter plugs or seventy-two (72) 1.5" diameter plugs. Plugs come in a wide selection that is specifically chosen for rooftop environments are available from Carlisle. Refer to **Roof Garden Attachment III** for more information.

2. **Cuttings** - Carlisle sedum cuttings are available in bulk and are sold by the pound. More than 12 different varieties of sedum cuttings can be used to propagate Carlisle Roof Gardens. Carlisle sedum cuttings must be planted with Carlisle Moisture Retention Gel to ensure that cuttings have adequate moisture to successfully root in a rooftop environment. Refer to **Roof Garden Attachment III** for more information.

3. **Vegetated Sedum Tiles** - Carlisle's Vegetated Sedum Tiles are available in 1.4 square foot trays. Designed to enable rapid installation and ensure full (95 %+) vegetated coverage on the day of installation. Each tile weighs approximately 4.5 pounds (3.2 pounds per square foot) and is planted with multiple varieties of sedum. Four different varieties of Sedum Tiles are available that cover nearly every environmental condition. Refer to **Roof Garden Attachment IV** for more information.

4. **Vegetated Sedum Mats** - Carlisle's Vegetated Sedum Mats are available in 25 square foot rolls. Mats enable full vegetative coverage on the day of installation with the fastest possible installation time. Carlisle's Vegetated Sedum Mats weigh approximately 5.5 pounds per square foot in a saturated state and are planted with nine varieties of sedum.

D. Polystyrene Insulation (available from Carlisle)

1. **Insulfoam XIV** is a minimum 40 psi compressive strength, moisture resistant, closed cell expanded polystyrene with ¼" x ¼" drainage channels every 2" O.C. Installed directly over the

roof membrane in Intensive (deep) garden assemblies. Available in 4' x 4' and 4' x 8' board sizes with a thickness of 1" to 40". Readily available in custom lengths and widths.

2. **Dow Roofmate or Foamular 404/604** is a minimum 40/60 psi compressive strength, moisture resistant, closed cell polystyrene foam insulation with drainage channels along board edges to promote drainage at the membrane level. Installed directly over the roof membrane in Intensive (deep) garden assemblies. Available in 2' x 8' board sizes with a thickness of 1" to 4".

- E. **Protection Fabric – Carlisle CCW 300HV** (16 oz/yd²) is a polypropylene non-woven needle-punched fabric that is stabilized to resist soil chemicals, mildew, and insects and is non-biodegradable. Designed to prevent abrasion to the membrane when a root barrier is used in some Extensive Roof Garden assemblies. Available in 12.5' x 200' and 40" x 200' rolls.

F. **Root Barriers**

1. **Root Barrier** – Carlisle 40-mil non-reinforced Geomembrane Root Barrier is a non-reinforced polypropylene sheet specifically formulated for use in below grade and vegetated applications to resist root growth and soil bacteria. Used in Deep (Intensive) and Medium Depth (Extensive) Roof Garden Systems. Available in widths of 12' and lengths of 100'. Carlisle 40-mil non-reinforced Geomembrane passes the demanding DIN-4062 long-term root penetration tests.
2. **Biobarrier** – In certain Deep (Intensive) Roof Garden applications, Biobarrier synthetic hormone root barrier is used in selective areas. Biobarrier releases a root-thwarting compound at a few parts per billion, preventing particularly invasive roots from damaging the waterproofing membranes. Biobarrier is available in 12" x 100' rolls and 58.5" x 100' rolls. Contact Carlisle when considering special planting choices.

- G. **Carlisle Aluminum Roof Garden Edge** – a 0.080" thick extruded aluminum edge used to separate roof garden assemblies from adjacent walkways or perimeter stone ballast. The edging comes in 10' lengths and 4" high with a 3" flange or 8" high with a 6" flange. Additional heights are available from Carlisle.

- H. **Carlisle Aluminum Roof Garden Drain Box** – a 0.125" thick extruded aluminum drain box that is 12" x 12" with a welded 4-1/2" flange to keep the drain areas clear of stone ballast or growth media. The drain box is available in 4" or 8" heights. Drainage holes are pre-punched around the sides. Access to the drain is provided by a removable lid. Custom sized Drain Boxes are available from Carlisle.

- I. **Carlisle Modified Base Sheet** – A tough, glass fiber, reinforced, SBS-modified asphalt, base sheet (nominal 39" wide by 50' long) that meets or exceeds the requirements for ASTM D 6163 Type I, Grade S for SBS-modified bituminous sheet materials. The Carlisle Modified Base Sheet is used directly under AFX-Plus Membrane.

J. **Hanover Architectural Products (available through Carlisle)**

1. **Carlisle Prest Pavers** – 2' x 2' x 2" thick precast concrete pavers weighing 25 psf with a compressive strength of 8500 psi. Absorption is less than 5% and Flexural is 1,100 psi. Additional standard and custom made sizes available.
2. **Carlisle Pedestal Paver** – 2'x2'x2.25" thick precast concrete pavers weighing 22 psf and an elevated clearance of 1/2" from incorporated footing.
3. **Carlisle Guardian Paver** – Developed for high wind and special conditions. The paver is 2'x2'x2" or 3" thick and weighs 25 psf to 38 psf.
4. **Carlisle RockCurb** – transition component between paver system/hard caped areas and adjoining roof garden assembly. Rock Curb comes in three standard heights (8", 12", and 16")

and is manufactured either straight or with a radius.

5. **Carlisle Paver Accessories** – High Tab Pedestal with shims, EPDM Pedestal with shims, Compensator, Elevator Coupler, and Elevator Pedestal.

- K. **Carlisle Stained Glass Stone** –Stained Glass Stone is 100% post-consumer recycled & tumbled glass in a 1”– 2” particle size used as a special effects accessory for Roof Gardens and Plazas. Available in 12 different colors, Stained Glass Stone can be utilized around perimeters, penetrations or even to create colorful logos in any size or shape. Stained Glass Stone is applied at a minimum rate of 10 pounds per square foot over a minimum 1” thick drainage composite such as Carlisle MiraDRAIN G4.

2.05 OTHER NON-CARLISLE PRODUCTS

A. “Hardscaped” Items:

1. **Individual concrete plaza pavers** – 2' x 2' x 2" thick precast concrete pavers weighing a minimum of 18 psf with a minimum compressive strength of 6500 psi.
2. **Paver Pedestals** – Rubber paver pedestals to elevate the surface of the pavers above the roof membrane and promote positive drainage and protection from freeze/thaw.
3. **Stone Ballast** – Nominal 1-1/2" diameter rounded water worn gravel which conforms to ASTM D448, gradation size #4, applied at a minimum of 10 pounds per square foot.
4. **Other** – Products such as concrete curbs, landscape lumber (wood timbers, etc.) or other desired landscape products suitable for this application. Used to transition between roof garden and hardscaped areas to act as a “growth media stop.”

- B. **Asphalt** (ASTM D 312): Type III or IV Hot Asphalt used for mopping AFX-Plus FleeceBACK membrane to structural concrete or approved base sheets. As an option, Modified SBS or SEBS Asphalt may be used. Application rate is 18–22 pounds per square (100 square feet) for membrane mopping (28–32 pounds per square for insulation attachment, if applicable).

Property/ASTM	Type III	Type IV	Modified Asphalt
Softening Point (° F) D-36	Min. – 195 Max. – 205	Min. – 210 Max. – 225	Min. – 215 Max. – 235
Flash Point (° F) D 92	Min. – 525 Max. – 600	Min. – 525 Max. – 600	Min. – 525 Max. – 600
Penetrations Units D 5	@ 32 ° F = 6 @ 77° F = 16–24	@ 32 ° F = 6 @ 77° F = 13–22	@ 32 ° F = 7 @ 77° F = 18
Ductility @ 77° F, cm D 113	3.0	2.0	7.0
Solubility in Trichloroethylene % D 2042	99.8	99.8	97.5

- C. **“Cut Back” Asphalt Primer** – Meets ASTM D 41 – Used to prime structural concrete decks prior to mopping AFX-Plus FleeceBACK membrane or associated base sheets. Coverage rate is 1 to 2 gallons per 100 square feet depending on surface porosity.

PART III EXECUTION

3.01 GENERAL

When feasible, begin the application at the highest point of the highest roof level and work to the lowest point to prevent moisture infiltration and minimize construction traffic on completed sections. This will include completion of all flashings and terminations.

3.02 ROOF DECK CRITERIA

Proper decking shall be provided by the building owner. The building owner or its designated representative must ensure that the building structure is investigated by a registered engineer to assure its ability to withstand the total weight of the specified roofing system, as well as construction loads and live loads, in accordance with all applicable codes. The specifier must also designate the maximum allowable weight and location for material loading and storage on the roof.

- A. For **Shallow (Ultra-Extensive) Roof Garden Systems**, any roof deck capable of withstanding the roof loading may be accepted.
- B. For **Medium Depth (Extensive) and Deep (Intensive) Roof Garden Systems**, structural concrete roof decks are recommended due to the increased weight of the roof assembly when the system is at its maximum water capacity
- C. Defects in the roof deck must be reported and documented to the specifier, general contractor and building owner for assessment. The Carlisle Authorized Roofing Applicator shall not proceed unless the defects are corrected.

3.03 SUBSTRATE REQUIREMENTS

The substrate must be dry, relatively smooth and free of protrusions, debris, sharp edges or foreign materials and must be free of accumulated water, ice and snow. Cracks or voids in the substrate greater than 1/4" (6 mm) must be filled with a suitable material.

3.04 WATERPROOFING INSTALLATION

Before beginning installation, refer to the applicable Material Safety Data Sheets, OSHA safety requirements, and Technical / Product Data Bulletins for cautions and warnings.

A. Insulation Attachment

- 1. Base layer of insulation can be mechanically attached with acceptable Carlisle Fasteners and Insulation Plates, Refer to applicable Adhered Application section for acceptable decks and the Carlisle Fasteners.
- 2. Fastening density is determined from insulation type and thickness. Refer to appropriate insulation attachment details in Sure-Seal/Sure-White Adhered Application Details, Sure-Weld Adhered Application Details or the Sure-Flex Specification.
- 3. As an alternate to mechanically attaching the base layer of insulation, Carlisle FAST Adhesive can be used. Refer to Sure-Seal/Sure-White Adhered Application – Attachment III, Sure-Weld Adhered Application – Attachment IV, or the Sure-Flex Adhered Specification Section 602116, paragraph 3.04.
- 4. Top layer of insulation must be an acceptable cover board adhered with FAST Adhesive. Refer to Sure-Seal/Sure-White Adhered Application – Attachment III or Sure-Weld Adhered Application – Attachment IV for application procedure. Cover boards shall be minimum ½-inch thick Dens-Deck Prime or Securock.

B. Membrane Installation

1. FleeceBACK Membranes either Sure-Seal EPDM or Sure-Weld TPO may be adhered with the appropriate adhesive directly over sloped structural concrete or wood roof decks. Direct application over cellular or perlite lightweight insulating concrete substrate may also be specified (contact Carlisle for acceptable lightweight insulating concretes).
2. Follow Carlisle's applicable Adhered Roofing System Specifications for insulation types, surface preparation procedures, membrane positioning, and adhesive application requirements.

C. Membrane Splicing

1. Refer to appropriate splicing procedures published in Sure-Seal EPDM or Sure-Weld TPO Adhered Application Specification.
2. **In addition to the standard splice procedure all field splices shall be overlaid with the appropriate EPDM 6" Pressure-Sensitive Cover Strip or TPO 6" wide Pressure-Sensitive Cover Strip.**
3. Prior to Pressure-Sensitive Cover Strip application, the splice area must be primed with Sure-Seal HP-250 or Low VOC EPDM or Low VOC TPO Primer.

D. Flashing

1. Walls, curbs, skylights and all other penetrations through the membrane must be flashed in accordance with Carlisle's published specifications/details for the applicable membrane specified. Refer to Roof Garden Details RG7, RG8 and RG12.
2. Flashing heights shall be greater in height than the specified depth of the Roof Garden assembly (Drainage composite, growth media, etc.).
3. Vertical field splices at walls, curbs, etc., must be overlaid in the same fashion as the field splices.

E. Roof Drains

1. Roof garden drains should be covered with Carlisle Aluminum Drain Box or a perforated drain box by others with removable lid (at the growth media surface height) for inspection purposes. 1-1/2" nominal diameter rounded river washed gravel is applied around the drain box a minimum 18" to promote drainage. Refer to Roof Garden Details RG10 and RG11.
2. In Shallow (Ultra-Extensive) and Medium Depth (Extensive) Roof Garden Waterproofing assemblies, standard cast iron compression ring clamping drains may be able to be used with 1-1/2" nominal diameter rounded river washed gravel applied around the drain sump area (minimum 18" in width) for drainage.

3.05 ROOF GARDEN INSTALLATION

Refer to **Roof Garden Attachment I** – Carlisle Roof Garden Assembly Options

A. Prior to installation of Roof Garden Components

1. Limit foot traffic over completed waterproofing system. Heavily traveled areas (staging areas, corridors used to transport roof garden components) must be protected using 1/2" thick plywood or other sheathing.

2. Perform a Flood Test or Electronic Test (TPO Membrane only) to ensure the watertight integrity of the waterproofing system. Testing should take place after the membrane and flashings have been in place a minimum of 24 hours. Plug drains and provide necessary barriers to contain water.
3. "Flood Test" the membrane surface with water for 48 hours at a minimum depth of 2". Inspect for leaks and repair membrane if damage to waterproofing assembly is found. Retest after repairs have been made.

Note: On Sure-Weld TPO System, electronic testing such as Electric Field Vector Mapping (EFVM) may be used to test membrane for defects. Contact the appropriate testing agency for procedures

4. Sweep the surface of the membrane to remove all debris and loose or foreign material.

B. Shallow (Ultra-Extensive) Roof Garden Installation

1. MiraDrain G4 Drainage Composite

- a. Unroll the drainage composite and flip over so green or white moisture retention mat is facing upwards.
- b. Place drainage composite directly over the waterproofing membrane with the built-in overlapping flap facing the direction of the slope.
- c. Position additional drainage composite rolls next to each other with green moisture retention mat butted against the long side. Once in place, flip 6" retention mat flap over the first drainage composite. For runs of MiraDRAIN G4 exceeding 50 feet in length, peel back both fabrics approximately 3" on the adjacent ends of the rolls and insert two rows of the MiraDRAIN "cups" into the cups of the abutting roll. This locks the MiraDRAIN rolls together and does not allow for passage of growth media directly onto the waterproofing membrane.
- d. Continue with placement of drainage component until the designated roof garden area is covered.

2. Carlisle Engineered Growth Media (Refer to Roof Garden Attachment II for growth media types based on building location and depth of growth media.)

- a. Hoist growth media in SuperSacks by crane to the roof area that is receiving the Roof Garden.
- b. Distribution of the Carlisle Engineered Growth Media shall be directly over the MiraDRAIN G4 Drainage Composite from SuperSacks that are lowered by crane 2' to 4' above the drainage composite.
- c. Slit the bottom of the sack with a knife or other cutting device to dispense the growth media directly over the drainage composite or into wheelbarrows for transportation to hard to access areas.

Caution: Location points for distribution of growth media must not overload the structural capacity of building.

- d. Coverage rate per sack for a shallow assembly is approximately 150 square feet for a 4"

depth.

Caution: Care must be taken when distribution of Carlisle Growth Media is during windy conditions to limit potential scouring of media. If growth media is not used on the day of arrival, product should be stored under a trap or other opaque cover to prevent direct exposure to sunlight and moisture.

3. **Carlisle Roof Garden Plants** (Refer to **Roof Garden Attachment III** for specific plants based on types and hardening zone.)

a. Vegetative Plugs

- i. Place plug trays in the vicinity of where planting has been specified.
 1. If 2.5" diameter plugs are planted, spacing is recommended 8" to 9" on center (1.78 to 2.25 plugs per square foot).
 2. If 1.5" diameter plugs are planted, spacing is recommended 6" to 8" on center (2.25 to 4 plugs per square foot).
- ii. Make a 2" deep indentation into the growth media and insert plug.
- iii. Tamp the growth media around the base of the plug by hand to ensure that plug is securely buried.

b. Sedum Cuttings

- i. Prior to installation of the sedum cuttings apply Carlisle Retention Gel over the growth media at a rate of 1 pound per 200 square feet either through manual / hand broadcasting or a rotary seed / fertilizer spreader.
- ii. Broadcast sedum cuttings by hand with a coverage rate of 1 pound per 10 square feet.
- iii. Immediately water the assembly until the system is saturated and the Retention Gel is fully expanded.
- iv. Irrigate the Roof Garden for a minimum of 60 days following installation according to Carlisle's Roof Garden Maintenance guidelines. (Refer to **Roof Garden Attachment IV**)

c. Vegetated Tiles

- i. Remove tile from container with care and lay directly onto the growth media.
- ii. Place additional vegetated tiles with edges butted together to within ¼".
- iii. Continue with placement of vegetated tiles until the designated roof garden area is covered.
- iv. Water the Roof Garden assembly by hand or sprinkler(s) until the system is saturated.

d. Vegetated Mats

- i. Lift the 48" x 75" mats from the pallets and unroll the mats directly over the growth media.
- ii. Unroll Vegetated Mats adjacent to each other with edges butted together to within ¼".
- iii. Continue with placement of vegetated mats until the designated roof garden area is covered.
- iv. Water the Roof Garden assembly by hand or sprinkler(s) until the system is saturated.

C. Medium (Extensive) Roof Garden Installation

1. CCW 300HV Protection Fabric

- a. Unroll protection fabric directly over the waterproofing membrane.
- b. Position the next roll of protection fabric to overlap the first a minimum of 2".
- c. Additional rolls shall follow the above procedure.

2. Geomembrane Root Barrier

- a. Unroll root barrier over the protection fabric.
- b. Position the next roll of root barrier to overlap the first a minimum of 3".
- c. Clean splicing area with Carlisle Weather Membrane Cleaner to remove any dirt / contaminates.
 - i. Root barrier sheets shall be spliced together by heat welder.
 - ii. Seaming root barrier with a heat welder refer to Sure-Weld Application Section I Heat Welding Procedure.
- d. Extend root barrier up walls, curbs, etc. to the height of the top of the growth media depth.

Caution: Placement of root barrier must not impede drainage for the roof area.

3. MiraDrain G4 Drainage Composite (Refer to article 3.05-B1 for installation instructions.)

4. Carlisle Engineered Growth Media

- a. Refer to **Roof Garden Attachment II** for installation instructions of growth media with the following exception: Coverage rate per SuperSack for Medium Roof Garden is approximately 75 square feet for a depth of 8".

5. Carlisle Roof Garden Plants

- a. Refer to **Roof Garden Attachment III** for specific plants based on types and hardening zones and options for planting of plugs, sedum cuttings, vegetated tiles and vegetated mats.
- b. If building owner requires special planting needs, contact Carlisle for assistance.

D. Deep (Intensive) Roof Garden Installation

1. Carlisle Expanded or Extruded Polystyrene (minimum 2" thick with drainage channels)

- a. Loose lay insulation board directly over the waterproofing membrane with channeled side facing down.
- b. Insulation boards shall be butted with no gaps greater than ¼".
- c. Note: As an alternate to the referenced insulation boards, CCW 300HV Protection Fabric may be used. Refer to article 3.05-C1 for installation instructions.

2. Geomembrane Root Barrier

- a. Refer to article 3.05-C2 for installation and seaming instructions with the following addition: Geomembrane Root Barrier shall be loose laid over the protection fabric or polystyrene insulation.

3. MiraDrain G4 Drainage Composite

- a. Refer to article 3.05-B1 for installation of the drainage composite with the following addition: When drainage composite is installed over polystyrene insulation joints in drainage composite and insulation shall be stagger a minimum of 6".

4. Carlisle Engineered Growth Media (Refer to **Roof Garden Attachment II** for growth media types abased on building location and depth of media)

- a. Refer to article 3.05-B2 for installation instruction of growth media with the following exception: Coverage rate per SuperSack for Deep Assemblies are determined based on total depth required for special plants.

5. Carlisle Roof Garden Plants (Refer to **Roof Garden Attachment I**)

- a. Because of unique design nature of Deep Roof Garden Assemblies, contact Carlisle for assistance on design and choices of plants.

E. **GreenGrid** – Refer to **Roof Garden Attachment V** for product installation instructions.

F. **After installation of Roof Garden Components**

1. Irrigate the Roof Garden with a lawn sprinkler, hand sprayer, or with a designed irrigation system until saturation to the point of runoff.
2. Refer to **Roof Garden Attachment VI** for maintenance schedule.

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Roof Garden "Attachment I" Carlisle Roof Garden Assembly Options

June 2010

Shallow (Ultra-Extensive) Roof Garden Assembly

A shallow planting system (2.5" to 4" in depth) ideally suited for areas that will receive little maintenance. Recommended plants include sedums, herbs and grasses. The anticipated weight of the assembly above the membrane is generally between 4.8 and 6 pounds per square foot, per inch of growth media depth, in a saturated state.

A. Vegetative Components – Carlisle vegetated components are installed directly above the waterproofing components.

1. CCW MiraDRAIN G4 Drainage Composite
2. 2.5" – 4" Carlisle Engineered Growth Media
 - a. Saturated Weight of 4" deep: Approx. 27-lbs per square foot
 - b. Dry Weight of 4" deep: Approx. 16-lbs per square foot
3. Carlisle Vegetated Sedum Tiles, Carlisle Vegetated Sedum Mats, Carlisle Sedum Plugs, or Sedum Cuttings & Carlisle Moisture Retention Gel

B. Waterproofing Components

Membrane Options for 10 or 15 Year Warranty	Membrane Options for 20-Year Warranty
60-mil Sure-Seal EPDM ⁽¹⁾⁽²⁾	75-mil Sure-Tough EPDM ⁽¹⁾⁽²⁾
60-mil Sure-Weld TPO or 60-mil Sure-Flex PVC ⁽¹⁾⁽³⁾⁽⁴⁾	72-mil Sure-Weld EXTRA TPO or 80-mil Sure-Flex PVC ⁽¹⁾⁽³⁾⁽⁴⁾
105 AFX-Plus FleeceBACK ⁽¹⁾⁽²⁾ or 135 AFX TPO ⁽¹⁾⁽³⁾ hot mopped directly over structural concrete.	105 AFX-Plus FleeceBACK ⁽¹⁾⁽²⁾ or 135 AFX TPO ⁽¹⁾⁽³⁾ hot mopped with two plies of base sheets directly over structural concrete.
115-mil Sure-Weld TPO ⁽³⁾ or Sure-Seal FleeceBACK ⁽²⁾ adhered with FAST Adhesive directly over structural sloped concrete.	115-mil Sure-Weld TPO ⁽³⁾ or Sure-Seal FleeceBACK ⁽²⁾ adhered with FAST Adhesive directly over structural sloped concrete.

⁽¹⁾ When positive slope is incorporated by tapered insulation, non-FleeceBACK or AFX membranes may be adhered to a coverboard (DensDeck Prime or SecuRock) which has been adhered to the insulation with Carlisle Insulation Adhesive.

⁽²⁾ Sure-Seal and Sure-Tough EPDM Membranes shall be seamed with 3" Factory Applied Tape and overlaid with 6" Pressure-Sensitive Cured Cover Strip

⁽³⁾ Sure-Weld TPO membrane seams shall be heat-welded and overlaid with 6" TPO Pressure-Sensitive Cover Strip

⁽⁴⁾ Sure-Flex PVC Membrane seams shall be heat-welded and overlaid with a 6" PVC welded cover strip

Medium (Extensive) Roof Garden Assembly

A medium depth planting system (growth media depth of 5" to 8") where recommended plants include sedums, herbs, grasses and other vegetation which can grow in this depth of media. In temperate climates, un-irrigated systems can be provided without difficulty; however, drip, mist or spray irrigation systems may be required to support more diverse plant types or for installations in semi-arid climates. The anticipated weight above the membrane assembly is generally less than 50 pounds per square foot.

A. Vegetative Components – Carlisle vegetated components are installed directly above the waterproofing components.

1. CCW 300HV Protection Fabric
2. 40-mil non-reinforced Geomembrane Root Barrier
3. CCW MiraDRAIN G4 Drainage Composite
4. 5" – 8" Carlisle Engineered Growth Media
 - a. Saturated Weight: 27-lbs to 50-lbs per square foot
 - b. Dry Weight: 14.5-lbs to 31-lbs per square foot
5. Carlisle Vegetated Sedum Tiles, Carlisle Vegetated Sedum Mats, Carlisle Sedum Plugs, Perennial Plugs, Grasses, or Sedum Cuttings & Carlisle Moisture Retention Gel

B. Waterproofing Components

Membrane Options for 10 or 15 Year Warranty	Membrane Options for 20-Year Warranty
75-mil Sure-Tough EPDM ⁽¹⁾⁽²⁾	90-mil Sure-Seal EPDM ⁽¹⁾⁽²⁾
72-mil Sure-Weld EXTRA TPO or 80-mil Sure-Flex PVC ⁽¹⁾⁽³⁾⁽⁴⁾	80-mil Sure-Weld EXTRA TPO or 80-mil Sure-Flex PVC ⁽¹⁾⁽³⁾⁽⁴⁾
105 AFX-Plus FleeceBACK ⁽¹⁾⁽²⁾ or 135 AFX TPO ⁽¹⁾⁽³⁾ hot mopped with two plies of base sheets directly over structural concrete.	105 AFX-Plus FleeceBACK ⁽¹⁾⁽²⁾ or 135 AFX TPO ⁽¹⁾⁽³⁾ hot mopped with two plies of base sheets directly over structural concrete.
115-mil Sure-Weld TPO ⁽³⁾ or Sure-Seal FleeceBACK ⁽²⁾ adhered with FAST Adhesive directly over structural sloped concrete.	115-mil Sure-Weld TPO ⁽³⁾ or Sure-Seal FleeceBACK ⁽²⁾ adhered with FAST Adhesive directly over structural sloped concrete.

⁽¹⁾ When positive slope is incorporated by tapered insulation, non-FleeceBACK or AFX membranes may be adhered to a coverboard (DensDeck Prime or SecuRock) which has been adhered to the insulation with Carlisle Insulation Adhesive. ⁽²⁾ Sure-Seal and Sure-Tough EPDM Membranes shall be seamed with 3" Factory Applied Tape and overlaid with 6" Pressure-Sensitive Cured Cover Strip

⁽³⁾ Sure-Weld TPO membrane seams shall be heat-welded and overlaid with 6" TPO Pressure-Sensitive Cover Strip

⁽⁴⁾ Sure-Flex PVC Membrane seams shall be heat-welded and overlaid with a 6" PVC welded cover strip

Deep (Intensive) Roof Garden Assembly

A deep planting system (growth media depth greater than 8") where recommended plants available include turf grass, annual or perennial flowers, shrubs and even small trees. In most climates, deep systems require regular maintenance such as watering, fertilizing and mowing/weeding. This system typically requires a structural concrete roof deck to support the larger dead load. An irrigation system may be utilized in these assemblies, as required. The anticipated weight above the membrane assembly is generally greater than 50 pounds per square foot.

A. Vegetative Components – Carlisle vegetated components are installed directly above the waterproofing components.

1. Min 2" polystyrene (Carlisle Insulfoam, Foamular, or Dow) with drainage channels or CCW 300HV Protection Fabric
2. 40-mil non-reinforced Geomembrane Root Barrier
3. CCW MiraDRAIN G4 Drainage Composite
4. Greater than 8" Carlisle Engineered Growth Media
 - a. Saturated Weight: Greater than 50-lbs per square foot
 - b. Dry Weight: Greater than 23-lbs per square foot
5. Carlisle Vegetated Sedum Tiles, Carlisle Vegetated Sedum Mats, Carlisle Sedum Plugs, Perennial Plugs, Grasses, Shrubs, or Sedum Cuttings & Carlisle Moisture Retention Gel

B. Waterproofing Components

Membrane Options for 10 or 15 Year Warranty	Membrane Options for 20-Year Warranty
90-mil Sure-Seal EPDM ⁽¹⁾⁽²⁾	
80-mil Sure-Weld EXTRA TPO or 80-mil Sure-Flex PVC ⁽¹⁾⁽³⁾⁽⁴⁾	
105 AFX-Plus FleeceBACK ⁽¹⁾⁽²⁾ or 135 AFX TPO ⁽¹⁾⁽³⁾ hot mopped with two plies of base sheets directly over structural concrete.	
115-mil Sure-Weld TPO ⁽³⁾ or Sure-Seal FleeceBACK ⁽²⁾ adhered with FAST Adhesive directly over structural sloped concrete.	145-mil Sure-Seal FleeceBACK ⁽²⁾ adhered with FAST Adhesive directly over structural concrete.

⁽¹⁾ When positive slope is incorporated by tapered insulation, non-FleeceBACK or AFX membranes may be adhered to a coverboard (DensDeck Prime or SecuRock) which has been adhered to the insulation with Carlisle Insulation Adhesive.

⁽²⁾ Sure-Seal and Sure-Tough EPDM Membranes shall be seamed with 3" Factory Applied Tape and overlaid with 6" Pressure-Sensitive Cured Cover Strip

⁽³⁾ Sure-Weld TPO membrane seams shall be heat-welded and overlaid with 6" TPO Pressure-Sensitive Cover Strip

⁽⁴⁾ Sure-Flex PVC Membrane seams shall be heat-welded and overlaid with a 6" PVC welded cover strip

Roof Garden "Attachment II" Carlisle Engineered Growth Media

June 2010

Carlisle Engineered Growth Media (CEGM) is available in five different blends based on geography and depth requirements for plant growth. These blends are engineered specifically for roof gardens to be lightweight, resistant to decomposition, and high water holding capacity while maintaining air porosity within the growth media. Carlisle Engineered Growth Media is blended to strict FLL-compliant standards. Each Carlisle Blend is packaged in 1.35 to 2.0 cubic yard SuperSacks weighing 1,450 to 3,000 pounds.

1. **Intensive** blends are for growth media depths 6-inches and greater
2. **Extensive** blends are for growth media depths less than 6-inches.
3. **Lightweight** blend can be used anywhere the Extensive blend is used and is 27% lighter in lbs per cubic foot.
4. **Pacific Northwest** blends are limited to WA, OR, ID, MT and WY

Below is a chart showing the physical properties of each blend:

Depths		FLL Standards 6-inches or greater		2.5-inches to 5.9-inches			6-inches or greater	
Growth Media Blends ⁽¹⁾		Extensive	Intensive	Extensive	Lightweight ⁽²⁾ Extensive	Pacific Northwest Extensive	Intensive	Pacific Northwest Intensive
Bulk Density (dry weight)	lbs/ft ³			45.7	35.8	34.0	41.6	32.8
Bulk Density (saturated weight)	lbs/ft ³			72.5	57.5	69.3	74.4	72.1
Total Pore Volume	Vol %			71.9	78.0	73.4	74.1	75.3
Maximum Water Holding Capacity	Vol %	>35	>45	46.0	37.0	61.6	53.2	50.1
Air-Filled Porosity (at max. WHC)	Vol %	>10	>10	25.6	41.0	16.0	20.9	15.2
Water Permeability	cm/s	>0.001	>0.005	0.03	0.48	0.063	0.02	0.058
Water Permeability	in/min.	>0.0236	>0.0118	0.731	11.4	1.49	0.38	1.29
pH		6.5 - 8.0	5.5 - 8.0	6.6	7.4	6.7	6.1	6.5
Soluble Salts (water, 1:10, m:v)	mmhos/cm			0.1	0.4	0.23	0.25	0.31
Soluble Salts (water, 1:10, m:v)	g (KC1)/L	<3.5	<2.5	0.47	1.3	0.96	1.07	1.29
Organic Matter Content	mass %	<8	<12	5.2	7.0	7.2	9.3	10.9

(1) Saturated weight of growth media is approximately 6 lbs/ft²/in unless otherwise noted.

(2) Saturated weight of growth media is approximately 4.8 lbs/ft²/in.

Installation – Carlisle growth media shall be applied over an approved Carlisle Roof Garden Waterproofing Assembly and protection courses. Sacks may be lowered to 2' – 4' above the rooftop by crane where the bags are slit with a knife or other cutting device and then dispensed directly from the sack to the roof or into wheelbarrows to be transported to hard to reach areas. Approx. coverage rate per sack: 4" depth approximately 150 square feet and 8" depth 75 square feet per sack.

Caution must be exercised when Carlisle Growth Media is applied during windy conditions to limit potential scouring of media and if not used on the day of arrival, product should be stored under a tarp or other non-clear cover to prevent direct exposure to sunlight and moisture.

Roof Garden

"Attachment III"

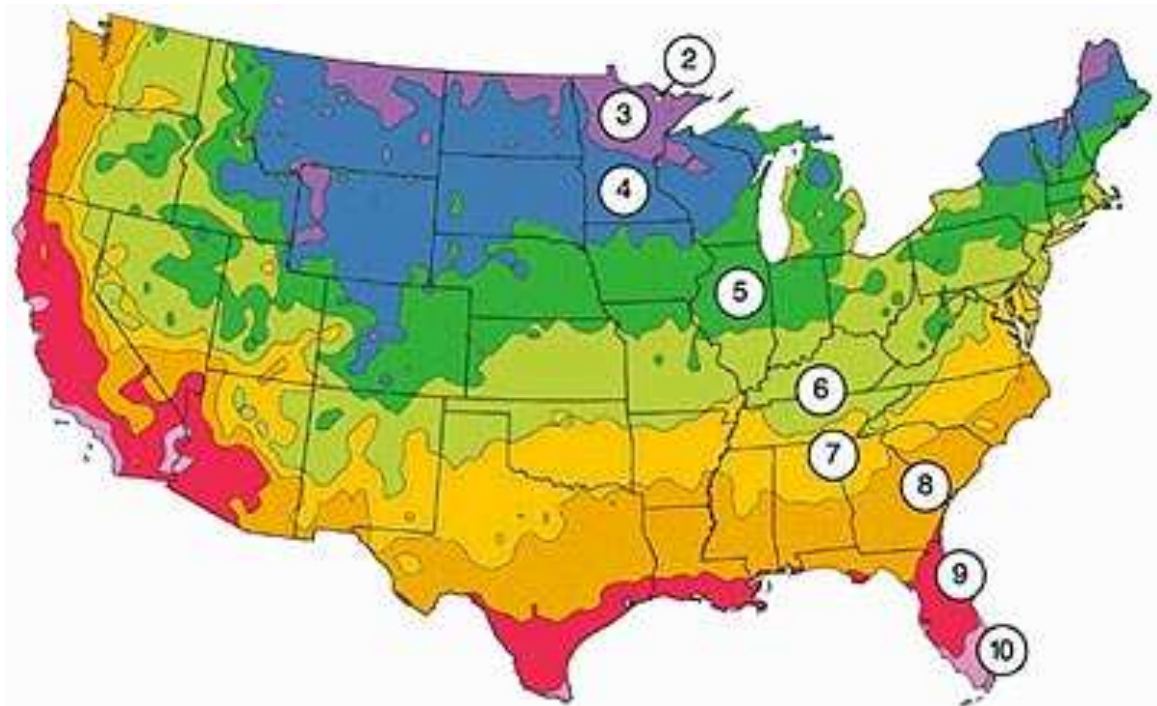
Carlisle Roof Garden Plants

Plugs and Cuttings

June 2010

- A. **Sedums** – A low growing groundcover plant that is very resilient and drought tolerant. There are over 500 varieties from annual and creeping herbs to shrubs. These succulents can be found throughout the northern hemisphere, but location is important; some varieties are able to handle a cold-hardy condition while others are more heat tolerant. Carlisle has specifically chosen the listed sedums for rooftop environments. Selection assistance is available through Carlisle SynTec Incorporated.
1. **Sedum Plugs** – Carlisle sedum plugs are available in 10"x 20" flats/trays weighting approximately 4 pounds each containing either twenty-four 2.5" diameter plugs or seventy-two 1.5" diameter plugs.
 - a. **Installation** – 2.5" diameter plugs are recommend to be spaced 8" to 9" on center (1.78 to 2.25 plugs per square foot). 1.5" diameter plugs are recommended to be spaced 6" to 8" on center (2.25 to 4 plugs per square foot). After spacing has been determined, a 2" deep indentation is made into the growth media, the plug is inserted, vegetation facing upwards, and the growth media is tamped by hand around the submerged plug base. Once planting is complete, irrigate the Roof Garden to the point of runoff.
 2. **Carlisle Moisture Retention Gel and Sedum Cuttings**
 - a. **Carlisle Moisture Retention Gel** – Used in conjunction with **Carlisle's Sedum Cuttings** to ensure rapid rooting and growth of vegetated rooftops. Designed to hold large quantities of water at the surface of the growth media so that cuttings have immediate access to hydration as the plants' roots form and grow. Available in sealed 50 lb. bags, with a coverage rate of 1lb per 200 ft².
 - i. **Installation** – Apply via a handheld rotary spreader or by hand broadcast. Most rotary spreaders should be operated at a rate of roughly 1 pound per 200 square feet. Once Carlisle Moisture Gel is applied, apply sedum cuttings and water the surface of the growth media until the gel expands to roughly four times its applied size.
 - b. **Sedum Cuttings** – Carlisle sedum cuttings are available in bulk and are sold by the pound. More than 12 different varieties of sedum cuttings can be used to propagate Carlisle Roof Gardens. Carlisle sedum cuttings must be planted with **Carlisle Moisture Retention Gel** to ensure that cuttings have adequate moisture to successfully root in a rooftop environment. Available in insulated boxes containing between 20 to 35 lbs. of single-variety or mixed cuttings.
 - i. **Installation** – Once Carlisle Retention Gel is distribute across the entire surface of the growth media, cuttings may be applied manually or by hand broadcasting. Recommended rate of cuttings application is 1 pound per 10 square feet for rapid vegetative coverage. After cuttings are applied, the Roof Garden must be immediately irrigated to the point of runoff and the Moisture Retention Gel becomes expanded and saturated. When cuttings are used to propagate the Roof Garden, it is absolutely mandatory that an irrigation system be used for a minimum of 60 days to ensure proper establishment of the cuttings. **Refer to Roof Garden Attachment VI for irrigation and maintenance.**

3. Available Plant Varieties from Carlisle by Hardening Zones



United States Hardening Zones 2 through 10

a. **Zone 2**

- *Arenaria montana*
- *Cerastium tomentosum*
- *Saponaria ocymoides*
- *Thymus praecox* 'Purple Carpet'
- *Veronica liwanensis*

b. **Zone 3**

- | | |
|---|---|
| • <i>Achillea</i> 'Appleblossom' | • <i>Phlox subulata</i> 'White Delight' |
| • <i>Achillea millefolium</i> 'Summer Pastels' | • <i>Saponaria ocymoides</i> |
| • <i>Achillea millefolium</i> 'Summer Wine' | • <i>Scabiosa columbaria</i> 'Pink Mist' |
| • <i>Achillea</i> 'Moonshine' | • <i>Sedum acre</i> 'Gold Moss' |
| • <i>Achillea</i> 'Paprika' | • <i>Sedum album</i> 'Coral Carpet' |
| • <i>Achillea</i> 'Terra Cotta' | • <i>Sedum hispanicum</i> 'Purple Form' |
| • <i>Arenaria montana</i> | • <i>Sedum kamtschaticum</i> |
| • <i>Armeria maritima</i> 'Alba' | • <i>Sedum kamtschaticum</i> 'W. Gold' |
| • <i>Artemisia stelleriana</i> 'Silver Brocade' | • <i>Sedum sieboldii</i> |
| • <i>Aurinia saxatilis</i> 'Gold Dust' | • <i>Sedum spurium</i> 'Fuldaglut' |
| • <i>Cerastium tomentosum</i> | • <i>Sedum spurium</i> 'John Creech' |
| • <i>Phlox subulata</i> 'Candystripe' | • <i>Sedum spurium</i> 'Red Carpet' |
| • <i>Phlox subulata</i> 'Crimson Beauty' | • <i>Sedum spurium</i> 'Tricolor' |
| • <i>Phlox subulata</i> 'Drummons Pink' | • <i>Thymus praecox</i> 'Purple Carpet' |
| • <i>Phlox subulata</i> 'Emerald Blue' | • <i>Thymus pseudolanuginosus</i> 'Wooly Thyme' |
| • <i>Phlox subulata</i> 'Fort Hill' | • <i>Veronica liwanensis</i> |
| • <i>Phlox subulata</i> 'Red Wing' | |

c. **Zone 4**

- *Achillea* 'Appleblossom'
- *Achillea millefolium* 'Summer Pastels'
- *Achillea millefolium* 'Summer Wine'
- *Achillea* 'Moonshine'
- *Achillea* 'Paprika'
- *Achillea* 'Terra Cotta'
- *Achillea x lewisii* 'King Edward'
- *Arenaria montana*
- *Armeria maritima* 'Alba'
- *Armeria maritima* 'Splendens'
- *Artemisia stelleriana* 'Silver Brocade'
- *Aurinia saxatilis* 'Gold Dust'
- *Aurinia saxatilis* 'Summit'
- *Cerastium tomentosum*
- *Dianthus deltoides* 'Brilliant'
- *Dianthus* 'Spangled Star'
- *Phlox subulata* 'Candystripe'
- *Phlox subulata* 'Crimson Beauty'
- *Phlox subulata* 'Drummons Pink'
- *Phlox subulata* 'Emerald Blue'
- *Phlox subulata* 'Fort Hill'
- *Phlox subulata* 'Red Wing'
- *Phlox subulata* 'White Delight'
- *Potentilla nepalensis* 'Miss Wilmot'
- *Saponaria ocymoides*
- *Scabiosa columbaria* 'Pink Mist'
- *Sedum acre* 'Gold Moss'
- *Sedum album* 'Coral Carpet'
- *Sedum hispanicum* 'Purple Form'
- *Sedum kamtschaticum*
- *Sedum kamtschaticum* 'W. Gold'
- *Sedum kamtschaticum* k. *varigatum*
- *Sedum rupestre* 'Angelina'
- *Sedum sexangular*
- *Sedum sieboldii*
- *Sedum spurium* 'Fuldaglut'
- *Sedum spurium* 'John Creech'
- *Sedum spurium* 'Red Carpet'
- *Sedum spurium* 'Tricolor'
- *Sempervivum* 'Black'
- *Sempervivum* 'Cobweb Buttons'
- *Thymus praecox* 'Bressingham'
- *Thymus praecox* 'Purple Carpet'
- *Thymus pseudolanuginosus* 'Wooly Thyme'
- *Thymus serpyllum* 'Albus' ('Album')
- *Thymus serpyllum* 'Coccineum'
- *Thymus serpyllum* 'Elfin'
- *Veronica liwanensis*

d. **Zone 5**

- *Achillea* 'Appleblossom'
- *Achillea x lewisii* 'King Edward'
- *Achillea millefolium* 'Summer Pastels'
- *Achillea millefolium* 'Summer Wine'
- *Achillea* 'Moonshine'
- *Achillea* 'Paprika'
- *Achillea* 'Terra Cotta'
- *Arenaria montana*
- *Armeria maritima* 'Alba'
- *Armeria maritima* 'Dusseldorfer Stolz'
- *Armeria maritima* 'Splendens'
- *Artemisia stelleriana* 'Silver Brocade'
- *Aurinia saxatilis* 'Gold Dust'
- *Aurinia saxatilis* 'Summit'
- *Cerastium tomentosum*
- *Delosperma nubigenum*
- *Dianthus deltoides* 'Brilliant'
- *Dianthus* 'Spangled Star'
- *Lavandula angustifolia* 'Hidcote'
- *Phlox subulata* 'Candystripe'
- *Phlox subulata* 'Crimson Beauty'
- *Phlox subulata* 'Drummons Pink'
- *Phlox subulata* 'Emerald Blue'
- *Phlox subulata* 'Fort Hill'
- *Phlox subulata* 'Red Wing'
- *Phlox subulata* 'White Delight'
- *Potentilla nepalensis* 'Miss Wilmot'
- *Saponaria ocymoides*
- *Scabiosa columbaria* 'Pink Mist'
- *Sedum acre* 'Gold Moss'
- *Sedum album* 'Coral Carpet'
- *Sedum hispanicum* 'Purple Form'
- *Sedum kamtschaticum*
- *Sedum kamtschaticum* k. *varigatum*
- *Sedum kamtschaticum* 'W. Gold'
- *Sedum rupestre* 'Angelina'
- *Sedum sexangular*
- *Sedum sieboldii*
- *Sedum spurium* 'Fuldaglut'
- *Sedum spurium* 'John Creech'
- *Sedum spurium* 'Red Carpet'
- *Sedum spurium* 'Tricolor'
- *Sempervivum* 'Black'
- *Sempervivum* 'Cobweb Buttons'
- *Thymus praecox* 'Bressingham'
- *Thymus praecox* 'Purple Carpet'
- *Thymus pseudolanuginosus* 'Wooly Thyme'
- *Thymus serpyllum* 'Albus' ('Album')
- *Thymus serpyllum* 'Coccineum'
- *Thymus serpyllum* 'Elfin'
- *Veronica liwanensis*

e. **Zone 6**

- *Achillea* 'Appleblossom'
- *Achillea* x *lewisii* 'King Edward'
- *Achillea millefolium* 'Summer Pastels'
- *Achillea millefolium* 'Summer Wine'
- *Achillea* 'Moonshine'
- *Achillea* 'Paprika'
- *Achillea* 'Terra Cotta'
- *Agastache* 'Blue Fortune'
- *Arenaria montana*
- *Armeria maritima* 'Alba'
- *Armeria maritima* 'Dusseldorfer Stolz'
- *Armeria maritima* 'Splendens'
- *Artemisia stelleriana* 'Silver Brocade'
- *Aurinia saxatilis* 'Gold Dust'
- *Aurinia saxatilis* 'Summit'
- *Cerastium tomentosum*
- *Delosperma cooperi*
- *Delosperma nubigenum*
- *Dianthus deltoides* 'Brilliant'
- *Dianthus* 'Spangled Star'
- *Lavandula angustifolia* 'Hidcote'
- *Phlox subulata* 'Candystripe'
- *Phlox subulata* 'Crimson Beauty'
- *Phlox subulata* 'Drummons Pink'
- *Phlox subulata* 'Emerald Blue'
- *Phlox subulata* 'Fort Hill'
- *Phlox subulata* 'Red Wing'
- *Phlox subulata* 'White Delight'
- *Potentilla nepalensis* 'Miss Wilmot'
- *Saponaria ocymoides*
- *Scabiosa columbaria* 'Pink Mist'
- *Sedum acre* 'Gold Moss'
- *Sedum album* 'Coral Carpet'
- *Sedum hispanicum* 'Purple Form'
- *Sedum kamtschaticum*
- *Sedum kamtschaticum* k. *varigatum*
- *Sedum kamtschaticum* 'W. Gold'
- *Sedum reflexum* 'Blue Spruce'
- *Sedum rupestre* 'Angelina'
- *Sedum sexangulare*
- *Sedum sieboldii*
- *Sedum spurium* 'Fuldaglut'
- *Sedum spurium* 'John Creech'
- *Sedum spurium* 'Red Carpet'
- *Sedum spurium* 'Tricolor'
- *Sempervivum* 'Black'
- *Sempervivum* 'Cobweb Buttons'
- *Thymus praecox* 'Bressingham'
- *Thymus praecox* 'Purple Carpet'
- *Thymus pseudolanuginosus* 'Woolly Thyme'
- *Thymus serpyllum* 'Albus' ('Album')
- *Thymus serpyllum* 'Coccineum'
- *Thymus serpyllum* 'Elfin'
- *Veronica liwanensis*

f. **Zone 7**

- *Achillea* 'Appleblossom'
- *Achillea* x *lewisii* 'King Edward'
- *Achillea millefolium* 'Summer Pastels'
- *Achillea millefolium* 'Summer Wine'
- *Achillea* 'Moonshine'
- *Achillea* 'Paprika'
- *Achillea* 'Terra Cotta'
- *Agastache* 'Blue Fortune'
- *Arenaria montana*
- *Armeria maritima* 'Alba'
- *Armeria maritima* 'Dusseldorfer Stolz'
- *Armeria maritima* 'Splendens'
- *Artemisia stelleriana* 'Silver Brocade'
- *Aurinia saxatilis* 'Gold Dust'
- *Aurinia saxatilis* 'Summit'
- *Cerastium tomentosum*
- *Delosperma cooperi*
- *Delosperma nubigenum*
- *Dianthus deltoides* 'Brilliant'
- *Dianthus* 'Spangled Star'
- *Lavandula angustifolia* 'Hidcote'
- *Phlox subulata* 'Candystripe'
- *Phlox subulata* 'Crimson Beauty'
- *Phlox subulata* 'Drummons Pink'
- *Phlox subulata* 'Emerald Blue'
- *Phlox subulata* 'Fort Hill'
- *Phlox subulata* 'Red Wing'
- *Phlox subulata* 'White Delight'
- *Potentilla nepalensis* 'Miss Wilmot'
- *Saponaria ocymoides*
- *Scabiosa columbaria* 'Pink Mist'
- *Sedum acre* 'Gold Moss'
- *Sedum album* 'Coral Carpet'
- *Sedum hispanicum* 'Purple Form'
- *Sedum kamtschaticum*
- *Sedum kamtschaticum* k. *varigatum*
- *Sedum kamtschaticum* 'W. Gold'
- *Sedum reflexum* 'Blue Spruce'
- *Sedum rupestre* 'Angelina'
- *Sedum sexangulare*

- Sedum sieboldii
- Sedum spurium 'Fuldaglut'
- Sedum spurium 'John Creech'
- Sedum spurium 'Red Carpet'
- Sedum spurium 'Tricolor'
- Sempervivum 'Black'
- Sempervivum 'Cobweb Buttons'
- Thymus praecox 'Bressingham'

- Thymus praecox 'Purple Carpet'
- Thymus pseudolanuginosus 'Wooly Thyme'
- Thymus serpyllum 'Albus' ('Album')
- Thymus serpyllum 'Coccineum'
- Thymus serpyllum 'Elfin'
- Veronica liwanensis

g. **Zone 8**

- Achillea 'Appleblossom'
- Achillea x lewisii 'King Edward'
- Achillea millefolium 'Summer Pastels'
- Achillea millefolium 'Summer Wine'
- Achillea 'Moonshine'
- Achillea 'Paprika'
- Achillea 'Terra Cotta'
- Agastache 'Blue Fortune'
- Armeria maritima 'Alba'
- Armeria maritima 'Dusseldorfer Stolz'
- Armeria maritima 'Splendens'
- Artemisia stelleriana 'Silver Brocade'
- Aurinia saxatilis 'Gold Dust'
- Aurinia saxatilis 'Summit'
- Delosperma cooperi
- Delosperma nubigenum
- Dianthus deltoides 'Brilliant'
- Dianthus 'Spangled Star'
- Lavandula angustifolia 'Hidcote'
- Sedum acre 'Gold Moss'
- Sedum album 'Coral Carpet'

- Sedum hispanicum 'Purple Form'
- Sedum kamtschaticum
- Sedum kamtschaticum k. variegatum
- Sedum kamtschaticum 'W. Gold'
- Sedum reflexum 'Blue Spruce'
- Sedum rupestre 'Angelina'
- Sedum sexangular
- Sedum sieboldii
- Sedum spurium 'Fuldaglut'
- Sedum spurium 'John Creech'
- Sedum spurium 'Red Carpet'
- Sedum spurium 'Tricolor'
- Sempervivum 'Black'
- Sempervivum 'Cobweb Buttons'
- Thymus praecox 'Bressingham'
- Thymus praecox 'Purple Carpet'
- Thymus pseudolanuginosus 'Wooly Thyme'
- Thymus serpyllum 'Albus' ('Album')
- Thymus serpyllum 'Coccineum'
- Thymus serpyllum 'Elfin'
- Veronica liwanensis

h. **Zone 9**

- Achillea millefolium 'Summer Pastels'
- Achillea millefolium 'Summer Wine'
- Achillea 'Moonshine'
- Achillea 'Paprika'
- Achillea 'Terra Cotta'
- Agastache 'Blue Fortune'
- Armeria maritima 'Dusseldorfer Stolz'
- Armeria maritima 'Splendens'
- Artemisia stelleriana 'Silver Brocade'

- Delosperma cooperi
- Delosperma nubigenum
- Dianthus deltoides 'Brilliant'
- Dianthus 'Spangled Star'
- Sedum kamtschaticum k. variegatum
- Sedum reflexum 'Blue Spruce'
- Sedum sieboldii
- Sempervivum 'Black'

i. **Zone 10** – Please contact Carlisle for plants suitable to Zone 10.

Roof Garden

"Attachment IV"

Carlisle Vegetated Tiles

June 2010

- A. Vegetated Sedum Tiles** – Carlisle's Vegetated Sedum Tiles are well suited for high slope applications and are pre-grown in four different mixes of 6 to 8 sedum varieties. Each tile is available in 1.4 square foot trays weighing approximately 4.5 pounds (~3.2 pounds per square foot). Vegetated coverage after installation is approximately 95% or greater. Vegetated Sedum Tiles can be specified for US Hardening Zones 3 through 8. For Hardening Zones 9 and 10, please contact Carlisle for guidance. For US Hardening Zone Map refer to Roof Garden Attachment III.

B. Sedum Tiles Mixes

1. **All Season Mix** – This mix provides flowers throughout the whole growing season. Winter interest and seasonal foliage color changes are also found in this group. This is a good, general-purpose mix that provides year-round beauty.



a. Sedum varieties:

- Sedum album 'Coral Carpet'
- Sedum h. 'Immergrunnen'
- Sedum floriferum 'Weihenstephaner Gold'
- Sedum middendorffianum diffusum
- Sedum reflexum 'Green Spruce'
- Sedum spurium 'Coccineum'
- Sedum spurium 'Fuldaglut'
- Sedum spurium 'John Creech'
- Sedum spurium 'Red Carpet'
- Sedum spurium 'Roseum'
- Sedum stefco
- Sedum takesimensis 'Golden Carpet'
- Sedum tetractinum 'Coral Reef'

2. **Color Max Mix** – Color Max includes a bed of sedums for use when maximum color is desired. This comes in the form of brightly colored foliage, flowers in abundance, and colors that blend together well.



Sedum varieties:

- Sedum acre 'Aurea'
- Sedum album 'Coral Carpet'
- Sedum album 'Orange Ice'
- Sedum floriferum 'Weihenstephaner Gold'
- Sedum kamtschaticum 'Variegatum'
- Sedum reflexum 'Blue Spruce'
- Sedum rupestre 'Angelina'
- Sedum spurium 'Green Mantle'
- Sedum spurium 'John Creech'
- Sedum spurium 'Red Carpet'
- Sedum spurium 'Summer Glory'
- Sedum spurium 'Tricolor'

3. **Shade Mix** – The plants in Shade Mix are those that have demonstrated abilities to withstand shaded areas. Most sedums do best in higher light, but this group excels when the rooftop receives less than 4 hours of direct sunlight per day.



a. Sedum varieties:

- Sedum acre ‘Aurea’
- Sedum h. ‘Immergrunnen’
- Sedum pachyclados
- Sedum sexangulare
- Sedum spurium ‘Album Superbum’
- Sedum spurium ‘Eco Mt. Emei’
- Sedum spurium ‘Fuldaglut’
- Sedum spurium ‘Green Mantle’
- Sedum spurium ‘John Creech’
- Sedum ternatum

4. **Tuff Stuff Mix** – The sedums in Tuff Stuff are the toughest, most durable, most drought resistant choices available. They have proven ability to survive wind, cold, heat, drought, and tough environments that limit plant choices.



a. Sedum varieties:

- Sedum album ‘Coral Carpet’
- Sedum caucicolum
- Sedum ellacombianum
- Sedum hybridum ‘Czar’s Gold’
- Sedum kamtschaticum
- Sedum middendorffianum diffusum
- Sedum rupestre
- Sedum sexangulare
- Sedum spurium sp.
- Sedum spurium ‘Roseum’
- Sedum spurium ‘Voodoo’
- Sedum stefco

- C. **Installation** - Remove the tiles from the cardboard stacking containers with care. Simply place the Sedum Tiles over a minimum 2.5” of Carlisle Growth Media, leaving 1/8”-1/4” gap between the Tiles. Water the Roof Garden assembly to the point of system saturation and water begins to leave the assembly.

Roof Garden "Attachment V" Carlisle Roof Garden GreenGrid® System

January 2010

A. DESCRIPTION

As an option to using the traditional vegetated components (i.e., drainage boards, root barriers, moisture mats, and growth media), the Carlisle Roof Garden GreenGrid® System can be installed with appropriate protection fabric / slip sheet above the specified adhered roofing membrane.

Refer to Carlisle's Roof Garden Waterproofing System specifications for specific requirements concerning membrane adhesion and splicing criteria, insulation type and securement methods, product delivery, storage and handling guidelines, and applicable installation of all materials and details.

B. CARLISLE GreenGrid® MODULE

GreenGrid modules are black in color, made from recycled material and contain a drainage/root barrier layer already placed in the module. Modules are pre-planted with growth media and plant species of the color and type desired by the building owner. Physical properties are as follows:

Element	Description
Depth of Modules	4" (standard); 8" (special order)
Module Size	4" depth – 2' x 4', 2' x 2', 40" x 40" 8" depth - only available in 2' x 4'
Weight of Planted Modules (fully saturated weights)	4" depth - Approx. 23 lb. per sq. ft. 8" depth (special order) - Approx. 48 lb. per sq. ft.
Module Material	HDPE (60% of material derived from recycled post industrial HDPE) <ul style="list-style-type: none">• 4" deep modules - formed of 150 mil HDPE• 8" deep modules (special order) - formed of 175 mil HDPE
Module Clearance above Roofing Surface	0.5"
Color of Modules	Black
Drainage/Root Resistance Layer	3 oz. Spunbonded Polypropylene Geotextile
Growth Media	Proprietary rooftop blend consisting of organic and inorganic components.
Required underlayment for modules	Carlisle CCW 200V Protection Fabric (12 oz/yd ² polypropylene fabric)
Plants	Perennial, grass, or shrub species specifically selected for climate, hardiness zone, color, and size.
Edge Treatment	Wood, recycled composite wood, aluminum, pavers or other specialty materials

C. DESIGN GUIDELINES

1. For 10 or 15-year membrane system warranties, the roofing assembly requires the use of 60-mil EPDM, 60-mil TPO, 60-mil PVC, Sure-Seal, Sure-Flex or Sure-Weld FleeceBACK® 100 membranes, or AFX EPDM FleeceBACK or 105 AFX TPO FleeceBACK membranes.
2. For 20-year warranties, the roofing assembly requires the use of 75-mil Sure-Tough™ Reinforced EPDM, 72-mil Sure-Weld® TPO, 80-mil Sure-Flex PVC or Sure-Seal, Sure-Flex or Sure-Weld FleeceBACK 115 membranes, or AFX EPDM FleeceBACK Plus or 135 AFX Sure-Weld FleeceBACK membranes.

3. Insulation shall be either adhered or secured with fasteners and plates to the structural deck. If fastener and plates are utilized, an additional layer of insulation or an acceptable cover board shall be adhered with a Carlisle Insulation Adhesive.
4. Waterproofing Membranes shall be fully adhered with appropriate adhesive to either an acceptable cover board, 25-psi Carlisle Polyisocyanurate HP-H, or minimum 20-psi Carlisle SecurShield that has been set in insulation adhesive to additional layers of insulation or the structural deck. Additional layers of insulation can be mechanically fastened to the roof deck.
5. Overlayment of field membrane splices will not be required when splices are shingled to avoid bucking of water. If field splices buck water or if they are located in areas of ponded water, they shall be overlaid. Use 6" wide Sure-Seal Pressure-Sensitive Cured Cover Strip for Sure-Seal EPDM membranes and 6" wide Sure-Weld Pressure-Sensitive Cover Strip for Sure-Weld TPO membrane.
6. A **minimum roof slope of ¼" in 12"** must be provided at the waterproofing membrane level to facilitate drainage.
7. Prior to installing the GreenGrid modules, a slip sheet of Carlisle CCW 200V Protection Fabric shall be installed over the waterproofing membrane at all areas where the modules will be placed. As an alternate to the Carlisle CCW 200V Protection Fabric, a layer of loose laid membrane may be used when a cover board is specified.
8. Contact Carlisle when projects have building heights greater than 50 feet and/or is located in a wind zone of 110 mph or greater based on ASCE 7 Basic Wind Speeds regarding appropriate methods to increase tray stability and/or soil media wind erosion.

D. CCW 200V Protection Fabric - A 12 oz/yd² polypropylene non-woven needle-punched fabric used as a protection sheet beneath the GreenGrid planting modules. Stabilized to resist soil chemicals, mildew, insects, and is non-biodegradable. Available in rolls 12.5' in width by 200' in length.

E. PLANTS

1. GreenGrid recommended design mix of grasses, perennials and groundcovers that can thrive in a non-irrigated, ultra-extensive/shallow environment based on the project location. Plants to be selected according to the USDA hardiness zone classification.
2. Standard System (4-inch deep module) has a typical planting density of 2 plugs per square foot (16 plants per 2' x 4' tray) and comes with 5 different types of sedum as follows (Sedums are chosen for the specific climate zone). USDA Hardiness Zones 4 through 7 selected plant species:
 - a. Sedum floriferum 'Weienstaphaner Gold'
 - b. Sedum kamtshaticum
 - c. Sedum reflexum
 - d. Sedum sexangular
 - e. Sedum spurium 'Fuldaglut'
3. Special Order: Other than the standard system listed above, unique patterns may be accomplished with various plant species to give a pattern look for color, plant height, etc. that meet the climate zone. This is accomplished by coordinating a specific design with the owner/architect. Special plants can be installed in both the 4" and 8" trays.
4. When 8" deep modules are to be used (a special order product for extensive/medium garden assemblies), plants will be selected on a job-by-job basis based on project location and installed in accordance with a landscape design.

F. APPLICATION OF GreenGrid MODULES

1. **Remove** all debris from waterproofing membrane system.
2. **Install** the CCW 200V Protection Fabric or slip sheet over the waterproofing membrane.
3. **Place** modules with care to avoid damaging the protection fabric / slip sheet or underlying membrane. **Do not drag** modules into position. Modules must be **lifted** and gently positioned.

4. After installing of trays, all modules shall be sufficiently watered with a fine spray to ensure growth. Water must be free of contaminants or substances harmful to plant growth.
5. Do not install modules over saturated roof surfaces or under freezing conditions without prior approval from Carlisle.
6. For connecting trays together, drill a hole through the middle of the outer lip at the top of the tray continuing through the inner wall of tray. Using a 150 pound black “zip tie,” put the tie through the hole and cinch up tight. The hole/zip tie shall be at 2 foot centers:
 - a. 2' x 2' trays - 4 ties per tray
 - b. 2' x 4' trays - 6 ties per tray
 - c. 40" x 40" trays - 8 ties per tray

Roof Garden "Attachment VI" Roof Garden Maintenance

June 2010

Immediately After Planting

1. Water/irrigate the roof to the point of run-off.
2. If Carlisle's Sedum Tiles or Mats are used, no further watering will likely be required. If planting was accomplished by use of hydrated cuttings, the Roof Garden must be irrigated for a minimum of 60 days. The initial two weeks irrigation should occur twice a day, morning and early afternoon, tapering to once per day in the mid-morning for the remainder of the 60-day establishment period.
3. If planting was accomplished by the use of plugs, the Roof Garden must be irrigated for a minimum of 30 days. Watering events should occur once per day in the mid-morning during this period.
4. If irrigation is an option for the duration of the first growing season, Roof Garden plants will thrive and faster vegetative coverage will be obtained.

First Season

1. One month after planting, all weeds and non-specified plant material must be pulled from the growth media and removed from the rooftop. A minimum of two weed removal events should occur during the first season. If Carlisle's Sedum Tiles or Mats are used, little to no weeding should be necessary.
2. During weed removal events, all drains must be inspected. If Carlisle Roof Garden Drain Boxes are utilized, remove the four Phillips head screws on the lid and remove to visually inspect the drain internals.
3. After the local trees have dropped their leaves, a final Autumn inspection must be performed. All debris must be removed from the Roof Garden and drains must be given a final inspection for the season.

Second Season

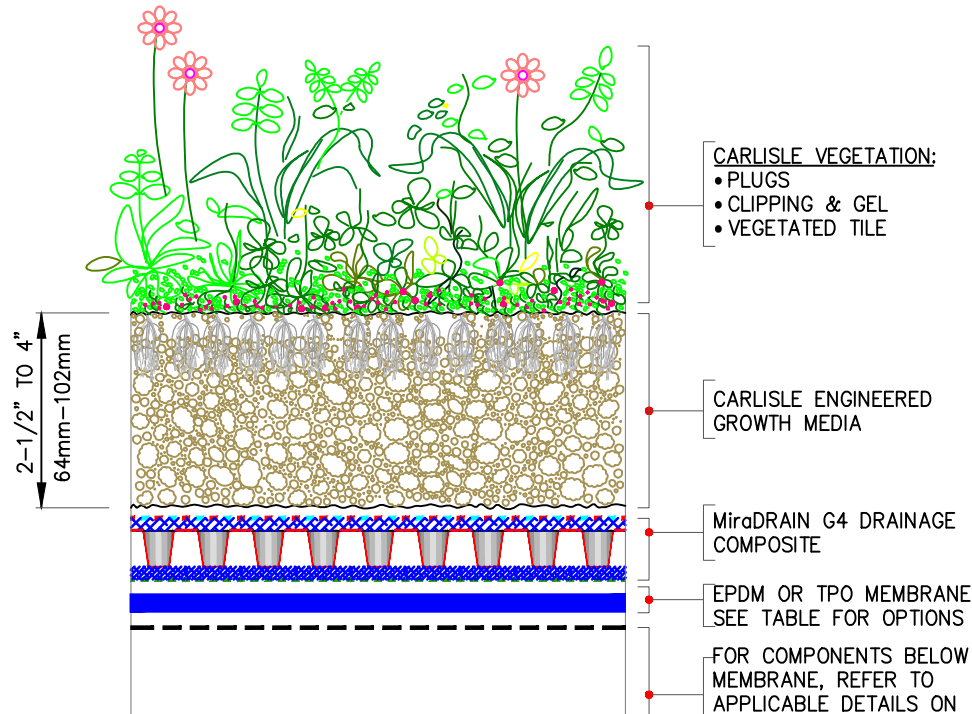
1. If in USDA climate 7 or above, a Spring fertilizer application may be given. Granular **organic** fertilizer can be used at the full rate recommended on the packaging. Petrochemical-based time-release fertilizer (Osmocote, Miracle-Gro, etc.) can be used at **half** the rate recommended on the packaging. Organic fertilization will result in a lower water requirement for the plants. On all-sedum roofs, fertilization should not be needed.
2. A mid-Spring weed removal and drain inspection event must occur. A total of two weed removal and drain inspection events should occur during the second season

3. If irrigation is available during the second season, it will serve to enhance the growth of your Carlisle Roof Garden. If Carlisle's Sedum Tiles or Mats are used, neither watering nor weeding should be required.
4. After the local trees have dropped their leaves, a final Autumn inspection must be performed. All debris must be removed from the Roof Garden and drains must be given a final inspection for the season.

Third season

1. A Spring fertilizer application may be given, if needed.
2. One weed removal event must occur, in the mid-Spring
3. During the Autumn maintenance event, all foreign debris must be removed from the roof

If possible, monitor your Carlisle Roof Garden by visual examination at least once a month to make sure that the plants appear healthy. Should your roof garden experience any health-related issues, contact Carlisle SynTec Inc. for support. Once established, your Carlisle Roof Garden should provide you with decades of beautiful and trouble-free service.



NOTE:

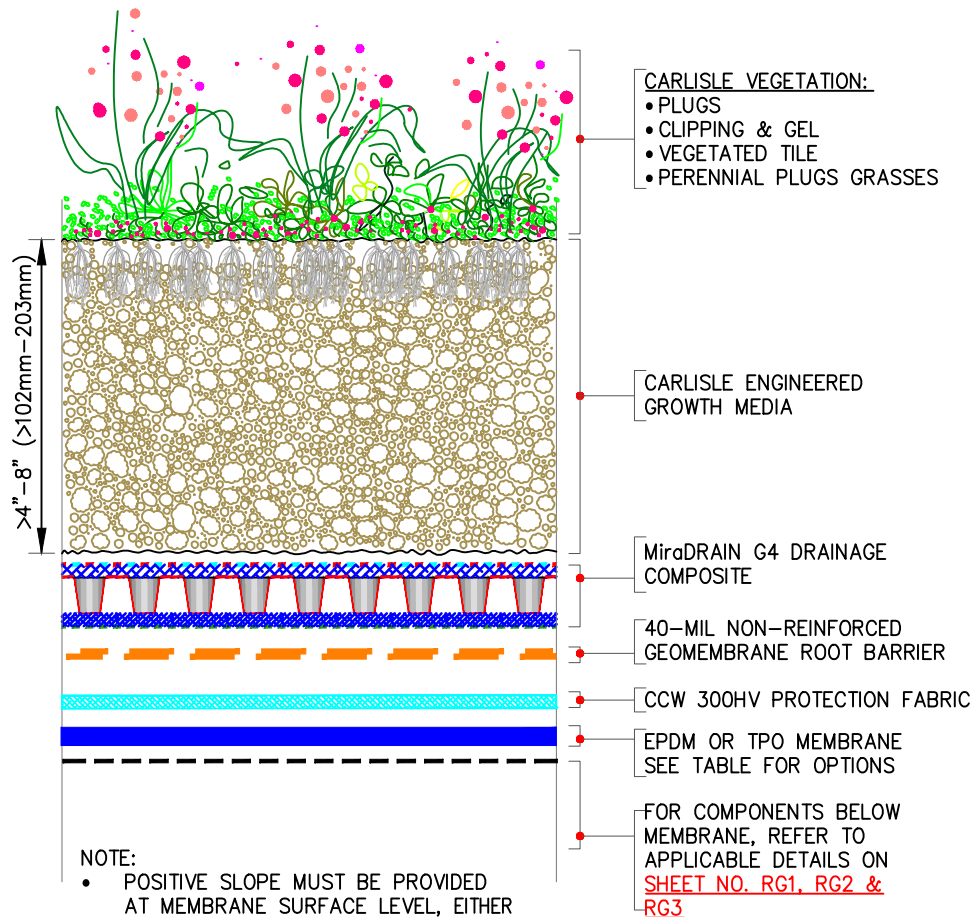
- POSITIVE SLOPE MUST BE PROVIDED AT MEMBRANE SURFACE LEVEL, EITHER BY SLOPING THE STRUCTURAL DECK OR BY ADDING TAPERED INSULATION BOARD ON FLAT STRUCTURAL DECK. FOR ADDITIONAL INFORMATION, SEE SHEET 4A.

MEMBRANE OPTIONS SHALLOW ASSEMBLY

TABLE FOOT NOTES	10/15 - YEAR WARRANTY	20 - YEAR WARRANTY
EPDM MEMBRANES		
(A) (C)	60-MIL EPDM MEMBRANE.	75-MIL SURE-TOUGH EPDM.
(C)	115-MIL SURE-SEAL FleeceBACK, ADHERED WITH FAST ADHESIVE DIRECTLY OVER STRUCTURAL CONCRETE.	115-MIL SURE-SEAL FleeceBACK, ADHERED WITH FAST ADHESIVE DIRECTLY OVER STRUCTURAL CONCRETE.
(C)	105-MIL AFX-PLUS FleeceBACK, HOT MOPPED DIRECTLY OVER STRUCTURAL CONCRETE.	105-MIL AFX-PLUS FleeceBACK, HOT MOPPED WITH TWO PLIES OF BASE SHEETS OVER STRUCTURAL CONCRETE.
TPO MEMBRANES		
(A) (D)	60-MIL SURE-WELD TPO.	72-MIL SURE-WELD EXTRA TPO.
(D)	115-MIL SURE-WELD FleeceBACK TPO, ADHERED WITH FAST ADHESIVE DIRECTLY OVER STRUCTURAL CONCRETE.	115-MIL SURE-WELD FleeceBACK TPO, ADHERED WITH FAST ADHESIVE DIRECTLY OVER STRUCTURAL CONCRETE.
(D)	135-MIL AFX TPO FleeceBACK, HOT MOPPED DIRECTLY OVER STRUCTURAL CONCRETE.	135-MIL AFX TPO FleeceBACK, HOT MOPPED WITH TWO PLIES OF BASE SHEETS DIRECTLY OVER STRUCTURAL CONCRETE.

TABLE FOOT-NOTES

- A. ACCEPTABLE INSULATION SUBSTRATE:** A COVER-BOARD (DensDeck Prime OR Securock) MUST BE ADHERED TO THE INSULATION WITH FAST ADHESIVE, PRIOR TO MEMBRANE ADHESION.
- B. ACCEPTABLE MEMBRANE ON CONCRETE:** WHEN WATERPROOFING MEMBRANE TO BE APPLIED DIRECTLY TO STRUCTURAL OR LIGHTWEIGHT CONCRETE SUBSTRATE, FleeceBACK OR FleeceBACK AFX MEMBRANE MUST BE USED.
- C. EPDM SEAMS:** EPDM MEMBRANE SHALL BE SEAMED WITH MINIMUM 3" (76 mm) F.A.T. (FACTORY APPLIED TAPE) AND OVERLAID WITH 6" (152 mm) PRESSURE-SENSITIVE CURED COVER STRIP.
- D. TPO SEAMS:** SURE-WELD TPO MEMBRANE SEAMS SHALL BE HEAT-WELDED AND OVERLAID WITH 6" (152 mm) TPO PRESSURE-SENSITIVE COVER STRIP.



MEMBRANE OPTIONS MEDIUM ASSEMBLY		
TABLE FOOT NOTES	10/15 - YEAR WARRANTY	20 - YEAR WARRANTY
EPDM MEMBRANES		
(A) (C)	75-MIL SURE-TOUGH EPDM MEMBRANE.	90-MIL SURE-SEAL EPDM MEMBRANE
(C)	115-MIL SURE-SEAL FleeceBACK, ADHERED WITH FAST ADHESIVE DIRECTLY OVER STRUCTURAL CONCRETE.	115-MIL SURE-SEAL FleeceBACK, ADHERED WITH FAST ADHESIVE DIRECTLY OVER STRUCTURAL CONCRETE.
(C)	105-MIL AFX-PLUS FleeceBACK, HOT MOPPED WITH TWO PLIES OF BASE SHEETS OVER STRUCTURAL CONCRETE.	105-MIL AFX-PLUS FleeceBACK, HOT MOPPED WITH TWO PLIES OF BASE SHEETS OVER STRUCTURAL CONCRETE.
TPO MEMBRANES		
(A) (D)	72-MIL SURE-WELD TPO.	80-MIL SURE-WELD EXTRA TPO.
(D)	135-MIL AFX TPO FleeceBACK, HOT MOPPED WITH 2 PLIES OF BASE SHEETS OVER STRUCTURAL CONCRETE.	135-MIL AFX TPO FleeceBACK, HOT MOPPED OVER 2 PLIES OF BASE SHEETS OVER STRUCTURAL CONCRETE.
(D)	115-MIL SURE-WELD FleeceBACK TPO, ADHERED WITH FAST ADHESIVE DIRECTLY OVER STRUCTURAL CONCRETE.	115-MIL SURE-WELD FleeceBACK TPO, ADHERED WITH FAST ADHESIVE DIRECTLY OVER STRUCTURAL CONCRETE.

TABLE FOOT-NOTES

- A. ACCEPTABLE INSULATION SUBSTRATE:** A COVER-BOARD (DensDeck Prime OR Securock) MUST BE ADHERED TO THE INSULATION WITH FAST ADHESIVE, PRIOR TO MEMBRANE ADHESION.
- B. ACCEPTABLE MEMBRANE ON CONCRETE:** WHEN WATERPROOFING MEMBRANE TO BE APPLIED DIRECTLY TO STRUCTURAL OR LIGHTWEIGHT CONCRETE SUBSTRATE, FleeceBACK OR FleeceBACK AFX MEMBRANE MUST BE USED.
- C. EPDM SEAMS:** EPDM MEMBRANE SHALL BE SEAMED WITH MINIMUM 3" (76 mm) F.A.T. (FACTORY APPLIED TAPE) AND OVERLAID WITH 6" (152 mm) PRESSURE-SENSITIVE CURED COVER STRIP.
- D. TPO SEAMS:** SURE-WELD TPO MEMBRANE SEAMS SHALL BE HEAT-WELDED AND OVERLAID WITH 6" (152 mm) TPO PRESSURE-SENSITIVE COVER STRIP.



GREATER THAN 8" (25mm)

NOTE:

- POSITIVE SLOPE MUST BE PROVIDED AT MEMBRANE SURFACE LEVEL, EITHER BY SLOPING THE STRUCTURAL DECK OR BY ADDING TAPERED INSULATION BOARD ON FLAT STRUCTURAL DECK. FOR ADDITIONAL INFORMATION, SEE SHEET 4A.

CARLISLE VEGETATION:

- PLUGS
- CLIPPING & GEL
- VEGETATED TILE
- GRASSES
- SHRUBS
- SPECIAL PLANTS

CARLISLE ENGINEERED GROWTH MEDIA

MiraDRAIN G4 DRAINAGE COMPOSITE

40-MIL NON-REINFORCED GEOMEMBRANE ROOT BARRIER

EXPANDED OR EXTRUDED POLYSTYRENE WITH DRAINAGE CHANNELS

EPDM OR TPO MEMBRANE SEE TABLE FOR OPTIONS

FOR COMPONENTS BELOW MEMBRANE, REFER TO APPLICABLE DETAILS ON SHEET NO. RG1, RG2 & RG3

ALTERNATE:

IN APPLICATIONS WHERE INSULATION IS BELOW WATERPROOFING MEMBRANE, CCW 300HV MUST BE USED BELOW THE ROOT BARRIER

MEMBRANE OPTIONS DEEP ASSEMBLY

TABLE FOOT NOTES	10/15 - YEAR WARRANTY	20 - YEAR WARRANTY
EPDM MEMBRANES		
(A) (C)	90-MIL SURE-SEAL EPDM MEMBRANE.	
(C)	115-MIL SURE-SEAL FleeceBACK, ADHERED WITH FAST ADHESIVE OVER STRUCTURAL CONCRETE.	145-MIL SURE-SEAL FleeceBACK, ADHERED WITH FAST ADHESIVE OVER STRUCTURAL CONCRETE.
(C)	105-MIL AFX-PLUS FleeceBACK, HOT MOPPED WITH TWO PLIES OF BASE SHEETS OVER STRUCTURAL CONCRETE.	
TPO MEMBRANES		
(A) (D)	80-MIL SURE-WELD EXTRA TPO.	
(D)	135-MIL AFX TPO FleeceBACK, HOT MOPPED WITH 2 PLIES OF BASE SHEETS OVER STRUCTURAL CONCRETE.	
(D)	115-MIL SURE-WELD FleeceBACK TPO, ADHERED WITH FAST ADHESIVE OVER STRUCTURAL CONCRETE.	

TABLE FOOT-NOTES

- ACCEPTABLE INSULATION SUBSTRATE:** A COVER-BOARD (DensDeck Prime OR Securock) MUST BE ADHERED TO THE INSULATION WITH FAST ADHESIVE, PRIOR TO MEMBRANE ADHESION.
- ACCEPTABLE MEMBRANE ON CONCRETE:** WHEN WATERPROOFING MEMBRANE TO BE APPLIED DIRECTLY TO STRUCTURAL OR LIGHTWEIGHT CONCRETE SUBSTRATE, FleeceBACK OR FleeceBACK AFX MEMBRANE MUST BE USED.
- EPDM SEAMS:** EPDM MEMBRANE SHALL BE SEAMED WITH MINIMUM 3" (76 mm) F.A.T. (FACTORY APPLIED TAPE) AND OVERLAID WITH 6" (152 mm) PRESSURE-SENSITIVE CURED COVER STRIP.
- TPO SEAMS:** SURE-WELD TPO MEMBRANE SEAMS SHALL BE HEAT-WELDED AND OVERLAID WITH 6" (152 mm) TPO PRESSURE-SENSITIVE COVER STRIP.



DEEP (GREATER THAN 8") ROOF GARDEN ASSEMBLY

DETAIL(S) NOT TO SCALE

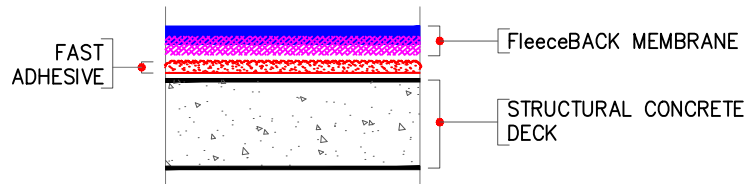
JULY 07, 2010

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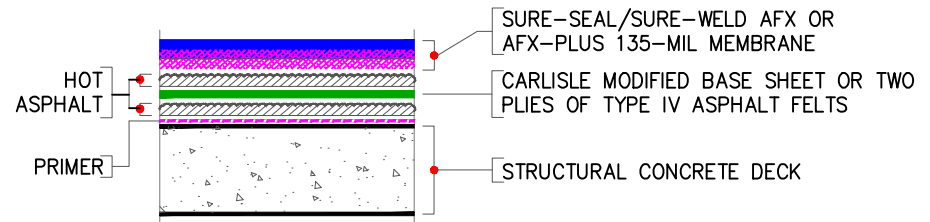


SHEET NO.
RG | **3**
ROOF GARDEN

A MEMBRANE DIRECT TO DECK

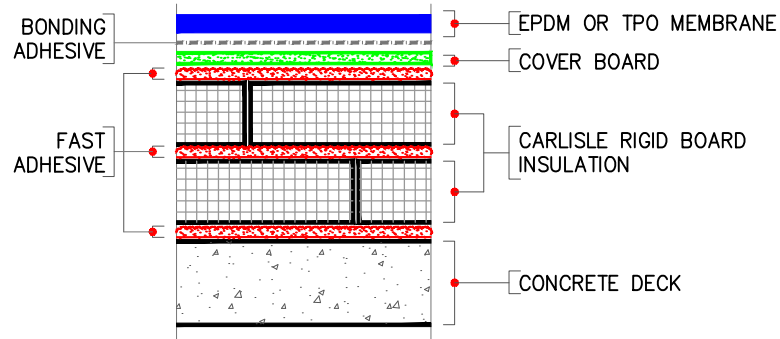


OPTION 1

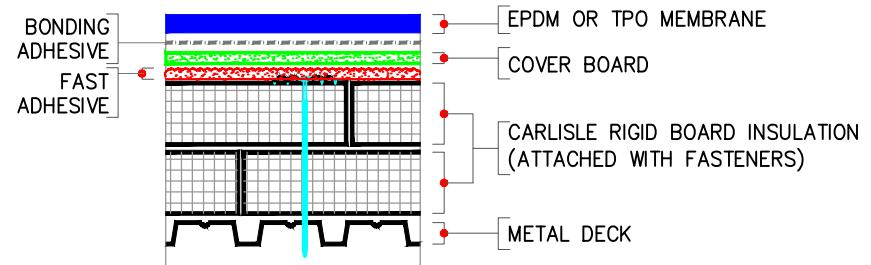


OPTION 2

B INSULATION BELOW MEMBRANE



OPTION 1



OPTION 2

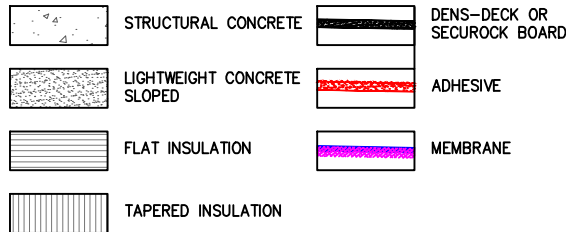
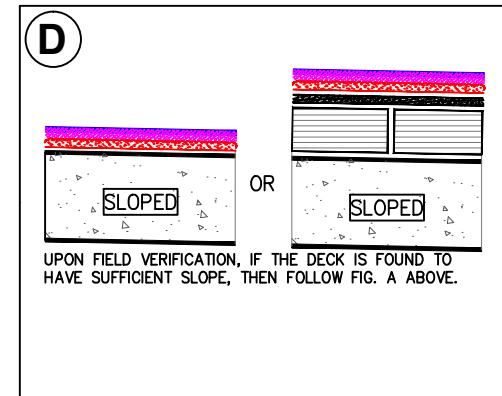
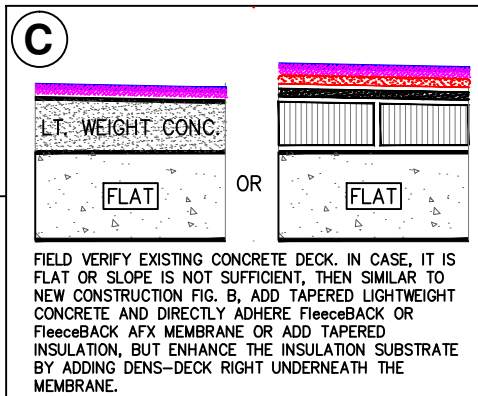
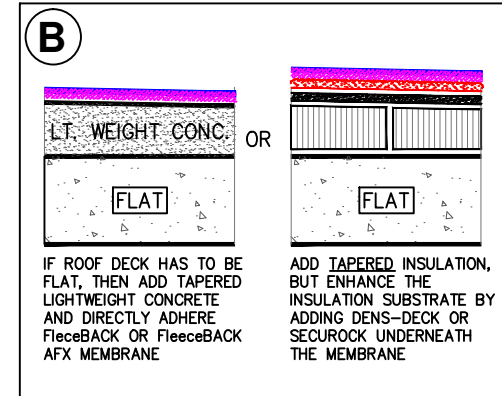
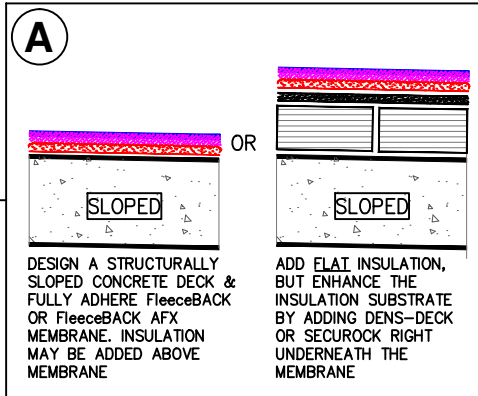
NOTE:
TOP/BOTTOM LAYER OF CARLISLE RIGID BOARD INSULATION SHOULD BE TAPERED OR THE DECK SHALL BE STRUCTURALLY SLOPED IN BOTH OPTIONS.

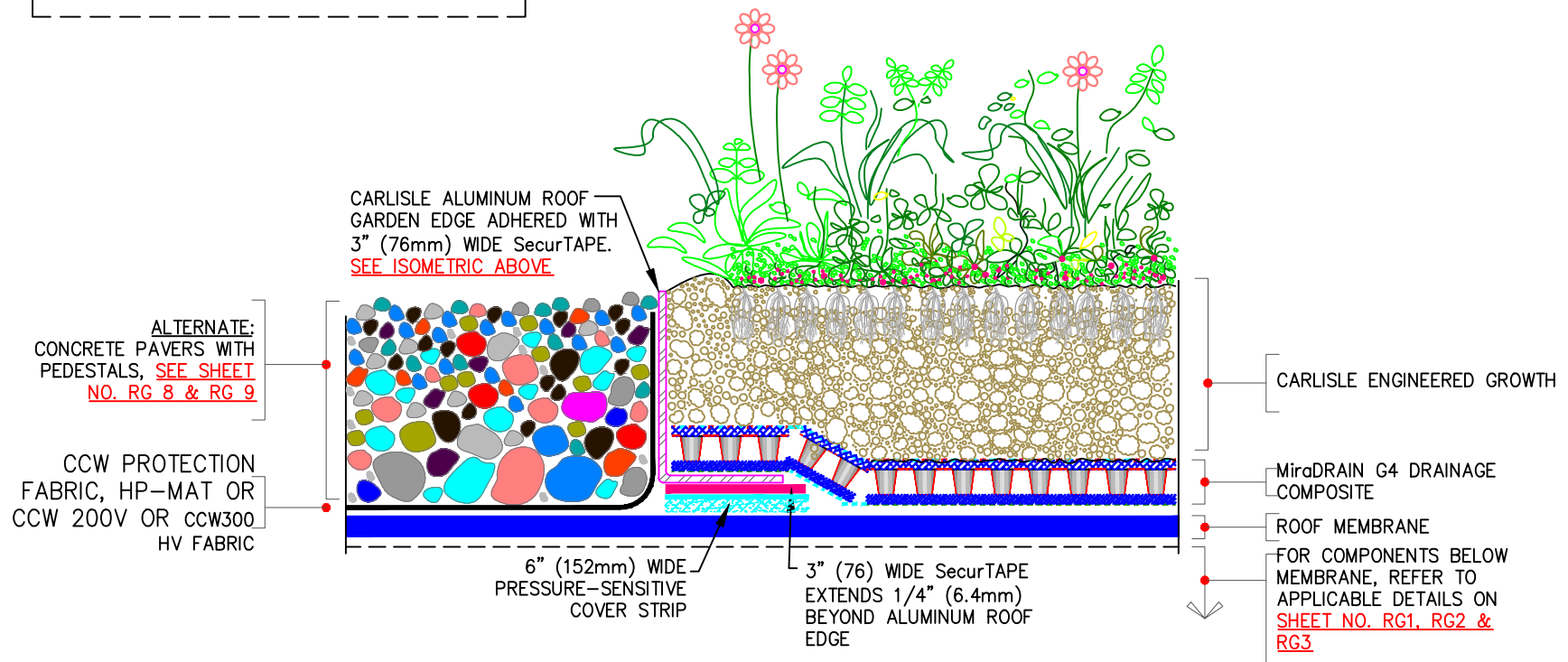
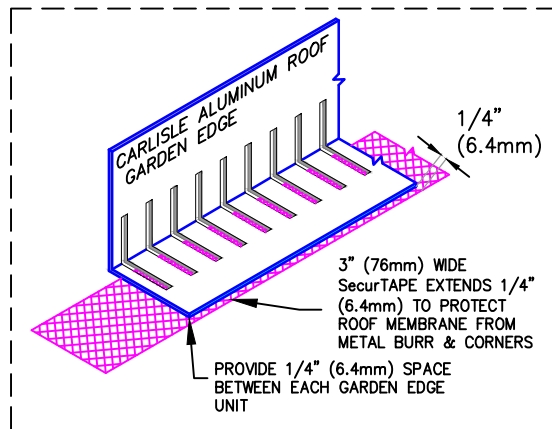


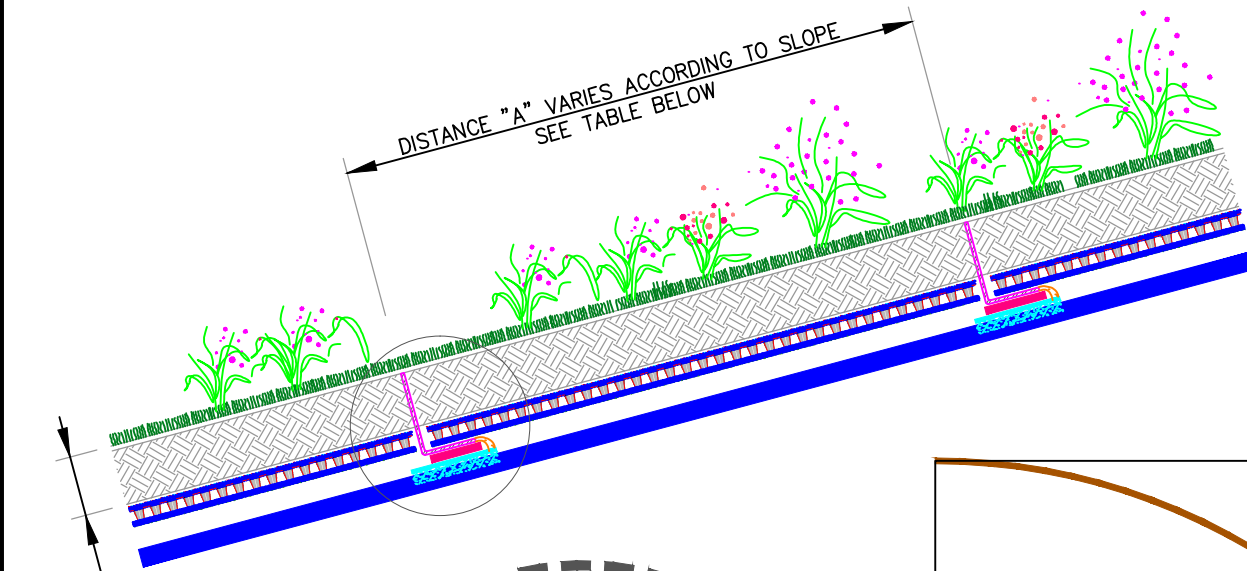
CARLISLE SUGGESTS POSITIVE SLOPE AT MEMBRANE LEVEL. IN RESULT, FLAT OR DEAD-LEVEL DECK IS NOT ACCEPTABLE UNLESS SLOPE IS CREATED. SEE VARIOUS OPTIONS BASED ON NEW CONSTRUCTION OR EXISTING DECKS

NEW
CONSTRUCTION

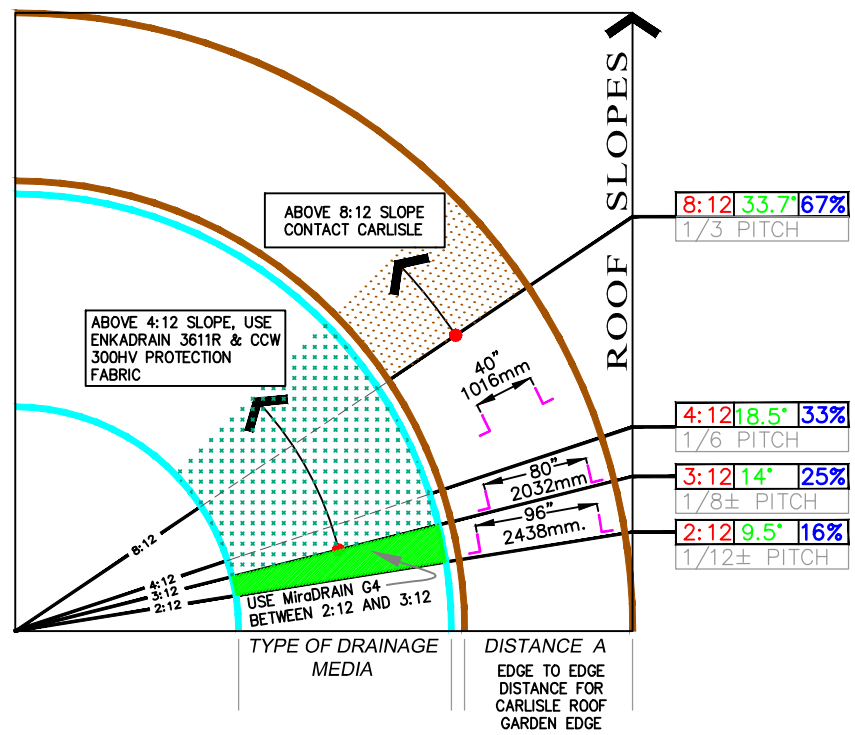
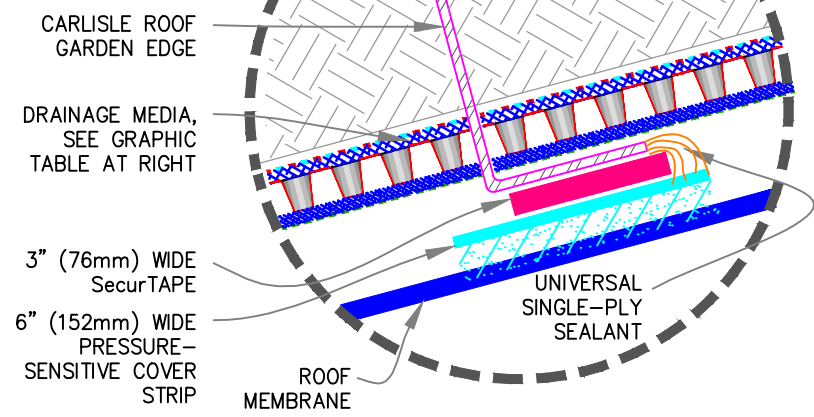
EXISTING DECKS







2.5" - 4"
(63.5-102mm)

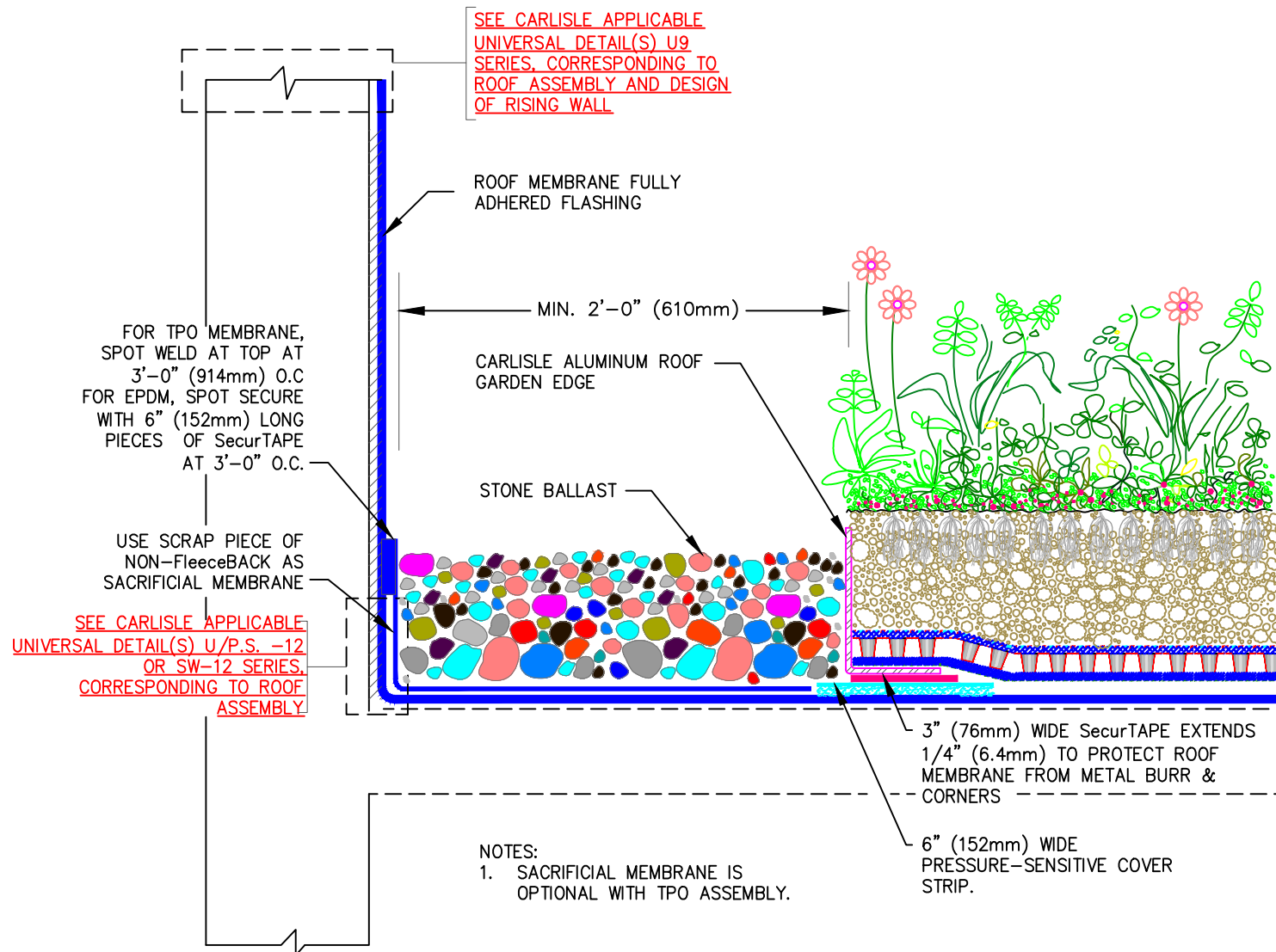


STEEP SLOPE - SHALLOW ASSEMBLY

DETAIL(S) NOT TO SCALE
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SHEET NO.
RG | 6
ROOF GARDEN



SEE CARLISLE APPLICABLE
UNIVERSAL DETAIL(S) U9
SERIES, CORRESPONDING TO
ROOF ASSEMBLY AND DESIGN
OF RISING WALL

ROOF MEMBRANE FULLY
ADHERED FLASHING

MIN. 2'-0" (610mm)

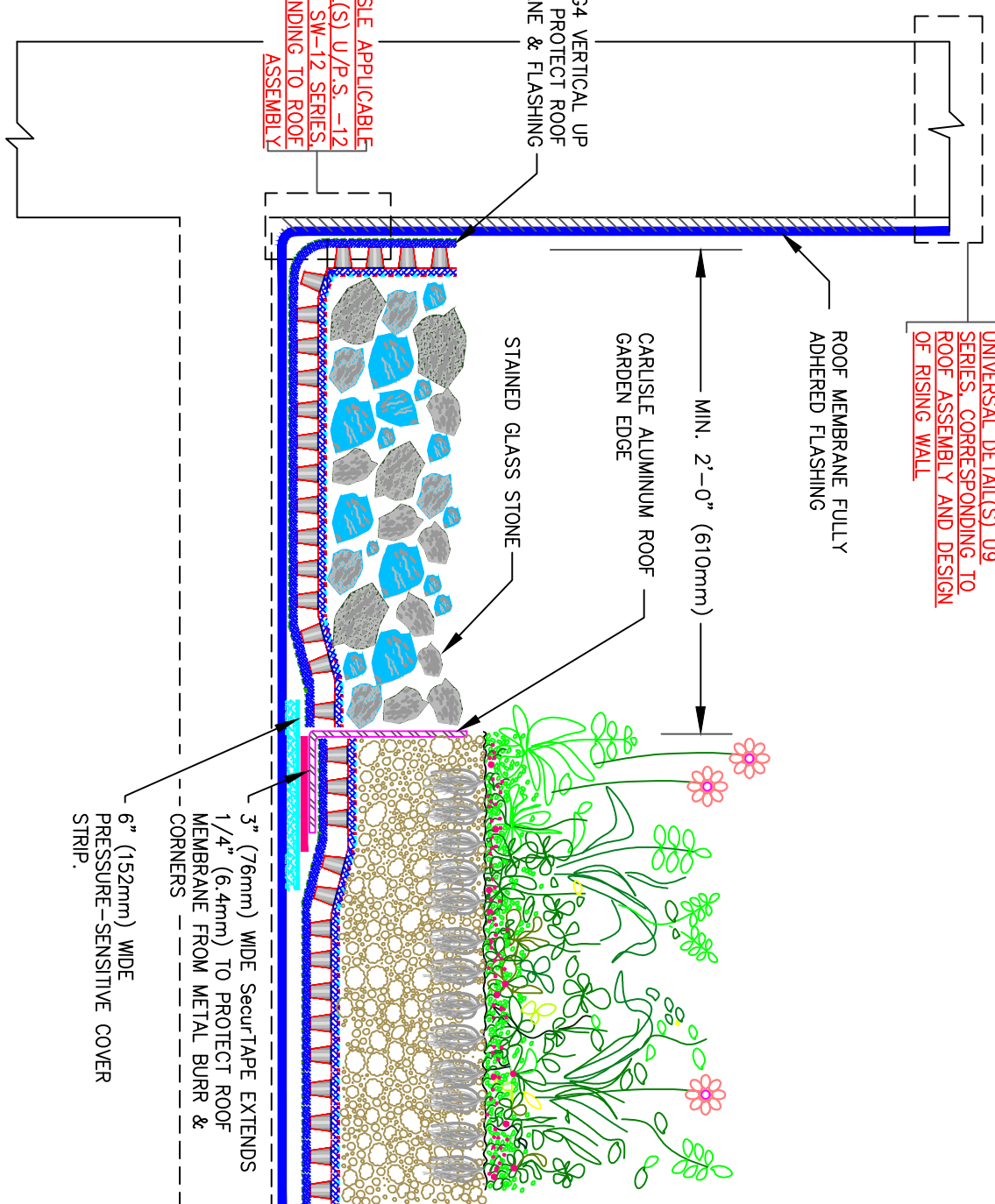
CARLISLE ALUMINUM ROOF
GARDEN EDGE

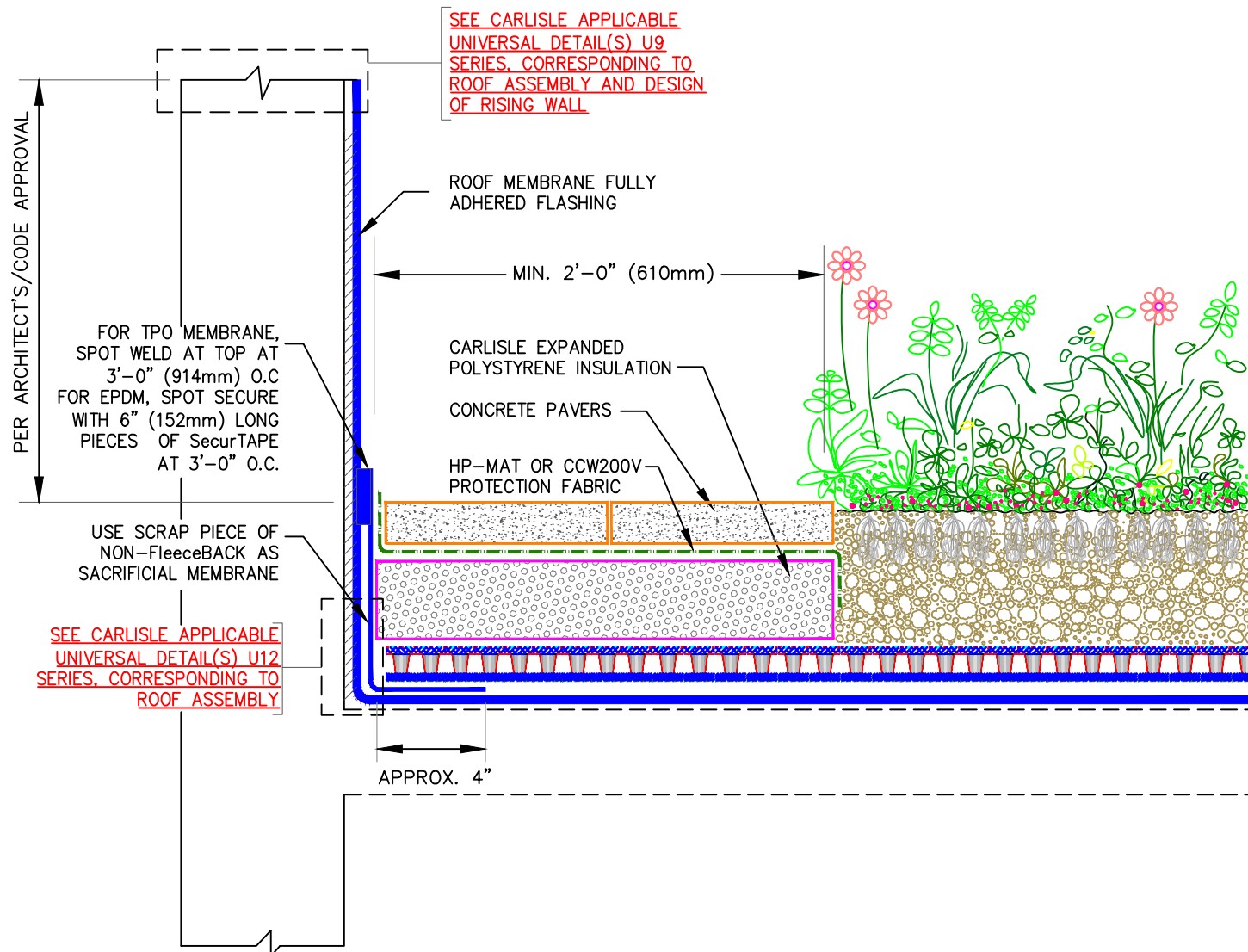
STAINED GLASS STONE

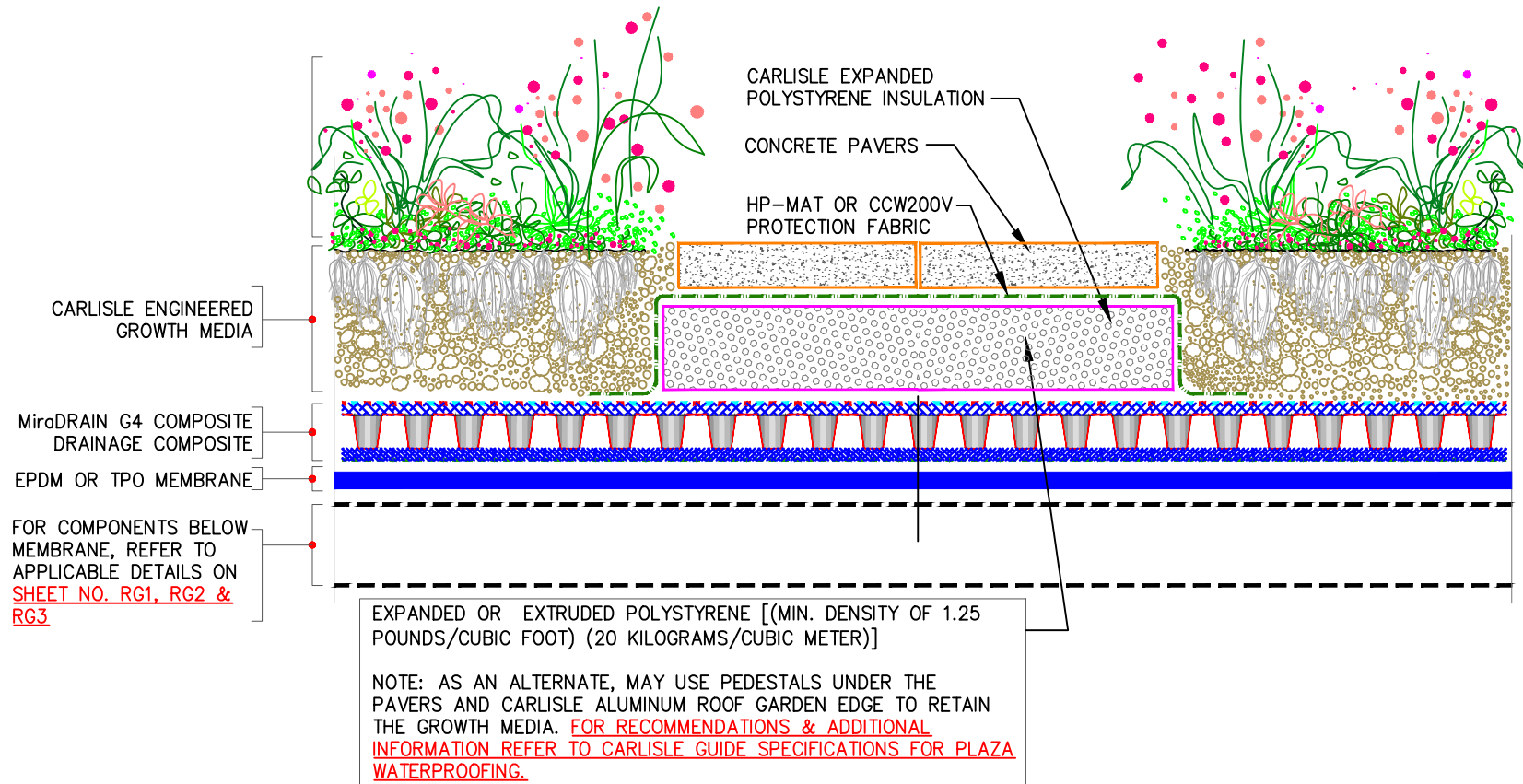
EXTEND G4 VERTICAL UP
TO PROTECT ROOF
MEMBRANE & FLASHING

SEE CARLISLE APPLICABLE
UNIVERSAL DETAIL(S) U/P.S. -12
OR SW-12 SERIES,
CORRESPONDING TO ROOF
ASSEMBLY

3" (76mm) WIDE SecuriTAPE EXTENDS
1/4" (6.4mm) TO PROTECT ROOF
MEMBRANE FROM METAL BURR &
CORNERS
6" (152mm) WIDE
PRESSURE-SENSITIVE COVER
STRIP.

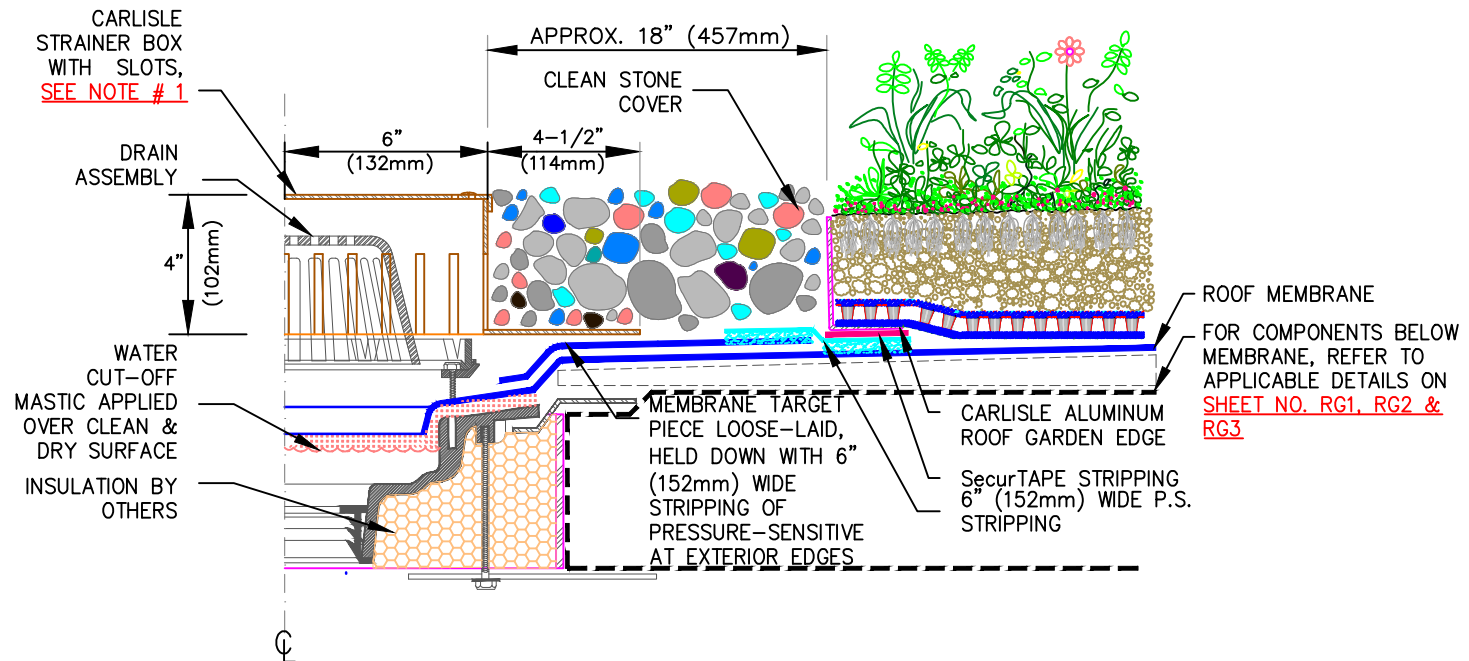






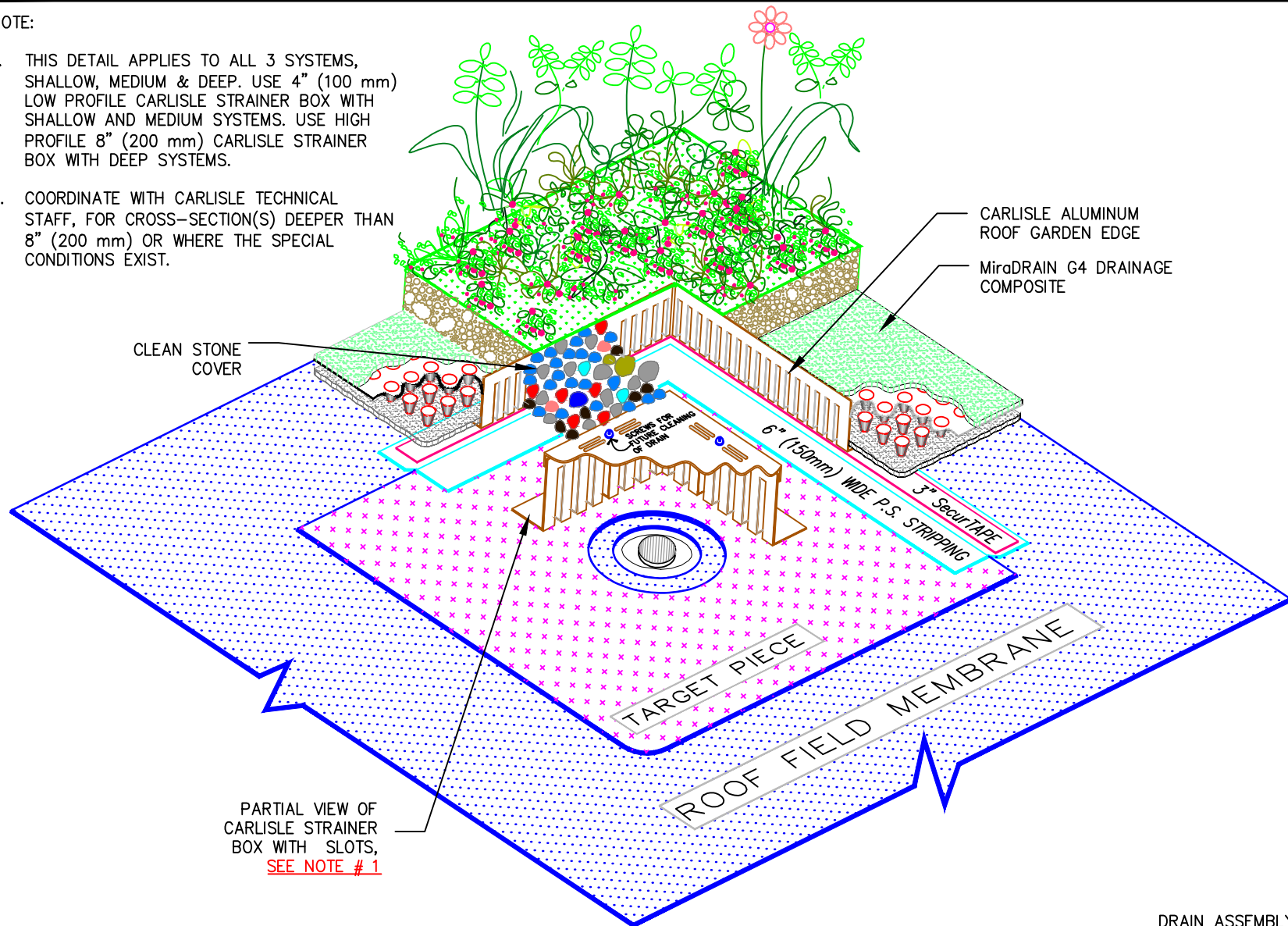
NOTE:

1. THIS DETAIL APPLIES TO ALL 3 SYSTEMS, SHALLOW, MEDIUM & DEEP. USE 4" (100 mm) LOW PROFILE CARLISLE STRAINER BOX WITH SHALLOW AND MEDIUM SYSTEMS. USE HIGH PROFILE 8" (200 mm) CARLISLE STRAINER BOX WITH DEEP SYSTEMS.
2. COORDINATE WITH CARLISLE TECHNICAL STAFF, FOR CROSS-SECTION(S) DEEPER THAN 8" (200 mm) OR WHERE THE SPECIAL CONDITIONS EXIST.



NOTE:

1. THIS DETAIL APPLIES TO ALL 3 SYSTEMS, SHALLOW, MEDIUM & DEEP. USE 4" (100 mm) LOW PROFILE CARLISLE STRAINER BOX WITH SHALLOW AND MEDIUM SYSTEMS. USE HIGH PROFILE 8" (200 mm) CARLISLE STRAINER BOX WITH DEEP SYSTEMS.
2. COORDINATE WITH CARLISLE TECHNICAL STAFF, FOR CROSS-SECTION(S) DEEPER THAN 8" (200 mm) OR WHERE THE SPECIAL CONDITIONS EXIST.



DRAIN ASSEMBLY IS NOT SHOWN FOR CLARITY



ROOF DRAIN DETAIL

DETAIL(S) NOT TO SCALE

JULY 07, 2010

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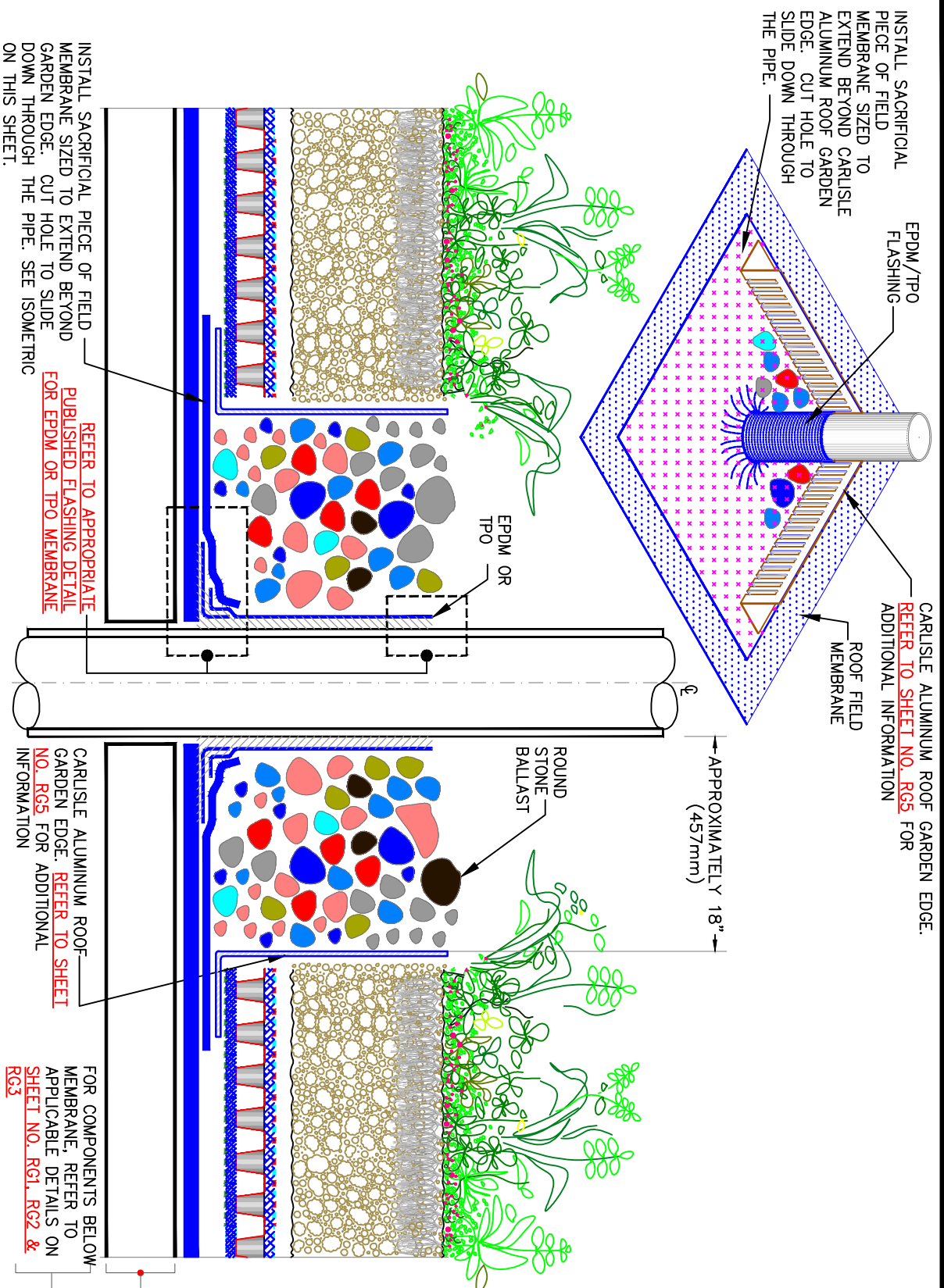
carlislegreen

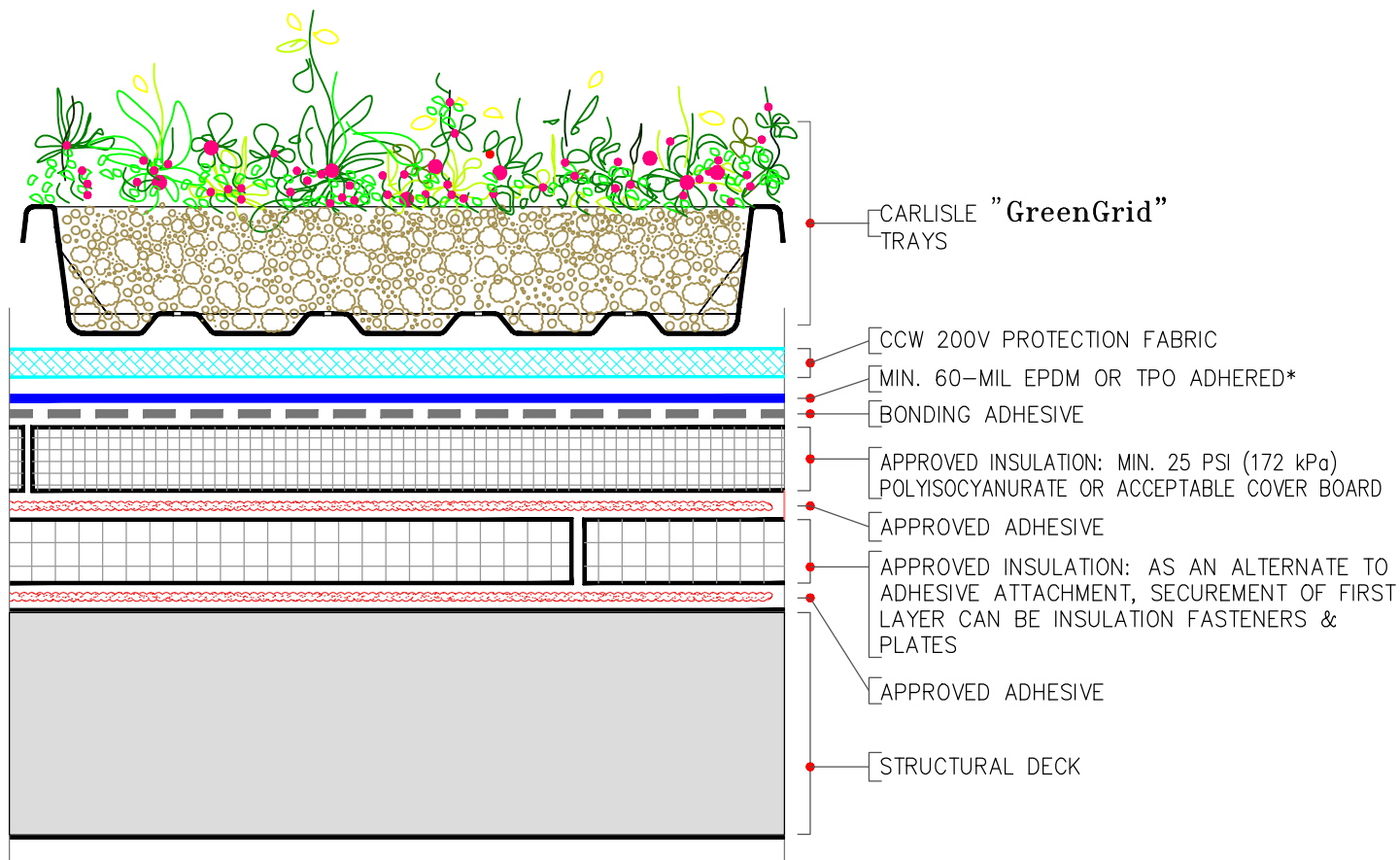
2010 ROOF GARDEN DETAILS

RG | ROOF GARDEN

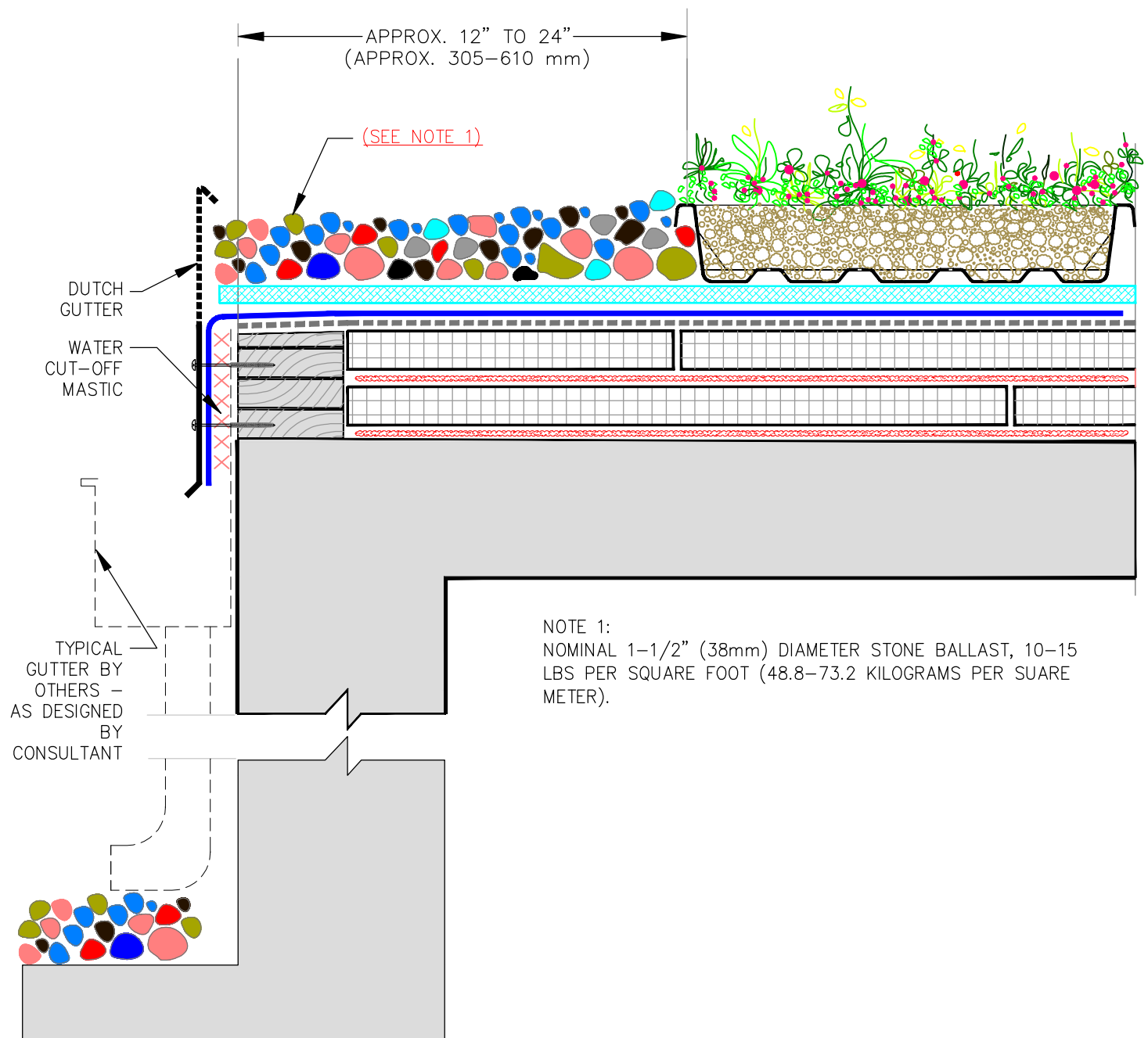
SHEET NO.

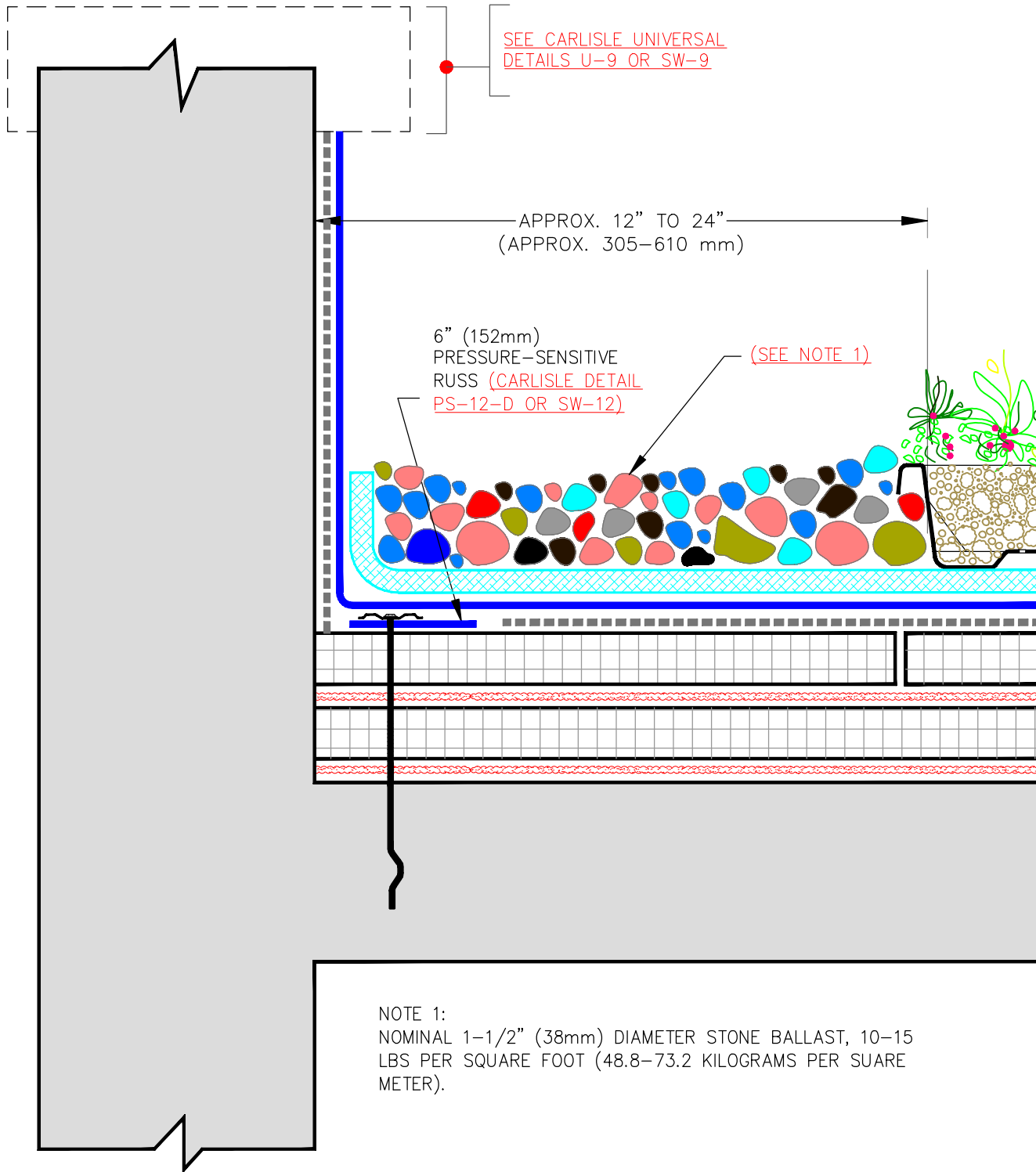
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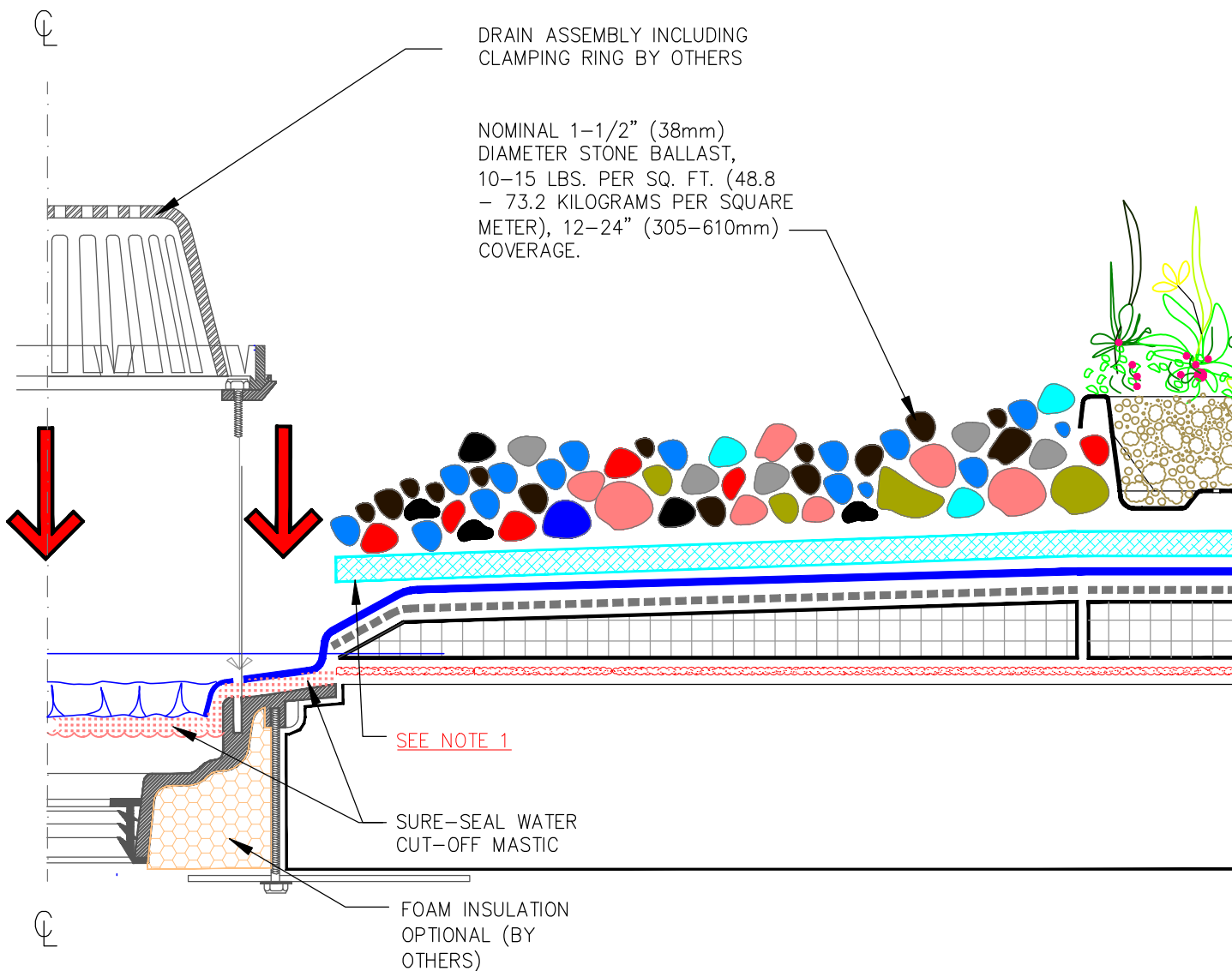




*NOTE:
MEMBRANE THICKNESS IS DEPENDENT UPON WARRANTY LENGTH.
REFER TO "ROOF GARDEN ATTACHMENT" FOR SPECIFIC REQUIREMENTS.

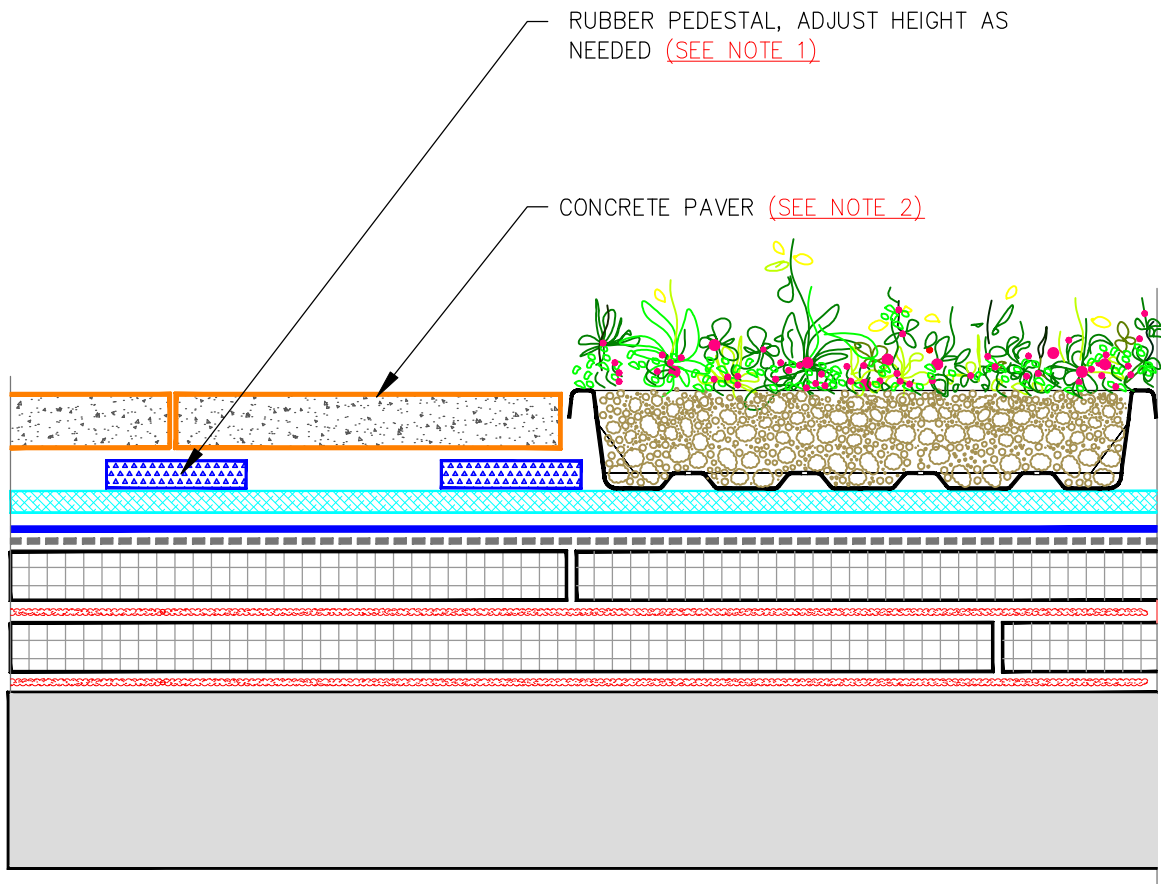






NOTES:

1. STOP CCW 200V PROTECTION FABRIC MAT BASE OF DRAIN.
2. ALL BOLTS OR CLAMPS MUST BE IN PLACE TO PROVIDE CONSTANT COMPRESSION ON WATER CUT-OFF MASTIC.
3. CUT THE MEMBRANE SO IT EXTENDS A MIN. OF 1/2" (13mm) FROM THE ATTACHMENT POINTS OF THE DRAIN CLAMPING RING.
4. HOLE IN MEMBRANE MUST EXCEED THE SIZE OF DRAIN PIPE.
5. ROOF DRAIN SIZE AND NUMBER OF DRAINS SHALL BE IN ACCORDANCE WITH APPLICABLE LOCAL CODES.
6. REMOVE ALL LEAD AND OTHER FLASHING, WHERE EXISTING DRAINS ARE FLASHED.



NOTES:

1. ALTERNATE: EXPANDED OR EXTRUDED POLYSTYRENE BOARDS WITH MINIMUM DENSITY OF 1.25 POUNDS PER CUBIC FOOT (20 KILOGRAMS PER CUBIC METER).
2. ALTERNATE: STONE BALLAST, 10–15 POUNDS PER SQUARE FOOT (48.8 – 73.2 KILOGRAMS PER SQUARE METER)

CARLISLE

MIRA DRAIN G4

FOR ROOF GARDEN APPLICATIONS



Overview

Carlisle's MiraDRAIN G4 Roof Garden Drainage Composite combines filter fabric, moisture retention mat, drainage mat and heavy-duty protection fabric into a single, easy-to-apply product specifically designed for vegetated roofs.

Features & Benefits

- Greatly simplifies Roof Garden installation
- Increased drainage rate and water-holding capacity
- Holds 1.63 pounds of water per square foot (0.2 gallons or 0.32" of rain)
- Moisture retention mat is 100% post-industrial recycled material
- The G4 drainage composite has a high compressive strength that resists crushing and allows a multitude of overburden options to be used.
- 20-year warranty

Installation

1. Roof must pass inspection prior to installation.
2. Roof must be swept free of debris and ambient temperature must be above 32°F. (0°C)
3. Unroll MiraDRAIN G4 and orient green side up. Butt adjacent rolls and overlap using the built-in 6" moisture retention flap.
4. If using gravel, ballast, pavers or other Roof Garden accessories, install these items over MiraDRAIN G4.
5. You are now ready to install growth media.

Roll Size

4' x 50'

Typical Properties and Characteristics

Test	Test Method	Units	Result
Composite			
Thickness	ASTM D1777	in (mm)	1.21 (30.7)
Compressive Strength	ASTM D1621	psf (kN/m ²)	9,500 (455)
Maximum Flow Rate	ASTM D4716	gpm/ft ² (l/min/m)	82 (1,300)
Installed Horizontally	ASTM D4716	gpm/ft ² (l/min/m)	21 (260)
Water Holding Capacity		lbs/ft ² (L/m ²)	1.63 (7.97)
Fabric			
Apparent Opening Size	ASTM D4751	US std. sieve (mm)	100 (0.149)
Flow Rate	ASTM D4491	gpm/ft ² (l/min/m)	75 (3055)
Grab Tensile Strength	ASTM D4632	lbs (Kn)	300 (1.33)
Grab Elongation	ASTM D4632	%	50
Puncture Resistance	ASTM D4833	lbs (Kn)	175 (0.78)

Investing in Roofing Solutions for Over 45 Years

800-4-SYNTEC • P.O. Box 7000 • Carlisle, PA 17013 • Fax: 717-245-7053 • www.carlisle-syntec.com

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Reprint Code: 603806 "Carlisle MiraDRAIN G4 Product Data sheet" 03/13/09 © 2009 Carlisle.



Carlisle SynTec

C A R L I S L E

GROWTH MEDIA

FOR ROOF GARDEN



Overview

Carlisle Growth Media is a blend of carefully selected materials optimized for roof garden use. Designed to be one of the lightest and most effective roof garden growth mediums available, it offers the following advantages over conventional mixes:

Features & Benefits

- Lightweight - Saturated: between 4.8 and 6 pounds psf per inch of depth
- High water holding capability for maximum storm water retention
- Manufactured to strict FLL-compliant standards
- Will not compact once planted and retains its volume after years of use
- No need for moisture retention mat on roof gardens deeper than 6"

Carlisle Growth Media supports all species of plants used on roof gardens with minimal maintenance. For special situations such as a slope exceeding 2:12", contact Carlisle Design Services prior to specifying this material.

Installation

Surface Preparation: Carlisle Growth Media shall be applied over an approved Carlisle Roof Garden Waterproofing Assembly.

Application: Apply Carlisle Growth Media from the super sack bags in which it is supplied. The bags may be lowered to 2'-4' above the rooftop by crane where the bags are carefully slit with a knife or other cutting device. Carlisle Growth Media may be spread to an even depth using an asphalt broom or lute rake. Immediately after Carlisle Growth Media is spread to the desired depth, wet the surface of the product using an irrigation system or by hand-watering.

Precautions

- Carlisle Growth Media should not be applied during windy conditions
- If not used on the day of arrival, Carlisle Growth Media should be stored under a tarp or other cover to prevent direct exposure to sunlight and moisture.

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CARLISLE
Carlisle SynTec

Product Data

Typical Properties & Characteristics

Type	Dry Weight (lbs./cu. ft.)	Wet Weight (lbs./cu. ft.)	Water Retention (lbs./cu. ft.)	Water Retention (gal./cu. ft.)	Water Holding Ability (inches of rain in 4" media)
Extensive East Coast Mix	45	72	27	3.21	1.72"
Extensive West Coast Mix	34	69	35	4.19	2.24"
Extensive Ultra Light Mix	35.5	57.5	22	2.64	1.41"

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Carlisle Growth Media Analysis

Results on dry weight basis unless specified otherwise

Analysis	Units	Result	FLL Reference Values
Particle Size Distribution (See accompanying report)			
< 0.05 mm (FLL reference value based on < 0.06 mm)	mass %	6.2	< 15
Density Measurements			
Bulk Density (dry weight basis)	g/cm ³	0.73	
Bulk Density (dry weight basis)	lb/ft ³	45.75	
Bulk Density (at max. water-holding capacity)	g/cm ³	1.16	
Bulk Density (at max. water-holding capacity)	lb/ft ³	72.52	
Water/ Air Measurements			
Moisture (as received basis)	mass %	13.4	
Total Pore Volume	Vol. %	71.9	
Maximum water-holding Capacity	Vol. %	46.3	> 35
Air-Filled Porosity (at max water-holding capacity)	Vol. %	25.6	> 10
Water permeability (saturated hydraulic conductivity)	cm/s	0.031	> 0.001
Water permeability (saturated hydraulic conductivity)	in/min	0.731	> 0.0236
pH and Salt Content			
pH (CaCl ₂)		6.6	6.5 - 8.0
Soluble salts (water, 1:10, m:v)	mmhos/cm	0.10	
Soluble salts (water, 1:10, m:v) Organic	g (KCl)/L	0.47	< 3.5
Measurements			
Organic matter content Nutrients	mass %	5.2	< 8.0
Phosphorus, P205 (CAL)	mg/L	26.5	< 200
Potassium, K ₂ O (CAL)	mg/L	192.4	< 700
Magnesium, Mg (CaCl ₂)	mg/L	40.6	< 160
Nitrate + Ammonium (CaCl ₂)	mg/L	6.3	< 80

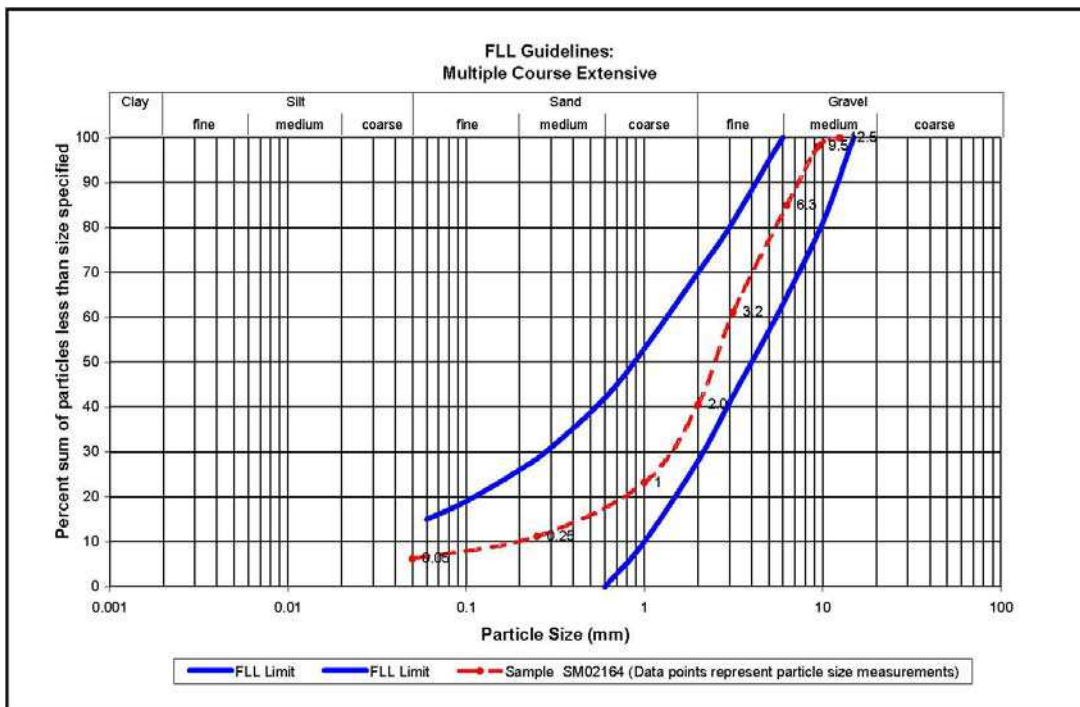
¹ Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (FLL). 2002. Guidelines for the Planning Execution and Upkeep of Green-Roof Sites

Carlisle Growth Media Analysis

Green Roof Media Particle Size Distribution

Particle Size Analysis		Sum of particles less than size specified			
Diameter -mm-	%	Diameter -mm-	Diameter -in-	Sieve size	% sum of particles
< 0.002	1.3	< 0.002	---	---	1.3
0.002-0.05	4.9	< 0.05	---	---	6.2
0.05-0.25	5.0	< 0.25	0.0098	60 mesh	11.2
0.25-1.0	12.1	< 1.0	0.0394	18 mesh	23.2
1.0-2.0	17.3	< 2.0	0.0787	10 mesh	40.5
2.0-3.2	20.6	< 3.2	0.125	1/8 inch	61.1
3.2-6.3	23.8	< 6.3	0.250	1/4 inch	84.9
6.3-9.5	13.2	< 9.5	0.375	3/8 inch	98.1
9.5-12.5	1.9	< 12.5	0.500	1/2 inch	100.0
> 12.5	0.0				

1 FLL Particle Size Distribution Graph for Multiple Course Extensive Systems



Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (FLL). 2002.

Guidelines for the Planning Execution and Upkeep of Green-Roof Sites

Carlisle Intensive Growth Media Analysis

Results on a dry weight basis unless specified otherwise

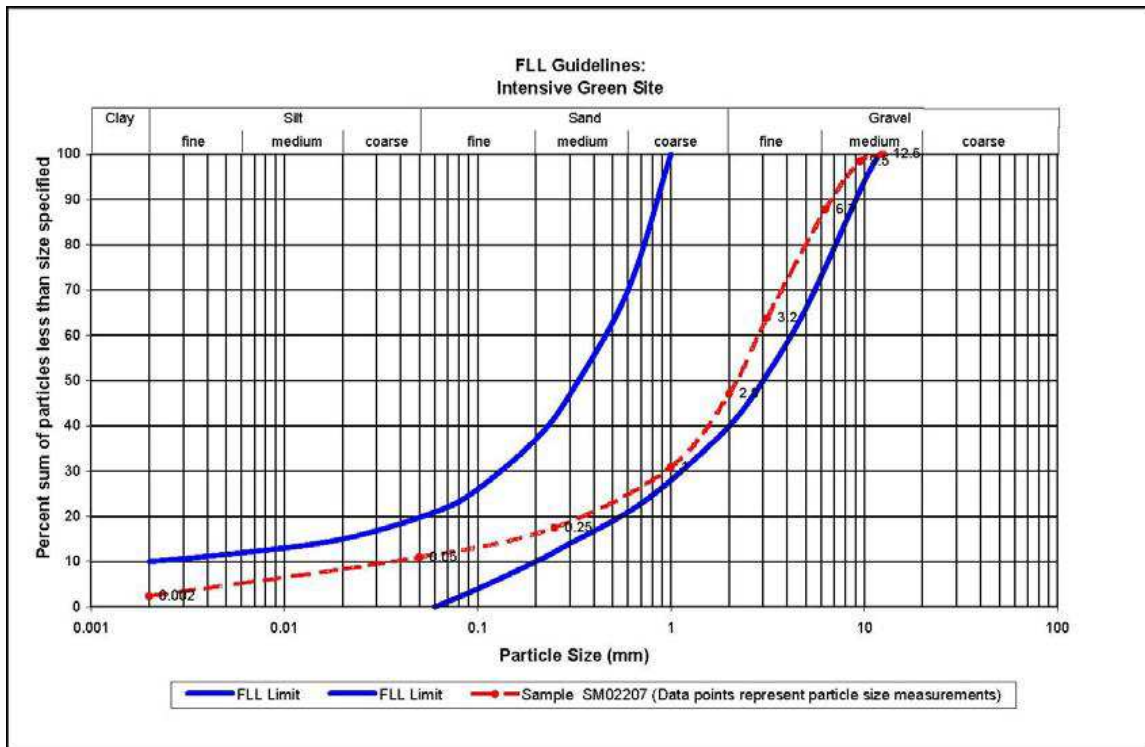
Analysis	Units	Result	FLL Reference Values
Particle Size Distribution (See accompanying report)			
< 0.05 mm (FLL ¹ reference value based on < 0.06 mm)	mass %	11.0	< 20
Density Measurements			
Bulk Density (dry weight basis)	g/cm ³	0.67	
Bulk Density (dry weight basis)	lb/ft ³	41.64	
Bulk Density (at max. water-holding capacity)	g/cm ³	1.19	
Bulk Density (at max. water-holding capacity)	lb/ft ³	74.41	
Water/Air Measurements			
Moisture (as received basis)	mass %	16.9	
Total Pore Volume	Vol. %	74.1	
Maximum water-holding Capacity	Vol. %	53.2	> 45
Air-Filled Porosity (at max water-holding capacity)	Vol. %	20.9	> 10
Water permeability (saturated hydraulic conductivity)	cm/s	0.02	> 0.005
Water permeability (saturated hydraulic conductivity)	in/min	0.38	> 0.0118
pH and Salt Content			
pH (CaCl ₂)		6.1	5.5 - 8.0
Soluble salts (water, 1:10, m:v)	mmhos/cm	0.25	
Soluble salts (water, 1:10, m:v)	g (KCl)/L	1.07	< 2.5
Organic Measurements			
Organic matter content	mass %	9.3	< 12.0
Nutrients			
Phosphorus, P ₂₀₅ (CAL)	mg/L	85.0	< 200
Potassium, K ₂ O (CAL)	mg/L	471.0	< 700
Magnesium, Mg (CaCl ₂)	mg/L	85.1	< 160
Nitrate + Ammonium (CaCl ₂)	mg/L	5.7	< 80

¹Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (FLL)
Guidelines for the Planning, Execution and Upkeep of Green-Roof Sites

Green Roof Media Particle Size Distribution

Particle Size Analysis		Sum of particles less than size specified			
Diameter -mm-	%	Diameter -mm-	Diameter -in-	Sieve size	% sum of particles
< 0.002	2.4	< 0.002	---	---	2.4
0.002-0.05	8.6	< 0.05	---	---	11.0
0.05-0.25	6.5	< 0.25	0.0098	60 mesh	17.5
0.25-1.0	13.4	< 1.0	0.0394	18 mesh	30.9
1.0-2.0	16.2	< 2.0	0.0787	10 mesh	47.1
2.0-3.2	16.8	< 3.2	0.125	1/8 inch	63.9
3.2-6.3	23.9	< 6.3	0.250	1/4 inch	87.8
6.3-9.5	10.6	< 9.5	0.375	3/8 inch	98.4
9.5-12.5	1.6	< 12.5	0.500	1/2 inch	100.0
> 12.5	0.0				

FLL¹ Particle Size Distribution Graph for Intensive Systems



¹ Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (FLL). 2007.
Guidelines for the Planning Execution and Upkeep of Green-Roof Sites

Carlisle Pacific/LAC Extensive Growth Media Analysis

Results on a dry weight basis unless specified otherwise

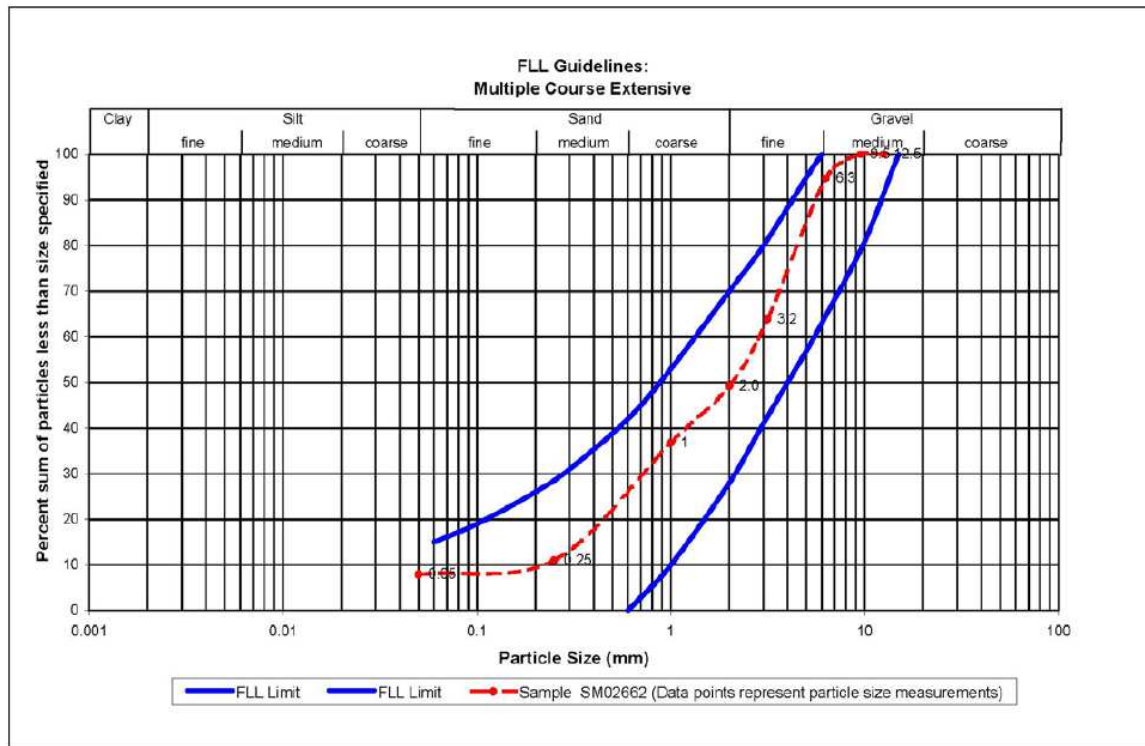
Analysis	Units	Result	FLL Reference Values
Particle Size Distribution (See accompanying report)			
< 0.05 mm (FLL ¹ reference value based on < 0.06 mm)	mass %	7.9	< 15
Density Measurements			
Bulk Density (dry weight basis)	g/cm ³	0.54	
Bulk Density (dry weight basis)	lb/ft ³	34.02	
Bulk Density (at max. water-holding capacity)	g/cm ³	1.11	
Bulk Density (at max. water-holding capacity)	lb/ft ³	69.32	
Water/Air Measurements			
Moisture (as received basis)	mass %	32.2	
Total Pore Volume	Vol. %	73.4	
Maximum water-holding Capacity	Vol. %	57.4	> 35
Air-Filled Porosity (at max water-holding capacity)	Vol. %	16.0	> 10
Water permeability (saturated hydraulic conductivity)	cm/s	0.063	> 0.001
Water permeability (saturated hydraulic conductivity)	in/min	1.485	> 0.0236
pH and Salt Content			
pH (CaCl ₂)		6.7	6.5 - 8.0
Soluble salts (water, 1:10, m:v)	mmhos/cm	0.23	
Soluble salts (water, 1:10, m:v)	g (KCl)/L	0.96	< 3.5
Organic Measurements			
Organic matter content	mass %	7.2	< 8.0
Nutrients			
Phosphorus, P ₂₀₅ (CAL)	mg/L	165.5	< 200
Potassium, K ₂ O (CAL)	mg/L	532.1	< 700
Magnesium, Mg (CaCl ₂)	mg/L	79.8	< 160
Nitrate + Ammonium (CaCl ₂)	mg/L	7.4	< 80

¹ ¹Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (FLL).
Guidelines for the Planning, Execution and Upkeep of Green-Roof Sites

Green Roof Media Particle Size Distribution

Particle Size Analysis		Sum of particles less than size specified			
Diameter -mm-	%	Diameter -mm-	Diameter -in-	Sieve size	% sum of particles
< 0.002	2.5	< 0.002	---	---	2.5
0.002-0.05	5.4	< 0.05	---	---	7.9
0.05-0.25	3.1	< 0.25	0.0098	60 mesh	11.0
0.25-1.0	25.8	< 1.0	0.0394	18 mesh	36.8
1.0-2.0	12.4	< 2.0	0.0787	10 mesh	49.2
2.0-3.2	14.7	< 3.2	0.125	1/8 inch	63.9
3.2-6.3	30.9	< 6.3	0.250	1/4 inch	94.8
6.3-9.5	5.2	< 9.5	0.375	3/8 inch	100.0
9.5-12.5	0.0	< 12.5	0.500	1/2 inch	100.0
> 12.5	0.0				

FLL² Particle Size Distribution Graph for Extensive Systems



² Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (FLL). 2007.
Guidelines for the Planning Execution and Upkeep of Green-Roof Sites

Carlisle Ultra-Light Extensive Growth Media Analysis

Results on a dry weight basis unless specified otherwise

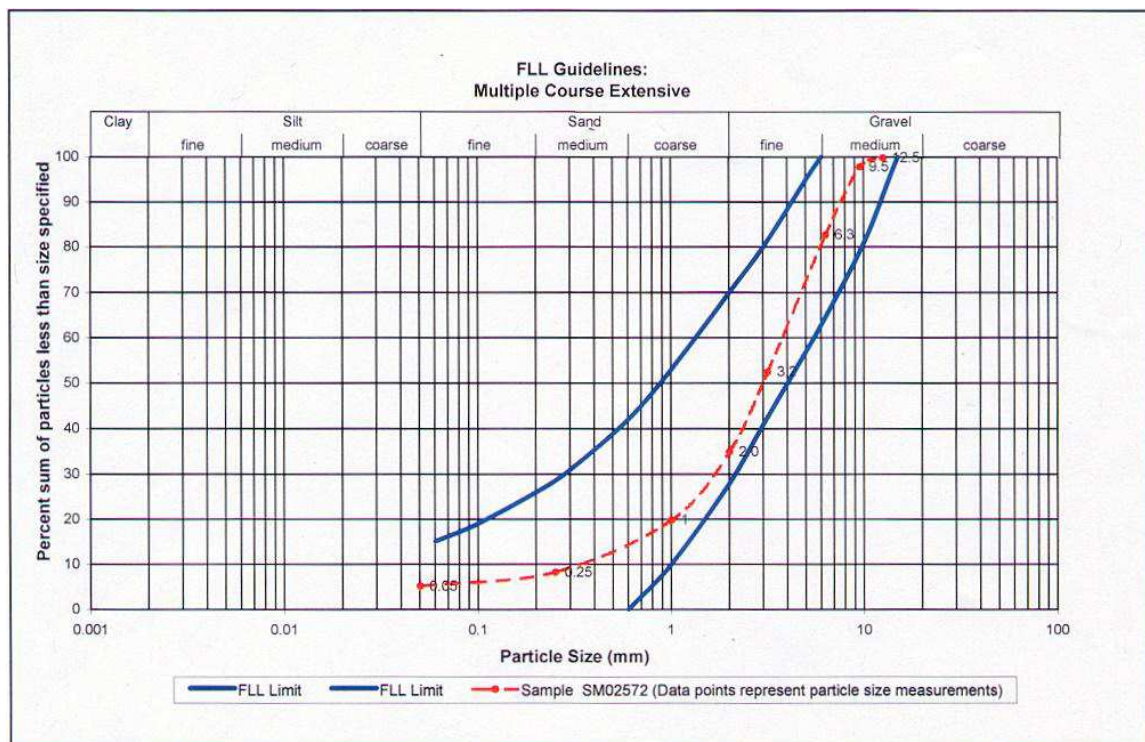
Analysis	Units	Result	FLL Reference Values
Particle Size Distribution (See accompanying report)			
< 0.05 mm (FLL ¹ reference value based on < 0.06 mm)	mass %	5.1	< 15
Density Measurements			
Bulk Density (dry weight basis)	g/cm3	0.57	
Bulk Density (dry weight basis)	lb/ft3	35.81	
Bulk Density (at max. water-holding capacity)	g/cm3	0.92	
Bulk Density (at max. water-holding capacity)	lb/ft3	57.53	
Water/Air Measurements			
Moisture (as received basis)	mass %	12.7	
Total Pore Volume	Vol. %	78.0	
Maximum water-holding Capacity	Vol. %	37.0	> 35
Air-Filled Porosity (at max water-holding capacity)	Vol. %	41.0	> 10
Water permeability (saturated hydraulic conductivity)	cm/s	>0.483	> 0.001
Water permeability (saturated hydraulic conductivity)	in/min	>11.419	> 0.0236
pH and Salt Content			
pH (CaCl2)		7.4	6.5 - 8.0
Soluble salts (water, 1:10, m:v)	mmhos/cm	0.37	
Soluble salts (water, 1:10, m:v)	g (KCl)/L	1.31	< 3.5
Organic Measurements			
Organic matter content	mass %	7.0	< 8.0
Nutrients			
Phosphorus, P205 (CAL)	mg/L	85.0	< 200
Potassium, K2O (CAL)	mg/L	471.0	< 700
Magnesium, Mg (CaCl2)	mg/L	85.1	< 160
Nitrate + Ammonium (CaCl2)	mg/L	5.7	< 80

¹ ¹Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (FLL).
Guidelines for the Planning, Execution and Upkeep of Green-Roof Sites

Green Roof Media Particle Size Distribution

Particle Size Analysis		Sum of particles less than size specified			
Diameter -mm-	%	Diameter -mm-	Diameter -in-	Sieve size	% sum of particles
< 0.002	1.9	< 0.002	---	---	1.9
0.002-0.05	3.2	< 0.05	---	---	5.1
0.05-0.25	3.1	< 0.25	0.0098	60 mesh	8.2
0.25-1.0	11.6	< 1.0	0.0394	18 mesh	19.8
1.0-2.0	15.1	< 2.0	0.0787	10 mesh	34.9
2.0-3.2	17.5	< 3.2	0.125	1/8 inch	52.4
3.2-6.3	30.3	< 6.3	0.250	1/4 inch	82.7
6.3-9.5	15.1	< 9.5	0.375	3/8 inch	97.8
9.5-12.5	2.0	< 12.5	0.500	1/2 inch	99.8
> 12.5	0.2				

FLL² Particle Size Distribution Graph for Extensive Systems



² Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (FLL). 2007.
Guidelines for the Planning Execution and Upkeep of Green-Roof Sites

CCW 200V/300HV Protection Fabrics**GENERAL:**

CCW 200V (12 oz./yd.²) and 300HV (16 oz./yd.²) Protection Fabrics are extremely tough non-woven polypropylene fabrics designed for use as protection courses over Carlisle Roof Garden Waterproofing membranes and as filter fabrics used in conjunction with drainage gravel in “deep” garden assemblies. They exhibit excellent puncture strength, and protect the waterproofing membrane from damage by construction traffic and debris. The lightweight 4’ by 50’ panels are supplied in roll form to allow fast, cost-efficient installation, and the polypropylene construction makes these fabrics naturally resistant to acids, alkalis, and biological degradation. CCW protection fabrics may be left exposed to the sun for up to 30 days without ill effect.

TYPICAL PROPERTIES AND CHARACTERISTICS:

Property	Test Method	Unit	Typical Value	
			200V	300HV
Puncture Resistance	ASTM D 4833	lbs (kN)	130 (0.58)	235 (1.05)
Mullen Burst	ASTM D 3786	psi (kPa)	400 (2,756)	750 (5167)
Elongation	ASTM D 4682	%	50	50
Thickness	ASTM D 5199	mils (mm)	90 (2.3)	150 (3.8)

PACKAGING:

200V - 12.5' x 200' (3.81m x 61m) 140 lbs (63 kg)

300HV - 12.5' x 200' (3.81m x 61m) 195 lbs (90 kg)

CAUTIONS AND WARNINGS:

- CCW 200V/300HV must not be permanently exposed to sunlight. Limit exposure to no more than 30 days prior to covering.
- Materials damaged during installation must be removed and replaced prior to covering.
- Use proper stacking procedures to ensure sufficient stability of the materials.

INSTALLATION:

- Unroll CCW 200V or 300HV Protection Fabric with a minimum two-inch side and end overlap.
- Under windy conditions, secure Protection Fabric with overburden or use CCW DRAIN GRIPTM construction adhesive.
- For best results, proceed with placement of designated cover material as soon as possible.

Refer to Carlisle’s Roof Garden Waterproofing System Specification for specific usage requirements.

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DRAIN GRIP is a Trademark of Carlisle Coatings and Waterproofing.

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02/04



CARLISLE'S **GeoMembrane**

TECHNICAL DATA BULLETIN

CARLISLE SYNTEC INCORPORATED

CARLISLE NON-REINFORCED POLYPROPYLENE GEOMEMBRANE™

Carlisle Non-Reinforced Polypropylene GeoMembrane is a heat-weldable non-reinforced sheet designed for liners in potable water and industrial containment applications. The membrane is specifically formulated for long-term use in buried or exposed geomembrane applications. The membrane is based on a UV-stabilized polypropylene copolymer, which does not require either polymeric or liquid plasticizers to maintain flexibility.

Physical properties of the membrane are enhanced by the high tensile, elongation, and tear resistance of the reactor grade polypropylene base resin. The smooth surface of Carlisle's GeoMembrane facilitates production of a total surface fusion weld that creates a consistent, watertight monolithic sheet.

FEATURES:

- Outstanding heat seamability
- Superb extensibility / elongation
- Plasticizer and chlorine free
- Excellent low temperature impact resistance
- Excellent chemical and environmental stress-cracking resistance
- Exceptional resistance to solar UV, ozone, and oxidation
- Low water vapor permeance and water absorption
- Hot melt extrusion processed (not calendared) for very low machine induced shrinkage
- ANSI/NSF-61 Drinking Water contact certification (Potable Grade)

Carlisle's Non-Reinforced Polypropylene GeoMembrane is manufactured in two grades; Potable (water) Grade and Industrial Grade. The Potable Grade was tested by NSF International and meets the requirements of ANSI / NSF Standard 61 for Drinking Water System Components – Health Effects.

Available colors are black, tan and white (black bottom ply) in 40-mil and 60-mil thicknesses. Special colors are available on request. Standard roll sizes are 12 ft wide by 600 ft in 40-mil and 12 ft wide by 400 ft in 60-mil.

TYPICAL PROPERTIES AND CHARACTERISTICS:

See table that is attached.

Typical weights are 0.21 lb/ft² (1.03 kg/m²) for 45-mil and 0.30 lb/ft² (1.42 kg/m²) for 60-mil membrane.

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CARLISLE NON-REINFORCED POLYPROPYLENE GEOMEMBRANE

TYPICAL PROPERTIES AND CHARACTERISTICS

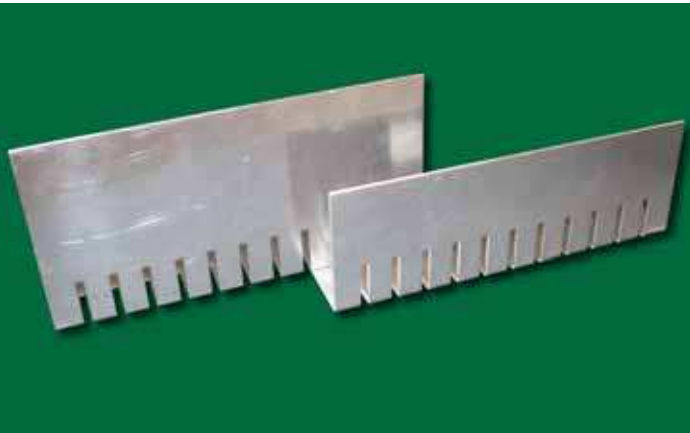
Physical Property	Test Method	Property Of Unaged Sheet	Property After Aging 30 days @ 185 °F
Tolerance on nominal thickness, %	ASTM D 5199	± 10	
Mass per unit area, lb/ft ² (g/ ft ²) (kg/m ²) 40-mil 60-mil	ASTM D 5261	0.21 (95) (1.03) typical 0.30 (136) (1.46) typical	
Tensile strength, lbf (kN)	ASTM D 638 Dumbbell IV	72 (12.6) min. 96 (16.8) typical	72 (12.6) min. 96 (16.8) typical
Tensile elongation, %	ASTM D 638	700 min. 750 typical	700 min. 750 typical
Tear resistance, lbf (N)	ASTM D 1004	12 (53.3) min. 18 (80.0) typical	12 (53.3) min. 18 (80.0) typical
Low temperature flexibility, °F (°C)	ASTM D 2136 1/8 in. mandrel 4 hour @ temp.	- 40 (- 40) max. - 50 (- 46) typical	
Linear Dimensional Change (shrinkage), %	ASTM D 1204		+/- 1.0 max. - 0.5 typical
Ozone resistance, 100 pphm, 168 hours	ASTM D 1149	No cracks	No cracks
Carbon Black content, % (Black membrane only)	ASTM D 4218	2 min. 2.75 typical	
Resistance to water (distilled) absorption After 30 days immersion 122 °F (50 °C) Change in mass, %	ASTM D 471	1.0 max. 0.5 typical	
Field seam strength, lbf/in. (kN/m) Seam tested in peel after weld	ASTM D 1876	Cannot separate weld (breaks outside weld)	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, lbf (N)	ASTM D 4833	30 (133) min. 40 (178) typical	30 (133) min. 40 (178) typical
Resistance to xenon-arc weathering ¹ Xenon-Arc, 10,080 kJ/m ² total radiant exposure, visual condition at 10X	ASTM G 155 0.70 W/m ² 80 °C B.P.T.	No cracks No loss of breaking or tearing strength	

¹ Approximately equivalent to 8000 hours exposure at 0.35 W/m² irradiance

C A R L I S L E

ALUMINUM EDGE

FOR ROOF GARDEN APPLICATIONS



Overview

Carlisle's Aluminum Roof Garden Edge is made from .080 gauge aluminum bent to 3"x 4" or 6"x 8" in height and is supplied in 10' lengths. This metal edge is pre-punched for maximum drainage while holding the roof garden soil in place.

Features & Benefits

- Excellent growth media retention
- Allows maximum drainage
- Two edge heights in one product (3"x4" or 6"x8")
- Will not rust or corrode
- Extremely Durable

Installation

Carlisle Aluminum Roof Garden Edge shall be installed over the protection fabric layer of the roof garden assembly.

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C A R L I S L E

ALUMINUM DRAIN BOX

FOR ROOF GARDEN APPLICATIONS



Overview

Carlisle's Aluminum Roof Garden Drain Box is made from .125 gauge aluminum and is available in 4" or 8" heights and is pre-punched for maximum drainage.

Features & Benefits

- Allows maximum drainage
- Available in 4" and 8" heights
- Will not rust or corrode
- Extremely Durable

Installation

Carlisle Aluminum Roof Garden Drain Box shall be installed over the protection fabric layer of the roof garden assembly.

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CARLISLE'S **VEGETATED SEDUM TILES** FOR ROOF GARDEN APPLICATIONS



Overview

Carlisle's Vegetated Sedum Tiles are the fastest and easiest way to achieve full vegetative coverage on a Roof Garden during the day of installation. These lush and vibrant tiles are the perfect way of quickly finishing your Roof Garden project.

Features and Benefits

- Instantaneous vegetative coverage
- No waiting for plants to "grow in"
- Up to 12 different varieties of sedum can be used
- All but eliminates plant maintenance
- Further simplifies Roof Garden installation

Installation

Remove the tiles from the plastic trays. Place the tiles over a minimum 2.5" of Carlisle growth media. Water the Roof Garden assembly to the point of runoff. Your Roof Garden is now fully vegetated!

Size & Coverage Rate

- 1.4 square feet per tile
- 10" Wide x 20.2" long
- 4.5 lbs/sf fully saturated
- Minimum 95% vegetative coverage

CARLISLE'S VEGETATED SEDUM TILES FOR ROOF GARDEN APPLICATIONS



All Season Mix

This mix provides flowers throughout the whole growing season. Winter interest and seasonal foliage color changes are also found in this group. This is a good, general purpose mix that provides year-round beauty. Each tile includes 6–8 of the listed varieties.



Color Max Mix

Color Max includes a blend of sedums for use when maximum color is desired. This comes in the form of brightly colored foliage, flowers in abundance, and colors that blend together well. Each tile includes 6–8 of the listed varieties.



Shade Mix

The plants in Shade Mix are those that have demonstrated abilities to withstand the difficult conditions of shade. All sedums do best in higher light, but this group tolerates low-light better than most. Each tile includes 6–8 of the listed varieties.



Tuff Stuff Mix

The sedums in Tuff Stuff are the toughest, most durable, most drought resistant choices available. They have proven ability to survive wind, cold, heat, drought, and tough environments that limit plant choices. Each tile includes 6–8 of the listed varieties.

All Season Mix

Plant Name	Bloom Time	Flower Color
Sedum album 'Coral Carpet'	Mid Summer	White
Sedum h. 'Immergrunnen'	Mid Summer	Yellow
Sedum floriferum 'Weihenstephaner Gold'	Late Spring	Gold
Sedum middendorffianum diffusum	Mid Summer	Yellow
Sedum reflexum 'Green Spruce'	Early Summer	Yellow
Sedum spurium 'Coccineum'	Mid Summer	Red
Sedum spurium 'Fuldaglut'	Early Summer	Red
Sedum spurium 'John Creech'	Mid Summer	Pink
Sedum spurium 'Red Carpet'	Mid Summer	Red
Sedum spurium 'Roseum'	Early Summer	Pink
Sedum stefco	Late Summer	White
Sedum takesimensis 'Golden Carpet'	Mid Summer	Yellow
Sedum tetractinum 'Coral Reef'	Late Spring	Yellow

Color Max Mix

Plant Name	Bloom Time	Flower Color
Sedum acre 'Aurea'	Late Spring	Yellow
Sedum album 'Coral Carpet'	Mid Summer	White
Sedum album 'Orange Ice'	Mid Summer	White
Sedum floriferum 'Weihenstephaner Gold'	Late Spring	Gold
Sedum kamtschaticum 'Vareigatum'	Mid Summer	Yellow
Sedum reflexum 'Blue Spruce'	Late Spring	Yellow
Sedum rupestre 'Angelina'	Mid Summer	Yellow
Sedum spurium 'Green Mantle'	Early Summer	Yellow
Sedum spurium 'John Creech'	Mid Summer	Pink
Sedum spurium 'Red Carpet'	Mid Summer	Red
Sedum spurium 'Summer Glory'	Mid Summer	Pink
Sedum spurium 'Tricolor'	Early Summer	Pink

Shade Mix

Plant Name	Bloom Time	Flower Color
Sedum acre 'Aurea'	Late Spring	Yellow
Sedum h. 'Immergrunnen'	Mid Summer	Yellow
Sedum pachyclados	Mid Summer	White
Sedum sexangulare	Mid Summer	Yellow
Sedum spurium 'Album Superbum'	Mid Summer	White
Sedum spurium 'Eco Mt. Emei'	Early Summer	Yellow
Sedum spurium 'Fuldaglut'	Early Summer	Red
Sedum spurium 'Green Mantle'	Early Summer	Yellow
Sedum spurium 'John Creech'	Mid Summer	Pink
Sedum ternatum	Early Summer	White

Tuff Stuff Mix

Plant Name	Bloom Time	Flower Color
Sedum album 'Coral Carpet'	Mid Summer	White
Sedum cauticulum	Mid Summer	Pink
Sedum ellacombianum	Early Summer	Yellow
Sedum hybridum 'Czar's Gold'	Mid Summer	Yellow
Sedum kamtschaticum	Early Summer	Yellow
Sedum middendorffianum diffusum	Mid Summer	Yellow
Sedum rupestre	Mid Summer	Yellow
Sedum sexangulare	Mid Summer	Yellow
Sedum spurium sp.	Mid Summer	Pink
Sedum spurium 'Roseum'	Early Summer	Pink
Sedum spurium 'Voodoo'	Summer-Fall	Rose
Sedum stefco	Late Summer	White

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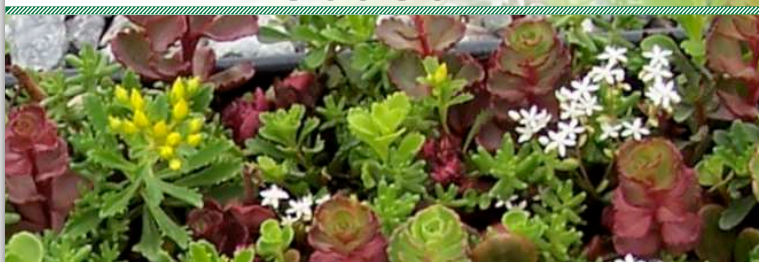
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SEDUM TILE PRODUCT DATA

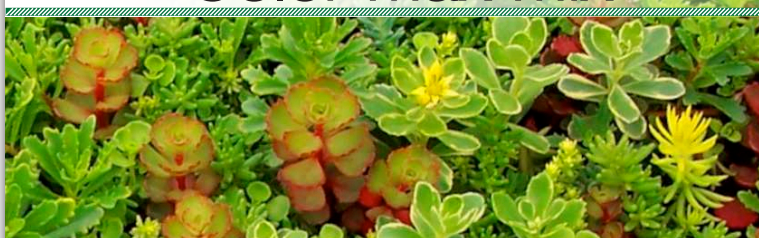
All Season Mix



This mix provides flowers throughout the whole growing season. Winter interest and seasonal foliage color changes are also found in this group. This is a good, general purpose mix that provides year-round beauty. Each tile includes 6 - 8 of the listed varieties.

Plant Name	Bloom Time	Flower Color
Sedum album 'Coral Carpet'	Mid Summer	White
Sedum h. 'Immergrunchen'	Mid Summer	Yellow
Sedum floriferum 'Weihenstephaner Gold'	Late Spring	Gold
Sedum middendorffianum diffusum	Mid Summer	Yellow
Sedum reflexum 'Green Spruce'	Early Summer	Yellow
Sedum spurium 'Coccineum'	Mid Summer	Red
Sedum spurium 'Fuldaglut'	Early Summer	Red
Sedum spurium 'John Creech'	Mid Summer	Pink
Sedum spurium 'Red Carpet'	Mid Summer	Red
Sedum spurium 'Roseum'	Early Summer	Pink
Sedum stefco	Late Summer	White
Sedum takesimensis 'Golden Carpet'	Mid Summer	Yellow
Sedum tetractinum 'Coral Reef'	Late Spring	Yellow

Color Max Mix



Color Max includes a blend of sedums for use when maximum color is desired. This comes in the form of brightly colored foliage, flowers in abundance, and colors that blend together well. Each tile includes 6 - 8 of the listed varieties.

Plant Name	Bloom Time	Flower Color
Sedum acre 'Aurea'	Late Spring	Yellow
Sedum album 'Coral Carpet'	Mid Summer	White
Sedum album 'Orange Ice'	Mid Summer	White
Sedum floriferum 'Weihenstephaner Gold'	Late Spring	Gold
Sedum kamtschaticum 'Variegatum'	Mid Summer	Yellow
Sedum reflexum 'Blue Spruce'	Late Spring	Yellow
Sedum rupestre 'Angelina'	Mid Summer	Yellow
Sedum spurium 'Green Mantle'	Early Summer	Yellow
Sedum spurium 'John Creech'	Mid Summer	Pink
Sedum spurium 'Red Carpet'	Mid Summer	Red
Sedum spurium 'Summer Glory'	Mid Summer	Pink
Sedum spurium 'Tricolor'	Early Summer	Pink

Shade Mix



The plants in Shade Mix are those that have demonstrated abilities to withstand the difficult conditions of shade. All sedums do best in higher light, but this group tolerates low-light better than most. Each tile includes 6 - 8 of the listed varieties.

Plant Name	Bloom Time	Flower Color
Sedum acre 'Aurea'	Late Spring	Yellow
Sedum h. 'Immergrunchen'	Mid Summer	Yellow
Sedum pachyclados	Mid Summer	White
Sedum sexangulare	Mid Summer	Yellow
Sedum spurium 'Album Superbum'	Mid Summer	White
Sedum spurium 'Eco Mt. Emei'	Early Summer	Yellow
Sedum spurium 'Fuldaglut'	Early Summer	Red
Sedum spurium 'Green Mantle'	Early Summer	Yellow
Sedum spurium 'John Creech'	Mid Summer	Pink
Sedum ternatum	Early Summer	White

Tuff Stuff Mix



The sedums in Tuff Stuff are the toughest, most durable, most drought resistant choices available. They have proven ability to survive wind, cold, heat, drought, and tough environments that limit plant choices. Each tile includes 6 - 8 of the listed varieties.

Plant Name	Bloom Time	Flower Color
Sedum album 'Coral Carpet'	Mid Summer	White
Sedum cauticolum	Mid Summer	Pink
Sedum ellacombianum	Early Summer	Yellow
Sedum hybridum 'Czar's Gold'	Mid Summer	Yellow
Sedum kamtschaticum	Early Summer	Yellow
Sedum middendorffianum diffusum	Mid Summer	Yellow
Sedum rupestre	Mid Summer	Yellow
Sedum sexangulare	Mid Summer	Yellow
Sedum spurium sp.	Mid Summer	Pink
Sedum spurium 'Roseum'	Early Summer	Pink
Sedum spurium 'Voodoo'	Summer-Fall	Rose
Sedum stefco	Late Summer	White

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CARLISLE'S **VEGETATED SEDUM MATS** FOR ROOF GARDEN APPLICATIONS



Overview

Carlisle's Vegetated Sedum Mats are a quick and cost-effective method of obtaining instant vegetative coverage on your building's Roof Garden. Applied in a similar manner to single-ply membrane, Carlisle's Vegetated Sedum Mats ensure a no-hassle installation and immediate vegetative coverage.

Features and Benefits

- Instantaneous vegetative coverage
- No waiting for plants to "grow in"
- Greatly reduced plant maintenance
- Easy installation

Installation

The rolls of Carlisle's Vegetated Sedum Mats are hoisted to the rooftop and unrolled over a minimum 2.5" of Carlisle's Growth Media. The rolls are placed adjacent to each other with no overlap. The Roof Garden is then irrigated until fully saturated.

Size and Coverage Rate

- 25 square feet per mat
- 48"-wide by 75"-long
- 5.5 lbs./sq. ft. fully saturated
- Approximately 100 lbs. Per roll, as delivered
- Minimum 85% vegetative coverage

Plants

Carlisle Vegetated Sedum Mats are planted with these plants:

- Sedum Kamtschaticum
- Sedum Spurium 'John Creech'
- Sedum Spurium 'Tricolor'
- Sedum Spurium 'Red Carpet'
- Sedum Spurium 'Fuldaglut'
- Sedum Acre 'Gold Moss'
- Sedum Sexangular
- Sedum Album
- Sedum Reflexum 'Blue Spruce'

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CARLISLE'S SEDUM CUTTINGS FOR ROOF GARDEN APPLICATIONS



Overview

Carlisle sedum cuttings are the most cost-effective method of vegetating your Roof Garden. Available in 14 different varieties, they are shipped in bulk bins and are sold by the pound. Carlisle sedum cuttings must be planted with Carlisle Moisture Retention Gel to ensure that cuttings have adequate moisture to root successfully in a rooftop environment. Carlisle sedum cuttings are available in insulated boxes containing between 20 to 35 lbs. of single-variety or mixed cuttings.

Features and Benefits

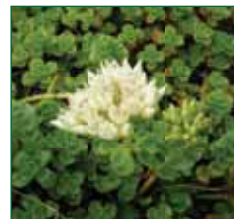
- 14 varieties available
- Easy, low-cost installation
- Rapid vegetative growth
- Require minimum soil depth of only 2.5 inches

Installation

Once Carlisle Retention Gel is distributed across the entire surface of the growth media at a rate of 1 pound per 200 square feet, cuttings may be applied manually or by hand broadcasting. Recommended rate of cuttings application is 1 pound per 10 square feet for rapid vegetative coverage. After cuttings are applied, the Roof Garden must be immediately irrigated to the point of runoff and the Moisture Retention Gel becomes expanded and saturated. When cuttings are used to propagate the Roof Garden, it is mandatory that an irrigation system be used for a minimum of 60 days to ensure proper establishment of the cuttings. Refer to Roof Garden Attachment VI for irrigation and maintenance.



Sedum acre 'Gold Moss'



Sedum album 'Coral Carpet'



Sedum hispanicum 'Purple Form'



Sedum kamtschaticum



**Sedum kamtschaticum
'Weihenstephaner Gold'**



**Sedum kamtschaticum k.
variegatum**



Sedum reflexum 'Blue Spruce'



Sedum rupestre 'Angelina'



Sedum sexangular



Sedum sieboldii

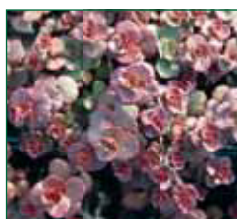
CARLISLE'S SEDUM CUTTINGS FOR ROOF GARDEN APPLICATIONS



Sedum spurium 'Fuldaglut'



Sedum spurium 'John Creech'



Sedum spurium 'Red Carpet'



Sedum spurium 'Tricolor'

Sedum Cuttings

Typical Properties and Characteristics

Plant Name	Height	Width	Bloom Time
Sedum acre 'Gold Moss'	6 inches	18 inches	Late Spring
Sedum album 'Coral Carpet'	6 inches	18 inches	Late Spring
Sedum kamtschaticum 'Weihenstephaner Gold'	6 inches	18 inches	Late Spring
Sedum reflexum 'Blue Spruce'	6 inches	16 inches	Late Spring
Sedum kamtschaticum	8 inches	15 inches	Early Summer
Sedum sieboldii	6 inches	18 inches	Early Summer
Sedum spurium 'Fuldaglut'	3 inches	18 inches	Early Summer
Sedum spurium 'John Creech'	2 inches	16 inches	Early Summer
Sedum kamtschaticum k. variegatum	6 inches	18 inches	Mid Summer
Sedum rupestre 'Angelina'	2 inches	18 inches	Mid Summer
Sedum sexangular	4 inches	18 inches	Mid Summer
Sedum spurium 'Red Carpet'	4 inches	24 inches	Mid Summer
Sedum spurium 'Tricolor'	4 inches	24 inches	Mid Summer
Sedum hispanicum 'Purple Form'	3 inches	12 inches	Late Spring

* View Carlisle's complete plant list online at www.carlisleroofgardens.com for more information on these and other plants.

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CARLISLE'S

MOISTURE RETENTION GEL



Overview

Carlisle's Moisture Retention Gel is used in conjunction with Carlisle's Sedum Cuttings to ensure rapid rooting and growth of vegetated rooftops. Moisture Retention Gel is designed to hold large quantities of water at the surface of the growth media so that cuttings have immediate access to hydration as the plants' roots form and grow.

Features & Benefits

- Fast and easy to apply
- Holds adequate water for tender sedum cuttings
- Acts as an erosion control to help hold cuttings in place
- Does not allow for excess water to accumulate
- Ensures success of propagating via live cuttings
- Inexpensive to use

Installation

Carlisle's Moisture Retention Gel is best applied via an inexpensive handheld rotary spreader or by hand broadcast. Most rotary spreaders should be operated on a lower setting to achieve the desired coverage rate. Moisture Retention Gel is applied over the growth media at a rate of roughly 1 pound per 200 square feet. Once Carlisle Moisture Retention Gel is applied, add sedum cuttings and water the surface of the growth media until the gel expands to approximately four times its applied size.

Size & Coverage Rate

- 50-pound bags
- 1 pound of Moisture Retention Gel per 200 square feet
- Keep dry at all times

Investing in Roofing Solutions for Over 45 Years

800-4-SYNTEC • P.O. Box 7000 • Carlisle, PA 17013 • Fax: 717-245-7053 • www.carlisle-syntec.com

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Carlisle SynTec

CARLISLE'S **STAINED GLASS STONE** SPECIAL EFFECTS ACCESSORY



Overview

Carlisle's Stained Glass Stone is a beautiful addition to any Roof Garden or Plaza. With 12 colors to choose from, the possibilities are endless for designing anything from faux water features to company logos. With 100% post-consumer recycled content, Stained Glass Stone is an environmentally intelligent choice to turn your roof garden or plaza into a dazzling oasis.

Features and Benefits

- 100% post-consumer recycled material
- Twelve color options give incredible aesthetic effects
- Available in 50-pound increments with a minimum order of 500 pounds
- Large particle-size and high-density prevents scouring
- Included in Carlisle's single-source warranty
- Eligible for LEED® Credits

Installation

Carlisle's Stained Glass Stone is delivered in SuperSacks containing up to 3,000 pounds of material. Material is hoisted to the rooftop and deposited over a 1" + thick drainage composite, such as Carlisle's MiraDRAIN G4. The Carlisle Stained Glass Stone is applied at a minimum of 10 pounds per square-foot.

Stained Glass Stone

Typical Properties and Characteristics

Test	Result
Density	85 lbs./cubic feet
SuperSack Capacity	1.3 cubic yards
Particle Size	1"– 2"
Coolness Factor	10 out of 10

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CARLISLE
Carlisle SynTec

CARLISLE'S

STAINED GLASS STONE

SPECIAL EFFECTS ACCESSORY



Indigo Blue



Kryptonite Green



Deep Purple



Aztec Turquoise



Coronado Amber



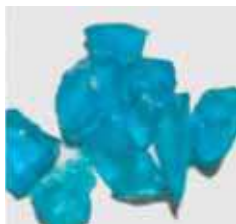
Cerulean Blue



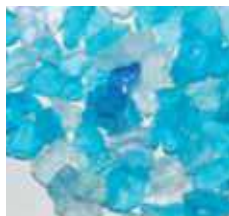
Tree Frog Green



Lucid Teal



Brilliant Aquamarine



Poseidon Mix



Rainforest Mix



Estuary Mix

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CARLISLE
Carlisle SynTec



Description

InsulFoam® DB (Drainage Board) is a high-performance, rigid insulation consisting of a superior closed-cell, lightweight and resilient expanded polystyrene (EPS) with an advanced filtration facer. The core of InsulFoam DB has 1/4" x 1/4" drainage channels every 2" O.C. and is the same high-quality as our InsulFoam brand insulations. InsulFoam DB has excellent dimensional stability, compressive strength and drainage capacity properties. In addition, InsulFoam DB is an Energy Star® qualified insulation and qualifies for LEED points.

Uses

InsulFoam DB is designed to be applied as an exterior foundation insulation and drainage board. InsulFoam DB aids in reducing hydrostatic pressure on the foundation from the adjacent backfill material while protecting the underlying damp proofing or waterproofing.

Advantages

- **Long-Term Effectiveness.** The InsulFoam DB facer prevents accumulation of the backfill material within the drainage channels unlike some unfaced grooved boards.
- **Added Protection.** InsulFoam DB provides protection to the waterproofing or damp-proofing and to the foundation during backfill installation and from any post-construction soil freeze-thaw cycling and settlement.
- **Stable R-Value.** Customers are well served knowing the product's thermal properties will remain stable over the entire service-life.
- **Cost Effective.** InsulFoam DB is typically less expensive than other below-grade or perimeter insulations.
- **Environmentally Friendly.** It contains no formaldehyde or ozone-depleting CFC's or HCFC's, may contain recycled material and the foam core is 100% recyclable.
- **Proven Performance.** The same fundamental chemistry has been in use since the mid-1950s so the actual performance of the foam core is well known.
- **Water Resistance.** InsulFoam insulation does not readily absorb moisture from the environment.

Sizes

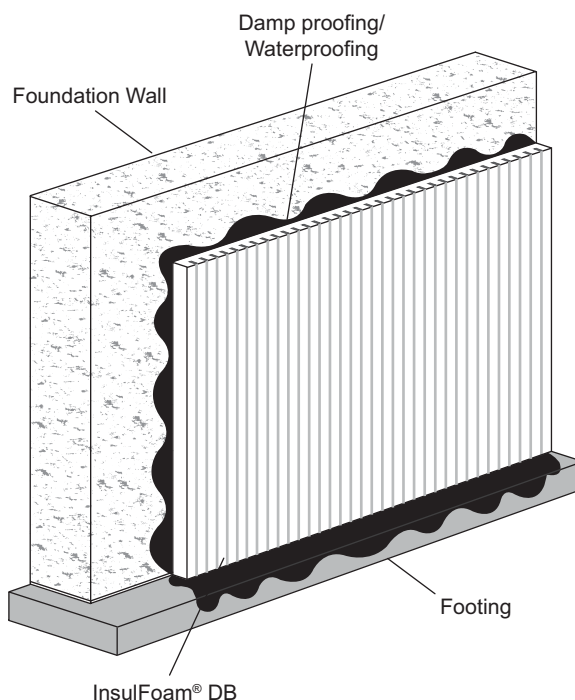
InsulFoam DB is typically manufactured in 4' x 8' sheets with square edges and is available in any thickness between 1" and 5". Different densities, sizes and thicknesses are available upon request.

InsulFoam DB Performance Property

Property	Test Method	Value
Drainage Capacity @ 1200 psf, gradient .19	ASTM D4716	5 gal/min/ft



Typical Foundation Drainage Application



Installation Recommendations

1. Install InsulFoam DB directly over damp-proofing or waterproofing. The InsulFoam DB can be attached with an EPS-compatible adhesive, mechanical fasteners or held in place by the backfill.
2. Tightly butt insulation joints to minimize dirt infiltration.
3. Seal the top edge of the InsulFoam DB with either caulk or a J-strip to minimize water and mud infiltration.

Carlisle Roof Garden Plants



In Bloom

Achillea 'Appleblossom'

Common Name:	Yarrow
Height:	36 in.
Width:	36 in.
Bloom Time:	Summer thru Fall
Flower Color:	Pink
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	6"+

'Appleblossom' is a member of the handsome Galaxy hybrids, with flat clusters of rich rosy pink blossoms atop sturdy 36-in. stems. Finely divided, fern-like foliage is grayish green; a splendid accent to many colors. Hardy and easy to grow, this perennial herb is virtually pest and disease-free.



In Bloom

Achillea millefolium 'Summer Pastels'

Common Name:	Yarrow
Height:	24 in.
Width:	36 in.
Bloom Time:	Summer thru Fall
Flower Color:	Mixed
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy Loam
Minimum Soil Depth:	6"+

'Summer Pastels' is a delightful mixture of soft, rich colors from white to peach, lavender to rose, in flat-topped flower clusters atop sturdy 24-in. stems. Excellent cut flower or as part of a natural border.



In Bloom

Achillea millefolium 'Summer Wine'

Common Name:	Yarrow
Height:	24 in.
Width:	36 in.
Bloom Time:	Late Summer
Flower Color:	Red
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy Loam
Minimum Soil Depth:	6"+

Shimmering colors sets this Yarrow apart - it's rich burgundy-red flowers that holds a long time, then slowly fades to mauve. These flowers make a nice contrast against the rich green ferny foliage. Flowers bloom all summer and into fall.



In Bloom

Achillea 'Moonshine'

Common Name:	Yarrow
Height:	24 in.
Width:	12 in.
Bloom Time:	Summer thru Fall
Flower Color:	Yellow
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	6"+

'Moonshine' is a gardener's favorite, with its flat-topped, 2- to 3-in. clusters of lemony yellow flowers atop sturdy 18- to 24-in. stems and striking silvery gray foliage. Excellent as a cut flower or as part of a naturalized border. Long blooming.



In Bloom

Achillea 'Paprika'

Common Name:	Yarrow
Height:	24 in.
Width:	36 in.
Bloom Time:	Summer thru Fall
Flower Color:	Red
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	6"+

'Paprika' has brilliant flat clusters of red flowers with cheery yellow centers atop sturdy 18-in. stems. Finely divided, fern-like foliage is grayish green; a splendid accent to many colors. Excellent as a cut flower or as part of a naturalized border. Long blooming.



In Bloom

Achillea 'Terra Cotta'

Common Name:	Yarrow
Height:	24 in.
Width:	60 in.
Bloom Time:	Summer thru Fall
Flower Color:	Orange
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	6"+

'Terra Cotta' has the delightful quality of changing its flower color gradually from dusky orange tones to a soft yellow. Finely divided, fern-like foliage is muted grayish-green—a splendid accent to many colors. Excellent as a cut flower or as part of a naturalized border. Long blooming.



In Bloom

Achillea x lewisii 'King Edward'

Common Name:	Lewis' Yarrow
Height:	6 in.
Width:	10 in.
Bloom Time:	Late Spring
Flower Color:	Yellow
Hardiness:	Z4 (-20)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	4" +

'King Edward' is a hybrid of *A. clavennae* and *A. tomentosa*. The plant bears pale yellow flowers in flat clusters. The fern-like foliage and small size make the plant suitable for rock gardens. Provide a sunny growing area and a well-drained soil. Woody foliage and very drought tolerant.



In Bloom

Agastache 'Blue Fortune'

Common Name:	Anise Hyssop
Height:	36 in.
Width:	24 in.
Bloom Time:	Mid Summer
Flower Color:	Lavender
Hardiness:	Z6 (0)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	6" +

'Blue Fortune', a hybrid of *A. foeniculum* and *A. rugosum*, is an extremely hardy, drought-tolerant and pest-free perennial. Profuse lavender-blue flower spikes from July through September are attractive to butterflies and make an excellent late summer refresher. The leaves are used in teas, salads, and drinks. Beekeepers love this plant, as it yields a light, fragrant honey.



In Bloom

Arenaria montana

Common Name:	Montana Sandwort
Height:	4 in.
Width:	20 in.
Bloom Time:	Late Spring
Flower Color:	White
Hardiness:	Z2 (-40)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	4"+

Large white flowers in June on long trailing stems with narrow lance-shaped leaves. Forms low mounds. Sun. A rather fast grower which can spread 2' in one season.



In Bloom

Armeria maritima 'Alba'

Common Name:	Common Thrift
Height:	15 in.
Width:	10 in.
Bloom Time:	Late Spring
Flower Color:	White
Hardiness:	Z3 (-30)
Light:	Full or Part Sun
Soil:	Sandy Loam
Minimum Soil Depth:	6"+

Neat, evergreen tufts of grass-like foliage with globular bright flowers on 8" stems. Flowers in the late spring, excellent for the front of a border. Does well and is colorful almost anywhere. Shear off all old flowers when blooming is done for attractive little clumps all year long. Evergreen for the southern gardens.



In Bloom

Armeria maritima 'Dusseldorfer Stolz' Dusseldorf Pride

Common Name:	Common Sea Thrift
Height:	6 in.
Width:	6 in.
Bloom Time:	Early Spring
Flower Color:	Maroon
Hardiness:	Z5 (-10)
Light:	Full or Part Sun
Soil:	Sandy Loam
Minimum Soil Depth:	4"+

Compact foliage with dark pink bubble-like flowers. Flowering March - May, this is great as a mixer in any container, for the garden or patio, or placed in a rockery, walls or paving. Ideal for any conditions, but needs free draining soil or compost. A hardy plant which will survive normal winter conditions outside, especially if protected from the worst frosts.



In Bloom

Armeria maritima 'Splendens'

Common Name:	Common Thrift
Height:	8 in.
Width:	10 in.
Bloom Time:	Early Summer
Flower Color:	Red
Hardiness:	Z4 (-20)
Light:	Full Sun
Soil:	Sandy Loam
Minimum Soil Depth:	4"+

Bearing flowers in solitary, dense, globe-shaped heads high above the foliage on leafless stems, these great garden plants are useful for cut flowers. They're tough as nails, often found growing in hard clay and poor, sandy soils near the coast. 'Splendens' bears intense red flowers above a tuft of narrow linear leaves. Relatively easy to grow, this is one of the most ornamental clutivars. Will tolerate full or part sun



Artemisia stelleriana 'Silver Brocade'

Common Name:	Beach Wormwood
Height:	10 in.
Width:	12 in.
Bloom Time:	Early Summer
Flower Color:	Yellow
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy Loam
Minimum Soil Depth:	6"+

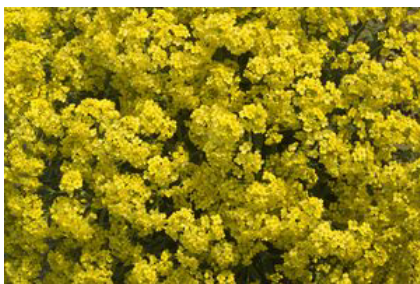
Dense ground-hugging cultivar with white, felted, deeply lobed silvery foliage. Easily grown artemesias are named for Artemis, Greek goddess of the hunt. Aromatic perennial herbs with splendid silvery white stems and foliage, they are at their loveliest when used for texture and color contrasts in the garden.



Aurinia saxatilis 'Gold Dust'

Common Name:	Basket of Gold
Height:	10 in.
Width:	18 in.
Bloom Time:	Mid Spring
Flower Color:	Yellow
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	6"+

Bright yellow flowers cover this compact Cultivar of Alyssum, otherwise known as Aurinia. A fast-growing rock garden plant that blooms early spring to summer. Keep Alyssum on the dry side.



In Bloom

Aurinia saxatilis 'Summit'

Common Name:	Alyssum, Basket of Gold
Height:	8 in.
Width:	18 in.
Bloom Time:	Summer thru Fall
Flower Color:	Yellow
Hardiness:	Z4 (-20)
Light:	Full or Part Sun
Soil:	Sandy
Minimum Soil Depth:	4" +

Alyssum saxatile, described as an alpine or rock garden plant, is familiar to us in spring as basket-of-gold or by its more recently conferred botanical name, Aurinia saxatilis. 'Summit', a Quality Award Winner by Syngenta Seeds B.V., has yellow single flowers in corymbs. The plant is a compact 20-30 cm rosette. Cold hardy.



In Bloom

Cerastium tomentosum

Common Name:	Snow-In-Summer
Height:	6 in.
Width:	18 in.
Bloom Time:	Early Summer
Flower Color:	White
Hardiness:	Z2 (-40)
Light:	Full Sun
Soil:	Sandy Loam
Minimum Soil Depth:	4" +

Cerastium tomentosum is an extremely cold hardy perennial which likes full sun and is tolerant to dry soil. The silver-grey foliage is useful for year-round contrast to stronger colors. The small white blossoms become showy in early summer. Cerastium is a rapidly spreading creeper that is great for rock gardens and edges.



In Bloom

Delosperma cooperi

Common Name:	Hardy Ice Plant
Height:	4 in.
Width:	48 in.
Bloom Time:	Late Spring
Flower Color:	Purple
Hardiness:	Z6 (0)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	4"+

A large family of succulent, drought-tolerant plants with splendidly showy flowers, ice plants are at home tumbling over rock walls or edging container gardens. *Delosperma cooperi* is one of the hardiest ice plants, giving cooler climate gardeners a chance to enjoy the brilliant carpeting display of neon purple blooms so familiar to Southern Californian gardeners. Showy flowers are splendidly showcased by rich-green, dense foliage. Plant in full sun in sharply draining soil and water infrequently for best summer performance.



In Bloom

Delosperma nubigenum

Common Name:	Hardy Ice Plant
Height:	3 in.
Width:	18 in.
Bloom Time:	Late Spring
Flower Color:	Yellow
Hardiness:	Z5 (-10)
Light:	Full Sun
Soil:	Sandy Loam
Minimum Soil Depth:	4"+

Delosperma nubigenum is the hardiest ice plant, with succulent, mat-forming, weed suppressing rich green foliage blanketed in bright yellow daisy-like flowers in early summer. Hardy as far north as Zone 5.



In Bloom

Dianthus deltooides 'Brilliant'

Common Name:	Maiden Pinks
Height:	8 in.
Width:	12 in.
Bloom Time:	Spring thru Summer
Flower Color:	Red
Hardiness:	Z4 (-20)
Light:	Full or Part Sun
Soil:	Loamy
Minimum Soil Depth:	2.5"+

'Brilliant' forms a ground-hugging mat of rich green blanketed by countless small crimson blooms in early summer that draw the eye like a magnet. Will tolerate full or part sun. Carnations and pinks were given their botanical name, dianthus, by the Greek botanist Theophrastus, who called them "dios-anthos" or "divine flowers."



In Bloom

Herniaria glabra

Common Name:	Rupturewort
Height:	2 in.
Width:	12 in.
Bloom Time:	No Flowers
Flower Color:	No flowers
Hardiness:	Z5 (-10)
Light:	Full or Part Sun
Soil:	Loamy
Minimum Soil Depth:	2.5"+

This strange member of the dianthus family is best used as an evergreen groundcover that literally clings to the ground. Flowers? Get a magnifying glass! Herniaria is quite the utilitarian plant as a filler between stepping stones...great in well-drained acidic sites.



In Bloom

Lavandula angustifolia 'Hidcote'

Common Name:	English Lavender
Height:	20 in.
Width:	36 in.
Bloom Time:	Early Summer
Flower Color:	Purple
Hardiness:	Z5 (-10)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	6"+

'Hidcote' is a dwarf cultivar of the classic sachet lavender. Richly aromatic, dusky blue-gray leaves. The fragrance is so enticing, orchardists use this variety to attract pollinating bees to their fruit trees. Shear back after first flush of blooms. Drought-tolerant, easily grown and maintained, and superb for dried arrangements.



In Bloom

Phlox subulata 'Candystripe'

Common Name:	Moss Pinks or Creeping Phlox
Height:	6 in.
Width:	12 in.
Bloom Time:	Early Spring
Flower Color:	Pink
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	3.5"+

'Candystripe' is a welcome surprise in hidden nooks and crannies. Its spreading, matted form creates carpet of pink and white striped flowers; the deep-green, needle-like leaves are evergreen. Shear back plants by half after flowers are spent to keep plants full and lush.



In Bloom

Phlox subulata 'Crimson Beauty'

Common Name:	Moss Pinks or Creeping Phlox
Height:	6 in.
Width:	36 in.
Bloom Time:	Mid Spring
Flower Color:	Rose
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	3.5"+

This evergreen perennial has rose red flowers in early to mid Spring. Perfect for edging walkways, bank plantings and rock gardens. Spreads to 3' in width and stays 4-6" in height. Best in Full Sun and good drainage is required.



In Bloom

Phlox subulata 'Drummons Pink'

Common Name:	Moss Pinks or Creeping Phlox
Height:	in.
Width:	in.
Bloom Time:	Early Spring
Flower Color:	Pink
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	3.5"+

Arguably the best pink of the subulata species, 'Drummons Pink' is a welcome surprise in hidden nooks and crannies. Its spreading, matted form creates a carpet of pink flowers over tiny, deep green, needle-like leaves that are evergreen. Shear back plants by half after flowers are spent to keep plants full and lush.



In Bloom

Phlox subulata 'Emerald Blue'

Common Name:	Moss Pinks or Creeping Phlox
Height:	6 in.
Width:	24 in.
Bloom Time:	Early Spring
Flower Color:	Purple
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	3.5"+

'Emerald Blue' is a splash of color for nooks and crannies. Its spreading, matted form creates a carpet of medium-blue flowers with deep-green, needle-like leaves. To keep this evergreen phlox full and lush, shear back by half after flowers are spent.



In Bloom

Phlox subulata 'Fort Hill'

Common Name:	Moss Pinks or Creeping Phlox
Height:	5 in.
Width:	18 in.
Bloom Time:	Early Spring
Flower Color:	Pink
Hardiness:	Z3 (-30)
Light:	Full or Part Sun
Soil:	Sandy
Minimum Soil Depth:	3.5"+

Creeping phlox is a low-growing species which forms a carpet-like mat no taller than 6 inches. This popular little perennial is best utilized in rocky areas, on slopes, and in flower borders. "Fort Hill" has cheery, pinkish-rose flowers with dark red centers which blanket the foliage from Spring into Summer. Tremendous color impact!



In Bloom

Phlox subulata 'Red Wing'

Common Name:	Moss Pinks or Creeping Phlox
Height:	3 in.
Width:	24 in.
Bloom Time:	Early Spring
Flower Color:	Red
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	3.5"+

'Red Wing' is a color infusion for nooks and crannies. Its spreading, matted form creates a carpet of scarlet red flowers with needle-like leaves. To keep this evergreen phlox full and lush, shear back by half after flowers are spent.



In Bloom

Phlox subulata 'White Delight'

Common Name:	Moss Pinks or Creeping Phlox
Height:	6 in.
Width:	12 in.
Bloom Time:	Early Spring
Flower Color:	White
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	3.5"+

'White Delight' is a welcome surprise in hidden nooks and crannies. Spreading, matted form creating carpet of pure white flowers. Gardeners have long been charmed by phlox, and have used them faithfully in formal borders and riotous cottage gardens. The mat-forming Creeping Phlox (or Moss Pinks) have tiny deep-green, needle-like leaves are evergreen. Shear back plants by half after flowers are spent to keep plants full and lush.



In Bloom

Potentilla nepalensis 'Miss Wilmot'

Common Name:	Creeping Potentilla
Height:	12 in.
Width:	12 in.
Bloom Time:	Summer thru Fall
Flower Color:	Pink
Hardiness:	Z4 (-20)
Light:	Full or Part Sun
Soil:	Sandy
Minimum Soil Depth:	4"+

Mounds of strawberry-like leaves and pink flowers with cherry-red centers make a charming accent. Useful for ground covers and borders, this dwarf, hardy, long-blooming plant tolerates a variety of soils. Potentilla perform best in full sun, but tolerate some shade.



In Bloom

Saponaria ocymoides

Common Name:	Rock Soapwort
Height:	9 in.
Width:	9 in.
Bloom Time:	Late Spring
Flower Color:	Pink
Hardiness:	Z2 (-40)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	4"+

Soapworts, most of which are native to the Mediterranean regions, produce a soapy liquid prized by curators for cleansing aged tapestries and lace work. Ocymoides is a sprawling groundcover with masses of pretty pink flowers in loosely branched clusters. Lovely when allowed to tumble over rock walls, steps, or the edge of containers and baskets



In Bloom

Scabiosa columbaria 'Pink Mist'

Common Name:	Pincushion flower
Height:	12 in.
Width:	18 in.
Bloom Time:	Spring thru Fall
Flower Color:	Pink
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy Loam
Minimum Soil Depth:	6"+

'Pink Mist' is a popular cultivar because of its especially lavish display of lavender-pink flowers. It is more compact and produces flowers over a longer period of time than other Scabiosas do.



In Bloom

Sedum acre 'Gold Moss'

Common Name:	Goldmoss Stonecrop
Height:	6 in.
Width:	18 in.
Bloom Time:	Late Spring
Flower Color:	Yellow
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	2.5"+

Stonecrops are a large family of over 600 species of succulents, very easily grown in quick-draining soils and sunny spots. Flower clusters will attract welcome visits from butterflies. 'Gold Moss' is a dense, carpet-forming variety, with bright green, needle-like fleshy leaves in tight clusters. Roots easily; can be invasive.



In Bloom

Sedum album 'Coral Carpet'

Common Name:	Stonecrop
Height:	6 in.
Width:	18 in.
Bloom Time:	Late Spring
Flower Color:	White
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	2.5"+

Stonecrops are a large family of over 600 species of succulents, very easily grown in quick-draining soils and sunny spots. Flower clusters will attract welcome visits from butterflies. 'Coral Carpet' is a low mounding variety, with dense mounds of fleshy, bright green leaves in tight little rosettes trailing from short red stems. Roots easily; can be invasive.



In Bloom

Sedum hispanicum 'Purple Form'

Common Name:	Blue Carpet Stonecrop
Height:	3 in.
Width:	12 in.
Bloom Time:	Late Summer
Flower Color:	Pink
Hardiness:	Z2 (-40)
Light:	Full or Part Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

Blue-gray foliage in summer then changing to deep blue and lovely hues of purple in colder weather. In late summer, foliage is completely covered with small pink star-shaped flowers. Extremely heat drought tolerant. A good plant for walkways, rock gardens and container plantings. Will 'flow' between other plantings and rocks for a stunning effect.



In Bloom

Sedum kamtschaticum

Common Name:	Stonecrop
Height:	8 in.
Width:	15 in.
Bloom Time:	Early Summer
Flower Color:	Yellow
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	2.5"+

Stonecrops are a large family of over 600 species of succulents, very easily grown in quick-draining soils and sunny spots. Flower clusters will attract welcome visits from butterflies. Kamtschaticum is a dense, mounding variety, with rich green, fleshy leaves in handsome rosettes. Roots easily; can be invasive.



In Bloom

Sedum kamtschaticum 'Weihenstephaner Gold'

Common Name:	Stonecrop
Height:	6 in.
Width:	18 in.
Bloom Time:	Late Spring
Flower Color:	Gold
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	2.5"+

Stonecrops are a large family of over 600 species of succulents, very easily grown in quick-draining soils and sunny spots. Flower clusters will attract welcome visits from butterflies. 'Weihenstephaner Gold' is a dense, mounding variety, with pale green, serrated leaves in handsome rosettes which take on a bronze cast in fall. Roots easily; can be invasive.



In Bloom

**Sedum kamtschaticum k.
variegatum**

	Striped Kamtschatka Stonecrop
Common Name:	
Height:	6 in.
Width:	18 in.
Bloom Time:	Mid Summer
Flower Color:	Yellow
Hardiness:	Z4 (-20)
Light:	Full or Part Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

This delightful and easy-to-grow form of *S. kamtschaticum* is not as aggressive as some selections of this species. This clumping form of *S. kamtschaticum* emerges in early spring with dozens of grass-green rosettes held horizontally on the end of 6" long stems. As the temperatures warm, the edges of the leaf take on a nice creamy gold border. The clumps are topped with sprays of bright yellow flowers held just above the foliage in midsummer...a real winner.



In Bloom

**Sedum reflexum 'Blue
Spruce'**

Common Name:	Stonecrop
Height:	6 in.
Width:	16 in.
Bloom Time:	Late Spring
Flower Color:	Yellow
Hardiness:	Z6 (0)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

Mats of blue-green pine like foliage creep along the ground. Great at the front of borders to add contrast and a must have for rock gardens. It is semi-evergreen in Zones 6 and warmer. Flowering late spring and summer. They enjoy full sun, but some shade o.k. Yellow flowers on Christmas tree-like foliage.

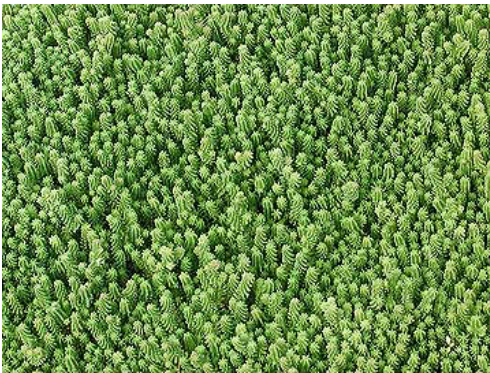


In Bloom

Sedum rupestre 'Angelina'

Common Name:	Stonecrop
Height:	2 in.
Width:	18 in.
Bloom Time:	Mid Summer
Flower Color:	Yellow
Hardiness:	Z4 (-20)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

One of the best groundcovers yet for quick coverage and brilliant yellow tones, Angelina spreads 2 feet wide in a single season, and in mild climates is evergreen, while in northern ones it turns rich orange for autumn! You can't beat this bold golden sun--lover for scrambling across hot, dry, poor soils that other plants shun! Just 4 inches high but spreading up to 24 inches wide in a single season, Angelina is ideal for a variety of settings -- as a spectacular carpet for the spring bulb garden, a container standout, a cover-up for slopes and other trouble spots in the dry, dusty garden, and even as a plain old border plant, carpeting its path in sunny yellow!



In Bloom

Sedum sexangulare

Common Name:	Stonecrop
Height:	4 in.
Width:	18 in.
Bloom Time:	Mid Summer
Flower Color:	Yellow
Hardiness:	Z4 (-20)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

One of the standards in roof garden vegetation. Hardy. Evergreen, vigorous compact mat. Flowers bright yellow in July. Grows on sandy or stony soil. From Western borders of Russia, Poland, Balkans, Central Europe & Scandinavia.



In Bloom

Sedum sieboldii

Common Name:	Stonecrop
Height:	6 in.
Width:	18 in.
Bloom Time:	Early Summer
Flower Color:	Pink
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth:	2.5"+

Stonecrops are a large family of over 600 species of succulents, very easily grown in quick-draining soils and sunny spots. Flower clusters will attract welcome visits from butterflies. Sieboldii is a trailing variety, native to Japan, with blue-grey fleshy leaves edged in red. Handsome choice for hanging baskets.



In Bloom

Sedum spurium 'Fuldaglut'

Common Name:	Stonecrop
Height:	3 in.
Width:	18 in.
Bloom Time:	Early Summer
Flower Color:	Red
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Loamy
Minimum Soil Depth::	2.5"+

Stonecrops are a large family of over 600 species of succulents, very easily grown in quick-draining soils and sunny spots. Flower clusters will attract welcome visits from butterflies. 'Fuldaglut' is a low, creeping variety, with fleshy, deep red leaves in tight little rosettes trailing from short stems. Roots easily; can be invasive.



In Bloom

Sedum spurium 'John Creech'

Common Name:	Stonecrop
Height:	2 in.
Width:	16 in.
Bloom Time:	Early Summer
Flower Color:	Pink
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

This wonderful and easy-to-grow groundcover is named after the former director of the US National Arboretum John Creech. Dr. Creech discovered the plant in the Siberian Academ Gorodok Gardens in 1971. This is not just any *S. spurium*, but a rare small foliage and pink flowered form. The small scalloped green leaves of this weed-smothering groundcover are topped with pink flowers in fall. We think you'll really enjoy this durable plant.



In Bloom

Sedum spurium 'Red Carpet'

Common Name:	Stonecrop
Height:	4 in.
Width:	24 in.
Bloom Time:	Mid Summer
Flower Color:	Red
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

Sedum Red Carpet is a wonderful ground cover that is a little different from the rest. The foliage is a dark red with green and produces a wonderful fall color. Sedum Red Carpet needs to be planted in full sun in well-drained soil. It will tolerate most soil types, and is drought resistant. A great choice for beds and borders and excellent as cut flowers. It is also a great butterfly and bee attractor, and is disease resistant.



In Bloom

Sedum spurium 'Tricolor'

Common Name:	Stonecrop
Height:	4 in.
Width:	24 in.
Bloom Time:	Mid Summer
Flower Color:	Red
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

Sedum 'Tricolor' is a wonderful ground cover that is a little different from the rest. It will tolerate most soil types, and is drought resistant. A great choice for beds and borders and excellent as cut flowers. It is also a great butterfly and bee attractor, and is disease resistant.



In Bloom

Sempervivum 'Black'

Common Name:	House Leeks
Height:	6 in.
Width:	in.
Bloom Time:	
Flower Color:	
Hardiness:	Z4 (-20)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

A very large family of avid sun-lovers, sempervivums should have a place in every garden. Although they endure austerity with composure, they also respond favorably to better living conditions, which they repay by more colorful and vigorous rosettes. Sempervivums are ideal for growing in pots, planters or rock walls, and as specimen plants on the patio or terrace.



In Bloom

Sempervivum 'Cobweb Buttons'

Common Name:	House Leeks
Height:	3 in.
Width:	18 in.
Bloom Time:	Mid Summer
Flower Color:	Pink
Hardiness:	Z4 (-20)
Light:	Full Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

Striking evergreen foliage has a unique webbed appearance. Dense webbing of gray threads over pale green leafy rosettes. Spreads slowly to form a dense mat. Best in well drained sandy or gritty soil. Use in containers, rock or wall gardens, on stony banks and groundcover. Excellent for strawberry jars and other containers. Attractive at garden's edge as well. 4" pinkish flower spikes in the summer from the larger rosettes.



In Bloom

Thymus praecox 'Bressingham'

Common Name:	Creeping Thyme
Height:	2 in.
Width:	24 in.
Bloom Time:	Late Spring
Flower Color:	Lavender
Hardiness:	Z4 (-20)
Light:	Full or Part Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

Very flow growing woolly, green foliage with masses of tiny rose-bud blooms in mid-summer.



In Bloom

Thymus praecox 'Purple Carpet'

Common Name:	Creeping Thyme
Height:	.5 in.
Width:	18 in.
Bloom Time:	Early Summer
Flower Color:	Purple
Hardiness:	Z2 (-40)
Light:	Full or Part Sun
Soil:	Sandy
Minimum Soil Depth:	2.5"+

There are a great many selections of Thyme grown in gardens, all of them with some degree of spicy fragrance. 'Purple Carpet' is a growing variety that features tiny dark green leaves, smothered by bright mauve-purple flowers in early summer. A strong grower, ideal as a drought-tolerant lawn substitute or for planting between flagstones, tolerating moderate foot traffic. Creeping Thyme is easily divided in spring or early fall, and even small pieces will take root and grow. Attractive to butterflies. Evergreen.



In Bloom

Thymus pseudolanuginosus 'Wooly Thyme'

Common Name:	Wooly Thyme
Height:	4 in.
Width:	48 in.
Bloom Time:	Early Summer
Flower Color:	Pink
Hardiness:	Z3 (-30)
Light:	Full Sun
Soil:	Sandy Loam
Minimum Soil Depth:	2.5"+

This vigorous creeper produces dainty, pale-pink flowers in midsummer, but the fuzzy, gray-green foliage always steals the show. Excellent in the rock garden or on a sunny bank.



In Bloom

Thymus serpyllum 'Albus' **('Album')**

Common Name:	Creeping White Thyme
Height:	2 in.
Width:	16 in.
Bloom Time:	Early Summer
Flower Color:	White
Hardiness:	Z4 (-20)
Light:	Full Sun
Soil:	Sandy Loam

Minimum Soil Depth: 2.5"+

This is a low-growing, 3 inch tall plant that is used as a ground cover. The plant tolerates dry soil and needs little care after it is established. The main ornamental trait is the white flowers that are borne in summer.



In Bloom

Thymus serpyllum **'Coccineum'**

Common Name:	Red Thyme
Height:	4 in.
Width:	12 in.
Bloom Time:	Early Summer
Flower Color:	Lavender
Hardiness:	Z4 (-20)
Light:	Full Sun
Soil:	Sandy Loam

Minimum Soil Depth: 2.5"+

Mat forming; small, smooth dark green leaves; crimson-red summer flowers in profusion. A creeping type of Thyme suited for well-known culinary and garden uses. Plant between pavers, in rock gardens, in wall plantings, and in containers for a tidy, fine-textured effect. Used as an edging plant, it softens the lines of walks and pathways. The foliage is a deep green, and dark red flowers in summer add to the display.



In Bloom

Thymus serpyllum 'Elfin'

Common Name:	Elfin Creeping Thyme
Height:	4 in.
Width:	12 in.
Bloom Time:	Early Summer
Flower Color:	Pink
Hardiness:	Z4 (-20)
Light:	Full Sun
Soil:	Sandy Loam
Minimum Soil Depth:	2.5"+

Minute, miniature bun of thyme demands sandy soil, but not drought. For a raised bed or trough. 1/2" x 3". Tiny leaves form a small mound. A very unique specimen. Very similar to the white creeping thyme but with purple summer blooms. Use in your fairy gardens, rock garden, tabletop landscapes, just another cutie pie.



In Bloom

Veronica liwanensis

Common Name:	Speedwell
Height:	1 in.
Width:	15 in.
Bloom Time:	Mid Spring
Flower Color:	Blue
Hardiness:	Z2 (-40)
Light:	Full Sun
Soil:	Clay Loam
Minimum Soil Depth:	2.5"+

Veronica liwanensis was introduced by Plant Select® in 1997 for its excellent performance in landscapes and gardens from the intermountain regions to the high plains. This carpet forming, nearly succulent groundcover has shiny, dark green foliage covered with cobalt blue flowers from April to June. Veronica liwanensis is an evergreen which may have a purplish tint in hot sun.

Frequently Asked Roof Garden Questions

1. Can I use standard topsoil? Why not?

Regular soil is heavy, can contain pathogens, undesirable insects, and weeds. Its high organic content would shrink over time, potentially leaving a 4" roof garden with only 2" of soil after a few years, resulting in severely hampered drainage. Good engineered growth mediums for roof garden use contains no more than 8% organic matter and weigh half (or less) of what topsoil weighs when saturated without sacrificing any water holding ability. With a quality, engineered product, there are no pathogens, hidden seeds, or insect eggs, and it should conform to strict FLL-guidelines.

(Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau -- Guideline for the Planning, Execution and Upkeep of Green-Roof Sites)

2. How do we address high wind conditions?

When was the last time your garden blew out of your backyard? After the establishment period (60-90 days), the plants' roots tie together and stabilize the growth media. If an established roof garden "blows off" during a storm, the rest of the building is probably in very poor shape.

As of this writing, there are no common wind standards for roof gardens. It is expected that standards will be in place within a year or two.

3. Extreme temperature changes? Variations in Weather?

The growth media components are tested to survive dozens and dozens of freeze-thaw cycles. In addition, the growth media stabilizes the temperature fluctuations encountered by the layers below, lengthening their life span.

4. What if my roof leaks?

A “belt-and-suspenders” approach is taken to roof garden design to ensure there are no leaks. All roofs are leak-tested before application of the roof garden components. However, in the extraordinarily rare circumstance of a roof garden assembly leak, the leak can be found with electronic vector mapping when a TPO or PVC roof is used. Because Carlisle uses a fully-adhered roof system, the leak usually occurs in very close proximity to where the water enters the building, simplifying the search. In these rare instances, the roof garden directly above and around the leak must be removed for roof repair. Carlisle can fully warrant overburden removal and replacement for up to 20 years.

5. How do I maintain this roof garden?

It depends on the type of roof garden. Most extensive (shallow) gardens require only minimal maintenance such as fertilization and weeding in the spring followed by a fall check up and removal of excess debris. Large intensive (deep) roof gardens could require as much maintenance as a typical estate garden, which would include regular pruning, weeding, irrigation, etc. All-sedum roofs after 1-3 years should require no watering or fertilization.

6. What are the maintenance requirements?

Most roof gardens require some irrigation during the establishment period (30-90 days). Extensive (shallow) roof gardens tend to require less physical maintenance but can dry out more quickly in hot environments. Once established, most roof gardens should not require much, if any, water beyond what nature provides.

At a minimum, there should be two maintenance events per year. In the Spring, the roof garden should be weeded, fertilized, and drains inspected. In the Fall, debris clean up and weeding should occur. If a permanent irrigation system is in use, it should be disconnected and drained in the Fall, then reconnected and tested in the Spring.

7. How much load does a roof garden put on my roof?

The typical 4" roof garden weighs between 20-25 pounds per square foot. Weight can reach 100+ pounds per square foot for intensive gardens with shrubs and trees. The typical 4" roof garden weighs between 20-25 pounds per square foot. In cases where weight is a concern, Carlisle Roof Gardens can be engineered to achieve a 12-17 pound per square foot saturated weight.

8. Do I need to mow it?

Only if you want to. The vast majority of roof gardens use sedums or other plants that do not require mowing or a high degree of maintenance. In certain cases, building owners will opt for having a functional lawn on their roof, which would require mowing in most cases.

9. Do I need to worry about insects?

No. There will be more insects on a roof garden than on a typical membrane roof. However, this is usually to the benefit of the newly formed rooftop ecosystem. Where there is a higher concentration of plants, there will be more insects. Where there is a higher concentration of insects, there will be more birds.

If edible plants are being grown, there could conceivably be issues with certain pests such as aphids or thrips. Rooftop gardens tend to be more unforgiving to pest insects than ground level gardens, limiting the potential problem.

10. What are the benefits?

The benefits are numerous: Greatly decreased storm water runoff with cleaner water quality, lowered cooling and heating bills, reduced noise infiltration into the living space, extended roof life, additional usable building space, potential food production, carbon dioxide sequestration, air and particulate filtration, and combating urban heat island effect to name a few.

11. What kind of R-Value does a roof garden have?

In a completely dry state, the R-Value of a typical 4" deep Carlisle roof garden is approximately 6. However, the higher the moisture content of the assembly, the lower the R-Value, as thermal conductivity increases. The massive cooling savings realized from a roof garden are a result of the plants' evapotranspiration. Plants function as small water pumps operating at high pressure and low volume. When materials experience a phase change from liquid to vapor, they absorb a large amount of heat energy from the surrounding environment. In the case of water, every gallon transpired by the plants absorbs roughly 8,000 BTU's of heat energy. As a result, during hot summer days, the roof membrane temperature is typically 5-10°F. cooler than the ambient air temperature.

12. What is the life expectancy of a roof garden?

The roof life is expected to increase by 100%. In Germany, there is a 90-year-old roof garden which has never been replaced and has never leaked. The waterproofing membrane beneath a roof garden receives no ultraviolet light or massive temperature fluctuations, contributing to its long life span.

13. Is erosion a problem?

The majority of roof gardens are designed with a ¼" in 12" slope which greatly limits the amount of erosion that can occur. Once a roof garden is established, the plants' roots tie the assembly together, biologically tying together the upper level of the roof assembly. In addition, Carlisle Growth Media is designed to allow rapid drainage rates, even when saturated which prevents erosion.

14. Does it have a warranty?

The traditional Carlisle warranty covers the products in the assembly, but the building owner is responsible for removal of the overburden (plants, growth media, drainage layer, etc.) in the event of a claim. For a nominal fee, an overburden warranty can be purchased by the building owner. If the overburden warranty is purchased, Carlisle would be responsible for locating the leak, overburden removal, leak repair, and overburden replacement.

15. Can it survive a drought?

Plants are chosen for the particular environment to have low water requirements. The use of native plants and/or sedums HALVES the water requirement of the roof garden.

16. Are roof gardens limited to low slope applications?

No. High slope roof gardens can be employed using various methods including stepped gardens, erosion mats and rows of cells to contain the growth media against erosion. Carlisle has designed Roof Gardens to be used on a 45° slope.

17. Water retention capabilities, weight implications?

On a year-round average, 55%-80% of all storm water that falls on a roof garden is retained and not released into the drains. All weights reported in roof garden assemblies reflect the saturated weight. As an example, if a growth media weighs 35 pounds per cubic foot dry and 60 pounds per cubic foot saturated, a 12" garden would hold up to 25 pounds of water per square foot. This is equivalent to 3 gallons of water or 4.8" of rainfall.

18. Aesthetic benefits: Can the Roof Garden be walked upon, used as courtyard / common area?

Absolutely. Many building owners use pavers or other methods to achieve a courtyard effect. Having an enjoyable outdoor space on the roof benefits all building users.

19. What is the benefit of using native plants?

Native plants are always recommended on roof gardens. Native plants, combined with an organic fertilization regimen, tend to halve the water requirements of the roof garden.

20. What kind of plants can be grown on a roof garden?

Although sedum is, by far, the most common plant used on roof gardens, one could grow just about anything, provided the plants will work in your USDA zone and the growth media on the roof is deep enough. Smaller alternate plants include herbaceous perennials such as sage and creeping thyme. Some chefs in large urban centers will grow their culinary herbs on the roof, which saves thousands of dollars per year and provides the freshest possible product. Larger plants can include native shrubs and even full-sized trees in extreme applications.

21. Can my roof be dead level / flat? Why not?

Roof gardens need minimal slope to prevent standing water and anaerobic conditions. Anaerobic conditions can occur very quickly when it is warm and the sun is shining, pushing the plants' photosynthetic factories at full tilt. The first sign of inadequate oxygen at the root zone usually manifests itself as wilting under conditions of high light intensity and warm temperatures. At this point, the roots' permeability to water and nutrient uptake is retarded, closely followed by an accumulation of toxins. The next stage of oxygen starvation is the plants' production of ethylene (the stress hormone of the plant world). This gas accumulates in the roots and collapses the root cells. When this occurs, the root zone becomes a haven for pathogens such as Fusarium, which causes rotting, wilting and die-off very quickly. With oxygen-starved roots on a hot and sunny day, both stages described above can literally happen in less than 48 hours.

The water retention performed by roof gardens is not accomplished by physical restraint, but rather by a process of absorption and adsorption. A good roof garden growth media at a depth of 4" will be able to retain a minimum of 60% of all rainfall during the course of a year. With 6" of growth media, some roof gardens have seen year-round retention levels of 85%. If retaining as much storm water as possible is a primary goal, many people install cisterns or basins for capturing what water does come off their roof garden. The benefit of this is that the water is generally cleaner after making its way through the growth media than it would have been had it come off a standard membrane roof.

In cases of a dead-level roof deck, tapered insulation can be used underneath the assembly to achieve a slight slope.

C A R L I S L E R O O F G A R D E N S Y S T E M S



ROOFGARDEN[®]



Carlisle SynTec

www.CarlisleRoofGardens.com

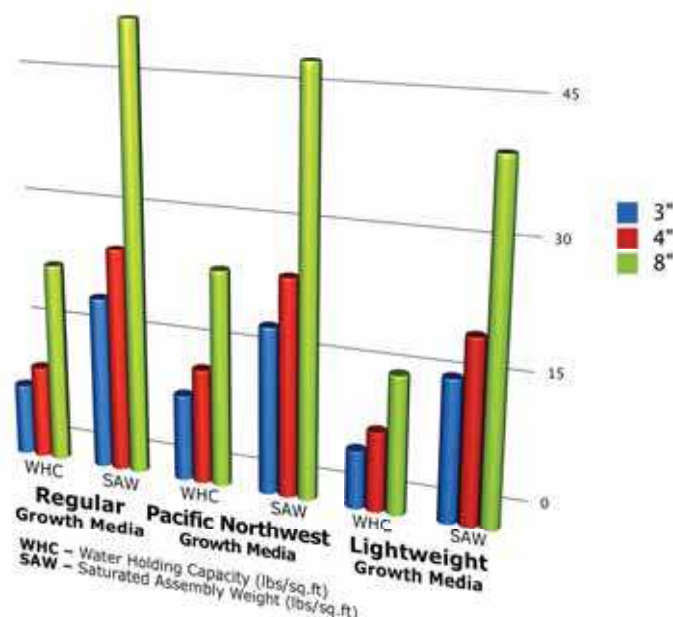


CARLISLE'S RoofGARDEN

For more than 45 years, Carlisle's products have set the standard for quality and performance in the commercial roofing industry. Carlisle repeatedly raises the bar through steady development and continuous introduction of innovative new products and technologies. The Carlisle Roof Garden line is no different, providing architects and building owners a huge selection of vegetative roofing options. With these systems, Carlisle offers an unparalleled variety of single-source roof garden solutions that provide numerous benefits, including:

- Improved stormwater management
- Increased air and water purification
- Superior sound insulation
- Energy efficiency
- Beautiful, usable building space
- Possible federal, state and local tax incentives
- Significantly extended roof life

Cumulative Water Retention in a Carlisle Roof Garden System (Per Sq. Ft.)



A 10,000 square foot, 4" deep Carlisle Roof Garden can retain up to 13,000 gallons of rainwater



Carlisle's Roof Garden Advantage



Carlisle Roof Garden Growth Media

Carlisle Roof Garden Growth Media is a FLL-Compliant blend of carefully selected materials that are optimized for use with roof gardens. Made from lightweight and water-absorbing components, Carlisle Roof Garden Growth Media supports all species of roof garden plants with minimum maintenance.

CCW MiraDRAIN® G4 Drainage Composite

CCW MiraDRAIN® G4 Drainage Composite combines a filter fabric, moisture retention mat, high-strength drainage core and protection fabric into one easy-to-use product. MiraDRAIN® G4 reduces installation costs and increases system performance. In shallow assemblies, one layer of MiraDRAIN® G4 is the only component required between the roof membrane and Growth Media.



Carlisle Roof Garden Metal Edge and Drain Box

Carlisle Roof Garden Metal Edge and Drain Box are excellent for retaining growth media while allowing adequate drainage. Carlisle's completely aluminum design provides superior resistance to rust and corrosion.

Carlisle Vegetated Sedum Tiles

Carlisle Vegetated Sedum Tiles offer full vegetative coverage on the day of installation. Placed over at least 2.5" of Carlisle Roof Garden Growth Media, Carlisle Vegetated Sedum Tiles sparkle with multiple varieties of sedum, leaving you with immediate beauty and minimal maintenance.



Carlisle Roof Garden System Warranty

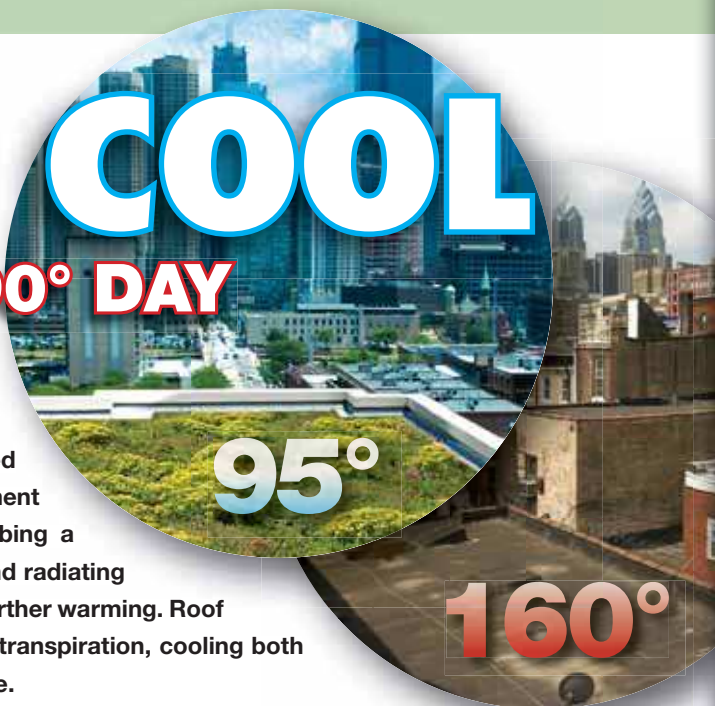
Carlisle Roof Garden System Warranty provides a single-source warranty for all components of the roof garden assembly, ensuring optimal performance.

KEEP COOL

ON A 90° DAY

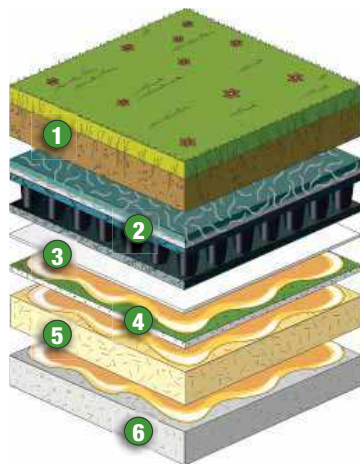
Reduces Heat Island Effects

Heat islands can occur in large cities where much of the vegetation has been replaced with roads and structures. Urban development can actually alter weather patterns, absorbing a significant amount of heat during the day and radiating it back into the atmosphere, which causes further warming. Roof Gardens keep these buildings cool through transpiration, cooling both the building and the surrounding atmosphere.



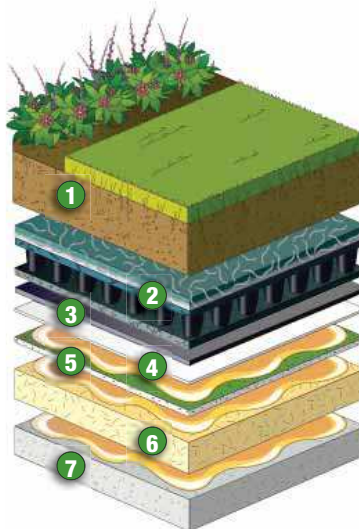
Carlisle's Traditional Roof Garden Assemblies

Carlisle offers a broad array of traditional Roof Garden Systems that incorporate a variety of waterproofing options with a full line of accessories to provide a high performance system. This includes a range of membranes that carry up to a 20-year warranty, engineered growth media and vegetation options.



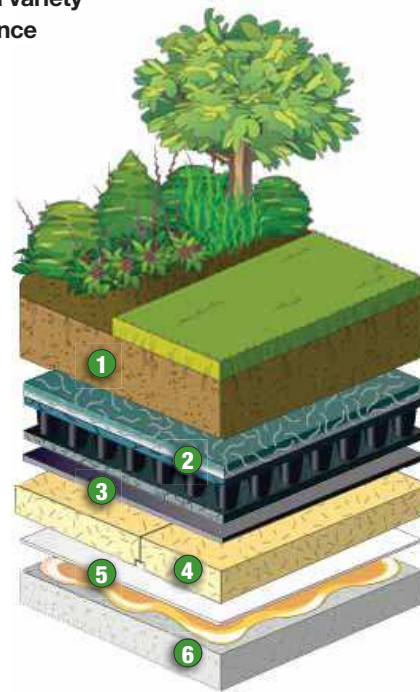
Shallow Assembly

1. Carlisle Growth Media and plants
2. MiraDRAIN® G4
3. Sure-Seal® EPDM or Sure-Weld® TPO Adhered Membrane
4. 1/2" DensDeck™ Prime or Securock
5. Approved Insulation
6. Substrate



Medium Assembly

1. Carlisle Growth Media and plants
2. MiraDRAIN® G4
3. 40-mil Root Barrier
4. Sure-Seal® EPDM or Sure-Weld® TPO Adhered Membrane
5. 1/2" DensDeck Prime or Securock
6. Approved Insulation
7. Substrate



Deep Assembly

1. Carlisle Growth Media and plants
2. MiraDRAIN® G4
3. 40-mil Root Barrier
4. Expanded Polystyrene Insulation with Drainage Channels
5. Sure-Seal® EPDM or Sure-Weld® TPO Adhered FleeceBACK® Membrane
6. Substrate

Roof Garden Warranties

Carlisle Roof Garden Overburden Warranty

Carlisle offers up to a 20-year overburden removal warranty covering the removal and replacement of the roof garden components if there is a need to investigate for a leak.

Carlisle Roof Garden Vegetation Warranty

Carlisle offers a 2-year vegetation warranty to ensure the proper establishment of plants and a minimum 50% coverage of vegetation within year one and 80% coverage by year two.



Investing in Roofing Solutions for Over 45 Years

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CARLISLE
Carlisle SynTec



Hassle-Free Roof Gardens

[®]
GREEN GRID

CARLISLE

GREENGRID

Carlisle's GreenGrid Roof Garden System offers distinct advantages over more complex systems with its simplicity in design, pre-planted modules and movable modular features.

With the introduction of its GreenGrid Roof Garden System, Carlisle has given contractors the opportunity to offer customers a premium, yet easy-to-install roof garden system.



Carlisle's GreenGrid Advantages

GreenGrid Roof Garden Systems are an easy way to create a rooftop that becomes more than just a one-dimensional waterproofing system. GreenGrid offers all the advantages of a traditional roof garden with some of the more important benefits outlined below.

Stormwater Management

GreenGrid Roof Garden Systems help alleviate stormwater runoff through retention and detention of precipitation. This benefit can cut costs associated with required municipal on-site stormwater retention.

Reduce Urban Heat Island Effect

As a result of decreased plant life and the increased use of concrete and pavement, downtown urban areas can be six to eight degrees Fahrenheit warmer than their surroundings – a phenomenon known as the urban heat island effect. Installing a Carlisle GreenGrid Roof Garden can contribute to reduction of urban heat islands and moderation of city temperatures.

Air Quality

GreenGrid Roof Garden Systems help to purify the air by converting CO₂ into oxygen, helping to reduce greenhouse gases. The GreenGrid growth media structure helps to purify the water and is designed to provide a method for neutralizing acid rain.



Extends Roof Life

GreenGrid Roof Garden trays can protect roof membranes from ultraviolet radiation, extreme temperature fluctuations and puncture or other physical damage. Minimization of such exposure can improve the long-term performance of the roofing system.

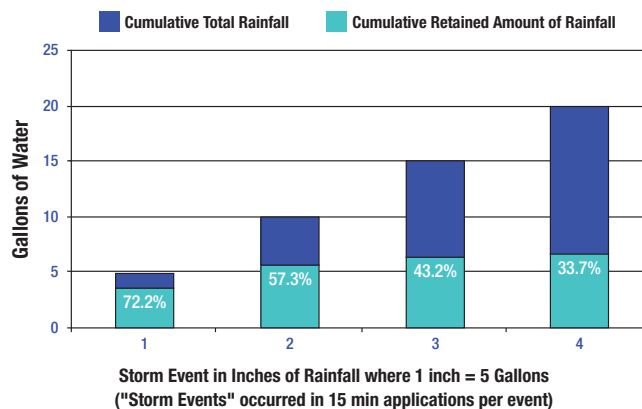
Added Aesthetic Value

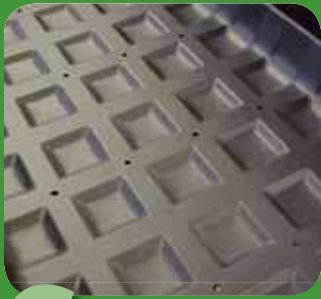
GreenGrid Roof Garden Systems provide urban environments with visually pleasing vistas and rooftop gardens. In urban environments, roof gardens also add value by converting space into areas usable for recreation by building occupants. In such locations, the scarcity of real estate makes the addition of a roof garden for such recreation a competitive alternative.

Maintenance

Minimal maintenance is required for GreenGrid Roof Garden Systems. Irrigate two to three times per week for the first three weeks to establish the root system. After that, maintain green roof as needed, which will include occasional weeding and irrigating during extended periods of drought.

Cumulative Water Retention in a Four-Inch GreenGrid Unit During a Simulated Two-Hour Rain Storm





CARLISLE

GREENGRID

SIMPLICITY.



Carlisle's GreenGrid Roof Garden System

offers distinct advantages over more complex systems with its simplicity in design, pre-planted modules and movable modular features.

Benefits:

- Single-source responsibility – roofing contractors can install both the waterproofing and the GreenGrid in one installation
- No planting on the roof – trays are pre-planted before arriving on the job site, including root barrier, growth media and plants
- Easy to handle and fast to install
- Trays are easily moved for modifications or roof repair
- Building owners receive single-source warranty coverage

Features:

Standard GreenGrid

Tray depth: Four inches

Weight: Four-inch tray weighs 23 psf wet

Tray sizes: 2' x 4', 2' x 2' (fill product) and 40" x 40" (larger designs)

Vegetation: Various sedum species

Special Order

Tray depth: Eight inches

Weight: Eight-inch tray weighs 45-50 psf wet

Tray sizes: 2' x 4' and 2' x 2'

Vegetation: Sedum and other perennials



Plant Suggestions by Region



Sedum kamtschaticum



Sedum album



Sedum moranense



Sedum sexangulare



Sedum spurium 'Fuldaglut'



Sedum spurium 'John Creech'

Contact your Carlisle representative for vegetation options specific to your region.

Investing in Roofing Solutions for Over 45 Years

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