

CCW 500R Green Roof Waterproofing System

PART I - GENERAL

1.01 DESCRIPTION

The Carlisle Green Roof Waterproofing System utilizes the CCW-500R Waterproofing System that is fully adhered to an approved substrate. The thickness of the membrane is 215mils reinforced. Refer to Paragraph 1.03, Design Guidelines, for specific requirements.

Various components including Root Barriers, Polystyrene Insulation, Water Retention Mats, Drainage and/or Water Retention Boards, Filter Fabrics, Engineered Growth Media and Vegetation are installed above the membrane dependant on desired planting schedule, allowable loads and the climactic region of the project.

1. 2 VEGITATIVE ROOF DEFINITIONS

- A. Intensive (10” of soil or more) Green Roof System: A planting system of greater depth that requires regular maintenance, such as watering, fertilizing and mowing/weeding. A variety of plants are available including sod 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 may be utilized in these assemblies, as required. The anticipated weight above the waterproofing membrane assembly is generally greater than 45 pounds per square foot when saturated.
- B. Extensive (6” to 10” of soil) Green Roof System: A medium depth planting system 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 waterproofing membrane assembly is generally less than 45 pounds per square foot when saturated.
- C. Ultra-Extensive (6” or less of soil) Green Roof System: A shallow planting system ideally suited for areas that will receive little maintenance. Recommended plants include sedums, herbs and grasses. The anticipated weight above the waterproofing membrane assembly is generally less than 25 pounds per square foot when saturated.

1. 3 DESIGN GUIDELINES

The Green Roof Waterproofing assemblies will incorporate a 215-mil hot applied rubberized asphalt membrane. Root barriers must be incorporated above the protection board. Moisture retention mats are required for shallow Green Roof assemblies and are recommended for Green Roofs with medium depth depending upon the site condition and the soil’s ability to retain moisture. To facilitate drainage, a minimum roof slope of 1/4" in 12" must be provided at the waterproofing membrane level.

- A. Intensive (10” of soil or more) Green Roof System: Proper substrate shall be provided beneath the waterproofing membrane.
 - 1. Install CCW 500R Hot Applied Waterproofing Membrane System.
 - 2. Install CCW Protection Board HS.
 - 3. Install CCW Root Barrier consisting of 40-mil non-reinforced Geomembrane.
 - 4. Install CCW MiraDRAIN 9800 Drainage Board.
 - 5. Install 10” or more of Carlisle Engineered Media.

- B. Extensive (6" to 10" of soil) Green Roof System: Proper substrate shall be provided beneath the waterproofing membrane.
 - 1. Install CCW 500R Hot Applied Waterproofing Membrane System.
 - 2. Install CCW Protection Board HS.
 - 3. Install CCW Root Barrier consisting of 40-mil non-reinforced Geomembrane.
 - 4. Install CCW MiraDRAIN 9800 Drainage Board.
 - 5. Install insulation as required.
 - 6. Install MiraDRAIN GR9200.
 - 7. Install CCW 300HV Water Retention Mat.
 - 8. Install CCW MiraDRAIN GR9400 with integrated water retention mat for as alternate to steps 6 & 7 for greater water retention.
 - 9. Install 6"-10" of Carlisle Engineered Media.
- C. Ultra-Extensive (6" or less of soil) Green Roof System: Proper substrate shall be provided beneath the waterproofing membrane.
 - 1. Install CCW 500R Hot Applied Waterproofing Membrane System.
 - 2. Install CCW Protection Board HS.
 - 3. Install CCW Root Barrier consisting of 40-mil non-reinforced Geomembrane.
 - 4. Install MiraDRAIN GR9200.
 - 5. Install CCW 300HV Water Retention Mat.
 - 6. Install CCW MiraDRAIN GR9400 with integrated water retention mat for as alternate to steps 4 & 5 for greater water retention.
 - 7. Install up to 6" of Carlisle Engineered Growth Media.

1.04 QUALITY ASSURANCE

- A. This Green Roof Waterproofing System must be installed by a Carlisle Coatings & Waterproofing Inc Authorized Applicator in compliance with shop drawings approved by Carlisle Coatings & Waterproofing Inc. There must be no deviations made from Carlisle's specifications or the approved drawings without the prior approval from Carlisle Coatings & Waterproofing Inc.
- B. A pre-installation meeting should be coordinated by the specifier and attended by the waterproofing applicator, membrane manufacturer's representative and other trades working on the Green Roof System both before and after installation. The purpose of this meeting is to discuss the necessity of ensuring proper waterproofing 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 Carlisle Coatings & Waterproofing Inc representative to ensure that the waterproofing membrane has been installed according to Carlisle Coatings & Waterproofing Inc specifications and details. This inspection shall be coordinated prior to installing the Green Roof components so that access to the membrane is not impaired.
- D. Flood testing, electronic testing or other leak detection means is strongly advised to check the waterproof integrity of the membrane prior to installing any above membrane components and is required for system warranty.
- 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 above membrane components.

1.05 SUBMITTALS

- A. General: Submit in accordance with Section 01300.
- B. Product Data: Submit manufacturer's product literature and installation instructions.

- C. Subcontractor's approval by Manufacturer: Submit document stating manufacturer's acceptance of subcontractor as an Approved Applicator for the specified materials.
- D. Warranty: Submit a sample warranty identifying the terms and conditions stated in Section 1.06.

1.06 WARRANTY –

Provide a written, single-source warranty for all system components agreeing that during the warranty period to promptly make repairs or replacement of defective materials of the waterproofing system without additional cost to the owner.

- 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 Coatings & Waterproofing Inc. 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. For a nominal charge, a 10, 15 or 20-year Overburden Warranty can be added. The warranty covers all components above the membrane limited to the protection fabric, polystyrene, drainage products, moisture retention mat, and growth media. In the event of a failure, Carlisle is responsible for overburden removal, roof repair, and replacement of the overburden up to the value of the components above the membrane.
- B. Access for warranty service - If a 10, 15 or 20-year Overburden Warranty is not obtained, it shall be the owner's responsibility to expose the waterproofing membrane assembly in the event warranty service is required.
- 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

- A. Coordination between various trades is essential to avoid unnecessary traffic to prevent damage to the membrane. Heavily traveled areas must be protected by placing temporary protection courses to prevent damage to the membrane.
- B. Coordinate waterproofing work with other trades. The applicator shall have sole right of access to the specified areas for the time needed to complete the application.
- C. Protect adjoining surfaces not to be waterproofed against damage or soiling. Protect plants, vegetation and animals which might be affected by waterproofing operations.
- D. Wear applicable protective clothing and respiratory protection gear.
- E. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in original, factory-sealed, unopened containers bearing manufacturer's name and label intact and legible with following information.
 - 1. Name of material
 - 1. Manufacturer's stock number and date of manufacture
 - 2. Material safety data sheet

- B. Store flashing, mastic and primer in a protected area out of direct sunlight. Protect from rain and physical damage.
- C. Carlisle Engineered Green Roof growth media, when specified, should be stored under cover whenever possible to avoid excessive moisture absorption. Care should be taken not to damage the packaging to avoid leakage when hoisted to the rooftop.
- D. Carlisle Green Roof Plants, when specified, should be used immediately upon arrival in the case of sedum cuttings. If plugs are specified, they should be unpacked immediately upon arrival and planted within three (3) days. Unused plugs 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

- A. Provide products manufactured and supplied by Carlisle Coatings & Waterproofing Inc, 900 Hensley Lane, Wylie Texas 75098, phone (800) 527-7098, fax (972) 442-0076.
- B. The components of this Green Roof System are to be products of Carlisle Coatings & Waterproofing Inc. The installation, performance or integrity of products by others is not the responsibility of Carlisle Coatings & Waterproofing Inc and is expressly disclaimed by the warranty.

2.02 MEMBRANE

- A. Hot-applied liquid membrane: Shall be CCW-500 Hot-Applied Membrane, rubberized asphalt compound, and shall meet or exceed the requirements of CGSB-37.50-M89.
- B. Reinforcing fabric: Shall be CCW-500 Reinforcing Fabric which is a 1.35 oz/square yard spun-bonded polyester fabric.

2.03 RELATED ACCESSORY PRODUCTS

- A. Flashings: Shall be CCW-711-90 90-Mil Sheet Membrane and Flashing for non-exposed areas and Sure-Seal[®] EPDM Flashing for exposed areas.
- B. Surface Primer: Shall be CCW-550 Primer.
- C. Mastic: Shall be CCW-704 Mastic.
- D. Sealants: Shall be CCW-703 Vertical Grade LIQUISEAL[™] Membrane or CCW-201 two-component Polyurethane Sealant.
- E. Backer Rod: Shall be closed-cell polyethylene foam rod.
- F. Expansion Joints: Shall be the EJ-500
- G. Protection Course: Shall be CCW Protection Board-HS.
- H. Root Barrier: Shall be the CCW Root Barrier consisting of 40-mil non-reinforced Geomembrane. with heat welded seams
- I. Drainage and/or Water Retention Composite: Shall be CCW MiraDRAIN as recommended by the manufacturer for each condition.
- J. Insulation: Shall be expanded or extruded polystyrene insulation with a minimum 60psi (or as specified by architect) compressive strength as manufactured by Insulfoam, Foamular or Dow.
- K. Pavers: Where required, shall be as recommended and supplied by the membrane manufacturer.
- L. Perimeter Drainage System: Where required, shall be CCW QuickDRAIN[™].
- M. H.P. Protective Mat shall be applied over insulation prior to ballast placement.

2.04 CARLISLE GREEN ROOF COMPONENTS

- A. Moisture Retention Mat – 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. It is available in rolls 12.5' in width by 200' in length.
- B. CCW MiraDRAIN GR9200 Drainage/Water Retention Board consists of a high impact polystyrene core with “cups” and pierced holes allowing water retention and drainage. A non-woven polypropylene filter fabric is bonded to the retention side of the molded core to prevent passage of particles into the water reservoirs. It is designed to retain water in Ultra-Extensive and Extensive Green Roofs while allowing excess water into the drainage system. It is installed under the CCW 300HV moisture retention mat. CCW MiraDRAIN GR9200 is 0.4" thick with a Water Flow Rate of 140 – 145 gpm/ft² (ASTM D 4491) and water retention with the CCW 300HV of .13 gal/ ft². It is packaged in 4' x 50' rolls.
- C. CCW MiraDRAIN GR9400 Drainage/Water Retention Board is a high flow drainage composite consisting of a high impact polystyrene core with a non-woven polypropylene moisture retention mat and filter fabric on the top side of the board to prevent passage of particles into the drainage core and add water retention to the system. It is used in Intensive (deep), Extensive Green (medium depth) and Ultra-Extensive (shallow depth) Green Roofs Systems above the root barrier. CCW MiraDRAIN GR9400 is 1" thick, and has a water flow rate of 82gpm/ft² (ASTM D 4491) and water retention of .2 gal/ ft². It is packaged in 4' x 50' rolls.
- D. Polystyrene Insulation -
 - 1. Insulfoam is a minimum 60psi compressive strength, moisture resistant, closed cell expanded polystyrene. It is installed directly over the MiraDRAIN drainage board in Intensive (deep) green roof assemblies. It is available in 4' x 4' and 4' x 8' board sizes with a thickness of 1" to 40". It is also available in custom lengths and widths.
- E. Root Barrier – Carlisle 40 mil non-reinforced Geomembrane is a non-reinforced polypropylene sheet specifically formulated for use in below grade applications to resist root growth and soil bacteria. It is used in Intensive (deep), Extensive Green (medium depth) and Ultra-Extensive (shallow depth) Green Roof Systems. It is available in widths of 12' and lengths of 100'. Adjoining sheets may be heat welded or spliced together with Carlisle SecurTAPE/HP-250 primer.
- F. Carlisle Engineered Growth Media – a lightweight FLL-approved growth media used for Green Roof applications. It is applied at the specified depth on Carlisle Green Roof assemblies.

Analysis	Units	Results				FLL Guidelines For Extensive Multi-Course Sites	FLL Guidelines For Intensive Multi-Course Sites
		Extensive Sites		Extensive and Intensive Sites	Intensive Sites		
		CEGM-R*	CEGM-L*	CEGM-P*	CEGM-I*		
Bulk Density (dry weight)	lbs/cu. ft.	45.7	35.8	34.0	41.6		
Bulk density (saturated weight)	lbs/cu. ft.	72.5	57.5	69.3	74.4		
Total Pore Volume	Vol. %	53	78	73.4	74		
Maximum water Holding Capacity	Vol. %	46	37	61.6	53.2	>35	>45
Air-Filled Porosity (at max. WHC)	Vol. %	25.6	41	16.0	20.9	>10	>10
Water Permeability	cm/s	0.03	0.48	0.063	0.02	>0.001	>0.005
Water Permeability	in/min.	0.731	11.4	1.49	0.38	>0.0236	>0.0118
pH		6.6	7.4	6.7	6.1	6.5-8.0	5.5-8.0
Soluble Salts (water, 1:10, m:v)	mmhos/cm	0.1	0.4	0.23	0.25		
Soluble Salts (water, 1:10, m:v)	g (KCl)/L	0.47	1.3	0.96	1.07	<3.5	<2.5
Organic Matter Content	mass %	5.2	7	7.2	9.3	<8	<12.0

* CEMG – Carlisle Engineered Growth Media

- H. Carlisle Green Roof Plants – a wide selection of plants specifically chosen for rooftop environments is available from Carlisle. Plant requirements are evaluated by Carlisle on a case-by-case basis.

2.05 OTHER NON-CARLISLE PRODUCTS

- A. Vegetation – Grasses, herbs, flowers, shrubs, small trees, etc., to be selected by the landscape architect/designer or other appropriate landscape professional and intended for the Green Roof type (Intensive, Extensive or Ultra-Extensive).
- B. Hanover Items:
 - 1. Individual concrete plaza pavers – 2' x 2' x 2" thick pre-cast concrete pavers weighing a minimum of 18psf 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 with ASTM D448, gradation size #4, applied at a minimum of 10 pounds per square foot.
 - 4. Other – Those products such as concrete curbs, landscape lumber (wood timbers, etc.) or other desired landscape products suitable for this application that are generally used to transition between Ultra-Extensive, Extensive and Intensive Green Roof areas to act as a “growth media stop.”

PART III EXECUTION

3.01 GENERAL

Before any waterproofing work is started the waterproofing applicator shall thoroughly examine all surfaces for any deficiencies. Should any deficiencies exist, the architect, owner, or general contractor shall be notified in writing and corrections made.

3.02 ROOF DECK CRITERIA

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 Green Roof system, as well as construction loads and live loads, in accordance with all applicable codes. The specifier must also designate the maximum allowable weight.

- A. Ultra-Extensive (6” or less of soil) Green Roof System, any roof deck capable of withstanding the roof loading may be accepted.
- B. Extensive (6” to 10” of soil) Green Roof System and Intensive (10” of soil or more) Green Roof System, 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 Coatings & Waterproofing Inc Authorized Applicator shall not proceed unless the defects are corrected.

3.03 SUBSTRATE REQUIREMENTS

The substrate must be relatively even without noticeable high spots or depressions and shall be dry, relatively smooth, 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 1/16" must be filled with a suitable material.

- A. Before any waterproofing work is started the waterproofing applicator shall thoroughly examine all surfaces for any deficiencies. Should any deficiencies exist, the architect, owner, or general contractor shall be notified in writing and corrections made.
- B. Condition of Concrete Surfaces:
 - 1. The concrete surfaces shall be of sound structural grade, 3500 psi minimum, and shall have a wood float or fine broom finish, free of fins, ridges, voids or entrained air holes.
 - 2. Concrete shall be cured by water curing method. Curing compounds must be of the pure sodium silicate type and be approved by the Carlisle representative.
 - 3. Concrete shall be cured at least 14 days and shall be sloped for proper drainage.
 - 4. Voids, rock pockets and excessively rough surfaces shall be repaired with approved non-shrink grout or ground to match the un-repaired areas.
 - 5. Two-stage drains shall have a minimum three inch flange and be installed with the flange flush and level with the concrete surface.
 - 6. Surfaces at cold joints shall be on the same plane.

3.04 INSTALLATION

Refer to the applicable Material Safety Data Sheets and Technical Data Bulletins for cautions and warnings.

- A. Flashing and Detail Installation - Follow Carlisle Coatings & Waterproofing Inc applicable waterproofing system specifications for specific surface preparation procedures, membrane positioning and adhesive application requirements.
 - 1. Detail expansion joints per manufacturer's recommendation using the CCW-EJ-500.
 - 2. Apply a thin film of CCW-550 primer 16" wide, centered over sealed cracks and joints. Apply 60-90 mils of CCW-500 membrane to cover primed areas. Install a 12" wide strip of CCW-711-90 centered over joints and cracks greater than 1/16" in width.
 - 3. Preferred Flashing Method: Apply CCW-550 Primer at the juncture of all horizontal surfaces and vertical surfaces to the height indicated on the drawings (eight inches min. recommended), such as parapet walls, curbs, columns and all penetrations through the deck at a rate of 400-600 sq. ft. per gallon. Avoid puddles. Allow primer to dry for 1 hour minimum, 8 hours maximum. **Membrane will not properly adhere to wet primer.** Apply 60-90 mils of CCW-500 membrane to cover primed areas. Install CCW-711-90 mil sheet membrane flashing into this first course of CCW-500 to cover the vertical section and extend six inches onto deck surface. Flashing installation may be done during crack and joint treatment or during installation of the first layer of CCW-500 membrane. Completely cover all flashing material during installation of the subsequent layers of CCW-500 membrane.
 - 4. Install Sure-Seal EPDM flashings in exposed areas per Carlisle recommendations. Always clean and prime EPDM with EP-95 Splice Cement per Carlisle splice procedure prior to application of CCW-500 membrane.
 - 5. Apply a thin film of CCW-550 Primer in a four foot square area around drains. Allow primer to dry, one hour minimum, eight hours maximum. Apply 60-90 mils of CCW-500 membrane to cover primed areas. Install a three foot square section of CCW-711-90 flashing over the drain and onto the deck. No splices or seams are allowed within three inches of the drain flange. Terminate the flashing under the clamping ring of the drain and cut away the inner portion of the flashing. Use firm pressure to press the flashing against the CCW-500 surface and ensure good adhesion. Do not interfere with weep holes.

- B. Membrane Installation - Follow Carlisle Coatings & Waterproofing Inc applicable waterproofing system specifications for specific surface preparation procedures, membrane positioning and adhesive application requirements.
1. Apply CCW-550 primer to all surfaces and at the juncture of all horizontal surfaces and vertical surfaces, to the height indicated on the drawings (eight inches min. recommended), such as parapet walls, curbs, columns and all penetrations through the deck, to receive CCW-500 Waterproofing Membrane, including over flashings, at a rate of 400-600 sq. ft. per gallon. Avoid puddles. Allow primer to dry for one hour minimum, eight hours maximum. Membrane will not properly adhere to wet primer.
 2. Heat CCW-500 Membrane blocks in a twin wall kettle with continuous agitation and apply at temperatures between 365°F to 395°F. (**Caution: Do not exceed maximum safe operating temperature of 400°F.**)
 3. Apply heated CCW-500 Hot Applied Membrane to primed area and any pre-installed flashings at a rate of 17.8 sq. ft. per gallon or as required to obtain an average thickness of 90 mils.
 4. Apply CCW-500 Reinforcing Fabric and any required flashings while membrane is still warm and tacky. Cut and trim off any wrinkles or overlap sections of the reinforcing fabric or hot the fabric splices together with CCW-500.
 5. Apply a second coat of CCW-500 Hot Applied Membrane at a rate of 12.8 sq. ft. per gallon or as required to obtain an average thickness of 125 mils. Total thickness of the CCW-500-R System shall be 215 mils.
 6. Apply CCW Protection Board HS into the last course of CCW-500 and splice the protection board seams together with CCW-500.
- B. Application of Green Roof Components - Limit traffic over completed roof membrane sections to essential personnel only. Heavily traveled areas (staging areas, corridors used to transport green roof components) must be protected using 1/2" thick plywood or other sheathing.
1. A water test is strongly advised to ensure the waterproof integrity of the membrane system and is required for system warranty.
 - a. Allow CCW-500 Membrane to cool. Plug drains and provide barriers necessary to contain flood water.
 - b. Flood surface with two inch head of water for 24 hours. Inspect for leaks and repair membrane if leaks are found.
 - c. Retest after repairs have been made.
 - d. **Note:** electronic testing (Electric Field Vector Mapping – EFVM) may be used to test membrane/flashing for defects as long as the testing wires remain in place after the installation of the Green Roof media and plants.
 2. Sweep the surface of the membrane to remove all debris and loose or foreign material.
 3. Carlisle 40 mil non-reinforced Geomembrane Root Barrier
 - a. Overlap the adjacent Geomembrane Root Barrier sheets a minimum of 2" in preparation for splicing. **The membrane must be spliced together as outlined below.**
 - b. Splicing surfaces shall be clean. Dirt/contaminants can be removed from splice areas with Carlisle Weathered Membrane Cleaner. Weathered Membrane Cleaner must be used to remove surface oxidation on the root barrier surface when the material has been exposed to the elements for 7 days. Apply Weathered Membrane Cleaner with a clean HP Splice Wipe or other white rag. **Prior to heat welding, wipe the surface of the root barrier where the cleaner has been applied with a clean, dry, HP Splice Wipe or white rag to remove all cleaner residue.**
 - c. Extend Geomembrane Root Barrier up walls, curbs, etc. to the height of the top of the growth media layer.

4. CCW MiraDRAIN 9800 Drainage Boards when insulation is used
 - a. Install the CCW MiraDRAIN 9800 drainage panels with the fabric side facing upward. The first panels should be positioned with the flanged edge facing uphill.
 - 1) Place Drainage Board panels so water flows with the overlap.
 - 2) Cut the fabric along the flanged edge and remove to expose the edge of the drainage board core and flange.
 - 3) Place the dimpled edge over the preceding flanged edge to join adjacent panels.
 - 4) Fabric on the drainage board panels extends beyond the edges of the polystyrene core to provide an overlap to adjacent panels. When placing panels adjacent each other, overlap fabric in the direction of water flow.
5. Polystyrene Insulation when required
 - a. Insulation shall have a minimum compressive strength of 60psi.
 - b. Install insulation loose laid directly over the membrane with all joints tightly butted.
 - c. Extend insulation up walls, curbs, etc. to the height of the top of the growth media layer.
6. CCW MiraDRAIN® GR9200 or GR9400 Drainage/Water Retention Boards
 - a. On Ultra-Extensive (6" or less of soil) Green Roof Systems, the CCW MiraDRAIN GR9200 or GR9400 Drainage/Water Retention Board is placed over the Geomembrane Root Barrier. On Extensive (6" to 10" of soil) Green Roof Systems, the CCW MiraDRAIN GR9200 or GR9400 Drainage/Water Retention Board is installed over the Geomembrane Root Barrier or over insulation. On Intensive (10" of soil or more) Green Roof Systems, CCW MiraDRAIN GR9200 or GR9400 Drainage/Water Retention Board is installed over the Geomembrane Root Barrier or over insulation (CCW 300HV Water Retention Mat is required over the MiraDRAIN GR9200 Drainage/Water Retention Board prior to application of the growth media).
 - b. Install the CCW MiraDRAIN GR9200 or GR9400 Drainage/Water Retention Board with the fabric side facing upward. The first panels should be positioned with the flanged edge facing uphill.
 - 1) Place Drainage/Water Retention Board panels so water flows with the overlap.
 - 2) Cut the fabric along the flanged edge and remove to expose the edge of the drainage board core and flange.
 - 3) Place the dimpled edge over the preceding flanged edge to join adjacent panels.
 - 4) Fabric on the drainage board panels extends beyond the edges of the polystyrene core to provide an overlap to adjacent panels. When placing panels adjacent each other, overlap fabric in the direction of water flow.
 - c. CCW 300HV Water Retention Mat is positioned over the MiraDRAIN GR9200 Drainage/Water Retention Board prior to application of the growth media.
 - d. Cover drainage board within 7 days of installation to prevent UV exposure.
 - e. Extend drainage boards up walls, curbs, etc. to the height of the top of the growth media layer.
7. Moisture Retention Mat -
 - a. Unroll CCW 300HV Water Retention Mat and loose lay over the CCW MiraDRAIN GR9200 Drainage/Water Retention Board overlapping side and end laps a minimum of 2".
 - b. Under windy conditions, provide temporary ballast to prevent wind disturbance. It is recommended to install the growth media over the moisture retention mat soon after its placement to prevent disturbance.
 - c. Extend the moisture retention mat up walls, curbs, etc. to the height of the top of the growth media layer.
8. Growth Media/Planting

- a. Spread Carlisle Engineered Green Roof growth media to the specified depth, plus 10-15%. Dispense to locations in a manner that will not overload the structure.
- b. Thoroughly soak soil with water using a sprinkler, hand sprayer, or sub-irrigation system (if installed at the same time as the Green Roof application).
- c. Plant vegetation in accordance with the landscape architect/designer plans and instructions for the intended soil and climate.

CCW MiraDRAIN is a registered Trademark of Carlisle Coatings and Waterproofing

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Green Roof Waterproofing System

"Attachment I"

Root Barrier Geomembrane Physical Properties

- A. 40 mil non-reinforced Geomembrane Root Barrier - A non-reinforced polypropylene sheet specifically formulated for use in below grade applications to resist root growth and soil bacteria. It is used on Intensive (deep) and Extensive (medium depth) Green Roof Systems. It is available in widths of 12' and lengths of 100' and conforms to the following physical properties.

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)	ASTM D 5261	0.21 (95) (1.03) typical	
Tensile strength, lbf (kN)	ASTM D 638 Dumbell 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. B.P.T. is black panel temperature 9/03