

# Killingsworth Station

1455 NE Killingsworth  
Portland Oregon



## Project Objective

- Install and Ecoroof on a wood frame condominium.
- Install and Ecoroof on a prefabricated carport structure.
- Provided protection over the roofing membrane from Uv and maintenance activity, extending the life expectancy of the roof membrane.
- Provide storm water detention which would allow the building owner to receive Storm Water user fee discounts.
- Provided additional insulation.
- Reduce heat sinks in the urban core.
- Provide habitat.
- Assist in the promotion of Portland as a sustainable environment.

## Project Description

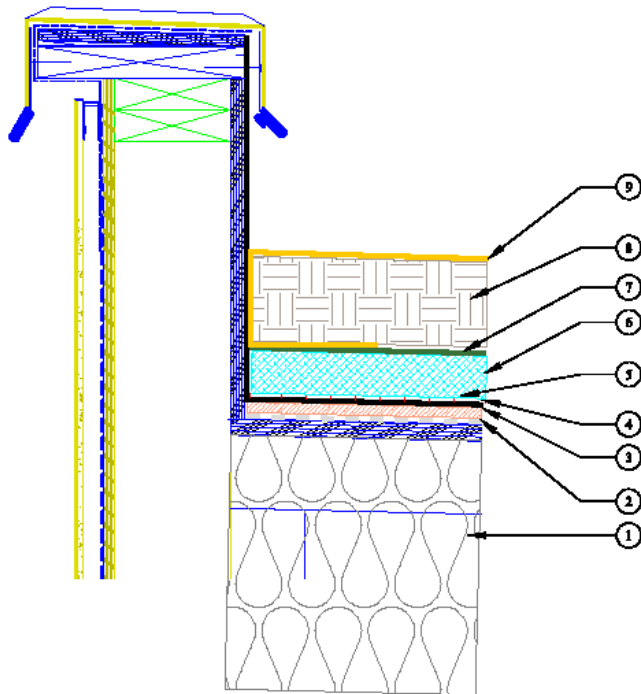
Ecoroof size: 20,783 sq ft

Project Type: Lightweight Ecoroof

General Description:

New wood construction development of 57 condominiums over 9,000 square feet of retail, and prefabricated metal carports.





## Ecoroof Design

1. R-85 Insulation
2. Metal grounding mat
3. Protection Board
4. TPO roofing membrane
5. Leak Detection
6. 2" rigid foam insulation
7. Carlisle Miradrain 9800
8. 4" ProGro Extensive
9. Jute
10. Sedum cuttings

### ▪ *R-85 Insulation*

In order to eliminate vent penetrations and attic cavity sprinklers, Killingsworth Station was designed with exterior insulation above the TPO to move the dew point out of the attic cavity. The attic cavity was then filled with unfaced batt insulation to eliminate the Fire and Life Safety requirement to have sprinklers.

### ▪ *Metal Grounding Mat* <http://www.leak-detection.com/>

The Ecoroof includes a leak detection system. Since the roof was constructed with wood, it is necessary to include a grounding mat of metal mesh under the protection board and roofing membrane.

### ▪ *Protection Board* [http://www.gp.com/build/roofboard\\_densdeckbrand](http://www.gp.com/build/roofboard_densdeckbrand)

Dens Deck protection board that covers the grounding mat and provides a smooth base for the roofing membrane.

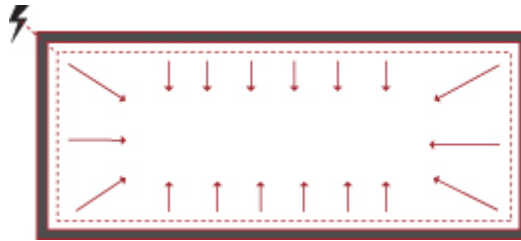
### ▪ *TPO Roofing Membrane*

TPO membranes are single-ply roof membranes constructed from ethylene propylene rubber. They are designed to combine the durability of EPDM rubber with the proven performance of hot-air weldable



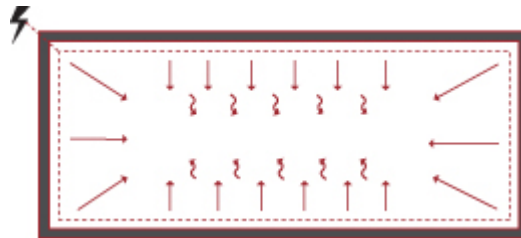
seams. They have been tested as having excellent resistance to ozone, are algae-resistant, environmentally friendly and safe to install. The material's manufacturers are so confident in properly welded seams that the material is sometimes advertised as a monolithic (seamless) roof. Seam strengths are reportedly 3 to 4 times those of EPDM's adhesive and tape seams.

- *Leak Detection* <http://www.leak-detection.com/>



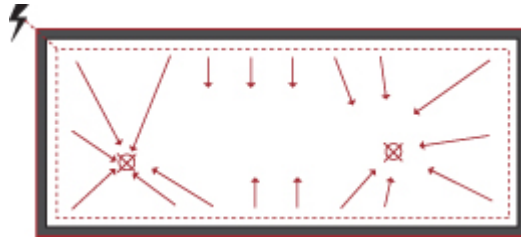
A. Small electrical pulses are directed onto the membrane. The electricity is searching for a ground connection.

An electric field is created by applying water on the membrane surface and using the water as a conductive medium. A breach in the membrane creates a vector (ground fault connection), which can then be measured by a certified ILD® technician.



B. If the membrane is watertight, the electricity is isolated and does not find a ground connection.

The EFVM® technician reads the electric flow traveling across the membrane, mapping the “vectors” with pin point accuracy.



C. If the membrane is not watertight, the electricity makes a ground connection and is pulled toward positive poles.

Once EFVM® testing is complete; customers receive CAD drawings, picture documentation and a written report detailing the location and nature of all breaches and defects.



- *Dow Styrofoam*
- <http://building.dow.com/na/en/products/insulation/deckmate.htm>

2" of Dow Styrofoam Brand Square Edge Insulation with an insulate value of approximately R-5 per inch and a compressive strength of 25 psi.



- *Carlisle Miradrain 9800*
- <http://www.carlisle-ccw.com>

CCW MiraDRAIN 9800 is a high-performance, high-strength drainage composite consisting of a three-dimensional, high-impact polystyrene core, and a superior, heavy weight nonwoven filter fabric. The filter fabric is bonded to the individual dimples of the molded polystyrene core to minimize fabric

intrusion into the flow channels caused by backfill pressure. The fabric provides unmatched filtration, preventing small particles of soil from clogging the drainage channel while allowing subgrade moisture to pass freely.

- **4" ProGro Extensive**
- <http://pro-gromixes.com>



*Pro-Gro Max Lite Extensive*

<b>Tested Weight Volume %</b>	<b>Weight per cubic foot</b>	<b>Water Retention weight <u>per cubic foot</u></b>	<b>Water Retention,</b>
Dry Weight (dry)	9.0 pounds per cubic foot.	0.0 pounds (dry)	0.0 %
Field Moisture Capacity (FMC)	39.0 pounds per cubic foot.	30.0 pounds	47.6%
Saturated Bulk Density (SBD)	50.7 pounds per cubic foot.	41.7 pounds	68%

Conclusion – At Field Moisture Capacity, 4 inches of media will hold 10 pounds of water or 1.2 gallons.  
At Saturated Bulk Density, 4 inches of media will hold 13.9 pounds of water or 1.7 gallons.

*I hope this is helpful. Please call me if you have any questions.*

Thank you,  
Dave Andrews  
Pro-Gro Mixes      Office 503 682-3500      Cell 503 320-0620

- **BoomEnvironmental Textiles** <http://www.boomenviro.com/greenGeotextiles.html>
- **Sedum Cuttings** <http://www.etera.com/>

Divergens, Oregonum, Album, Reflexum, Kamchaticum, Spurium, Sexangular mixed at #75's per thousand square feet.

- **Irrigation**

Domestic hose and sprinklers

## Costs

<b>Attic Insulation:</b>			<b>\$ 13,720.00</b>
Fill Cavity	Knez	\$	12,280.00
Tie Up R-38 to Deck	Knez	\$	1,440.00
<b>Delete Attic Roof Vents:</b>			<b>\$ (15,538.00)</b>
Delete Roof Vents	Pioneer S/M	\$	(15,538.00)
<b>Leak Detection:</b>			<b>\$ 30,840.00</b>
ILD	ILDNW / NW Solar	\$	22,040.00
Install Grounding Mat	McDonald Wetle	\$	8,800.00
<b>Blue Board Insulation &amp; Drainage Mat:</b>			<b>\$ 39,765.22</b>
Square Edge F.O.B.	White Cap	\$	12,906.00
MiraDrain 9800 F.O.B.	White Cap	\$	15,195.22
Labor	R&H	\$	11,664.00
<b>Moisture Blanket (5547 SF)</b>			<b>\$ 2,679.00</b>
Boom Enviro GN300	Allied Bldg Mat'ls	\$	2,300.00
Labor	R&H	\$	379.00
<b>Landscape:</b>			<b>\$ 55,156.00</b>
Plant Material - Main Roof	Etera	\$	9,734.00
Plant Material - Car Ports & Canopies	Etera	\$	3,640.00
Planting Labor	R&H	\$	1,137.00
Jute Material	White Cap	\$	3,965.00
Jute Labor	R&H	\$	2,274.00
Soil Material (250 CY @ \$53.90/CY)	Pro-Gro	\$	13,475.00
Soil Labor	R&H	\$	4,548.00
Rock Material (40 CY @ \$51.75/CY)	Pro-Gro	\$	2,070.00
Rock Labor	R&H		Incl in Soil Labor
Irrigation Materials	R&H	\$	888.00
Irrigation Labor	R&H	\$	948.00
Irrigation Plumbing (multi-port hose connections)	MSI Mechanical	\$	904.00
Crane (2 days, Main Roof)	R&H / Campbell	\$	4,395.00
Boom Truck Crane (1 day, Carports)	R&H	\$	1,080.00
Trucking (soil & rock)	R&H	\$	2,720.00
Quick Connect at each Carport	Greg Law Landscape	\$	878.00
Miscellaneous Costs	R&H	\$	2,500.00
<b>Carport &amp; Canopy Membrane:</b>			<b>\$ 5,890.00</b>
Carport Roof Membrane (Tremco 260)	Dowers	\$	6,451.00
TPO @Canopy Roofs	McDonald Wetle	\$	3,313.00
Walk-Pad Credit	McDonald Wetle	\$	(3,874.00)



Subtotal Direct		
Costs	\$	<b>132,512.00</b>
CCIP Insurance		
@2.59%	\$	<b>3,432.00</b>
Fee @3.75%	\$	<b>4,969.00</b>
Total Costs	\$	<b>140,913.00</b>
	\$	6.48

### Challenges to Resolve

- Leak detection system required a grounding mat. The mat is design to be cut 4~6” from vertical penetrations, which then leaves a blind spot in the electronic field at the very location of common breaches in the TPO. Typical TPO leaks are the result of vertical joints that were not properly seamed.
- In order to minimize vertical penetrations in the roofing membrane, the attic ventilation was removed and insulation on the exterior of the roofing membrane was introduced at a thickness that would move the dew point to the exterior of the roofing membrane. The roofing membrane is the vapor barrier separating the interior from exterior vapor. The attic space was then filled to 100% of capacity to eliminate a sprinkler system in the attic cavity. The additional insulation in the attic cavity may have moved the dew point back into the attic cavity. Further investigation is in process to determine the insulative value of the 4 inch section of the Ecoroof so that further analysis can be completed.
- The pre-manufactured carport metal roof panels were not of heavy enough gauge to allow for the installation of the



installation of the roof. The corrugated metal panels could not support a person walking directly on the panels without deflection, and water leaking through the metal panel joints onto park cars was a concern. To resolve the concern a cementitious Durarock tile backing board was installed with a

vapor barrier, over the vapor barrier a moisture retention blanket was installed under the 4 inch soil section.

### **Maintenance Program**

- Provide walk-thru to review and planting monthly until the fall of 2012
- Irrigate if required summer of 2012 Review irrigation coverage until September 15<sup>th</sup> 2010
- Provide one-year walk-thru and report to Bureau of Environmental Services.
- Log roof top activity
  - Do not allow landscape maintenance with tools.
  - Log roof access for mechanical and elevator maintenance.

### **Conclusions**

By working with the General Contractor to understand the simplicity of a successful Ecoroof design, we were able to accomplish the installation for \$6.48 per square foot. Taking an easier route of sub-contracting many of the Ecoroof elements would have resulted in substantial more costs. The General Contractor worked with the Design Team to find suppliers, and to use their laborers to perform the majority of the installation.

### **Special Thanks**

Once again the availability and spirited enthusiasm from the staff of Bureau of Environmental Services was contagious.

Special thanks to;

Tom Liptan and Alice Coker

Their energy and support make the Ecoroof program a success.

