

GARDEN ROOF[®] PLANNING GUIDE



Vancouver Public Library, Vancouver, BC

Garden Roof® Planning Guide

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LDS Conference Center, Salt Lake City, UT



901 Cherry Ave (The Gap), San Bruno, CA

INTRODUCTION



Oak Park Library, Oak Park, IL



Urban Challenges

Introduction

As our cities continue to grow, the natural landscape is being replaced with buildings, as well as parking lots and roadways of concrete and asphalt. Open green spaces within city centers are decreasing as the strong demand for land to build upon increases.

Temperature increases of 3°-10° F have been observed in city centers when compared to temperatures in outlying areas where Mother Nature is part of the natural surroundings. Commonly referred to as the “*urban heat island*” phenomenon, this dome of heat creates an unhealthy environment in which polluted air, smog and higher temperatures can take its toll on us all. In addition, these increased temperatures result in higher energy demands to keep our buildings cool.

To a great extent the rooftops, parking lots and roadways that make up the cityscape are impervious to water. This often results in an overload of the existing drainage and sewer systems and increases the risk of flooding following a heavy rain. Continued development in our cities will only add to this problem, making the cost of improving the existing sewer infrastructure prohibitive. Replacing the impervious surface of a conventional roof with a “green roof” can help to substantially reduce storm water runoff and restore the balance with nature in our urban centers.

Hydrotech’s Garden Roof® Assemblies combine the proven performance of our Monolithic Membrane 6125EV® roofing/waterproofing with proven green roof technology. Unlike conventional earth covered structures, Hydrotech’s Garden Roof Assemblies are lightweight and can be installed on a wider variety of new and existing structures.

The Garden Roof Concept

Hydrotech’s wide range of Garden Roof Assemblies are available to suit virtually any design requirement. They are typically classified as:

Extensive

Designed to be lightweight and support hardy plants, this option is considered low maintenance, with no irrigation required in most climates. This is an excellent choice if your objective is to mitigate the effects of urban heat islands and reduce stormwater runoff.

Shallow Intensive (Lawn)

Still considered a lightweight assembly, but with a slightly deeper soil depth, and designed to support sod lawns and perennials. Irrigation will depend on the plant choices and climate. Generally accessible by adjacent hardscape areas, such as a patio, beautiful additional usable space can be created.

Intensive

Deeper soil depths are required to support a wide variety of plants, shrubs and trees. Often designed to be accessible for recreational use, this comes as close as you can get to replicating your yard or garden on the roof. Irrigation and regular maintenance are necessary.



Seattle City Hall, Seattle, WA



Greenwich Academy, Greenwich, CT



65 E. Goethe, Chicago, IL

Why have a Green Roof?

Besides being aesthetically pleasing, a green roof can provide numerous ecological, technical and owner benefits.



Ecological

Mitigates Urban Heat Island: Green roofs cool and humidify the surrounding air creating a microclimate which has beneficial effects within the immediate area.

Natural Habitat for Animals and Plants: Green roofs create biodiversity, encouraging wildlife, such as birds, butterflies and insects, to remain within urban areas.

Reduction of Dust and Smog Levels: Green roof vegetation helps to filter out dust and smog particles. Nitrates and other aerosol contaminants are absorbed out of the air and rainfall and bound within the soil.



Technical Benefits

Storm Water Retention: Depending on the design, a green roof can typically reduce storm water run-off by 50 to 90%. Additionally, the peak flow volume is greatly reduced and the peak flow period is delayed by as much as 4 hours, minimizing the impact on existing sewer systems.

Additional Thermal Resistance: Green roofs can improve the thermal resistance of the roof assembly throughout the year, especially in summer months by helping to reduce cooling costs.

Reduced noise levels: Typical extensive green roofs (3" - 4" growing media) reduce reflective sound by up to 3 dB and improve sound insulation by up to 8 dB. This is most effective with buildings near airports, factories or busy freeways.



Owner Incentives

Increased Life Expectancy of the Roof: A green roof, much like a PMR (Protected Membrane Roof) Assembly, protects the roof membrane from climatic extremes and physical abuse, thereby greatly increasing the life expectancy of the roof.

Additional Usable Space: Converting or designing normally unused roof areas into green roofs, simply makes sense. Increase your property value by reclaiming the fifth elevation of a building and make it an amenity to be used by the buildings occupants.

Create a Therapeutic and Peaceful Environment: It is recognized that in a hospital or extended care facility, the ability to view or have access to a natural setting such as a green roof, can improve ones spirit and can aid in the healing process.

Produce Production: Grow your own vegetables or herbs? Why not. Some green roofs have been put to use by restaurants to provide their own source of herbs and vegetables.

Building Incentives: More and more municipalities and other government agencies are providing incentives that can help off-set the cost of a green roof. (U.S. Green Building Council's LEED program recognizes the benefits of a green roof)

Image: Since a green roof is good for the environment, it displays corporate responsibility and environmental leadership.

Hydrotech's "Total" Garden Roof® Assembly Approach

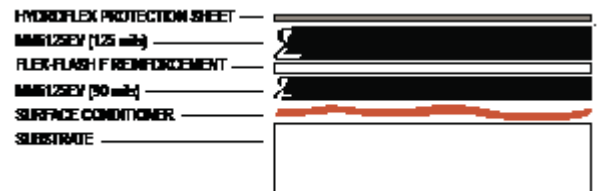
From the roof membrane up through the plants...

American Hydrotech, Inc. understands that a green roof needs to function first as a roof, keeping the structure watertight, and at the same time provide an environment conducive to the vegetation. In Hydrotech's Garden Roof® Assemblies we accomplish this by incorporating the very best in moisture protection, proven green roof technology and experience.

Building from the bottom up...

As a manufacturer of quality waterproofing and roofing products, Hydrotech's flagship product Monolithic Membrane 6125® (MM6125®), a fluid applied rubberized asphalt, has been keeping buildings watertight for over 40 years. Monolithic Membrane 6125EV (environmental grade), which contains 25% recycled materials, is the membrane of choice for Hydrotech's Garden Roof Assemblies. MM6125EV has been used in fountains, pools, reflecting ponds, planters and other applications where contact with water is to be expected. In addition to MM6125EV's ability to perform in a wet, submersed condition, MM6125EV has many other unique features that make it the best choice for Garden Roof applications...

- There are no seams to fail; the membrane is completely monolithic
- Bonded directly to the substrate
- Can be installed on substrates with little or no slope
- Easy to detail all critical penetrations and terminations
- Resistant to fertilizers and other mild acids
- No VOC restrictions; contains no PVCs
- Installed only by authorized, trained applicators



Hydrotech's history...

Over the years Hydrotech's Monolithic Membrane 6125EV has been used in numerous parking structures and plaza applications where large areas of planting were part of the overall design. These earth covered structures were engineered to accept the heavy loads because several feet of soil and various hardscape components were incorporated in the design. These installations were not referred to as "green roofs" back then, but are today by many. The difference between those early applications and the current green roof market is **weight**. Advancements in drainage/water retention technology and lightweight growing media have greatly reduced the weight of a green roof, allowing it to be used on a wider range of structures.



O'Donnell Park, Milwaukee, WI

Traditional earth covered applications were very heavy due to the type of soil used as well as the aggregate drainage.



The Hydrotech advantage...

In the early 1990's, Hydrotech was exposed to the green roof market in Europe and sought to duplicate this exciting advancement in roofing here in the United States. Hydrotech's first Garden Roof® Assembly (Mashantucket Pequot Museum) was installed in 1996; the first "single source" green roof assembly (everything from the deck up) in America. Since that time, Hydrotech expanded the product offerings to include a wide array of domestically sourced components, including soil and plants for Garden Roof Assemblies.

Design

Hydrotech's sales representatives and staff work closely with the design team, and can offer assistance with the specification development and details as part of the service offering. Each project is unique; here are some of the many issues each green roof application must consider.

- ✦ Structural requirements
- ✦ Wind uplift requirements
- ✦ Detailing of perimeter/penetrations
- ✦ Growing media (soil) requirements
- ✦ Safety
- ✦ USGBC's LEED credits
- ✦ Watertightness of roof
- ✦ Stormwater calculations
- ✦ Slope issues
- ✦ Plant palette/choices
- ✦ Maintenance issues
- ✦ Assembly warranty

Construction

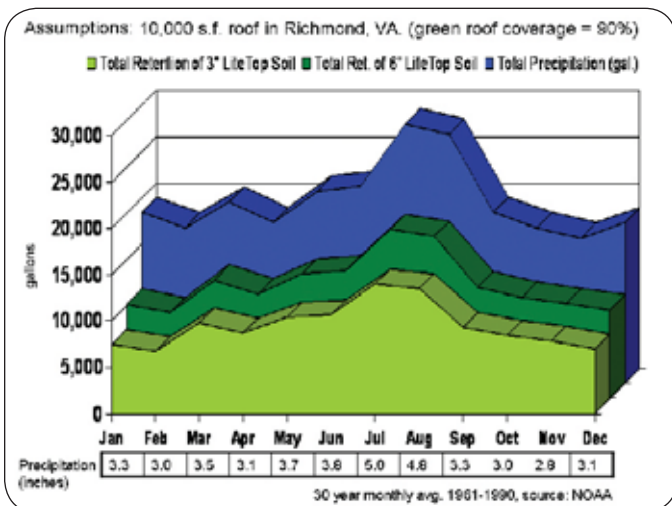
Hydrotech provides our Garden Roof Assembly to authorized, trained installers. On site assistance is available from Hydrotech.

Owner assurance

The Garden Roof Assembly consists of proven components from the deck up, which may include the waterproofing/roofing membrane, insulation, green roof components, growing media and even the vegetation for extensive applications. Hydrotech offers a range of warranty options to an owner providing long term assurance and peace of mind from the watertightness of the membrane, up to and including the plants. Contact Hydrotech for specifics.



601 Congress Street, Boston, MA



Example Stormwater Retention Analysis



Flamingo House at Lincoln Park Zoo, Chicago, IL

Extensive Garden Roof® Assembly

An extensive Garden Roof uses a select range of hardy plants, making it attractive to look at while requiring little maintenance. Extensive Garden Roofs are not intended for recreational use, but are usually chosen for their appearance or to help reduce the “urban heat island” effect and minimize stormwater run-off.

Extensive roofs only require a shallow growing media depth, generally as little as 3” - 4”, and therefore add little weight (typically 18-34 lb/sf wet weight) to the roof structure below.

Plant types for extensive roofs need to be drought, wind and frost resistant – such as self-generating sedums. See pages 22 - 26 for a list of suitable plants for extensive green roofs.

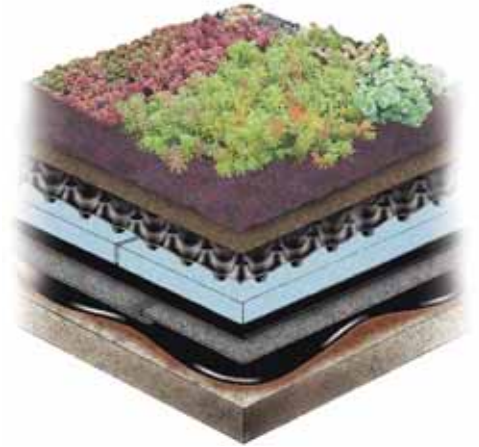
Features:

- Are lightweight with only 3” - 4” of growing media
- Ideal for inaccessible roofs
- Can be used on flat or sloping roofs
- Reduce stormwater runoff
- Help to mitigate the urban heat island
- Require minimum maintenance

The water stored in the growing media and drainage/retention layer is sufficient to sustain the drought resistant plants between periods of rainfall. Irrigation systems are not normally required except in extreme climates.

Extensive Green Roofs can be applied to flat roofs and sloping roofs with a pitch of up to 12:12 or 45°, provided the appropriate measures are taken to cope with the shear forces and soil retention. Please refer to page 42 for additional information regarding sloped applications.

Thinner assemblies and very lightweight growing media blends are available for extensive Garden Roof Assemblies. Contact Hydrotech for specifics.



Extensive Assembly



Slope Application



Lawrence Technological University - Taubman Student Services Center, Southfield, MI

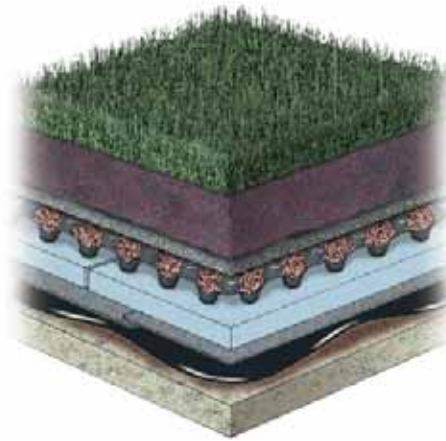


Evelyn P. Tyner Interpretive Center, Glenview, IL

Intensive Garden Roof® Assemblies

The landscape possibilities with intensive Garden Roofs are virtually limitless. They are intended for recreational, sporting and leisure purposes and are often indistinguishable from natural gardens in appearance.

Hydrotech's lawn and intensive Garden Roofs follow the same design concept as an extensive Garden Roof. However, the drainage/retention layer is usually deeper and filled with expanded aggregate to provide greater water storage and to support a greater depth of growing media.



Lawn Assembly



Intensive Assembly

The depth of the intensive growing media, which contains a greater amount of organic matter than an extensive blend, will generally dictate the type and size of plants that can be grown. See pages 25-28 for a list of suitable plants for intensive green roofs. Intensive green roof designs usually consist of a mixture of hard and soft landscaping. It is therefore important that the selected drainage/retention layer can support any type of landscape – from roadways and paths, to soil and trees, so as to permit excess water to drain unobstructed underneath.

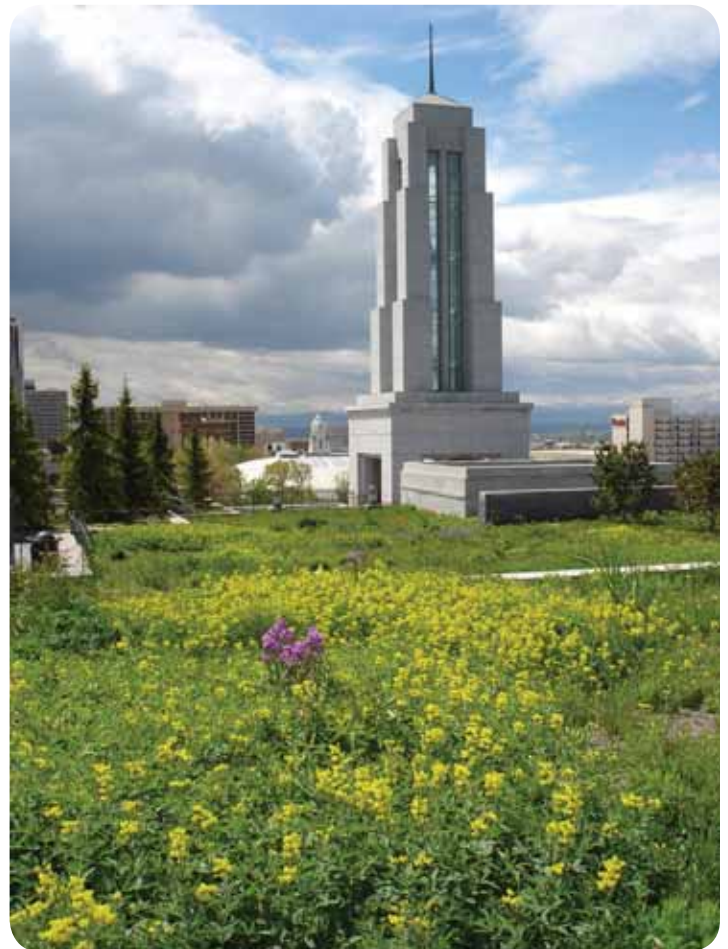
The water retention capacity of the Hydrotech drainage/retention layers is used to assist with the irrigation of the plants – it is not a substitute for an irrigation system, which should always be installed within either the intensive or lawn Garden Roof Assembly.

Features:

- ♦ Require greater growing media depths 6"-36"
- ♦ Can be used for recreation
- ♦ Accommodate a wider variety of plants/shrubs/trees
- ♦ Must be irrigated
- ♦ Require regular maintenance



555 W. Monroe, Chicago, IL



LDS Conference Center, Salt Lake City, UT

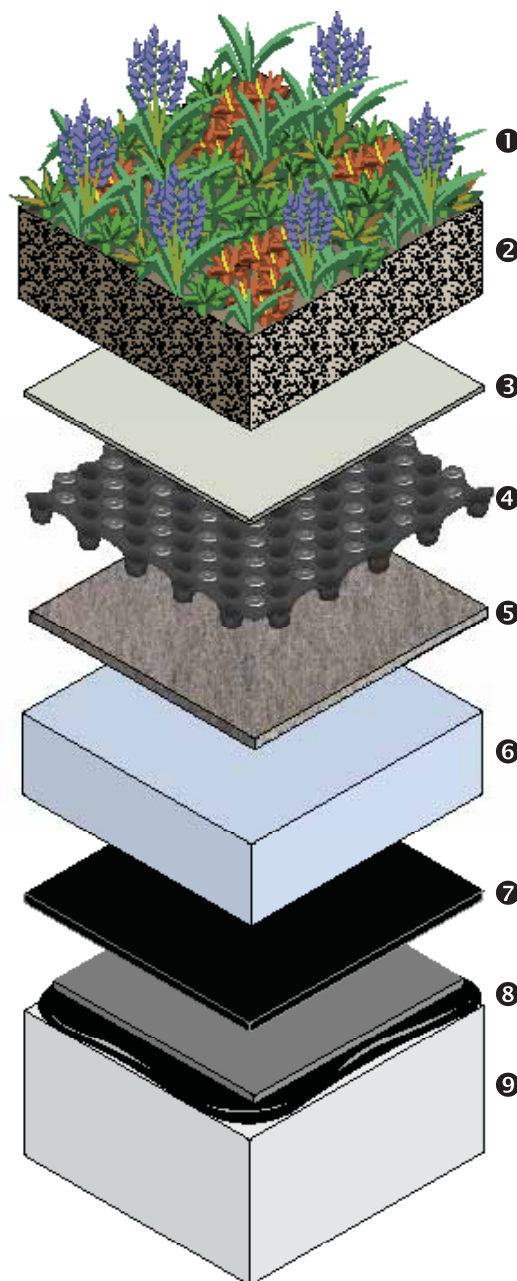
Components of a Garden Roof® Assembly

The range of Hydrotech's Garden Roof Assemblies ensures that the right design can be provided to meet the requirements of any landscape option, including:

- Extensive, Intensive Lawn and Intensive conditions
- Ponds, paved and play areas
- Sloping and flat roofs
- Pedestrian access onto the roof

A typical Garden Roof Assembly consists of...

- 1 Carefully selected plants** – extensive plants for low maintenance landscaping including the drought resistant, self-regenerating varieties available from Hydrotech. There are a wide range of plants for intensive landscaping that can be supplied by garden centers and nurseries. GardMat® erosion control blankets (not shown) are also available to aid in plant establishment.
- 2 Engineered lightweight growing media** – must have a well balanced structure and low weight. The pH values, nutrients, degree of porosity and vapor permeability must be suitable. The type and thickness of the growing media ultimately determine the plant choice as well as the structural load imposed on the roof structure. Hydrotech's LiteTop® growing media is specifically blended to meet the requirements of each project.
- 3 SystemFilter** – to prevent fine particles from being washed out of the substrate soil and therefore maintaining the efficiency of the drainage layer.
- 4 Drainage/retention / aeration element** – Hydrotech's Gardendrain™ retains water in the profiled troughs, even on sloping roofs. Excess water drains away through channels between the troughs. Strategically located holes provide the necessary aeration and ensure that moisture below diffuses up into the growing media.
- 5 Moisture Mat (optional, contact Hydrotech for recommendation)** – made of non-rotting fiber to retain moisture and nutrients as well as provide physical protection to the root barrier and waterproofing membrane.
(An air layer is required when placed directly over insulation - not shown)
- 6 Insulation (optional)** – situated above the roof membrane, an extruded polystyrene insulation which exhibits excellent moisture resistance, is dimensionally stable and has a high R-value. Dow Chemical's STYROFOAM® brand insulation is typically utilized.
- 7 Root barrier** – prevents roots from affecting the roof membrane. The type, thickness and method of installation depend on the nature of the landscape planned and the shape and slope of the roof.
- 8 Roofing membrane** – Only the best, Hydrotech's Monolithic Membrane 6125EV-FR® (Environmental Grade) Assembly with protection layer.
- 9 Structural roof deck** – must be designed to support the weight of the green roof as well as any other dead or live loads. Acceptable deck types include cast-in-place concrete, precast concrete, metal deck with cover board and plywood.



Replicating Nature on Roofs

A balance between air, water retention, drainage and more...

When designing and installing a green roof, it is important to provide a growing environment as close as possible to the plants natural habitat. One of the most important factors is to compensate for the lack of sub-soil.

Hydrotech's Garden Roof® Assemblies have the structure to properly aerate the growing media and retain the necessary quantities of water to support the plants while draining off the excess. The proper balance of oxygen and water is determined by the plant type, growing media, geographical region and the roof itself.

Hydrotech's Garden Roof Assemblies provide a number of solutions to these challenges and have been designed to function naturally, even though there is no direct contact with the ground and the entire assembly is normally not very deep. In short, the plants can enjoy a healthy growing environment without adversely affecting the main function of the roof - **KEEPING THE BUILDING DRY.**



Top soil ②

The Answer is in the DESIGN...

Each layer of the Garden Roof Assembly performs a particular function, just like natural soil. These functions include:

- ✦ Structure to support plants
- ✦ Provision of nutrients
- ✦ Water retention
- ✦ Aeration
- ✦ Drainage

Transition zone ③

Sub-soil ④ ⑤

Bedrock ⑤

Natural Soil Structure

Water Management in the Garden Roof® Assembly

Moisture retention, drainage and aeration...

Water Retention

At the heart of the Hydrotech Garden Roof Assembly is the drainage/retention element (Gardendrain™) with its array of channels on both the top and underside that ensure more than adequate drainage of water even with root growth into the elements. The profiled cups on the topside retain water, even on a sloping roof, and have strategically placed holes to ensure the roots receive the necessary aeration and allow water vapor to diffuse up into the growing media.

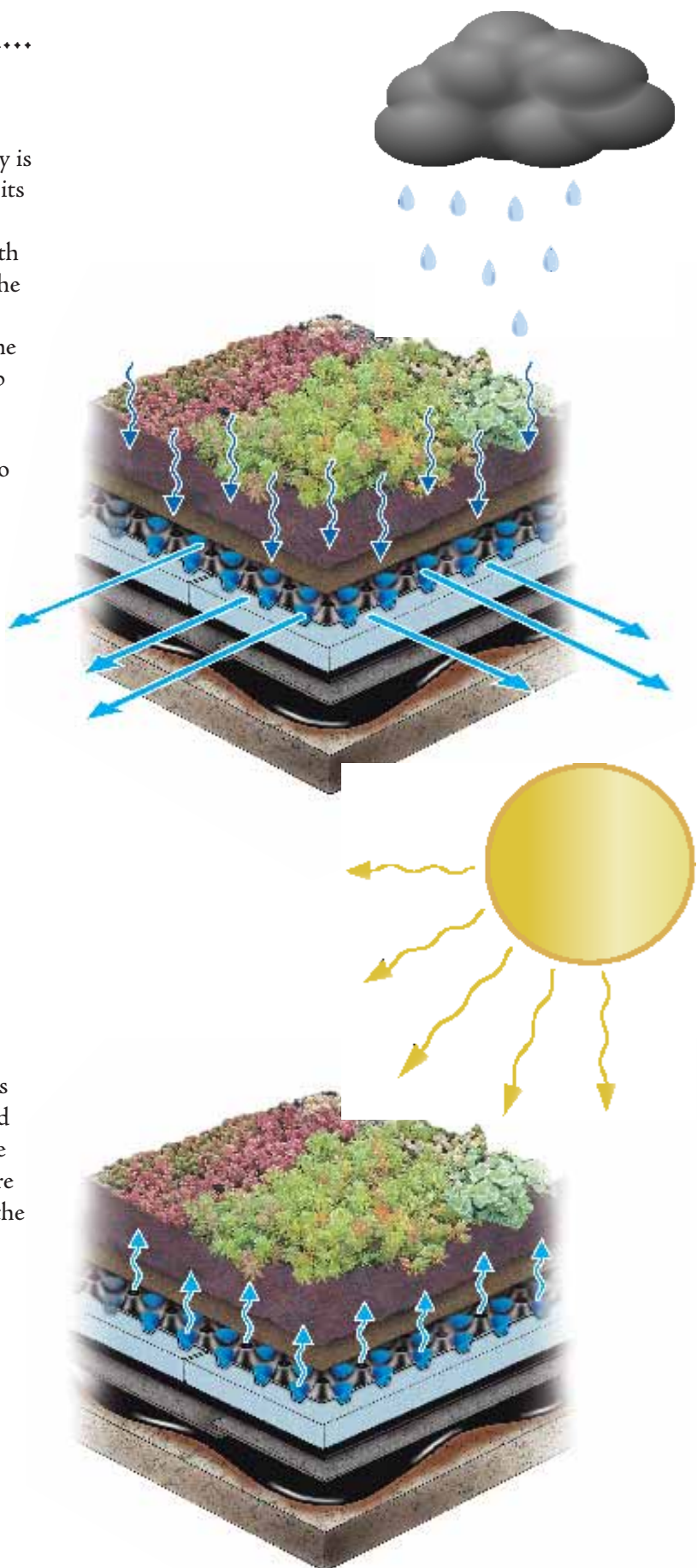
The availability of moisture for the roots is essential to maintain good, healthy vegetation on a green roof. Much of the moisture is supplied by natural rainfall, which is collected and stored by the layers within the Garden Roof Assembly.

The drainage/retention layer plays an essential part in storing rainwater that filters through the growing media. Once the cups in the drainage layer are full, excess water can be soaked up and held by a moisture mat (optional). Water that is not held in the cups or within the moisture mat is free to drain off the roof.

Normally a green roof can store between 50 and 90% of typical annual rainfall.

Releasing Stored Water

In dry periods, stored water will gradually diffuse up into the growing media for use by the plants roots. Plants are also capable of dropping roots into the cups of the drainage/retention layer to obtain much needed moisture. Once the drainage/retention layer is dry the moisture mat (optional) can release its stored moisture through diffusion up through the holes in the top of the drainage/retention layer and into the growing media.

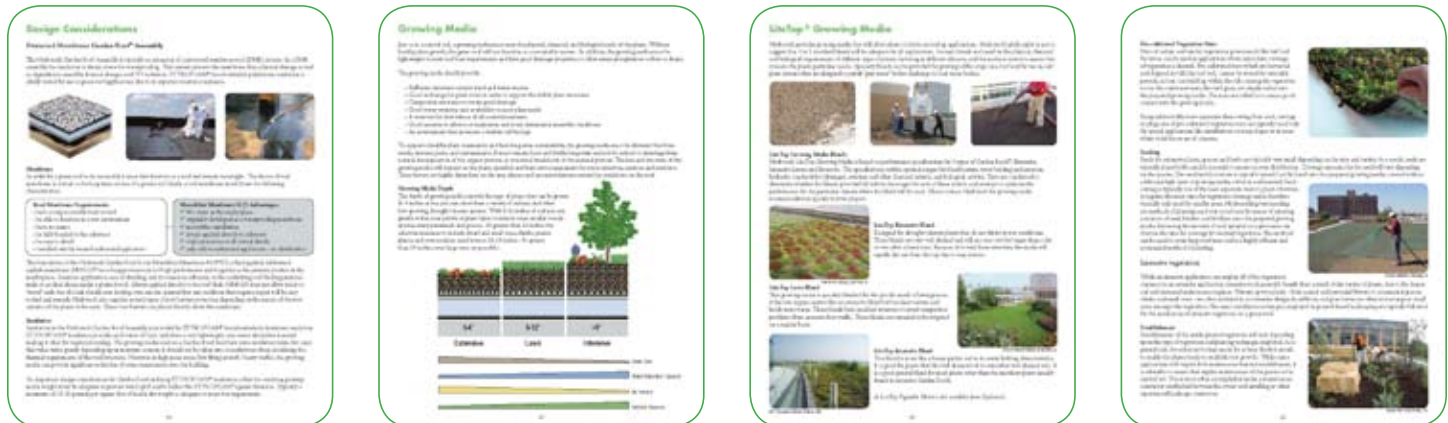


Unabridged Version of Planning Guide Available

For a complete copy of the Garden Roof Planning Guide, please send an email to guide@hydrotechusa.com

The full PDF will contain additional sections that include critical information pertinent to:

- Design Considerations



- Plant Palettes optimized for green roofs



- Assembly Components, Typical Installations & Maintenance

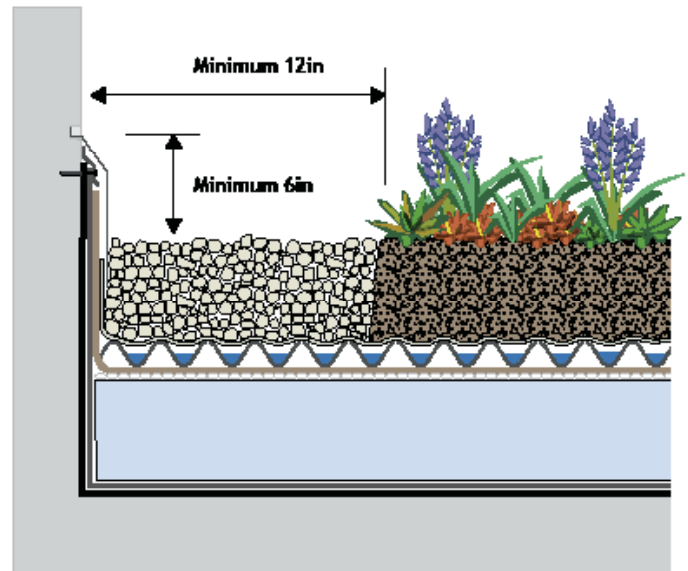


Typical Detailing Conditions

For specific membrane and flashing requirements, please refer to Hydrotech's MM6125® Guideline Details which are available online at www.hydrotechusa.com.

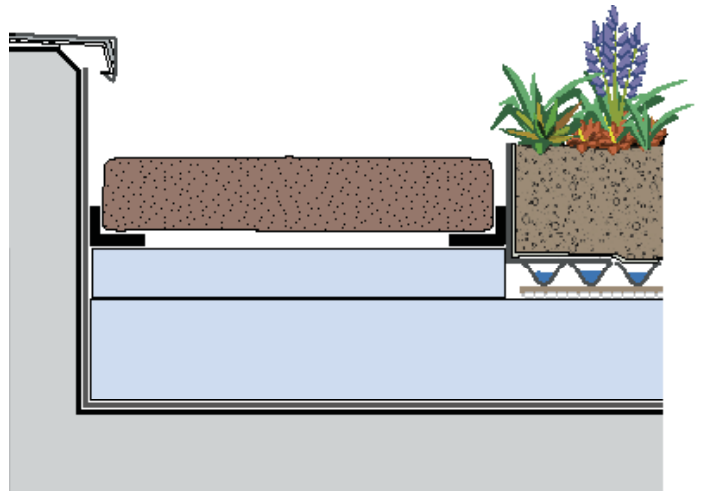
Building Wall

Membrane flashing must be extended above the final grade of the Garden Roof Assembly. Flashings must be properly terminated in accordance with Hydrotech guideline details. Vegetation-free-zones, minimum 12" wide, of gravel ballast or pavers are necessary to provide easy access to critical flashings, increased drainage of water, and maintenance paths.



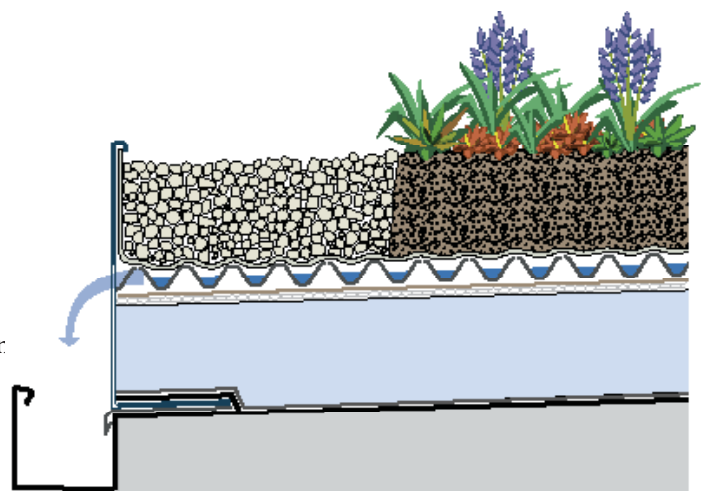
Parapets / Curbs

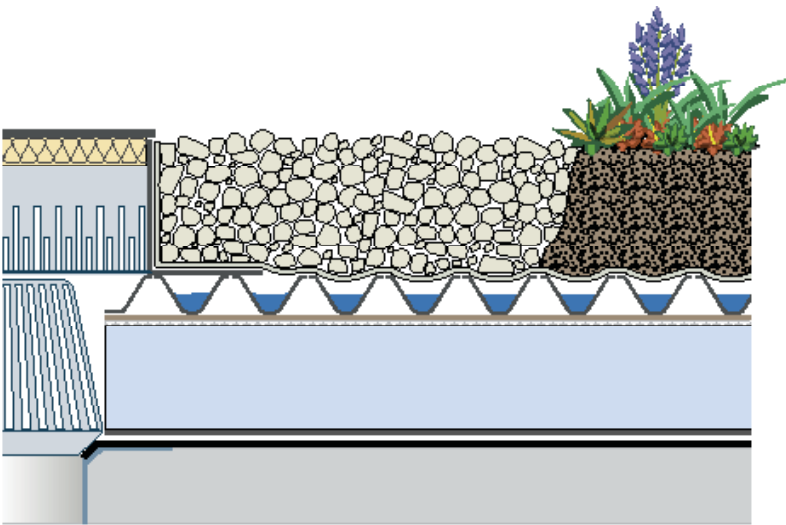
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Roof Edge

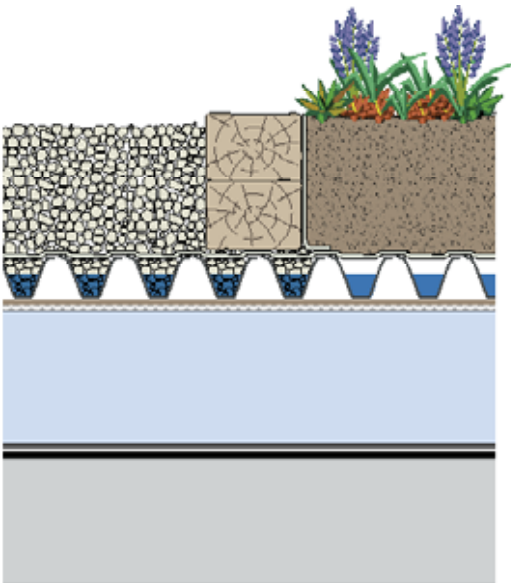
Perforated bent metal angles, properly engineered to accommodate anticipated loading, are necessary to retain Garden Roof Assembly components and allow water to drain off the roof edge or into perimeter gutters. Edge restraints must be properly flashed in accordance with Hydrotech guideline details. Vegetation-free-zones, minimum 12" wide, of gravel ballast or pavers are necessary to provide easy access to critical flashings, increased drainage of water, maintenance paths and increased wind blow-off resistance.





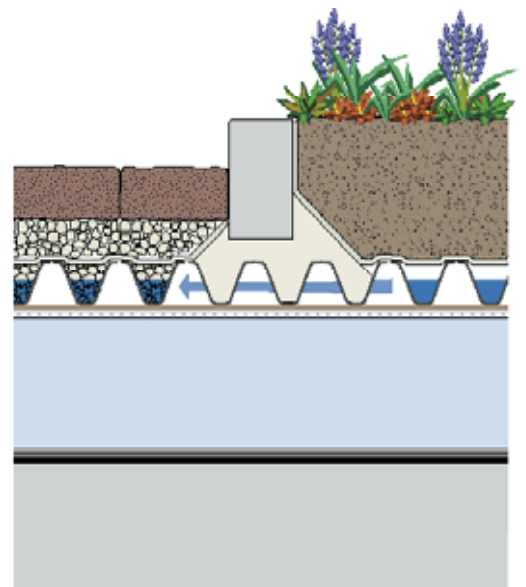
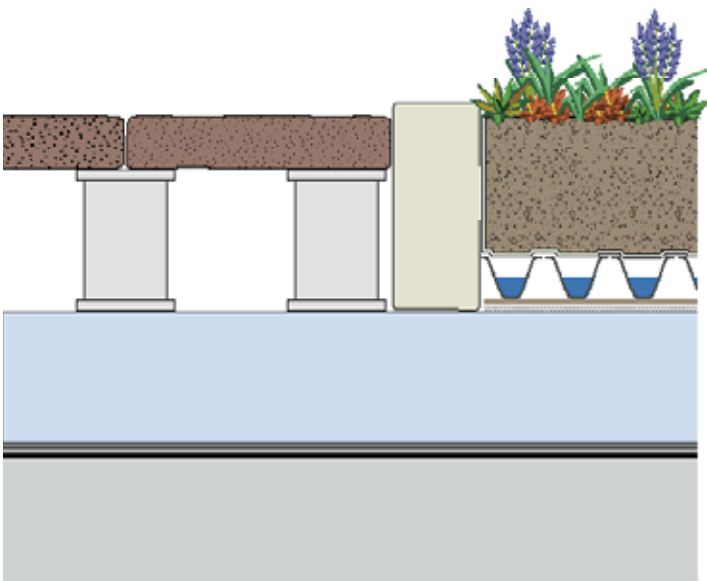
Roof Drains

When roof drains are located within planted areas, it may be necessary to provide inspection chambers over the drains to provide easy access for maintenance. This is especially important in the deeper intensive Garden Roof applications. Typical IRMA/PMR drains with perforated gravel guard rings are typically acceptable in shallower extensive application. Hydrotech can supply inspection chambers of various heights, with or without extensions, to suit the final depth of the assembly. Vegetation-free-zones, minimum 12" wide, of gravel ballast or pavers are necessary to prevent strong plant growth and promote increased drainage in the area around the drains.



Paving Edge Detail

Paved areas can easily be combined with planted areas. Built on the continuous base and drainage layers, the paving can be bedded onto LiteTop, crushed gravel or sand. Curbs of treated timber, precast concrete or brick pavers provide a simple border between the hard and soft landscaping.



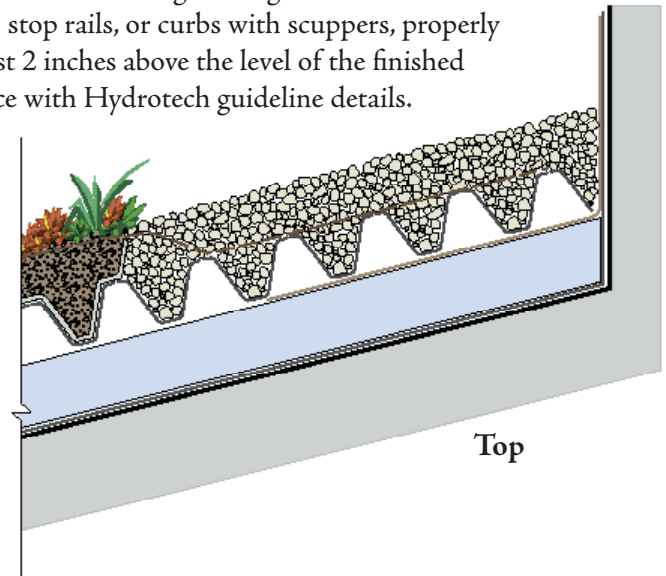
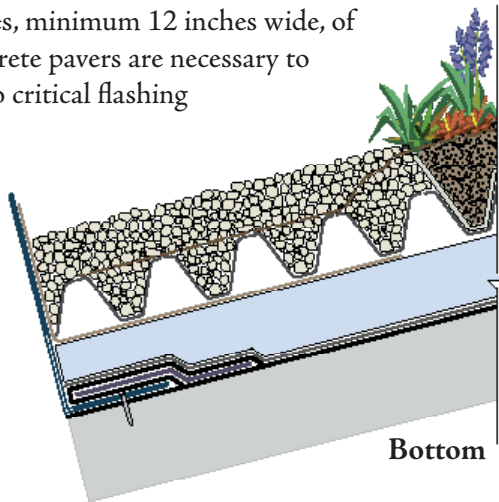
High Slope Applications

Slopes between 2:12 and 3:12 (14°, 25%)

Gardendrain™ GR50 may be used for slopes up to and including 3 inches in 12 inches. The SystemFilter is eliminated as the growing media is placed directly into the cups of the GR50 to increase slip resistance. At slopes greater than 2:12, total soil depth is limited to 3½ inches (1½ inches above the GR50 profile). SystemFilter is still required at perimeters, penetrations, etc. to contain the growing media.

A means of restraining the loose laid Garden Roof® components while still allowing drainage of water off the roof must be installed along the roof edge. Perforated bent metal angles, stop rails, or curbs with scuppers, properly engineered to accommodate anticipated loading, must extend at least 2 inches above the level of the finished grade. All roof edge detailing must be properly flashed in accordance with Hydrotech guideline details.

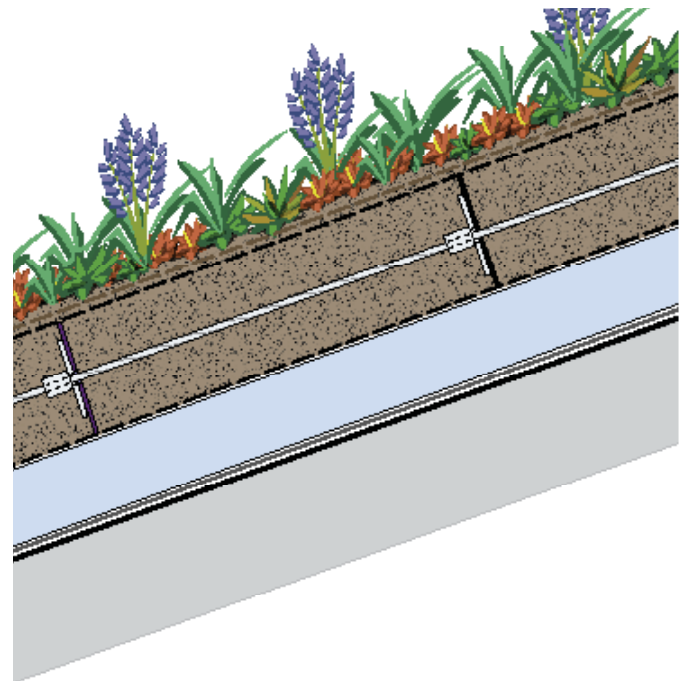
Vegetation-free-zones, minimum 12 inches wide, of gravel ballast or concrete pavers are necessary to provide easy access to critical flashing details, increase drainage of excess water, and increase wind blow-off resistance around the perimeters. Erosion control blankets must also be installed.



Slopes greater than 3:12 (14°, 25%) up to 12:12 (45°, 100%)

For roof slopes greater than 3 inches in 12 inches, the GardNet™ soil confinement system must be utilized. Soil depths of 3½ to 12½ inches can be accommodated with GardNet. A means of anchoring steel cable tendons must be provided at the ridge line or top of the slope. Properly spaced holes through steel angles or eyebolts must be engineered to accommodate the anticipated loading. Additionally, the gravel stop, curb or stop rails at the bottom of the roof slope must be adequately engineered to resist the loading from the growing media up-slope. All roof edge detailing must be properly flashed in accordance with Hydrotech guideline details.

Hydrodrain® 302 is installed below the GardNet to retain the growing media which is placed directly into the open cells of the GardNet. Additional layers of SystemFilter are installed to contain the growing media where necessary and separate it from the loose gravel used in vegetation-free-zones at the bottom of the slope.



Vegetation-free-zones, 1 cell wide, of gravel ballast are necessary to provide easy access to critical flashing details, increase drainage of excess water, and increase wind blow-off resistance around the perimeters. Erosion control blankets must also be installed.

Award Winning Projects



Mashantucket Pequot Museum, Mashantucket, CT



Millennium Park, Chicago, IL



Ballard Library, Seattle, WA



901 Cherry Ave (The Gap), San Bruno, CA

Award Winning Projects

Hydrotech is pleased to have been involved with the following projects:

♦ 601 Congress Street - Boston, MA

2006 Green Roof Award of Excellence - Industrial/Commercial

♦ Eastern Village Co-Op - Silver Spring, MD

2006 Green Roof Award of Excellence - Extensive Residential

♦ Phillips Eco-Enterprise Center - Minneapolis, MN

2006 Green Roof Award of Excellence - Extensive Industrial/Commercial

♦ Mashantucket Pequot Museum - Mashantucket, CT

2006 Green Roof Award of Excellence - Intensive Institutional

♦ Ballard Library - Seattle, WA

2006 Green Roof Award of Excellence - Extensive Institutional

2006 Institute Honor Awards for Architecture (AIA)

♦ Schwab Rehabilitation Hospital - Chicago, IL

2005 Green Roof Award of Excellence - Intensive Institutional

♦ Millennium Park - Chicago, IL

2005 Green Roof Award of Excellence - Intensive Industrial/Commercial

♦ The Solaire - New York, NY

2004 Green Roof Award of Excellence - Intensive Residential

♦ LDS Assembly Hall - Salt Lake City, UT

2003 Green Roof Award of Excellence - New Combination

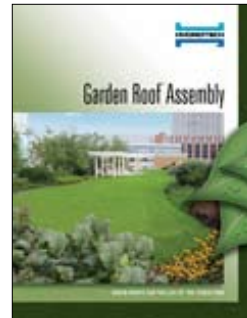
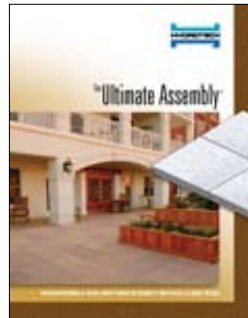
♦ 901 Cherry Avenue (The Gap) - San Bruno, CA

2003 Green Roof Award of Excellence - New Extensive

Additional Resources

Please visit our website www.hydrotechusa.com for information on the entire family American Hydrotech's waterproofing and roofing products. Downloads are available to assist you with each phase of a bringing a Garden Roof® project to life.

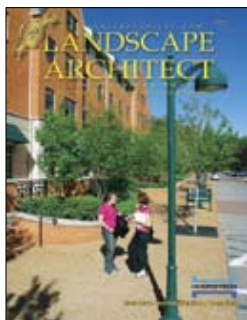
Product Brochures



Project Spotlights



Articles



American Hydrotech, Inc. proudly maintains memberships or works closely with multiple organizations that are dedicated to green roofs and other sustainable issues facing today's design professionals.



DESIGN BUILD GROW



American Hydrotech, Inc.

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800.877.6125; 312.337.4998
312.661.0731 (Fax)
www.hydrotechusa.com

Hydrotech Membrane Corporation

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514.353.6000; 514.354.6649 (Fax)

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