TOWARD A NEW REGIONALISM

Environmental Architecture in the Pacific Northwest

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CHAPTER 3

ENVIRONMENTAL STRATEGIES

The form of a building must first of all offer protection against the elements—wind, rain, heat, and cold—but the beauty and design of a building are as important as its usability and function. Only beautifully made buildings contribute to our built environment in a sustainable way and will be considered worthy of preservation. The challenge is to integrate function and aesthetic value into an enduring architecture that cooperates with nature and works in concert with ecological principles. The primary goal of sustainable design is to produce elegant architecture that utilizes a combination of the best ancient, proven building approaches and the best technological advances.

We should not expect to design buildings employing new sustainable-design strategies in the traditional design process. Sustainability is not a novel logic that we merely add to the design process. When we design buildings, the process must respect the underlying order of all living systems. The forms we conceive are really patterns, and patterns are the configurations of relationships between natural systems. As G. Z. Brown and Mark DeKay state in *Sun, Wind and Light,* architectural form is in part a manifestation of energy flows that are always present in a building. The architectural designer, by understanding the natural principles of heating, cooling, lighting, and envelope performance, can produce an integrated design. Integrated design leads to the discovery of design strategies that multiply benefits.[1]

When most architects attempt to integrate environmental technology, they first look at systems in isolation and then overlay these systems onto an architectural scheme. This approach is reinforced by the vast amount of literature on sustainable design that is organized on a systems basis. The most effective design strategies are those that are so carefully woven together that they appear seamless and read as one holistic strategy.

This chapter has been organized according to nature's most basic elements—earth, air, water, and fire—and their underlying principles and forces. This arrangement then provides a framework for integrated decision making. It concentrates on the elements and concepts of environmental design that contribute to architectural form and excludes issues that do not have formal consequences.

Looking at nature's elements helps architects and planners understand how buildings can function as organic systems, working in harmony with the biological cycles and processes of nature. Although discussed here in isolation, these elements are interdependent and interrelated. The parts of a building must create a whole, and this whole must be responsive to environmental conditions. A building affects the environment, just as the environment affects the building.

(Opposite) Reeve House, Lopez Island, Washington, by Cutler Anderson Architects. Photo: Art Grice

EARTH

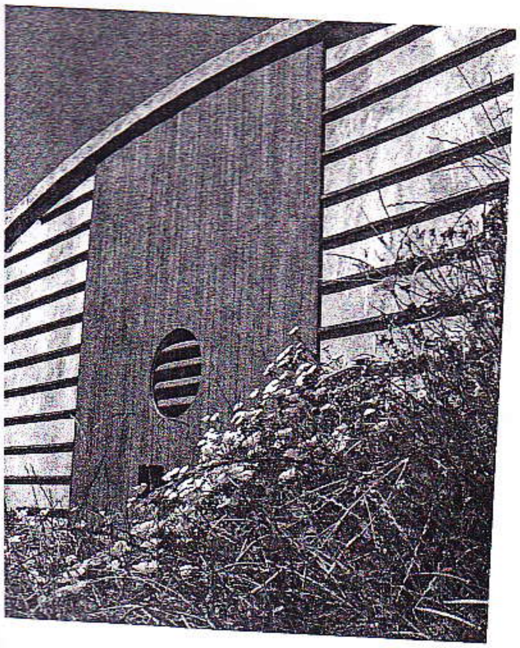
The Pacific Northwest's privileged relationship with the natural world is deeply inscribed in the still-recent history that links the built environment, cities and buildings, with the land. The topographic cornucopia of mountains, lowland terrain, and water provides the fundamental ingredients of the architect's palette.

The earth should be considered in terms of siting concepts for buildings, structural responses to soil and subsoil conditions and the dynamics of earthquakes, heating and cooling principles, and habitat enhancement. Concepts of earth-sheltered design, green roofs, and landscape enhancement are all effective earth-related strategies for the Pacific Northwest.

How a building meets the land is critical. When a choice is given for the siting, topography must be considered carefully. Structures may float above the ground on columns, rest on the land, or be dug down into the earth. Regardless of the approach, one should conceive of a building as an interval in the landscape that respects the natural conditions of a place. Topography also has a significant impact on site microclimate, which has important repercussions for interior comfort.

In the Pacific Northwest, the bottom of a slope is often protected by vegetation but subject to cool, foggy night and morning conditions as cool air settles at the base of the slope. The top of a slope is the most exposed, both to the sun and to the weather. Side slopes are difficult but are frequently the dominant condition in the Pacific Northwest. They can be used to advantage when south facing, as they receive more than 100 times the solar radiation as north-facing slopes. The correct orientation can also reduce negative wind impact on a structure.

Sokol Blosser Winery, Tualatin, Oregon, by SERA Architects. Photo: Charlie Johnson

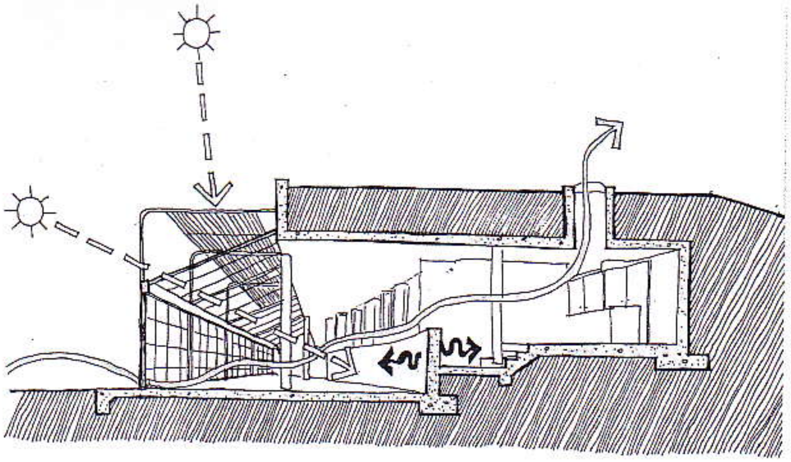


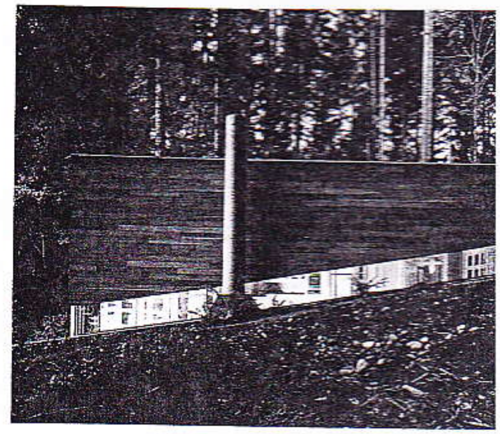
Earth-Sheltered Buildings

On sloped sites, one of the most effective environmental solutions can be to dig into the earth and construct an earth-sheltered structure. Earth sheltering may range from partially covered walls to totally covered walls and completely covered walls and roofs. These thermal flywheel strategies shield buildings from extremes of heat and cold by taking advantage of the relatively constant year-round temperature of the earth. In winter, the earth helps insulate the building, slowing heat loss, as the temperature of the earth is consistently warmer than the air temperature. In summer, the opposite occurs; the temperature of the earth is cooler than the temperature of the surrounding air and helps maintain cooler interior temperatures.

One major consideration in site planning for an earth-sheltered building is the specific location and orientation of the structure. Three factors come into play in the siting: sun, wind, and outside views. Proper orientation with respect to sun and wind produces significant energy savings, while exterior views are an important aesthetic and psychological determinant of orientation.

Although the climate of the Pacific Northwest is not typically regarded as one that supports solar design, the sun's radiant energy can be used effectively in combination with earth shelter. Available radiant heat has a great impact on site orientation of earth-sheltered design, as the window openings are likely to be concentrated on one side of the structure in order to maximize soil coverage. The best site orientation places all of the window openings on the south, with minimum glazing on the east, the west, and,





(Top, left) Earth shelter diagram of Hansen Residence, by Miller/Hull.

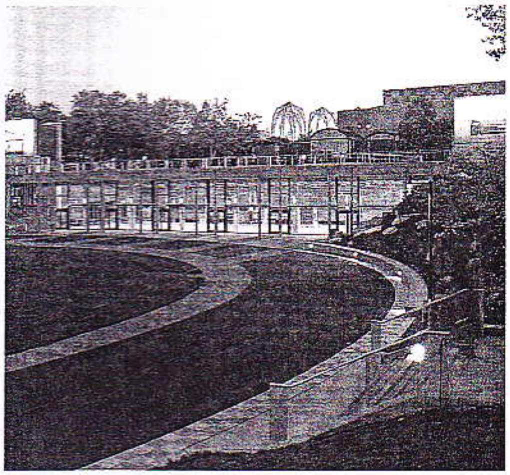
(Top, right) Mecry Residence, Carnation, Washington, by Miller/Hull. Photo: Ernest Braun

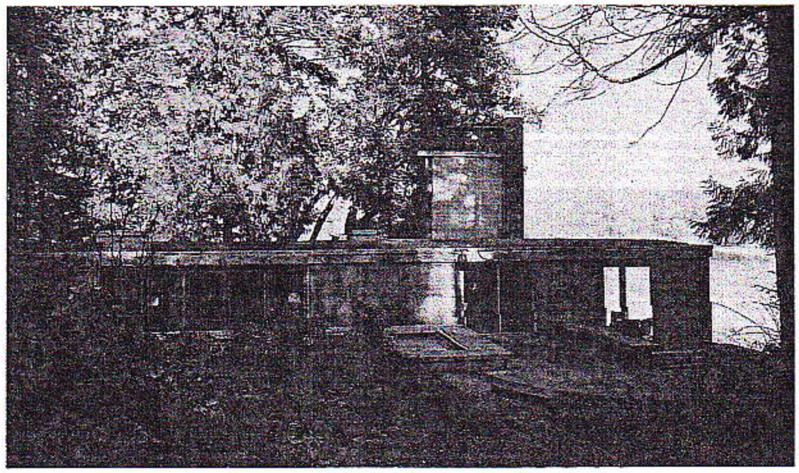
Lopez Island residence by Roland Terry. Photo: John Vaughan, Condé Nast Publications

particularly, the north. Although sunlight is desirable in the colder seasons, when heating is necessary, it is less desirable in the summer. Various techniques, such as vegetation and overhangs, reduce solar heat gain in the summer.

Buried buildings offer a unique opportunity to shield the structure from prevailing winds and use the earth to divert wind over the structure. An earth-sheltered design that includes a courtyard is additionally protected from wind. In summer, prevailing breezes could provide natural ventilation. Unfortunately, orienting an earth-sheltered structure so that all window openings are to the south will not create a well-ventilated building; however, there are many possible design variations that will result in good natural ventilation. (These concepts will be discussed later in detail in the Air section.)

The topography and soil conditions of a building site affect the design in a number of ways. A sloping site offers the opportunity to set an earth-covered building into the hillside. Given the varied topography of the Pacific Northwest, earth-sheltered design has had a long history in the





(Left) Fisher Pavilion, Seattle Center, by Miller/Hull. Photo: Stephen Keating

(Right) Olson residence, Longbranch, Washington, by Jim Olson. Photo: Dick Busher

region. Whether sited for passive solar gain or for preserving the natural features of a site, the Pacific Northwest probably has more beautiful earth-sheltered buildings than does any region in North America.

One of the earliest examples of sod-roof design, and still one of the most powerful site solutions in the region, is Roland Terry's summer residence on Lopez Island, in Washington's San Juan chain. Located on a south-facing hillside overlooking Fisherman's Cove, the program is split between two pavilions with a shared terrace. Rough logs, more than three feet in diameter, were pulled from the beach to make columns for the post-and-beam structure. This building emerges out of its site as an organic rampart onto a panorama that extends all the way to the horizon.

Other Pacific Northwest sod-roof houses that are beautifully integrated with their sites are Jim Olson's personal summer house in Longbranch, Washington, and Cutler Anderson's Reeve House on Lopez Island. Both are low-profile, one-story houses with narrow cross sections that maximize natural light penetration. With the Reeve House, the architects kept the 2,800-square-foot residence unobtrusive by sloping the grass-covered roof at an angle similar to the wind-shear angle of nearby weathered trees.

These three earth-sheltered houses are true sustainable models, merging so successfully with their sites that they have become profound and timeless lessons about relationships between the built and natural environments.

The recently completed Fisher Pavilion at Seattle Center, by Miller/Hull, is a very different earth-sheltered design. This 14,000-square-foot subterranean structure, built of cast-in-place and precast concrete, opens out to the International Fountain and Center Green. On its roof, a paved plaza serves as a forecourt for the adjacent Children's Theater and provides an elevated vantage point on the fountain and the green. This exterior public plaza functions as multiuse event space, effectively doubling the programmable area for the facility. The Fisher Pavilion demonstrates how a building can be subordinated to its context and play a background role yet project a potent architectural presence.

Throughout history, earth-sheltered structures have been some of the best examples of direct, clear, and site-specific architecture.

Soil Remediation

As Arthur Kruckeberg states in *The Natural History of Puget Sound Country,* "Humankind treats soil like dirt."[2] The earth's thin crust is a complex array of living, mutually dependent ecosystems. Fragile yet remarkably resilient, these soils harbor microcosms of miniature life: bacteria, fungi, protozoa, and small invertebrates. As our cities have grown, we have badly mistreated soil, bulldozing it, carting it away to landfills, or paving it over with asphalt and concrete. These actions reflect man's ignorance of soil's role in supporting natural and cultivated vegetation and in filtering water as it flows into aquifers and drainage basins.

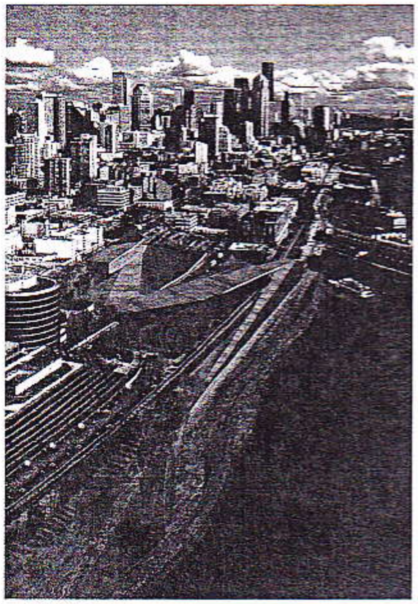
Pacific Northwest cities continue to increase in density, and industrial sites are becoming increasingly available for renovation and rehabilitation. Much of the industry that sprawled across the urban environment over the last century has been exported or become outmoded. The Pacific Northwest is experiencing a transformation, from its roots in manufacturing and extractive industry to a more service-end, technology-based economy. This transformation brings with it an opportunity to reclaim the soils within brownfields and Superfund-designated sites as well as rejuvenate the urban environment by incorporating natural processes.

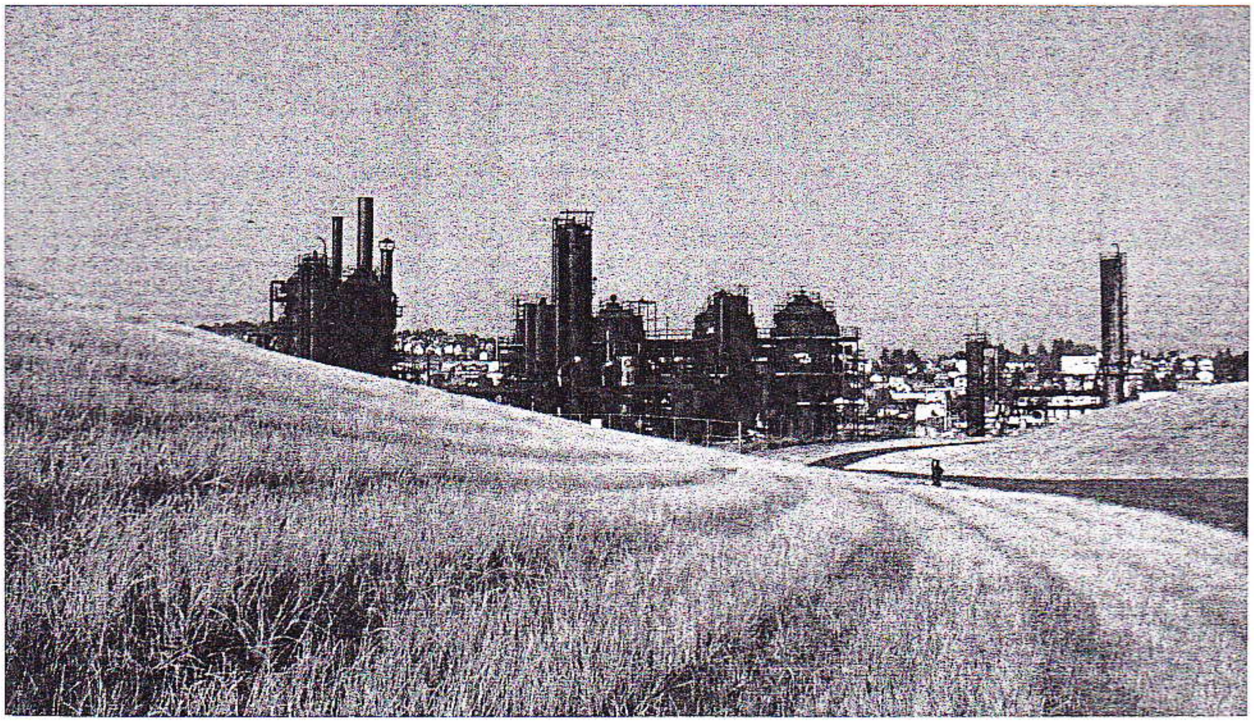
There are several examples of derelict industrial sites that have been redesigned as ecologically sound habitat. The new Seattle Sculpture Park designed by Weiss/Manfredi, New York, transforms a former industrial site along the water's edge into a valuable public green space. The new park creates a cultural edge to the city that highlights the sculpture against the backdrop of Puget Sound and the Olympic Mountains.

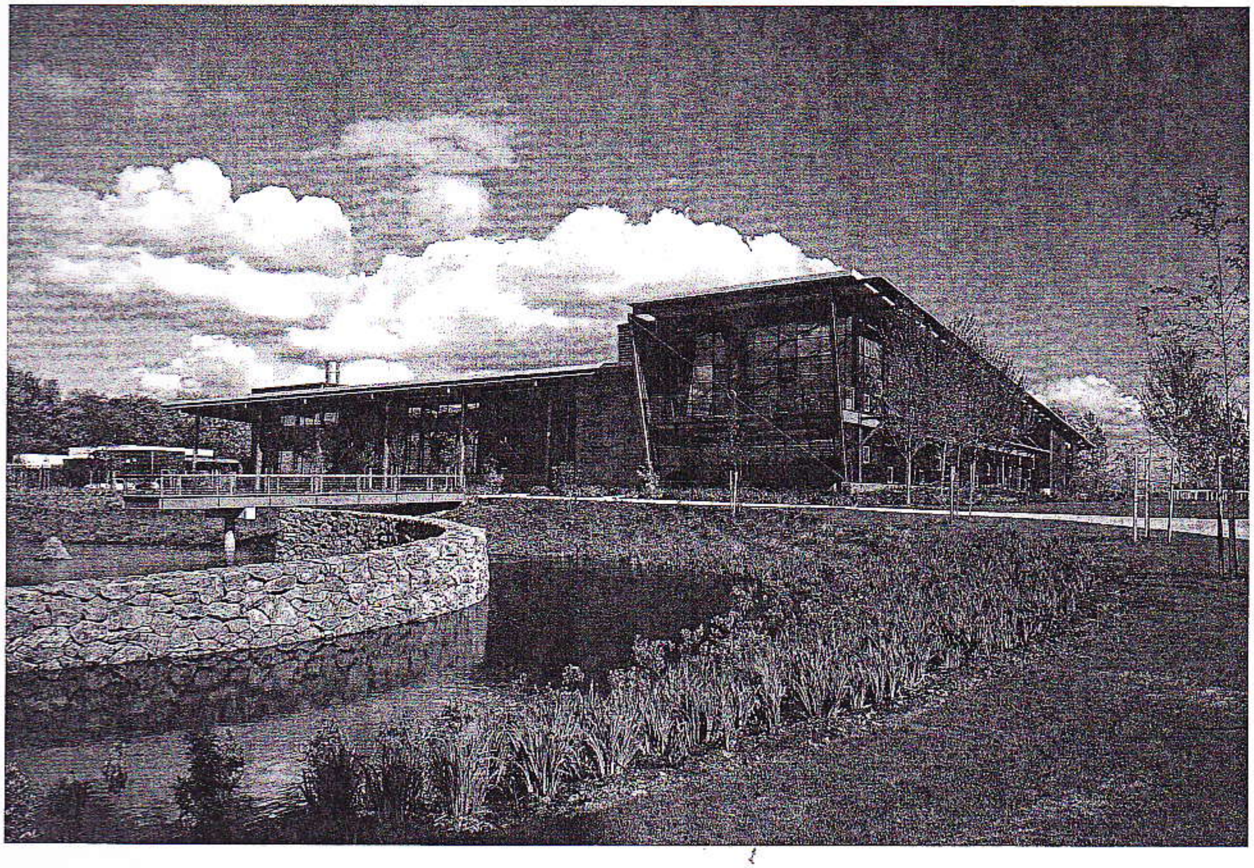
The site of Gas Works Park, designed by landscape architect Richard Haag, is a former gasification plant that supplied power to much of Seattle

Seattle Sculpture Park, by Weiss/Manfredi, New York. Photo: Weiss/Manfredi

(Bottom) Gas Works Park, Seattle, by Richard Haag. Photo: Mary Randlett







Stormwater garden at the Water Pollution Control Laboratory, Bureau of Environmental Services, Portland, Oregon, by Miller/Hull with SERA Architects. Photo: Eckert & Eckert

from 1907 to the mid-1950s. A massive soil-cleaning effort was needed to create the famous park that now stands in its place. Portions of the original gasworks remain as powerful sculptures on the shoreline of Lake Union. Recreational park space and public event shelters surround the equipment. Its position on the north shore of the lake, with panoramic views of the downtown skyline, makes it a breathtaking place for sightseeing and enjoying many lakefront activities.

One of the most recent examples of industrial site remediation is the Water Pollution Control Laboratory, located on the Willamette River, in Portland. This project, designed by Miller/Hull with SERA Architects of Portland for the city's Bureau of Environmental Services (BES), expresses the innate beauty of stormwater as an element of landscape form. The bureau is responsible for conducting research on the effect of contaminants on water quality, and the research concept was applied to the site's seven and a half acres of area. The result is an experimental outdoor laboratory that tests how stormwater may be treated in the landscape. Improvements to the former industrial site include stabilizing 900 feet of riverbank soil through bioengineering methods and replacing a collapsed stormwater line that drains a fifty-acre residential and commercial neighborhood situated uphill.

The solution was to create a detention pond and a series of bioswales in which to retain the runoff for a period and allow pollutants to settle out. To do this, landscape architect Robert Murase, the lead site designer on the team, created a one-acre pond formed by two converging circles with a concrete-and-stone flume as the centerpiece of the design. When stormwater pours into the flume, the stones dissipate the water energy and allow solids to settle. The water-borne pollutants—oil and grease, animal waste, pesticides, and heavy metals—are taken up and broken down by the lush plants that encircle the pond. The multitude of bioswales located around the building and integrated into the parking areas makes up a "stormwater garden" that unifies the site approach.

Like the site design, the 40,000-square-foot laboratory is seen as a porous membrane. The ample glazing, screened by a large overhang and steel sunshades, lets in natural light and promotes views of the beautiful river and landscaped ponds. The building, landscape, bioswales, and detention pond are carefully melded with the riverfront so that the city's commitment to environmental quality literally emanates from the site.

FIRE

The sun beats down on the Pacific Northwest through a cover of clouds, and the sky dome glows. The bright overcast sky is ideal for daylighting buildings, reducing energy demands for electrical lighting. Exposure to the direct rays of the sun is less certain in the Pacific Northwest than it is in other climates and at lower latitudes, and residents fervently appreciate and celebrate the sun when it appears.

Alvar Aalto's poignant musings on the roles of sun and light in the Scandinavian climate are equally relevant to the Pacific Northwest:

> Light and sun. Under extreme conditions one can no longer leave the dwelling's access to the sun to chance. Light and air are such important preconditions for living that the haphazard conditions that prevail today must be changed. The norms should . . . require that each dwelling get sun. . . . the sun is a source of energy; but only if we use it in a scientific way. . . . nor can we afford to allow the sun's and the light's energy to remain unused. At the same time we have to eliminate the inconveniences that these factors, under favorable circumstances, can lead to.[3]

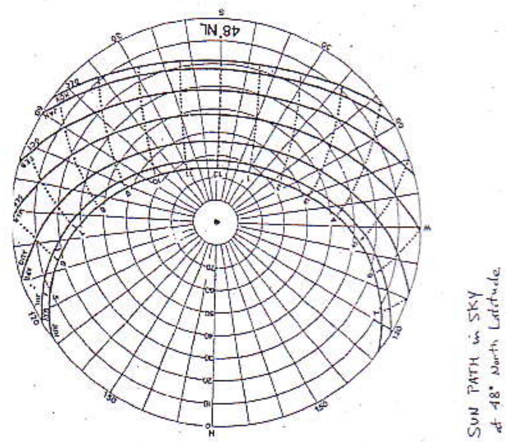
Although direct solar energy may be limited in the Pacific Northwest, favorable circumstances for beneficial solar strategies are numerous. First, during winter months, the low-altitude sun ensures a dramatic solar gain to interior spaces. Second, the region's moderate temperatures minimize heat loss to the exterior and reduce demands on thermal mass for solar collection. Third, the moderate climate also lessens the potential for overheating when a building includes large amounts of glazing. And fourth, cloudy conditions favor the natural daylighting of interior spaces without glare, consequently reducing electrical lighting loads, the second-largest consumer of energy (behind natural-gas space heating) in commercial buildings.

Passive Solar

Availability of direct sunshine is not the only factor in establishing the potential for solar energy in a particular location. The geography of the solar position, the temperature ranges, the amount of cloud cover, and the insolation—the total amount of direct, diffuse, and reflected solar radiation that strikes a surface—all contribute to the feasibility of solar architecture.

Northwest sun path at 48 degrees latitude

(Bottom) Percentage of sunshine



LOCATION	PERCENT OF POSSIBLE SUNSHINE/YEAR
Phoenix	85
Albuquerque	76
Los Angeles	73
Denver	67
Miami	67
Chicago	59
New York	59
Boston	57
Seattle	**45**

Solar index

LOCATION	AVERAGE DAILY SOLAR ENERGY RECEIVED DURING HEATING SEASON BTU/FT^2–DAY (OCT.–MAR.)	AVERAGE MONTHLY HEATING DUE (BASE 65 DEG. F.) DURING HEATING SEASON (OCT.–MAR.)	SOLAR HEATING INDEX BTU/FT^2–DEG.
Seattle	**560**	**660**	**0.79**
Spokane	660	920	0.72
Boston	680	800	0.85
Chicago	530	880	0.60
Great Falls, MT	770	1000	0.77
Madison, WI	710	1100	0.64
Medford, OR	750	700	1.00

The temperature difference between the outside air and a comfortable indoor environment is less in the Pacific Northwest. In fact, the region has the mildest climate of any place at its latitude in North America. The relatively mild winter temperatures reduce heat loss to the exterior, and less heat is required to raise inside temperatures to a comfortable level. A comparable solar index has been produced by the U.S. Department of Energy, which notes that Seattle and other Pacific Northwest cities have more potential for solar heating than do many other locations in the United States.[4]

Residential architecture and small commercial and public buildings with simple programs are most suitable for passive solar. Homes that utilize natural lighting and ventilation are typical in the Pacific Northwest. This contrasts with the artificial lighting and mechanical ventilation found in office spaces and buildings with complex programs. Office buildings often have significant internal heat gains because of desktop computer equipment, deep plans, and little natural ventilation. In such buildings, the problem is primarily one of cooling and not heating, even in the winter.

In the Pacific Northwest, given the cool temperatures from October through May, heating dwellings is a fundamental consideration. With careful design and use, except at night in the depth of winter, a dwelling can be heated in a sustainable manner, free of charge and without environmental degradation. There are four considerations: (1) collection, (2) storage, (3) distribution, and (4) conservation.

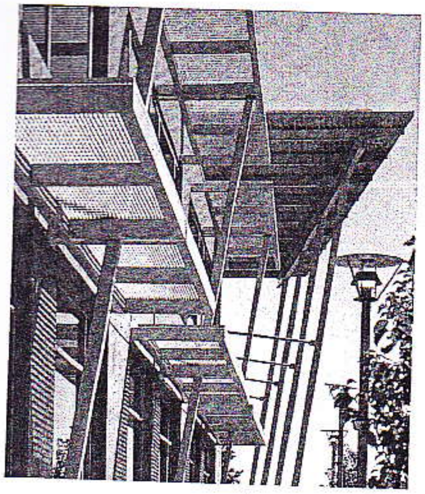
For passive heating, form and layout should maximize timely solar collection. With proper design, residential architecture can be particularly enjoyable at different times of the day or year: east-facing spaces in the morning; west-oriented spaces in the evening; south-facing in winter; and cool spaces in warm weather. At present, clear glazing facing more or less true south (preferably within 20 degrees) is the most effective strategy for passive solar collection. Energy collected from direct-gain solar radiation may be stored directly where it falls, in a wall or a floor, provided the material has a high thermal mass. The darker the material and the higher its thermal capacity, the better its performance.

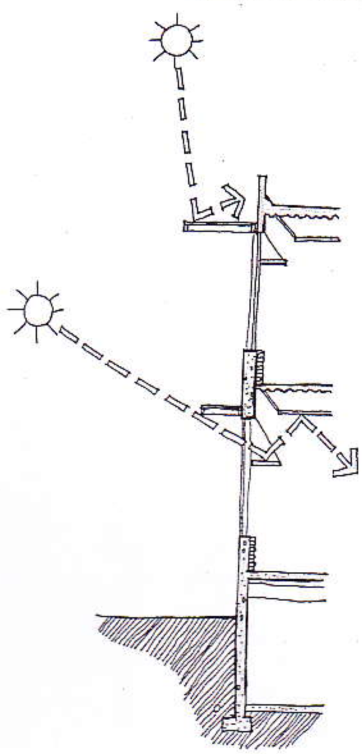
Both natural and mechanically assisted distribution of captured heat are options in a passive solar structure. In the Pacific Northwest, natural distribution is preferable, with stored heat transmitted by conduction, convection, or radiation. Once the heat has been captured and distributed throughout the structure, the external envelope must lose as little heat as possible. Windows may be double, triple, or "smart" glazed or use glass with special coatings that reflect heat back to internal surfaces. Insulated blinds, curtains, or shutter systems may then be closed at night so as to retain the solar energy captured through glazing during daytime.

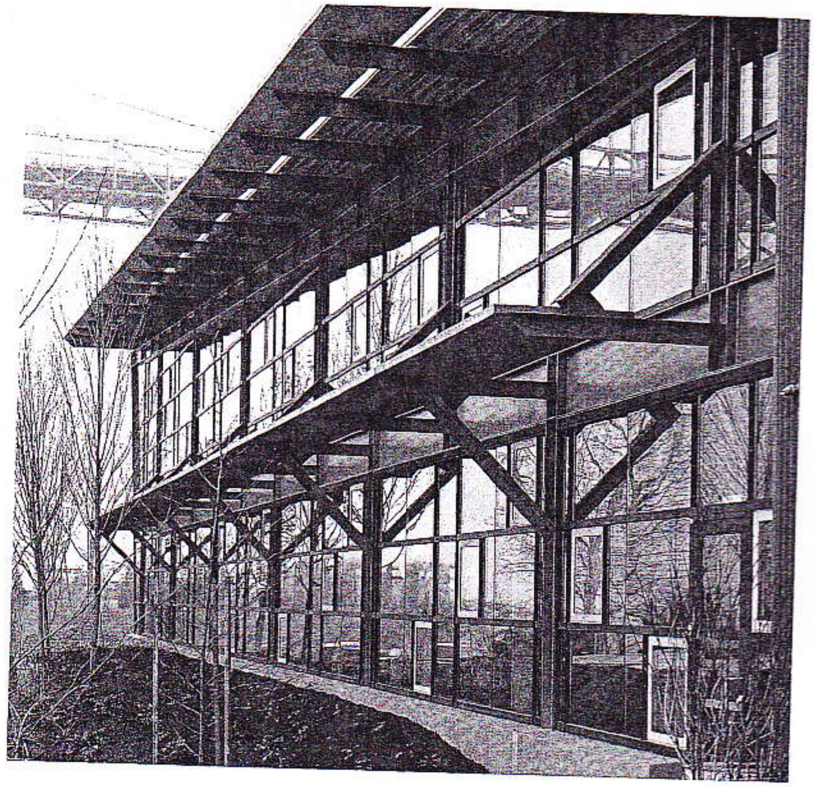
Although solar architecture is reasonably feasible in the Pacific Northwest, it may take some time to recoup the financial investment. Extra measures that burden the architectural budget may not make sense in the Pacific Northwest. Passive solar greenhouses, Trombe walls, and active systems such as solar hot water collectors are more appropriate for climates that benefit from extensive solar gain, for example, in the southwestern United States. Direct-gain passive strategies that orient the structure correctly and build in thermal storage mass as an integral part of the building are effective in the Pacific Northwest, in some cases more effective than in sunnier climates, where instantaneous solar gain tends to cause overheating.

Forms generated from this approach that respond to the ambient climate also heighten an occupant's awareness and appreciation of the rhythms of nature and the regenerative cycles of our world. The deployment of seasonal shading devices and operation of movable insulation, which involves decision making on the part of the building's inhabitants, further heightens this awareness.

South-facing glazing captures solar energy on the Greenwood Residence, Galiano Island, British Columbia, by Helliwell + Smith. Photo: Bo Helliwell







(Top, left) Sunshades on NW Federal Credit Union, Seattle, by Miller/Hull. Photo: Fred Housel

(Top, right) Sunshades on the Water Pollution Control Laboratory, Bureau of Environmental Services. Photo: Eckert & Eckert

Shading diagram of NW Federal Credit Union. Drawing by Alix Henry

Several Pacific Northwest architects have explored the world of passive solar architecture and created some beautiful houses.

Daylighting Techniques

In the Pacific Northwest, daylight is crucial to the quality of a building and the delight one takes in it. Limited access to the sun brings an awareness of its benefits for physical and spiritual health. This spiritual connection with the sun is reflected in the artwork of the Pacific Northwest, from the symbolic carvings of coastal Native peoples to contemporary Northwest School paintings.

In addition to the sun's passive solar energy contributions, properly modulated daylight significantly reduces the need for daytime artificial lighting. Good daylight does not equate with large areas of glazing. The key for a designer is to introduce the correct amount of daylight in a carefully orchestrated manner that supports the planned activities of a given space. Even with the diffused daylight of the Pacific Northwest, plans must address the critical issues of modulating the sun's incidence on a window and controlling the natural light once it enters a space. At certain times of the year, even in temperate climates, excessive solar radiation passing through glazing to interior surfaces causes discomfort.

Properly designed shading elements, or well-placed deciduous plantings, screen out excessive sun in the warm seasons yet admit solar energy when it is beneficial during the cool seasons. Except for buildings with high internal heat loads, the Pacific Northwest has a relatively short period during which cooling is required—generally from July through September. The most effective means of preventing overheating are sunscreens and overhangs (on the south) placed on a building's exterior.

Different types of external shading suit different facade orientations. Permanent, movable, or seasonal shading devices can be used to screen the sun when necessary. The Daylighting Lab, part of the Northwest Energy Alliance—Lighting Design Lab, also provides excellent instruction to students, architects, and owners about controlling daylight on a building's glazed surfaces. Generally, exterior shading elements are horizontal, vertical, or a combination in the "egg-crate" style. Horizontal devices provide the best shading on the south facade when the sun is high in the sky. Vertical shades are effective when the morning sun is low in the east and the afternoon sun is low in the west. Designers in the Pacific Northwest are particularly challenged, given that the solar aspect varies so much over the length of the year (see sun path chart, p. 41).

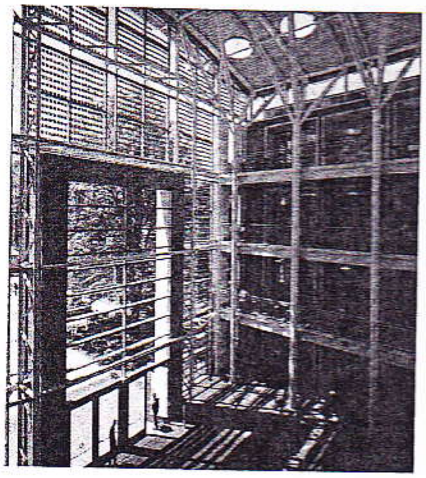
On Portland's Water Pollution Control Laboratory, designed by Miller/Hull and SERA Architects, the west glazing captured an excellent view up and down the Willamette River. Although conventional sunscreen design practice called for vertical screens, horizontal steel shading elements suspended approximately four feet off the structure proved 90 percent as effective and still maintained the view.

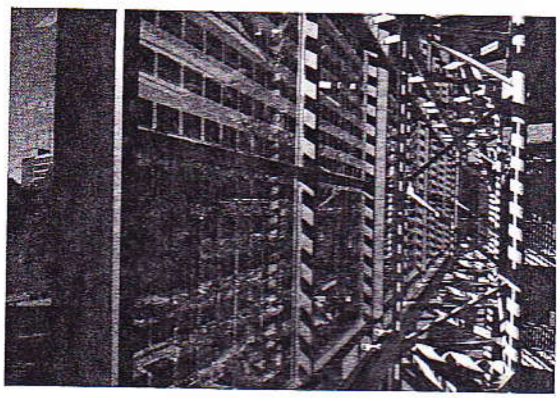
Because shading devices cut off the view of the sky dome through the windows, they also reduce interior daylight levels. Carefully designed slatted or perforated sunscreens maintain shading while reflecting light into the space. Pacific Northwest architects have designed many excellent solutions that combine effective shading elements with light shelves for interior daylighting. The Central Precinct Police Station in Seattle, by Weinstein/Copeland, and the Northwest Federal Credit Union in Seattle's Northgate area, by Miller/Hull, both utilize steel grates for sunscreens on the south-facing glazing.

Photovoltaic Systems

Photovoltaic cells convert direct sunlight into DC electricity. Although photovoltaics have not been used extensively in the Northwest, they are more widely employed of late owing to the relative first-cost reductions instituted in the last few years. Like any other solar collector, photovoltaics collect more energy when oriented properly. In the Pacific Northwest, with its higher latitude, winter yield is significantly reduced if the cells are not oriented to the south. Photovoltaics are most effective in this region when mounted on sloped roofs close to the angle of the area's latitude plus 15 degrees. Vertical output is also effective, although not nearly as efficient as with a horizontal application.

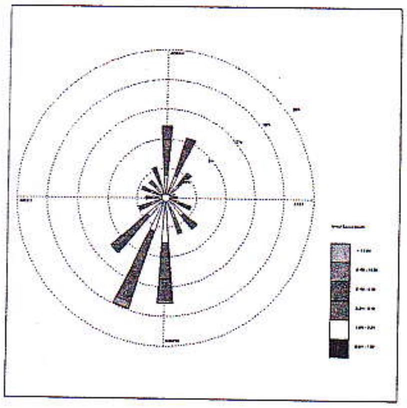
Photovoltaic arrays may be integrated with a building's structure or skin in several ways. They may be mounted on racks and attached so that they hover over the roof structure. They may be set directly on the roof as a panel system or integrated into the roofing system (i.e., in the form of photovoltaic shingles or standing seam roof panels). They can also be integrated into the skin in the form of other materials, such as spandrel panels, shading devices, or glazing. The new Lillis Business Complex at the University of Oregon, Eugene, by SRG Partnership, Portland, uses photovoltaic cells on the lobby curtain wall both to collect solar energy and to screen the direct gain into the space.

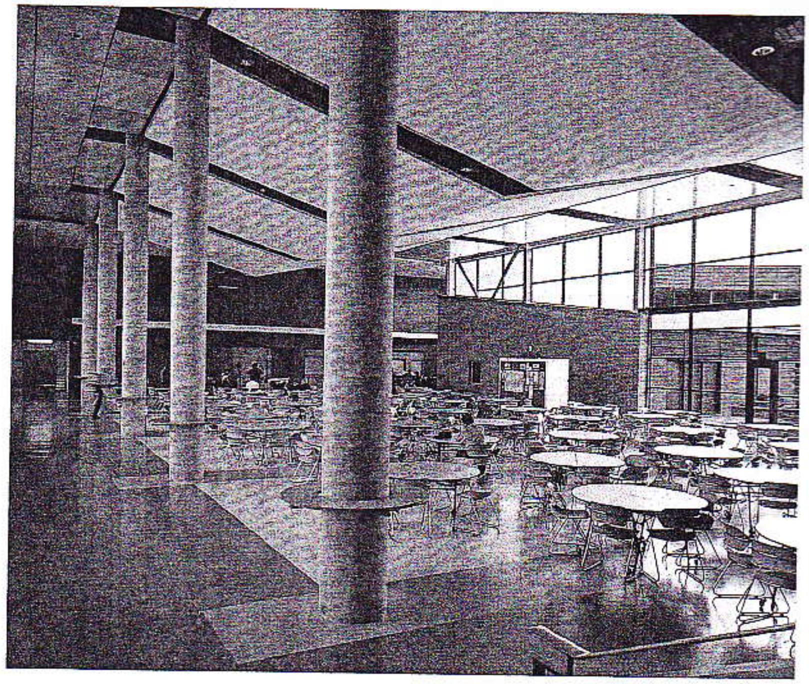


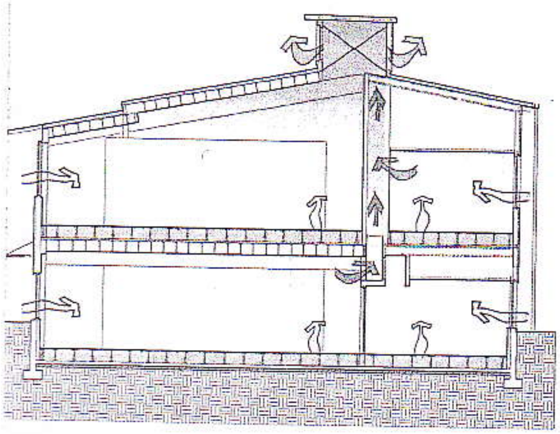


Photovoltaic panels on the Bradner Garden Community Building, Seattle, by SHED. Photo: Scot Carr

(Center and bottom) Lillis Business Complex, University of Oregon, Eugene, by SRG Partnership. Photo: Greg Williams, SRG Partnership







(Top, left) Wind rose diagram

(Top, right) Clackamas High School, Clackamas, Oregon, by BOORA Architects. Photo: Michael Mathas

Ventilation diagram, Wilsonville City Hall, Oregon, by Miller/Hull. Drawing: Miller/Hull

AIR

The flow of air in the Pacific Northwest is heavily influenced by maritime patterns. Warm air moves across the Pacific Ocean, absorbing moisture. Clouds form above the water. Air then travels over the Cascade mountains, rising in elevation, dropping in temperature, and releasing moisture as precipitation. Thus, for much of the year, the Pacific Northwest is cool, humid, and overcast.

As with the sun, the wind may have either a positive or a negative impact on a building's environmental performance. On the positive side, the greatest single advantage is the opportunity for passive cooling through natural ventilation. The Pacific Northwest's relatively cool and temperate climate makes natural ventilation an effective strategy for cooling the interior of buildings.

For good climatic design, one needs to know the wind conditions at a particular site. A designer may consult various environmental agencies such as the Puget Sound Air Pollution Control Agency for wind data. Wind roses also diagram wind frequency and speed for a given time of year.

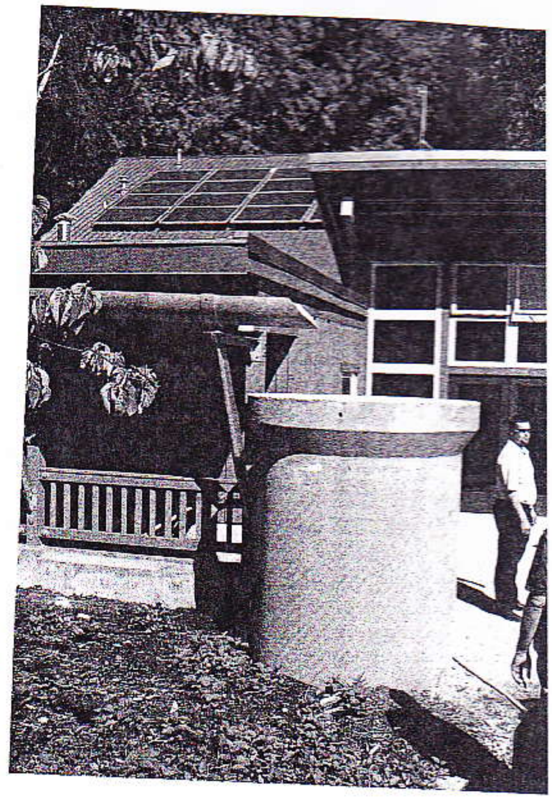
A building derives maximum benefit from natural ventilation when it is aligned to accept outside air at its high-pressure side and has exhaust points located on the low-pressure side. Wind-direction information for the Pacific Northwest suggests locating intake vents in south to southwest facades and outlets in north facades for most of the year. The larger the outlet size in relation to the inlet size, the higher the velocity of air movement through a space. Air velocity is important, as the occupants' sensation of cooling increases with a more rapid rate of evaporation from their bodies.

In the temperate climate of the Pacific Northwest, wind velocities are frequently low, so a combination of cross-ventilation and stack-ventilation strategies represents a more effective approach. Cross ventilation works in the horizontal dimension, and stack ventilation in the vertical dimension. This involves developing a passive cooling approach in both the plan and the section. Tall rooms, vertical stairways, and atrium spaces with inlet openings at the bottom and exhaust through clerestories at the top are effective air chimneys for natural ventilation.[5]

Thin buildings oriented with their long axes running east-west work best for natural ventilation as well as for daylighting and solar heating, as discussed in this section. Narrow buildings with an open plan or a single loaded-corridor layout are ideal for cross ventilation and stack ventilation. Room configurations and sections in large buildings are often more complex and require innovative ventilation design. When airflow is blocked by an adjacent room or corridor vertical shafts that vent to a clerestory or air chimney, transom vents or relites can transfer air through an adjacent space and facilitate ventilation. Clackamas High School, Oregon, by BOORA Architects, uses operable louvers to provide natural ventilation in each classroom. This project also makes extensive use of daylighting strategies by including sunscreens and light shelves on the south facade.

In the Pacific Northwest, wind conditions at a particular site may be problematic for comfortable outdoor use, but the building's orientation and plan configuration can mitigate excessive wind conditions. Locating outdoor rooms in relation to the combination of sun and wind frequently extends the seasons of outside use. Courtyards often buffer the stronger winds but still capture the breezes that help cool spaces. Many residential and smaller commercial projects employ courtyards in this manner. Paul Kirk (as discussed in chapter 2) was an admirer of the courtyard for its ability to create a positive microclimate, buffer wind, filter summer sun, and offer a human-scale, semi-private refuge for the building's occupants.

The site strategy for a particular structure has a substantial impact on thermal performance and human comfort. In the Pacific Northwest, cold air moving downhill collects at the bottom of valleys and other topographic depressions and creates frost pockets. It is generally preferable to site a building up from the valley floor, with a southerly aspect. If a particular site has a strong prevailing wind condition, a number of natural features may provide shelter. Semipermeable natural landscaping such as hedges, berms, and trees provides effective screens that buffer strong winds into gentle breezes. A slight slope will provide shelter on the lee side without inducing turbulence. A slope of about one in three on the windward side gives the best results. A solid wall provides protection to a distance of four to five times its height. Openings in walls must be carefully planned so that they don't turn into wind funnels. It is advantageous to stagger openings with successive walls or adjacent structures.

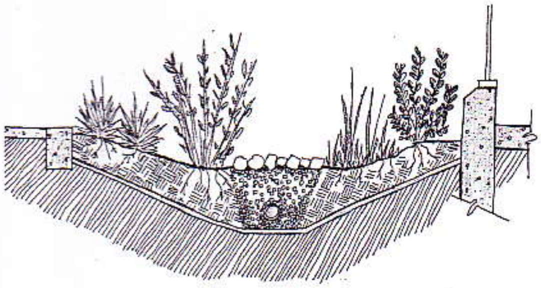


Detail of cistern at IslandWood, Bainbridge Island, Washington. ISLANDWOOD and Mithun Architects + Designers + Planners. Photo: Roger Williams

WATER

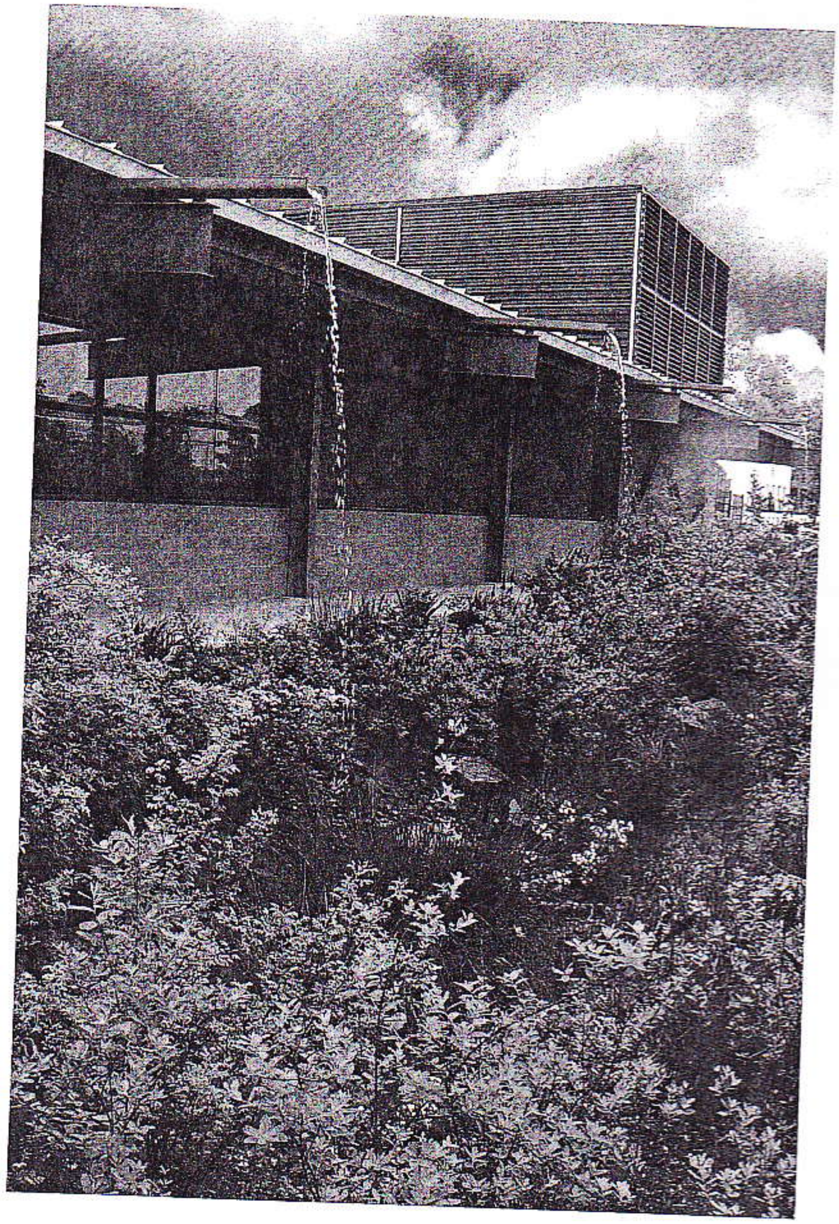
Water is plentiful around the Pacific Northwest during the fall, winter, and spring but scarce throughout the summer. The region is known for cool, drizzly, overcast days, when the surrounding mountains reveal themselves at infrequent and unpredictable intervals. Like the sun, the rain is not heavy, nor is it fleeting, but its gentle omnipresence for much of the year contributes a softness to our senses.

Water, as much as our mountains and forests, defines the Pacific Northwest. This precious resource should be conserved and enhanced with every



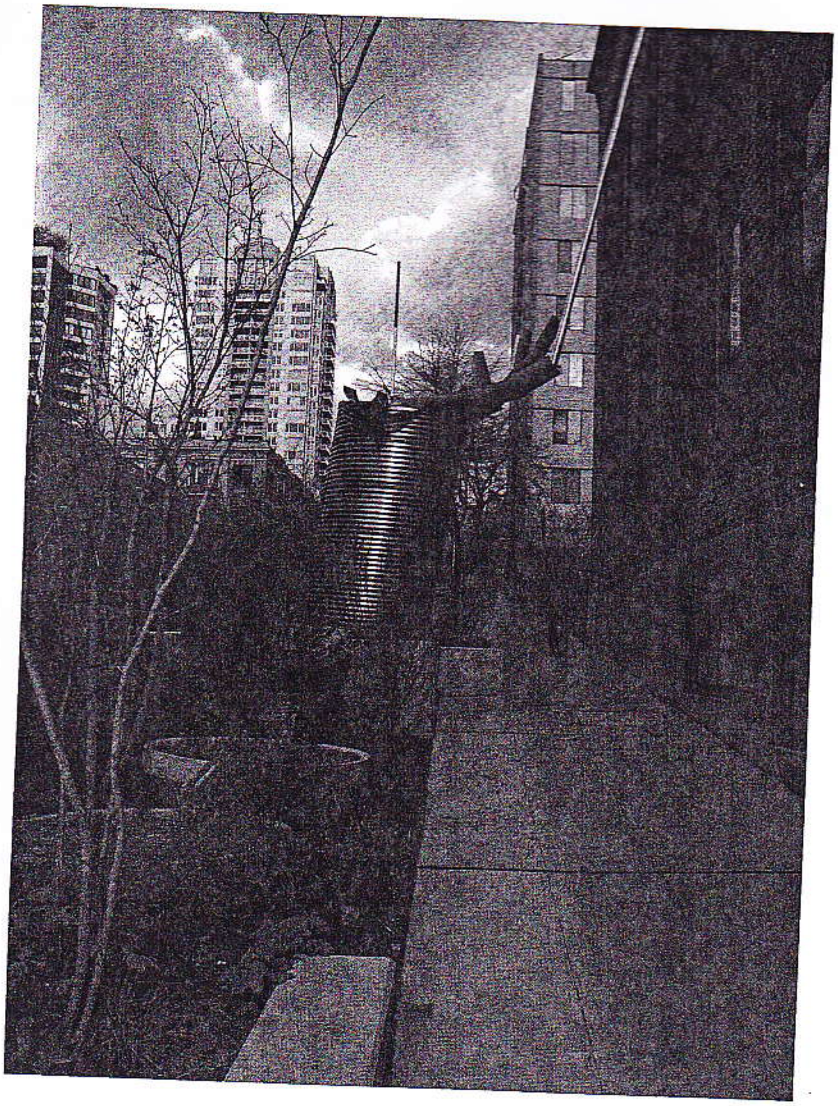
(Left) Bioswale section diagram. Drawing: Alix Henry

(Right) Scuppers send rainwater into bioswale at the Water Pollution Control Laboratory, Bureau of Environmental Services, in Portland, by Miller/Hull. Photo: Eckert & Eckert



building project. Buildings have a serious impact on water ecology. According to the architectural firm Mithun, "The challenge for the future is not a water supply problem, but a water management problem."[6]

At the site and at the building scale, rain is the great equalizer. It falls on roofs, decks and patios, parking lots, and roads. As it strikes these man-made elements, it is transformed into stormwater, which typically is whisked away through gutters, drains, catch basins, and an underground network of storm sewers. The pollutants carried by these systems ultimately degrade the quality of the beautiful waterways that are so plentiful in the Pacific Northwest. The need to mitigate stormwater's destructive potential has given rise to a number of environmental approaches, most aimed at retaining the



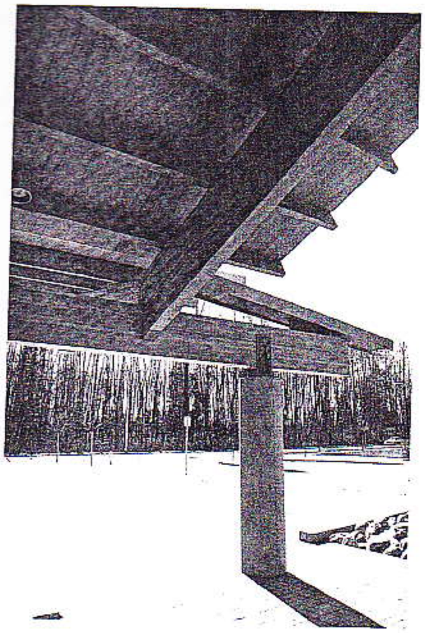
Rainwater catchment and garden on Vine Street, Seattle. Photo: David Miller

water on-site for a period of time. On-site detention and retention strategies with the proper design emphasis express the poetry of water and maximize its innate beauty as a landscape form.

Pacific Northwest environmental agencies have been leaders in establishing design standards for managing stormwater on-site through biofiltration. Bioswales are sunken, planted areas that filter runoff before it enters a storm drain or waterway. Landscape architect Robert Murase has designed several projects in the Portland area that elevate the bioswale to the status of water garden.

Murase's parking lot at the Oregon Museum of Science and Industry features bioswales that combine lush, exuberant wetland grasses with sculpted stonework. This innovative stormwater design, completed in 1996, set a new standard for bioswale design. More recently, Murase collaborated with architects Miller/Hull to produce a design that fully integrates building and site for the Water Pollution Control Laboratory of Portland's Bureau of

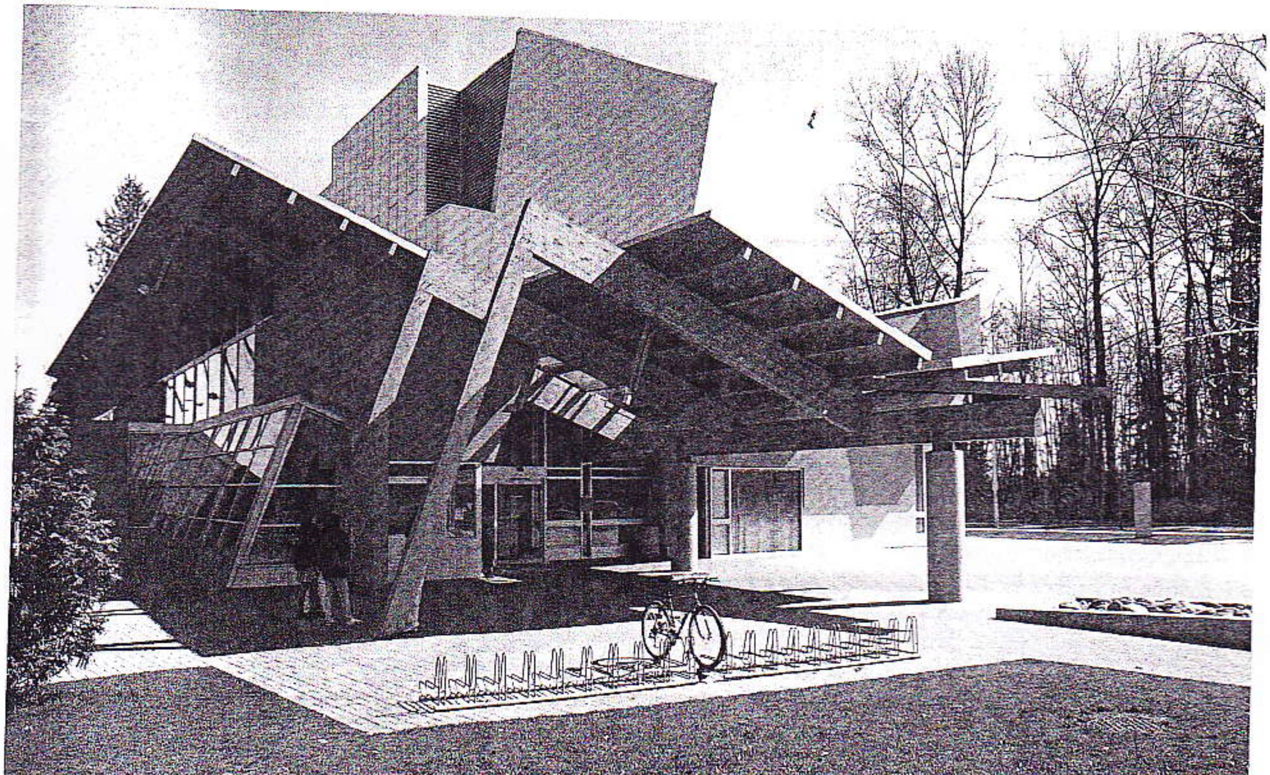
Environmental Services. The laboratory building has no gutters; instead, long scuppers extend from the roof, projecting rainwater beyond the building skin and into a rock-lined water garden. (The project's innovative detention pond is discussed in chapter 2.)

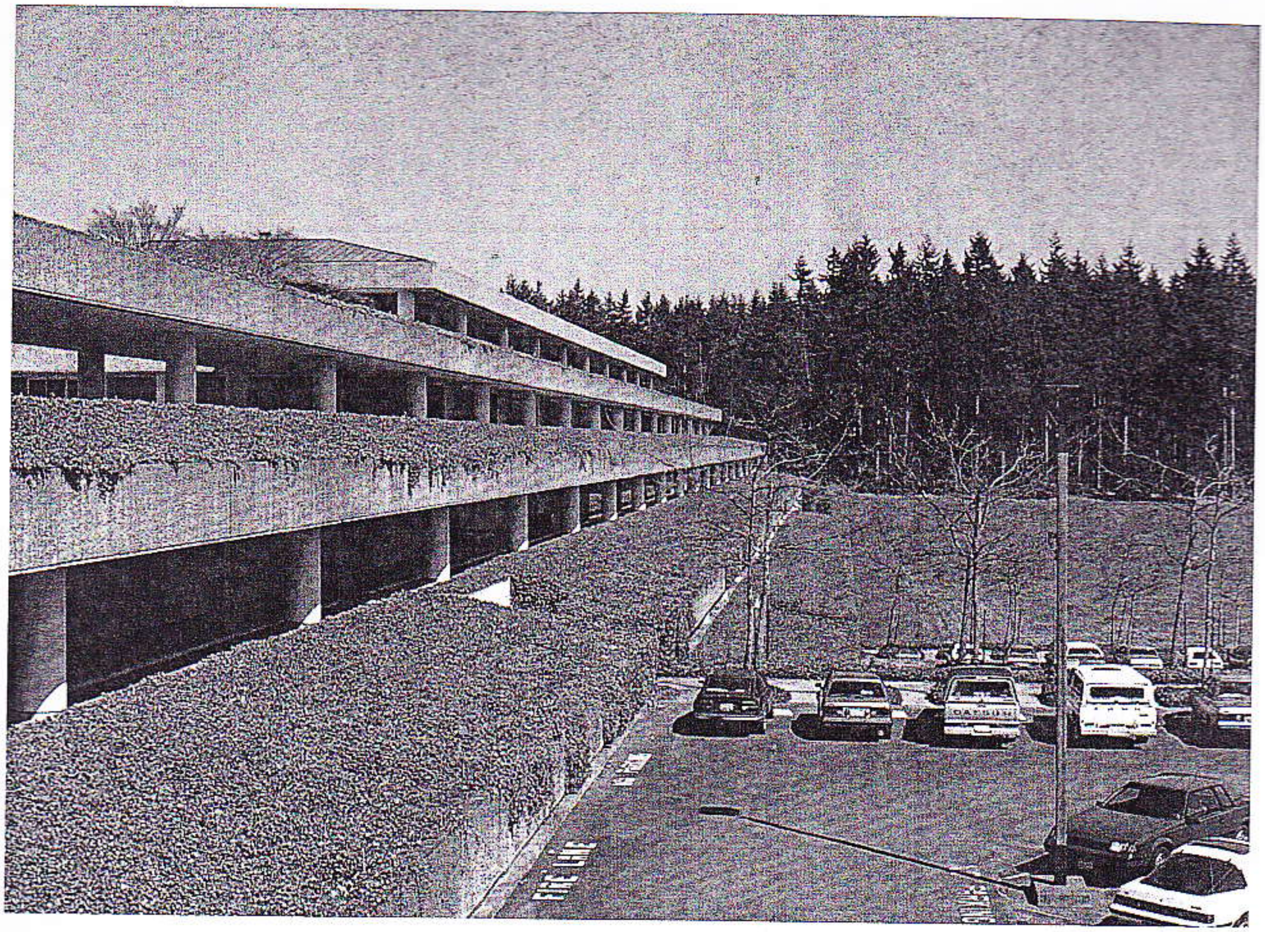


Inspired by advances in conservation technology as well as by the rediscovery of traditional systems, Pacific Northwest architects are expressing water's critical environmental role with innovative approaches to architectural form. Roof forms, catchment systems, greenhouse elements containing "living machines," and water conveyance components such as gutters, downspouts, scuppers, and cisterns are all formal architectural elements that express water strategies.

The Flanders Lofts project in Portland, by architects Vallaster and Corl, is an example of how designers can create tectonic expression with rainwater catchment systems. The mid-rise multifamily housing project incorporates a projecting inverted roof form that delivers water to a large downspout, which then irrigates a rooftop garden. The building's structural frame and associated seismic cross-bracing interact with the downspout and its collector head to form a dramatic assembly of building components.

The Newton Library in Surrey, British Columbia, by Patkau Architects, Vancouver, was designed so that the inverted roof gathers natural light into the interior and collects rainwater in a major gutter that runs the length of the building's central axis. The rainwater is then channeled off each end of the building through large galvanized steel scuppers and into rock-filled





catchment areas on grade. From there, it permeates back into the site. This poetic expression of the path of water forms a sculptural ensemble at the building's entry.

Architects, urban designers, and landscape architects working in the Pacific Northwest have unique opportunities to exploit the power and poetry of water. The region's architecture addresses a number of issues, but the relationship between water and buildings is among the most dominant. Not only are there numerous opportunities to express the conservation, detention, retention, and recycling of water within a structure or a site, but there are also many ways in which to express the symbiotic relationship between architecture and water that help articulate the spirit of place.

The Pacific Northwest is home to many fine examples of the poetic use of water to create powerful conceptual architecture. The Weyerhaeuser Headquarters Building in Tacoma, Washington, designed by Skidmore Owings and Merrill's San Francisco office, is a regional architectural icon. It integrates building massing, water feature design, and earth shelter to create a strong conceptual architectural statement, revealing the essence of what Christian Norberg-Schulz calls "natural place."

(Opposite) Scupper at entrance to Newton Library, Surrey, British Columbia, by Patkau Architects. Photo: David Miller

Weyerhaeuser Headquarters Building, Tacoma, Washington, by Skidmore Owings and Merrill. Photo: College of Architecture and Urban Planning