2
Site and Environmental Analysis
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By completing the exercises and scenarios in this chapter, you will gain an understanding of the field activities involved in site and environmental analysis. As you advance with your work in this chapter, you will find more challenging opportunities for learning.

The following information is taken from the NCARB IDP Guidelines:

2. Site and Environmental Analysis
Site and environmental analysis involves research and evaluation of a project's context and may include environmental evaluation, land planning or design, and urban planning.

Core Competencies
At the completion of your internship, you should be able to:
- Provide a coherent, logical, well-designed site plan for a specific program.
- Justify the site plan design based on your research.

Awareness and Understanding Activities
Review the information, concepts, and principles contained in AHPP topics 15.3, 15.4, and 17.3 and in EPC Chapter 2.

Skills and Application Activities
Document and evaluate the following issues for a specific project:
- Building location options on the site
- Regulatory restrictions (e.g., parking, zoning, building codes, ADA) for the site
- Natural conditions (e.g., topography, vegetation, climate considerations, orientation) on the site
- Constructed conditions (e.g., infrastructure, building foundation)
- Access to utilities
- Environmental hazards
- Input from consultants (e.g., landscape architect, geotechnical engineer)
- Input from groups with community interest (e.g., community organizations, historic preservation organizations)
- Information from public agencies with jurisdictional authority (e.g., zoning, planning, building, fire)
- Feasibility of alternative sites

SITE AND ENVIRONMENTAL ANALYSIS

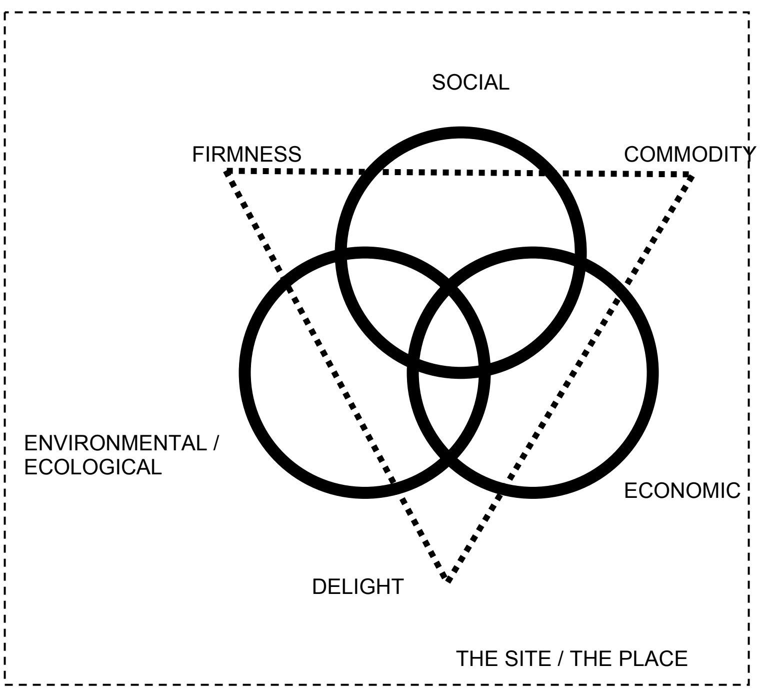
NARRATIVE

For most of the history of architecture, the site has been the literal and figurative foundation of building design. However, in the last half of the twentieth century, the advent of huge and versatile mechanical systems and cheap energy and the increase in density-related concerns led to building designs that were often separated not only from site constraints but also from site opportunities. An essential connection between site and architectural design was lost. In response to critical concerns about energy security, coupled with an increased appreciation of sustainable design, the interest in the relationship between the region, building design and site has grown.

(sidebar) We have urban growth boundaries and "smart growth" and sprawl conferences. And we still have sprawl. Between 1970 and 1990 the population of Chicago grew by four percent; its developed land area grew by 46 percent. Over the same period Los Angeles swelled 45 percent in population, 300 percent in settled area. "Better not Bigger", Ebden Fodor

The Site and Environmental Analysis is the step in project delivery services in which the architect gathers information about the project site and surroundings to use in site design as well as schematic design, design development and construction documents.

"….firmness, commodity and delight." Vitruvius



THIS FIGURE ILLUSTRATS THE RELATIONSHIP BETWEEN THE BASIC TENENTS OF ARCHITECTURE - FIRMNESS, COMMODITY AND DELIGHT - AND CONTEMPORY CONSIDERATIONS – SOCIAL, ECONOMIC AND ENVIRONMENTAL.

A SITE AND ENVIRONMENTAL ANALYSIS PRODUCES THE INFORMATION NEEDED TO INFORM THE DESIGNER ABOUT THE CHARACTERISTICS OF THE SITE THAT CAN BE INTEGRATED INTO THE DESIGN SOLUTION. THIS INFORMATION HELPS SOLVE THE PROGRAMIC NEEDS OF THE CLIENT AND THE COMMUNITY WHILE PROTECTING THE ENVIRONMENT.

NARRATIVE

A comprehensive site and environmental analysis is the foundation of good design. This is especially true in the twenty-first century, when energy scarcity and the transition to alternative energy sources offer prime design opportunities.

Site design begins with the analysis of the site and environmental conditions, which yield information the architect can integrate into the project program and design solution. In many cases, when the natural attributes of a site are considered, the energy consumption of a building can be reduced considerably, the longevity of the building increased, and short-term and long-term facility maintenance costs reduced. Achieving such desirable outcomes are critical to sustainability in design. It is essential for the architect to incorporate considerations of the natural place into the design process, design solutions and construction methods.

A site reflects the environmental, economic, and social characteristics of its location within the natural and built landscape. The term "place-based design" refers to a design executed with an understanding of the site and the natural and built systems associated with it. The natural character of a site uniquely informs the function and expression of a building designed to stand on it. Put another way, the site analysis provides regional character and context to a design.

The information from an in-depth and comprehensive site analysis also helps the architect determine building footprint and form, building scale, building orientation, glazing location and size, and landscape design. This information also makes possible development of a low maintenance/low energy use strategy for a project.

Such a study begins with analyzing a larger area—the region in which the site is located. Regional environmental conditions, including ecology, biology, geologic history, anthropology, and climate, as well as legal and regulatory issues, provide information about the site that is essential to the building design process.

A building design informed by a rigorous site analysis provides the architect with the following:

- helps create a design that is economically strong, works with nature, and is unique to the region and neighborhood,
- takes advantage of the site's microclimate, and
- addresses relevant legal and regulatory requirements.

SITE ANALYSIS OUTLINED

A project site is usually defined by a legal description furnished by the client This description includes a survey fixing the size, legal corners, and existing conditions, such as vegetation, contours, existing infrastructure, and existing utilities of a property. A site, however, is much more than the legal description and project location. The survey, plat, and legal description describe the location of the property within the regulatory jurisdiction, but a tremendous amount of important information related to past use (or abuse) of the site is also critical to a site analysis.

The architect's challenge is to design a project (a building or community) that considers the social, economic, and environmental considerations and characteristics of the site at the same time responding to the client's programmatic requirements. To accomplish this requires that the architect understand these considerations and create a solution that addresses them simultaneously. These characteristics and considerations are explained in brief as follows:

Building Location Options. Possible locations on the site for entry and egress, parking, stormwater storage, sidewalks, and other necessary features should be identified early in the site design phase. Pedestrian and vehicular access points to the site, the context and scale of the existing neighborhood, view corridor protection; sense of entry/place, neighborhood character, connections to transit, and relation to civic amenities and open space can affect the location of a building on the site.

Regulatory Restrictions. Local, county, state, and federal requirements must be adhered to unless a variance is applied for and obtained. In many cases setbacks, for instance, are generic rather than specific to site needs. The architect's role in many projects is to, as an additional service, apply for a variance to allow for a projects better fit within the neighborhood context or environmental issues such as solar access. Such restrictive regulations typically fix setbacks, height limits, lot coverage and landscaping, FARs floor area ratios, parking, and fire protection requirements, as well as construction types and, in some cases, aesthetic issues.

Natural Conditions. In sustainable design the natural conditions are the greatest contributor to the designer. Natural conditions are those conditions that are part of the site and the immediate surrounding that occur naturally (without human intervention). Though these conditions are similar to the regional climate and ecology, the micro climate of the site can vary considerably. This is why regional monthly climatic data, though important in the first analysis, yields to the micro climate conditions of the specific site for informing the design. Other topics of importance are existing and native vegetation; soils and topography and data on geology of the site and region.

Constructed Conditions. Two types of existing structures may affect building design. One is any infrastructure previously built on the site. This includes both structures no longer in use and slated for demolition and those that will remain on the site, as in renovation or preservation of a historic structure. The second type is off-site structures that may affect use of the site. The urban scale or character of structures on adjoining sites can restrict what can be built on a site, as can the public nature of adjacent spaces such as a community square or other public amenity. A not yet built structure may affect the solar gain, view corridors, or air quality considerations, on the site and most be considered as well.

Utilities. The existence and location of utilities greatly affects a site plan and ultimately the design itself. The cost required to put utilities underground, move them out of view or away from site access, or comply with ordinances can significantly affect the budget for a project.

Environmental Hazards. If a site has been built on before, it may be contaminated in some way. There are many levels of contamination, the worst being a toxic condition that must, by law, be cleaned up before any other activity is permitted on the site. Cleaning this type of site—a brownfield—whether toxic or nontoxic, before construction can greatly benefit the surrounding neighborhood and region. Constructing projects in previously built areas is a recommended strategy for reducing sprawl and improving the urban quality of life. Thus, projects that make use of these sites are awarded points from the AIA Top Ten Green Awards and toward USGBC LEED™ certification.

When the environmental hazards of a site are not addressed properly in the site design, it is more likely that a constructed project will have a negative effect on neighboring property. For instance, dangerous slopes and inadequately designed setbacks and stormwater controls could lead to flooding across property boundaries.

Natural disasters such as earthquakes, wind storms, flooding, draught, and fires should be addressed in the site plan analysis. The information and knowledge from the analysis carried into the design phase will inspire the design to contribute to the protection from and mitigation of such disasters.

Consultant Input. The complexity of building today often requires architects to bring consultants onto the design team early in the design process. Consultants that might contribute to site analysis would be soil engineers, ecologists, alternative energy specialists, waste management experts, green design professionals, landscape architects, and historic preservation architects, among others.

Community Interests. Today, establishing community consensus is part of virtually every project. NIMBYism (not in my backyard) is a challenge that needs considerable creative thought in most projects today. Zoning and building codes stem from a desire to protect the community. Preservation of neighborhoods and environmental quality can be a critical concern in site and environmental analysis.

Jurisdictional Input. Determining which jurisdictions have responsibility for a project site may require considerable research, especially as this can vary depending on the scale of a project. Agencies representing local, state, and federal issues such as protection of water quantity and quality, sewage districts, air quality, aviation flight patterns, concurrency (requires minimum services as well as police, libraries, transit, parks and other civic amenities), traffic, and open space may all have some jurisdiction over the site plan and project design. Having this information overlaid on the site plan from the beginning of a project is an excellent way to ensure the regulations will be addressed.

Alternative Site Selection. As an additional service, a client may ask for analysis of an alternate site(s) for the project. The architect would prepare an in-depth analysis of the alternate site(s) and a comparison evaluation of all the sites considered.

A site is always more than dirt on which to build (see figure: Bioregionalism/Biourbanism). It is a three-dimensional space, including the airspace, watershed, and geological strata of a site. An environmental analysis is intended to establish and illustrate the climatic and natural conditions that affect this space. A historic look at a project site determines how it was formed over time by local environmental forces and reveals historic uses of the site and surrounding area. Site characteristics that could affect building design include factors such as prevailing winds, presence of wetlands, frequency of flooding or drought, and types of soil.

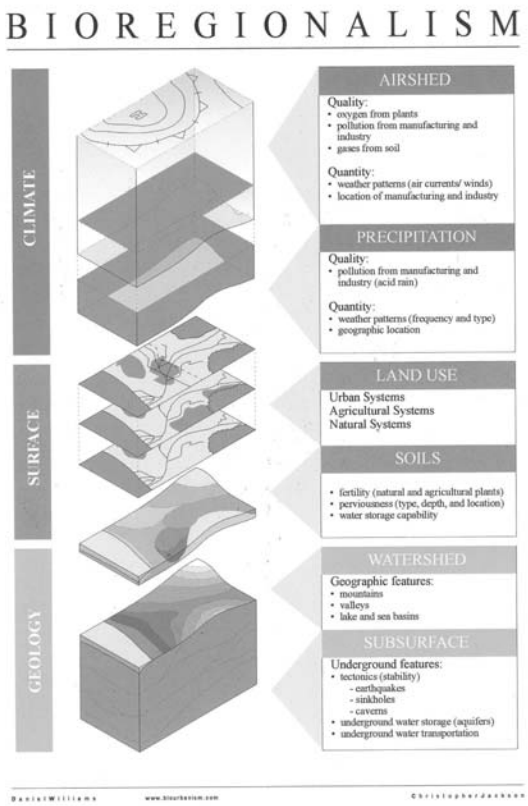
Along with the architects' analysis of the sites environmental conditions, it is also critical to be aware of regional conditions that may impact the site, the project and the community in which the project resides. The importance of this awareness lies in the potential for the architect to include within the design solution a regional or community issue while solving the client's programmatic needs. An example of such opportunity would be an area that floods and the design could include an area set aside to alleviate damage from flooding while developing a community open space. This is the designer acting as steward of the community and showing political savvy.

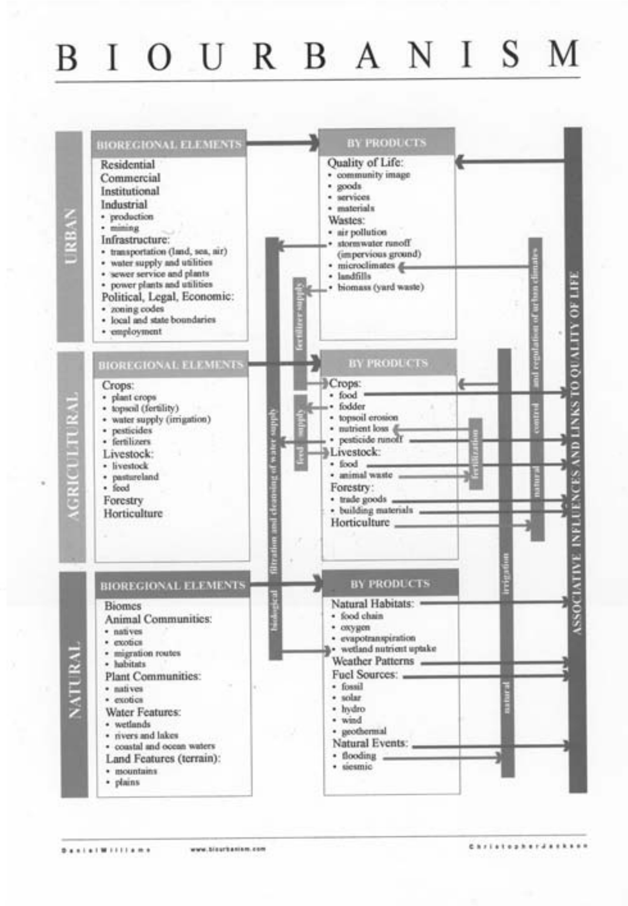
A SUSTAINABLE SITE ANALYSIS

A site analysis that focuses on natural features can inform a design in ways that will improve energy efficiency and building longevity; reduce maintenance expenses; and improve the quality of life, sense of community, and health of the users and the environment. The knowledge gained from an in-depth environmental analysis of a site, when integrated into a building design, can help the architect solve the design program with lower mechanical and environmental costs. Building designs that work with natural site characteristics are typically less expensive to use and maintain and better for the environment as well as the occupants. In addition, the increase in daylighting and natural ventilation provides a better indoor air quality that generally offers the user a better experience - therefore increasing both their spirit and productivity.

A site analysis begins with the study of regional solar and climatic patterns. These acquaint the designer with the attributes of the "place"—its climate and ecological niche and how solar and wind patterns along with soil and water have created the natural character of the site. Learning and working with these natural patterns is necessary for successful sustainable design.

The natural site is a subset or microcosm of a region—biologically, ecologically, and climatically acting much like the region but with specific characteristics and microclimates. A regional environmental analysis shows long-term patterns of solar gain, wind, and precipitation, while a site-specific analysis informs the context of a site and its specific connections to regional patterns. The regional climate informs a design about long-term issues, including natural disasters (wind damage, seismic hazards, drought and flooding, fire, insect infestation, etc.), sea level changes, air quality, water quality and quantity. Data about the microclimate, on the other hand, directly affects the architectural and urban form.





(The above figures illustrate the three dimensional characteristics of a site analysis. The elements: the air shed, watershed and geologic shed have both regulatory and natural conditions that impact the design process. The quality of life within a region is in direct relationship to how the design embraces the climatic and environmental factors. A design that disregards the environmental factors is one that is expensive to build and operate and has little chance to be cherished as a community asset.)

THE SITE ANALYSIS PROCESS

Although segments of the site and environmental analysis may become part of project demolition and site plan documents, acquiring information for these documents is not the main purpose of site analysis. Rather, the products of this process are intended to help designers become aware of legal and natural conditions and opportunities present on the site. This information is useful for both informing the design and the client and list the objectives of the project and illustrate the present site considerations to clients.

The initial step in site analysis may be as simple as making a series of sketches over a base drawing of the site geometry. These sketches list the things learned from the analysis of the conditions previously stated. The is an important part of the basic information gathering as well as the most critical aspect of designing to “fit” within the regional climate and environment.

There are seven basic steps to creating this first sketch and analysis. (these steps can be added to or simplified with experience).

(1) Briefly review the design program and write down the most important project requirements, - then answer questions such as the size of the project, height restrictions, setbacks, parking requirements and other regulations and restrictions that inform the design process, This review may also question "what does this project want to do, what are the opportunities and challenges?
(2) Visit the site! Arrive at the site by transit, bike, foot and car and ask what the arrival meant to the site? The site visit can also inform the designer of the uniqueness that can later be expressed in the design. Of all the site considerations this is the most important and basic to sustainable design. A projects unique and powerful inspiration and expresssion can be attributable to the site visit.
(3) Research the site considerations and characteristics (previous page) and list those specific to the site.
(4) Make a preliminary assessment, ask and answer questions such as: What are the opportunities present at the site that "fits" with the human comfort required of the occupants? What are some of the conflicts, such as glare from other buildings, traffic congestion, excessive noise, heat or pollution from adjacent buildings or sites, opportunities for daylight and passive heating? An analysis of the character and context of the surrounding community helps set the scale, the sense of entry, the connection to the neighboring community, egress
(5) Analyze the site and establish site analysis plan if further research is necessary,
(6) Evaluate the site in relationship to opportunities and conflicts. A possible organization for this would be the following:

Building to Site: How does the climate relate to the comfort zones—temperature, air movement, humidity of the client's building. How much precipitation is common? What types of vegetation does the soil easily support with the least maintenance? What is the relationship of the site geology to structural building issues? Does the thermal comfort required in the building correlate to the site's thermal conditions, if so how can the design use the site's climate rather than paying for mechanical assisted comfort?
Site to Site: What is the relationship between the site and its immediate surroundings? The context, scale, territorial view corridors, materials and construction methods, geometric relationships, neighborhood character, and proportion are all derived from the site and environmental analysis. Micro climates are also found in the "site to site" analysis. Existing and natural vegetation type along with the soil and water retention characteristics impact temperature, air movement and humidity on the site. Shading by vegetation and neighboring buildings impacts the solar gains, prevailing breezes, and daylighting.
Site to Region: The relationship between the site and its regional environment/climate, as well as the urban, agricultural and natural character is part of the analysis These cultural and economic considerations of what resources cultural and natural exist, what are the climate characteristics of the bioregional system that have formed the general attributes of the place?

(7) Prepare a Report of Findings that include drawings and text and include the criteria mentioned in characteristics and considerations

Once an architect has the results of site analysis in hand, he or she must determine how to incorporate this information into the design solution. Begin by considering this question: "How do these conditions affect the building program and how can design improve the site, the neighborhood, and the region in an economically and ecologically viable way?

Sidebar:

SITE ANALYSIS RESEARCH TASKS

1. Research and Illustrate the following conditions:
    a. Precipitation
    b. Prevailing winds
    c. Solar patterns. Determine summer and winter solstice dates to establish the location of the sun for light and heat on the longest and shortest days of the year.
    d. Temperature and humidity
    e. Hazards: hurricanes, wind storms, flooding, draught, earthquakes. Etc.
2. Identify topographical features.
    a. Ground- and surface water conditions and issues (natural and historical)
    b. Access and orientation
    c. Vegetation
    d. Potential slope problems or opportunities
    e. Structural issues - geologic conditions that might affect structural design?]
3. Identify geotechnical issues.
    a. Soil and rock type
    b. Seismic activity
    c. Environmental hazards
4. Locate existing utilities.
    a. Types
    b. Location
    c. Size
5. Investigate site context.
    a. Immediate surroundings
    b. Cultural and historical factors - historic buildings can inform the architect of past successful attempts at passively designed structures that have stood the test of time. By analyzing these existing structures the architect can incorporate successful techniques and methods while avoiding unsuccessful ones
    c. Economic concerns
6. Determine zoning and building regulations.

a. Height limits
b. Setbacks
c. Maximum site coverage
d. Floor area ratios
e. Required landscape area
f. Environmental regulations
g. View corridors or other protected requirements
h. Urban design criteria, if applicable

EXAMPLES: DESIGNS INFORMED AND INSPIRED BY THE SITE ANALYSIS

The projects on the following pages illustrate architecture that was informed by strong site and environmental analysis. These award-winning architectural projects include both building designs and regional planning designs. Listed for each project are design opportunities identified through site analysis and, in some cases, design responses to these opportunities.

Architectural Example 1
Project: Edificio Malecon, Buenos Aires
Architect: HOK

Edificio Malecon
Buenos Aires, Argentina –
Architects: HOK

This 125,000-square-foot office building was built on a reclaimed brownfield site (its garage was built within the foundations of a 19th century warehouse) at Puerto Madero, a redevelopment area in Buenos Aires. The building was developed as a long narrow slab to minimize solar gain on the structure, the east and west ends of which are "pinched." The broad northern face, the primary solar exposure, is shaped to track the sun and is fully screened with deep sunshades that virtually eliminate direct solar radiation during peak cooling months. The south face, which reflects the geometry of the northern façade, is equipped with the same high-performance curtain wall system as the other facades, minimizing solar gain. A "Green Roof" helps insulate the 40,000-square-foot podium from solar radiation and manages stormwater runoff. Open floor plates and raised floors provide flexibility for multi-tenant office or alternative future uses

Design elements attributable by the site and environmental analysis

- Thin plate (narrow cross section) for 100% daylighting
- Urban infill
- Urban design context
- Brownfield development
- Creation of urban edge
- Stormwater reclamation

Architectural Example 2

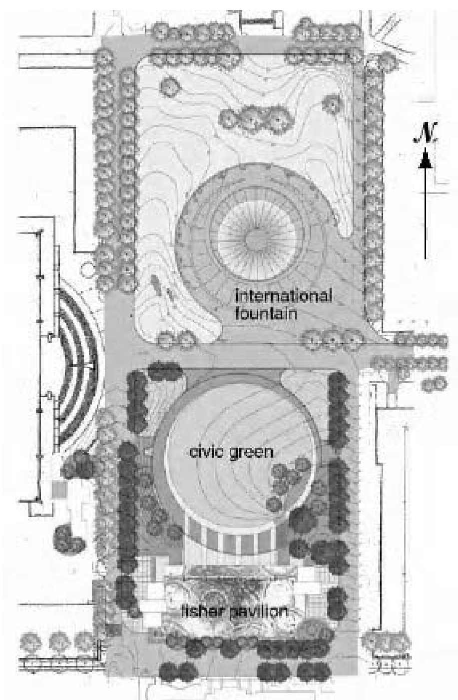
Project: Fisher Pavilion located in the City Center—Seattle, Washington

Architect: Miller+Hull

Fisher Pavilion is one of the first buildings in Seattle to be designed and constructed under the city policy requiring all public facilities over $5 million to achieve a LEED Silver Rating. "Burying" the building, and the use of a high mass (10 Ft. of concrete) roof decrease envelope loads on the building resulting in extensive energy and heating savings.

The site analysis enabled:

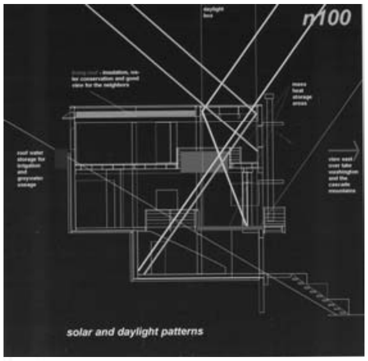
- Earth mass to be integrated into the design providing both cooling and heating.
- The opportunity to provide a civic space on the roof top (see section).
- 100% daylighting
- A pedestrian transit connection
- The building to open up to civic green – increasing civic space.
- The creation an infill urban center – more than just a building.

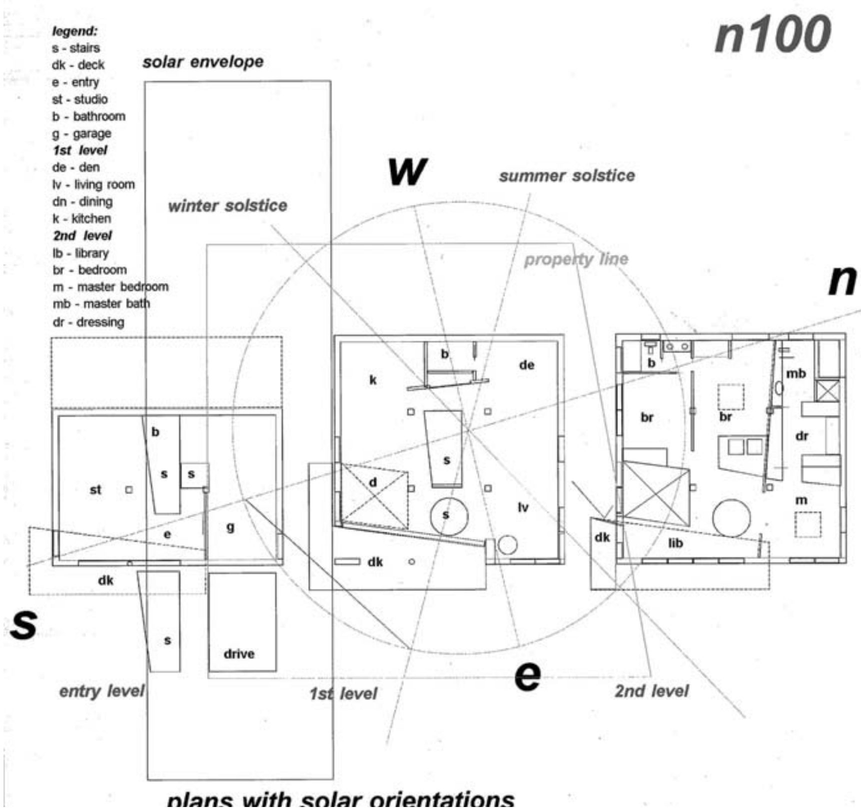


Design opportunities provided by site and environmental analysis:

- Creates a new urban infill square
- Uses thermal mass cooling and heating
- Takes advantage of day lighting for 85% of the building
- Is naturally ventilated
- Crated a roof top plaza
- Maximizes solar heat gains
- Connects interior/exterior space
- Transit a parking drop off
- created an urban amenity and square as architecture

Architectural Example 3
Project: Kahn/Williams HAUS—Seattle
Architect: Daniel Williams ARCHITECT



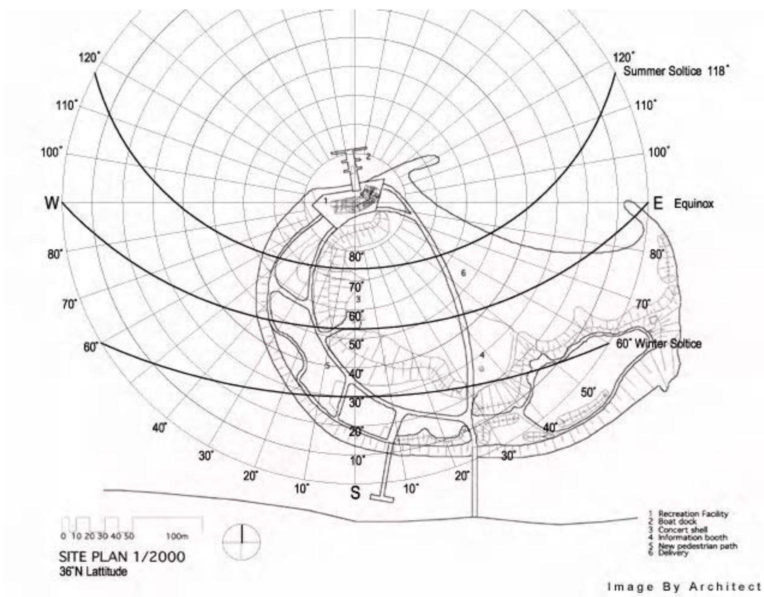


This site is an urban infill site. A site of this type provides a working neighborhood, transit, civic amenities, walkable shopping and open space for recreation, and regional view corridors.
The site is a steep slope with a small area 4200sf. Due to the site orientation it was determined in the analysis that the structure should be open from the east to the southwest corner.
The requirement to build into the hill suggested that the structure be the most static form (a cube) which also creates the most volume for the least exterior skin.

The site and environmental analysis established:

- Correct angles for appropriate light and heat penetration seasonally
- Required orientation of spaces in the plan to access daylight and territorial views
- Solar patterns to inform window design and detail.
- Possibilities for earth cooling and heating – thermal mass 61 degrees F.
- Factors affecting location on the site 1) maximize south (solar) yard.
- Possibilities for reuse of existing structure and demolition rubble
- Use living roof recovery, clean up and storage of rainwater. For irrigation and toilet flushing – gravity fed.

Architectural Example 4
Project: Steinhude Sea Recreation Facility, Germany
Randall Stout Architects
Los Angeles, Calif.



Design objectives informed by the site and environmental analysis:

Energy self-sufficiency

- photovoltaic panels,
- solar hot water collectors,
- a seed-oil fueled cogeneration micro turbine, daylighting,
- natural ventilation,
- passive solar design, building automation, and
- high-performance materials.

These systems provide complete lighting and power needs for the building while recharging a fleet of eight photovoltaic-powered boats, and also produce excess electricity to sell back to the utility grid.

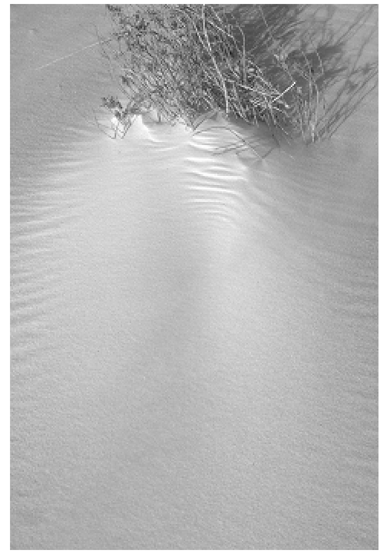
Other sustainability practices incorporated into the design include graywater and harvested water systems, green materials, and waste reduction.

The integration of solar and renewable ideas has led to a building that is a joy to its users.

Architectural/Urban Design Example 1
Sea Ranch, California

Architect: Moore Turnbull ARCHITECTS / Halprin Associates, Landscape Architects


Mikonos, Greece



Historic example: The urban form of Mikonos protects residents from the severe winter storms characteristic of the region. The town is a tightly packed urban core with meandering streets, a labyrinth, that buffer the force of the wind.

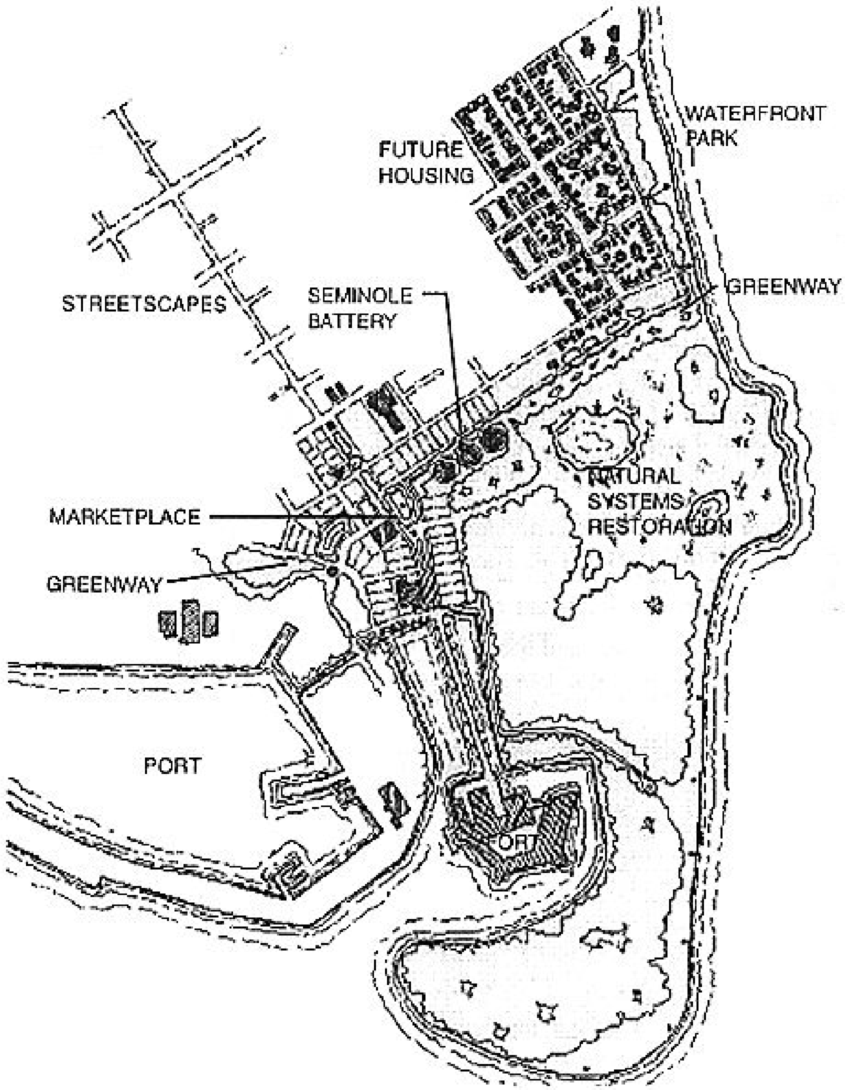
Ecological example: Beach sand in wind shadow —In nature, the energy organizes the form/structure (sand). In this photo the massing of the small plant creates protection from the strong winds. This knowledge can inform the design of a coastal community that experiences gale force winds.

Sea Ranch by Moore Turnbull Architects —a good example of a well planned and designed project stemming from a well-analyzed site with powerful environmental conditions.

Elements informed by site analysis:

- High wind forces inspired a tight knit urban form, (similar to Mikanos)
- Architectural urban forms comprised of exterior spaces
- interconnected trails protect the community from strong winds.
- local materials

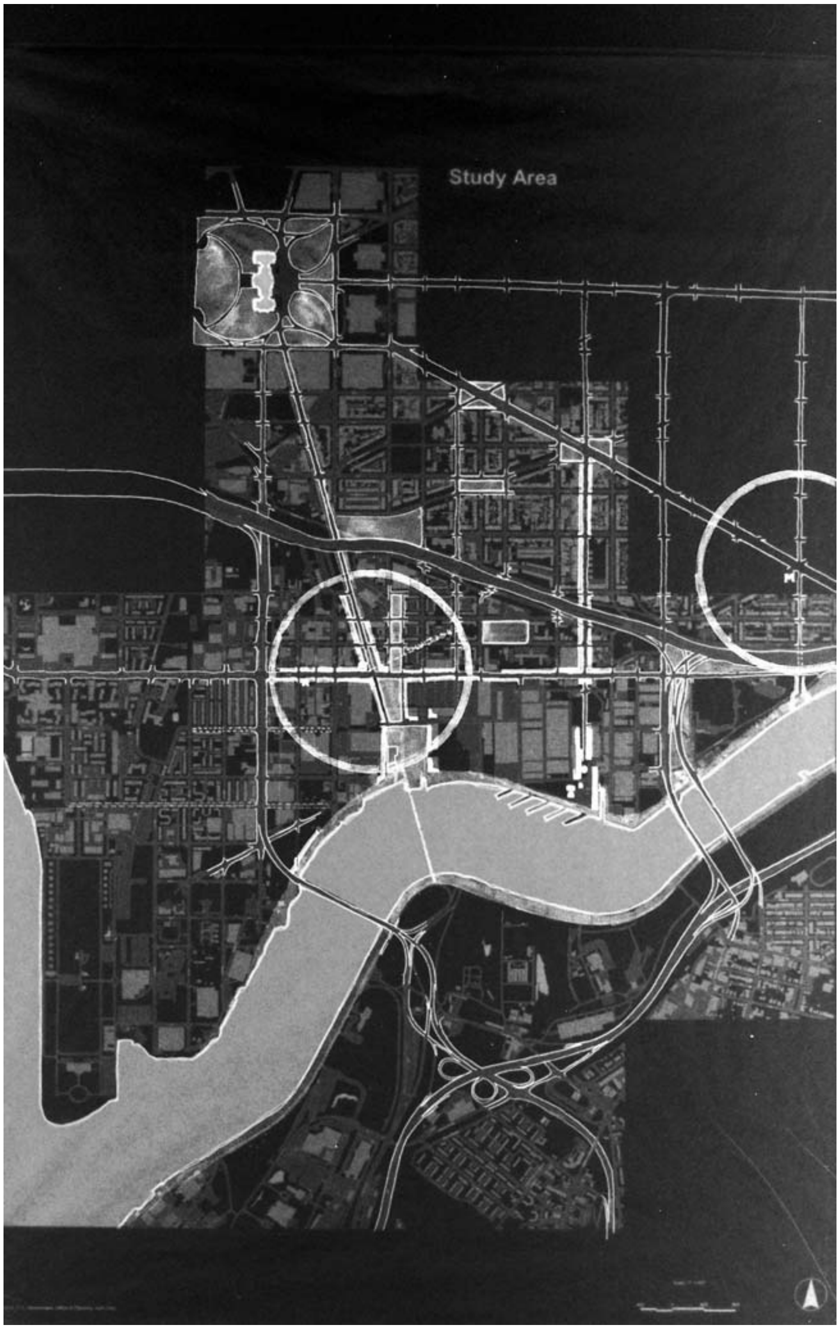
Urban Design Example 2
Bahama Village—Key West, Florida
Architect: Daniel Williams with Harrison Rue



Introduction: In the past century development has created more problems than it has solved. Bahama Village, the oldest African American village in the US, located in Key West was subjected to landfill that severely impacted the conch population, its economic base.
The opportunity here was to have the urban design solution reconnect the natural resources with the village's future.

- Increase human comfort by improving orientation to prevailing breeze for passive cooling.
- Reconstitute the cisterns for irrigation and potable water use.
- Restore economic and environmental benefits of reclamation of conch farm
- Reuse of existing materials
- Job incubation—train local residents as carpenters to protect and restore cultural and economic future of the community.
- Create land use zoning changes and tax breaks to preserve 150-year-old village. Increase density with rear cottage zoning improving the value of the property while bringing income to residents.
- Re-creation of beach zone and habitat

Urban & Regional Design Example
Anacostia River, District of Columbia
Architects and Planners: US:GSA & Congress for the New Urbanism



Introduction:

This is an urban and regional design project. The program included:

1. develop affordable housing and
2. foster economic development and
3. improve environmental stewardship and connection to the Anacostia River

The site and environmental analysis suggested the following possibilities:

- Daylighting (reconstruction of the creeks) the stormwater to create urban parks and creeks.
- Reclaim wetlands along river banks
- Support walkable neighborhoods by extending public transit to the riverfront
- Create public recreational space where the urban space meets the river's edge
- Integrate the Navy's Museum to illustrate ship technology purifying water for consumption.
- Remove sewage–stormwater combined outfall.
- Restore and replant lost wetlands along the rivers edge.