Green Projects Entry
Solar Umbrella (o)

Section 1 - Project Overview Information Part 1

Project name: Solar Umbrella (o)
Project owner: Angela Brooks and Lawrence Scarpa
Project address: 615 Woodlawn Ave.
Venice, California 90291

Section 2 - Project Overview Information Part 2

Project completion date:	4/2005	*(m/y) format*
Project Site:	Previously Developed	
Project type:	Single Family Residential	
Project site context/setting:	Urban	
Other Building description:	New (60% new, 40% renovated)	
Lot size:	4100.00 ft2	
Building gross floor area:	1790 ft2	
BOMA floor area method used?:	no	
Number of permanent occupants:	3	
Number of visitors:	15	
Occupants (hours/week/occupant):	105	
Visitors (hours/week/visitor):	3	
Total project cost:	$390,000	

Section 3 - Project Overview General Description

General description: Nestled amidst a neighborhood of single and two story bungalows in Venice, California, the Solar Umbrella Residence boldly establishes a precedent for the next generation of California modernist architecture for the couple and their six-year-old son.

Inspired by Paul Rudolph's Umbrella House of 1953, the Solar Umbrella provides a contemporary reinvention of the solar canopy. Taking advantage of the unusual through lot, the addition shifts the residence 180 degrees from its original orientation. What was formerly the front and main entry at the north becomes the back as the new design reorganizes the residence towards the south. This move allows the architects to create a gracious introduction to their residence and optimizes exposure to energy rich southern California sunlight. Conceived as a solar canopy, these panels protect the body of the building from thermal heat gain by screening large portions of the structure from direct exposure to the intense southern California sun. Rather than deflecting sunlight, the solar skin absorbs and transforms this rich resource into usable energy, providing the residence with 95% of its electricity. Like many design features at the Solar Umbrella, the solar canopy is multivalent and rich with meaning—performing several roles for functional, formal and experiential effect.

Section 4 - Top Ten Measures

Top Ten Measure 1: Sustainable Design Intent & Innovation

Key environmental aspects: Green buildings drum up vision of science fairs and survivalists, but the Solar Umbrella defies such stereotypes, giving sustainable living a much-needed modern point of view. The biggest problem in green building's legacy isn't the technology but how little design innovation goes into the architecture. We are interested in developing a new language through the use of sustainable materials environmental concerns.

The architects found inspiration when they were in graduate school and grew intrigued by the shotgun and other vernacular houses of central Florida; their built-in natural air circulation and shaded porches which are inherently energy efficient and sustainable. The Solar Umbrella is organized so that over 90% of the glazing is on the north and south facades. The south and west facades are shaded by a series of abstract fins and solar panels.

In accordance with what the architects call "global regionalism," they picked up on the California modern aesthetic and fluid connections between inside and out-that cropped up around Los Angeles beginning in the 1920s and mixed it with 21st-century technology. The project is a rich collage of interlocking spaces using recycled and sustainable materials in unconventional ways.

A building should take some responsibility for the environment however; you can't have a really sustainable building if it's not good design. People won't want to live in it. Playful elements are as important as avoiding waste and living responsibly.

Top Ten Measure 2: Regional/Community Design & Connectivity

Regional/Community Design: This project is located on a block, which are dominated by thru lots with public streets on two sides of the property. Most houses on the block treat Boccaccio Ave as the front of the house and treat Woodlawn Ave much like an alley detracting from the neighboring homes across the street. The addition and remodel to the existing house creates living spaces and porches on both sides addressing both streets equally. All services are concealed in the side yards to further enhance the quality of the street. Bike racks are located at the property entry gate to provide easy access to neighborhood shops located within just a couple of blocks of the site.

The existing single story structure located along Boccaccio was retained and remodeled while the garage located on Woodlawn Ave was demolished, replaced by a new entry and living space, in doing so transforming the pedestrian character along Woodlawn Ave. A variance was granted for a 13 foot wide carport (charging ports were provided for the owners' electric car) on Boccaccio Ave in lieu of a code required enclosed two-car garage that would have dominated the small 40-foot wide street frontage.

66% of building population uses transit options other that single occupancy vehicle 0.33 parking spaces per person

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Use other transport options:	66%
Parking spaces per person:	0.33

Top Ten Measure 3: Land Use & Site Ecology

Site ecology:

Specific variations from the regional climatic conditions were studied incorporating the microclimate with regional strategies; proper orientation, natural light and ventilation, regional material with global technologies such as solar panels for energy generation, in-floor heating and sustainable building materials which allowed the resultant building to be virtually energy neutral.

The existing 600 square foot structure built in 1923 was retained and remodeled despite being considered a tear down. The existing garage was torn down and replaced with a smaller carport. Even though the completed structure is three times it's original size the net increase in lot coverage is less than 400 square feet.

The project also has it’s own storm water retention system and retains 80% of roof storm water on site, virtually unheard of for a project in the area. While most structures in the area cover as much as 90% of the site with non-permeable surfaces this project maintains over 65% of the site unpaved or landscaped on a lot that is only 4100 square feet dramaticallyreducing heat island effects and runoff.

Permeable gravel is used in most places (including the carport and driveway) that would normally be covered with non-permeable surfaces. All landscaping is drought tolerant native planting that requires little or no maintenance. Much of the planting was selected to attract an unusually high concentration of hummingbirds in the area. Composting was included as part of the landscape design.

Top Ten Measure 4: Bioclimatic Design

Bioclimatic design:

The Solar Umbrella was designed to passively adapt to the temperate arid climate of Southern California. Due to the small site there were limited options for building placement. Therefore, our analysis focused on the placement of building components to take advantage of abundant natural ventilation, light and to control heat gain and heat loss.

The biggest challenge was to overcome the year round substantial temperature differential between day and night. To compensate for this condition concrete floors and some concrete walls were strategically placed and used as thermal heat sinks. Furthermore, the solar panels are building integrated and form canopies that shade the building. Overhangs are provided at south-facing glazed areas to control and regulate summer and winter heat gain. Dual-glazing with a low-E film was utilized in aluminum frames that have thermal breaks to control the indoor thermal environment.

Operable windows and a perforated-steel stair are strategically placed so that as hot air rises, it passes through and out of the house. The rooms are kept cool with a combination of window placement for cross ventilation; double-glazed, krypton-filled, low-e windows with stainless steel spacers; and recycled insulation that boosts the thermal value of the wall to 75% above a conventional, wood frame wall construction and reduces envelope infiltration.

Operable skylights are used in both the kitchen and a bathroom for natural light and ventilation and to maintain privacy.

Top Ten Measure 5: Light & Air

Light & Air:

The Solar Umbrella was conceived as a light filled garden pavilion. Standing on either street the viewer can see completely thru the building on both the first and second floors. The primary living space has a 10-foot by 24-foot triple pocket sliding glass door

that connects directly to the garden. There is no perceived separation between inside and outside. There are also natural convention areas in the kitchen and stair to the second floor that further induce airflow.

Every room has abundant natural light and rarely needs artificial lighting except at night and on overcast days. Even bathrooms and closets have natural light and ventilation using operable skylights and clerestory windows to maintain privacy. The only room in the entire structure without cross ventilation is a 6-foot by 8-foot outdoor accessible storage room. Beds have small built-in individually operated reading lights overhead. In-floor electric heating with individual floor sensors are used throughout the new addition. All building finish materials are formaldehyde free, natural or recycled materials and low or no V.O.C. content. Materials were selected to enhance indoor air quality.

Thermal comfort was of major importance. Glazing with a low Solar Heat Gain Coefficient and glazing with a minimum U-value of 0.33 when occupants will be adjacent to windows were used. Low mercury flourescent lamps were also used.

Percent of building area that is daylit:	100%
Percent of building that can be ventilated or cooled with operable windows :	92%

Top Ten Measure 6: Water Cycle

Water Cycle:	The landscaping is native and drought tolerant planting with a substantial amount of gravel to allow water to percolate into the ground. A drip irrigation system with seasonal adjustments was installed. The roof storm water is collected in a large scupper (shown at the front elevation), which is directly above an underground retention basin (drywell) that allows a majority of the roof water to be retained on site. The property is only 6 blocks from the beach and retaining water on-site contributes to cleaning up the bay- the water isn't allowed to flow into the streets and collect oil, trash and pesticides. Appliances were chosen for both energy-efficiencies and water conservation. The clothes washer (front-loading) and the dishwasher both use less water than traditional models. The kitchen faucet, showerheads and toilets are all low-flow fixtures. The existing house toilet was replaced with a new low-flow type through a city rebate program and was provided at no cost to the owner. Any rain water that falls on the patio, pool or the pond is retained using a collection and automatic overflow/recirculation pump.

Precipitation managed on site:	90%
Total water used indoors:	31280 gal/yr
Total water used outdoors:	4600 gal/yr
Percent of total water from reclaimed sources:	0%
Percent wastewater reused on-site:	0%
Calculated annual potable water use:	20 gal/sf/yr

Top Ten Measure 7: Energy Flows & Energy Future

Energy description:

A large part of the design of the house is the solar canopy. This solar canopy provides 95% of the building's electric load through 89 amorphous silicon solar panels. This system is on a 'net-meter' provided by the City of Los Angeles which allows the grid to be used as a storage system and eliminates the time-of-use charges with traditional electric use. For the existing house, new insulation was blown into the walls and roof and batt insulation was provided under-floor.

Heat is provided through an integrated with the solar electricity radiant in-floor heating system for the concrete floors of the new addition. Heat through the floor is a more efficient mode of heating than through forced air, air temperatures can be lower and energy use less. 100% of the house is daylit and requires no electric light except at night and on overcast days. Appliances were chosen for their energy efficiencies: the clothes washer (268 kWh/yr), the dishwasher (416 kWh/yr) and refrigerator (365 kWh/yr) are energy star rated and use substantially less energy than other models. Lighting control systems are used inside and out to further reduce consumption. Because of the very low power demand of the building, thousands of feet of wire were saved.

The pumps that are utilized for both the pond and the pool are sized to be as small as possible and are on timers to conserve energy and utilize non chemical filtration systems.

Three solar hot water panels are used (and are on the roof): one is to pre-heat the domestic hot water before it gets to the gas-fired hot water heater and the other is used to heat the pool. The domestic hot water solar panel has halved the house's natural gas use on a home 2.5 times the original size.

Payback for all energy system is anticipated in approximately 10 years.

Performance Rating

EPA

HERS

Percent total energy savings 77

	Base Case	Design Case
Total energy (Btu/sf/yr)	71706	16700
Electricity (Btu/sf/yr)	24986	640
Natural gas (Btu/sf/yr)	46720	16060
Other: 0(Btu/sf/yr)	0	-446047.989
Heating (Btu/sf/yr)	4912	2349
Cooling (Btu/sf/yr)	0	0
Cooling capacity (sf/ton)	583.062	1169.935
Lighting load connected (W/sf)	3.101	2.101
Lighting load after controls (W/sf)		1.3
Plug load (W/sf)		0.3
Peak electricity demand (W/sf)	5.5	1.8
Percent on-site renewable energy (%)		72.5
Percent grid-supplied renewable energy (%)		0

Supplemental Narrative

Employed analytical procedures per ASHRAE Residential, Cooling and Heating Load Calculation and supplemental in-house developed software for electric and domestic hot water demand and supply calculations for a typical year per local

weather data.

Renewable site generation includes 4.5kw of solar electric PV system. 94.3% of electricity. 3 Solar thermal collectors provides domestic hot water and swimming pool heating. The three collectors provide 81.7% of heat energy.

Top Ten Measure 8: Materials & Construction

Materials description:

Materials were selected based on their effects on indoor air quality. Indoor air quality was emphasized by minimizing off gassing. Also the designers selection criteria were: to use materials that are durable/long lasting and have low or no maintenance aspects, have some recycled content, have no formaldehyde content and are obtained and transported locally. Although not required by the city, over 85% of the construction debris was recycled by American Waste Industries.

The major materials used were concrete with 50% flyash content, recycled mild steel that was rusted and then sealed, wood products were constructed from composite recycled materials (MDF and OSB) for cabinetry, flooring and structure (TJI composite members used instead of conventional lumber). The stucco used on the exterior has an integral colored pigment so that painting is never required. All concrete forming materials and 20% of the framing material were from reclaimed sources.

Sealed OSB was used on the floor of the existing remodel and the kitchen cabinets. Formaldehyde-free MDF was used for the bedroom cabinets. Homosote (100% recycled newsprint) was used as a wall finish. All paint used was low VOC and the floors were left as a concrete finish. Smaller 'off-the-shelf' elements such as industrial broom bristles are used as design elements in lieu of a more costly 'virgin' material. Also we avoided rigid or blown foam insulation made with an HCFC blowing agent and sized electrical wiring properly.

These details, coupled with the qualities and character found throughout the Solar Umbrella, distinguish this project from similar projects and benefit not only each individual resident but also the community at large.

Top Ten Measure 9: Long Life, Loose Fit

Long life, loose fit:

We would argue that a building that is an energy hog that everyone loves is more sustainable than a building that uses no energy that nobody likes. Our goal was to create a beautiful, low maintenance high quality architecture.....that is sustainable.

The Solar Umbrella, both beautiful and energy-generating, will continue to serve its purpose long into the future. Utility costs in the past have been relatively low in this country. As we continue to see utility prices rise, the solar panels will become even more important. Showcasing solar panels in a way that lets people see they can be beautiful and serve a dual purpose has far reaching long lasting effects.

The surrounding neighborhood has a density of about 14 dwelling units/acre and most of the lots and houses are very small compared to the national average. Efficient use of space was seen as important: some of the furniture is built-in as in the kid's bedroom and the large couch in the living room (which allows storage to be built into the furniture)- the living room couch is sized so that a portion of it can be used as a queen-sized bed for overnight guests. In the master bedroom on the second floor, the wall becomes the storage: a built-in wall of cabinets conceals clothes and drawers and the individual lighting for the bed. The design also incorporates a relatively large garden space for such a small lot.

Top Ten Measure 10: Collective Wisdom & Feedback Loops

Collective Wisdom & Feedback Loops: The most important intelligent design strategy was proper planning and orientation and making the structure as passively sustainable as possible. Active systems then became icing on the cake. We also have made efforts to demystify the perceived complexity of sustainable design by demonstrating it can be accomplished with little difficulty and to show the range of strategies that can be implemented with their respective costs and paybacks.

Another important aspect for the owners and architects was the education of others regarding sustainable design. Several tours and events have been held at the house: for other architects, design professions, contractors, community organizations and institutions, such as the American Institute of Architects, the Boys and Girls Club, Venice Family Clinic, Los Angeles County Museum of Art and others. Within one year over 1000 people have visited the Solar Umbrella including routine trips from the 8 local area architecture and design schools.

Also important was to understand exactly how much energy is being used and generated and the life cycle costs of the energy systems. The owners have been diligent in recording how much energy the solar panels generate monthly. This and all project information is shared with visitors and has been make available to the public. Continuing collaboration is occurring with the solar consultant to fine-tune, monitor and document the sustainable features. This information is continually compiled and adjustments are made.

The biggest lesson learned was that a holistic approach to energy and environmental design, taking into account the competing performance, cost, social aspects, and regulatory constraints associated with the implementation of a series of energy design measures are a must when considering any sustainable project. This approach resulted in a highly efficient building that met even tougher standards for quality architecture.

Section 5 - Project Economics

Finance: The city department of water and power provided a rebate of over $18,600.00 and the Federal government provided a rebate of $4,000.00 for the solar system. Appliance rebates were utilized for low-flow and energy star: $300.00. The original house had minor dry-rot in the framing of the walls and the owners were able to re-use most of the wall framing and all of the roof and floor framing- even the original stucco was retained: it was sand-blasted and skim-coated with a new color which matches the new addition. Obtaining a variance to allow a carport in lieu of an enclosed garage also saved both money and space.

Another key strategy was to provide extra insulation (best return on investment!) and ensure minimal infiltration. A tight envelope resulted in a dramatically reduced demand for energy, therefore, reducing the need and costs for systems that would have been necessary to produce more energy.

Cost and payback analysis: The remaining cost of the solar system was still substantial (taking into account the rebates noted above): about $20,000.00. The payback time on this is estimated to be 12 years (the warranty on the panels is 25 years, although they should last a lot longer). The solar hot water which, preheats the gas-fired HWH, has a payback time of 10 years (equal to the warranty). Energy costs for the entire building are now less than $300.00/year. As utility costs increase the payback period will decrease.

Section 6 - Process and Results

PreDesign:	The existing building location on site was analyzed for proper orientation and heat gain and differences between the local and regional climate. The architects saw the potential of adding an addition that would re-orient the home 180 degrees that would dramatically change the relationship with the neighborhood and it's passive and active solar orientation while conserving precious open space. This also included an analysis that would result in saving the original 1923 bungalow that conserved building resources and saved time and money.
Design:	Numerous environmental considerations were incorporated in the early planning and design stages of the project. The architects and energy consultant collaborated from the outset to minimize energy use and best utilize natural features such as the sun and prevailing winds. The orientation and shape of the building and the placement of windows maximized natural daylighting and natural ventilation and provided shading where needed. The building's design and technologies allowed it to achieve a level of energy efficiency that exceeds both the State of California Title 24 Energy Code and local area standards set by the City of Santa Monica's Green Building Design and Construction Guidelines by more than 50%, resulting in annual energy bills of less than $300.00.
Construction Process:	The construction process was managed to be as resource efficient as possible. The architects provided the contractor with a waste management plan that resulted in over 85% of the construction waste being recycled. A waste removal company sorted and recycled construction debris, however, contractors were also required to recycle their own person waste such as soda cans, etc. Reclaimed wood products from another construction site were used for all concrete forming. Any remaining material in good condition were then used for structural framing. Construction was anticipated to take nine months. Actual construction lasted thirteen months due to many innovations and experimental applications and programs. Inspectors were not familiar with the solar system, and many materials associated with green building, therefore causing delays. The service planner for LADWP had problems locating the service due to the solar system causing further delays. The contractor had to be continually educated about sustainability and it took considerable work to explain to them; for example why they had to wait four days to get 50% fly-ash concrete when they could get a normal load of concrete the next morning.
Operations/maintenance:	The home was designed to significantly reduce operation and maintenance costs. An operation and maintenance program has been designed and an operation manual has been provided to the owner. All systems are currently being monitored for performance. It is important to coordinate rebate requirements with actual product and installation warranties. Materials, such as Homosote, oriented strand board, concrete, natural stone and natural solid woods were used which all have a homogeneous solid cores. When scratched or damaged it is easy to repair or is unnoticeable. Landscaping requires almost no maintenance and is drought tolerant. Exterior finishes are natural pigmented stucco, recycled and rusted cold rolled steel and concrete requiring no painting. After almost one year of occupancy there has been no required maintenance on the building other than adjusting and tuning the active solar, pumps and irrigation systems and cleaning gutters. In the first year of operation the utility cost for the building will be less than $300.00.

Commissioning:	The architects have previously completed a number of LEED certified buildings, including pioneering certification in sectors of the building industry where the USGBC had not yet developed certification standards. At the time of construction of this project there were no certification criteria for SFR or existing buildings. The architects had previous success at getting the USGBC to accept applications for certification for projects that had no LEED certification criteria, so the architects attempted (several times) to get the USGBC to use the Solar Umbrella as a pilot project for SFR Leed Certification; to no avail. The architects even went as far as sending a check to register the building for certification that was returned. Nonetheless, the architects independently commissioned and fully documented the building following LEED criteria and methodologies developed in house and with the sustainability consultant.
Measurement & verification/ post-occupancy evaluation:	Detailed records have been kept and performance has been measured against design criteria. Even though the building was designed to be a net zero energy user the building is currently generating only 95% of the energy used. Initially energy generation was only at 80-85% until adjustment of pool and pond pumps, automatic timers and the addition of some solar panels were made. Energy generation is lower than anticipated due largely to accumulation of dirt on the panels and the coastal fog due to the buildings location near the beach. The panels are now cleaned every 4 months which has increased energy output significantly. Stormwater retention, thermally broken glazing, in-floor heating, energy star appliances are all performing as planned. Water usage was also initially high. Sensors have been added, landscaping has been established and usage has decreased substantially. A number of unusual sustainable materials were used such as cabinetry and flooring made from oriented strand board (OSB) wall made from Homosote (recycled newsprint) and recycled rusted steel siding. These sustainable materials, as well as many others, have proved to be durable materials and are performing well. Initial payback for all sustainable systems was anticipated to take seven years. Current projections now anticipate 10-12 years. The entire sustainable items including the solar system, solar hot water system, thermally broken glazing had an incremental cost of $35,000.00 most of which was recovered in state and local rebates and federal tax credits. The Solar Umbrella provides a direct benefit to design, development and building professionals and students on and ongoing basis. Through comprehensive documentation, publication, and outreach, the project exposes valuable lessons on overcoming barriers to green, affordable development and showcases new strategies and technologies for others to build upon. In the last twelve months, the Solar Umbrella has been visited by over 1000 people and has been the subject of numerous workshops, case studies, and publications.
Rating System Name:	LEED (as a guideline)
Version:	v2
Rating Date:	
Score or rating level:	
Credits:	

Sections 7: Visuals

Exhibit A

Solar Umbrella001a.jpg

Image has been scaled down. Click it to view actual size...

Description: new front on woodlawn ave

Exhibit B

Solar Umbrella Existing comp.jpg

Image has been scaled down. Click it to view actual size...

Description: existing home before remodel and addition

Exhibit C

plans page1.jpg

Image has been scaled down. Click it to view actual size...

Description: plans

Exhibit D

siteplan page2.jpg

Image has been scaled down. Click it to view actual size...

Description: site plan and sections

Exhibit E

Elevations 001.jpg

Image has been scaled down. Click it to view actual size...

Description: elevations

Exhibit F

Solar Umbrella005.jpg

Image has been scaled down. Click it to view actual size...

Description: living space showing inside outside relationship

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Exhibit G

Solar Umbrella007.jpg

Image has been scaled down. Click it to view actual size...

Description: second floor showing solar canopy integrated into the building design

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Exhibit H

Solar Umbrella008.jpg

Image has been scaled down. Click it to view actual size...

Description: renovation along Boccaccio ave within the scale of the existing context

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Exhibit I

Solar Umbrella012.jpg

Image has been scaled down. Click it to view actual size...

Description: principal living space with remodeled kitchen dining area in background showing abundant daylight and view thru house.

Exhibit J

Solar Umbrella022.jpg

Image has been scaled down. Click it to view actual size...

Description: new master bedroom and bathroom on the second floor