

Natural Resource Efficiency Designed in New Urbanism: A Partnership Designing Efficient Buildings in Efficient Communities

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ABSTRACT

The partnership between a city, a design team, a utility and a building owner can be an effective means to realize efficient buildings in efficient communities. This paper reports on the process and cooperation between four partners to produce a comfortable and resource-efficient building in a challenging urban infill site.

Early on, the owner committed to a LEED Platinum building in a progressive City with a commitment to sustainability and to a New Urbanism design team. Together these decisions established the foundation for an innovative building design process. Various technologies and progressive ideas were entertained following the City's green building guidelines and the New Urbanism principles. Design alternatives were tested through computer simulations to balance building science with occupant comfort and available budget. The developer's building, among many highlights in sustainable design, uses only 40 kBtu/SF, exceeding the City's energy standards by 40 percent and California's Title 24 by over 50 percent; it harvests and recycles water for a 60 percent reduction in consumption; and recycled/salvaged nearly 90 percent of its construction and demolition waste.

Lessons from the partnership:

- Cooperation is necessary to test possibilities and be innovative.
- Computer modeling can help quantify design intentions.
- Final instrumentation and evaluation is needed to verify post-occupancy numbers and make sure that original design intentions and goals have been met.
- Energy efficiency has business benefits and behavioral costs.
- A city's vision for sustainable development requires developer/design/utility teams to challenge existing regulations that do not support the vision.
- A sustainable building does not need to be high-tech. Active users can control a passive building.

Introduction

One of the greenest of urban buildings stands in a city committed to being at the forefront of the green building movement. Santa Monica's Green Building Program (GBP) inspires many cities in the nation to be sustainable, and now the new Robert Redford building, housing the Los

Angeles office of the Natural Resource Defense Council (NRDC), challenges building owners and operators to be more sustainable, use fewer natural resources, and aspire to be off the water and energy grid.

The new building was made possible by a partnership between a developer (NRDC), a design team (including architect Moule and Polyzoides (M&P) and engineer Syska Hennessy Group (SH)), a utility (Southern California Edison (Edison)), and the City of Santa Monica, via an integrated design process. As part of the process, criteria were developed and continually clarified and transformed.

The criteria were developed in three major categories:

- Siting criteria
- Performance criteria
- Design criteria

The first set of criteria was developed by NRDC, and was used to identify a location, which also brought Santa Monica and Edison on board. The performance criteria were developed by NRDC in collaboration with Santa Monica and Edison. The design criteria were developed and elaborated by the integrated team, and in some cases led to results far exceeding the performance criteria. In other cases, designs required negotiations with Santa Monica and other authorities to enable innovative solutions that had not as yet been considered by regulators.

The process demanded from the members of the partnership integrity, commitment, trust, hope, and most importantly risk in doing what has not been done.

Each partner exposed itself to risks as part of collaborating on this project.

- NRDC was forced to let the budget and schedule slip to achieve its goal of a LEED platinum building
- Edison provided funding and services outside its initial scope out of a commitment to demonstrate unprecedented energy efficiency.
- M&P risked its track record to achieve a highly integrated building form and systems solution as part of realizing a sustainable building following New Urbanism principles.
- SH was willing to compromise the status quo and forego some of the highest technology solutions, as it advocated for the most appropriate passive systems.
- Santa Monica—as both green building advocate and regulator—was open to questioning its own traditions and regulations as it reaffirmed its commitment to the GBP and a sustainable city.

The process of developing the building can be divided into four phases:

- Selecting the site according to NRDC's criteria
- Selecting a design team committed to the performance criteria identified by NRDC in collaboration with Santa Monica and Edison
- Designing the building to meet or exceed the performance criteria
- Testing the design against the permitting, construction, and inspection processes

Phase 1: Selecting the Site

In mid-1999, NRDC needed new office space for its Los Angeles staff. Its criteria for a new site included the following considerations:

- The site must be a good investment.
- The site must be located in a pedestrian environment.
- The site must enable an inexpensive renovation solution.

As an environmental action organization, it was very important to NRDC to have its space embody its organizational mission. NRDC believes that green buildings are much more energy- and resource-efficient than standard energy-efficient buildings that focus exclusively on operational energy. After a long search, it was decided to purchase an existing structure in Santa Monica, California. Santa Monica, with its Green Building Program (GBP), offered NRDC an opportunity to work with a municipality holding congruent goals, as is apparent in the GBP's mission:

To lead the community and set an example for our neighbors in the creation of a sustainable built environment, as the foundation of a sustainable city, through the application of the principles of green building.

The Green Building Program will accomplish its mission through outreach and education, facilitation of green building projects during planning and approval processes, green building design support, and drafting of and enforcement of city ordinances.

The Santa Monica site also offered the opportunity to work with Edison and participate in the Edison Showcase program. The program promotes the demonstration of new energy efficiency technologies and practices and supports energy-efficient projects with funding, technical and economic analyses, detailed engineering, and extensive monitoring (Edison, 2000).

The site included two structures, which were intended to be joined with additional space to accommodate the desired office program of doubling staff size. Given that the building was constructed before 1920, it was expected that some seismic upgrading to the structure and upgrades to the electrical system would be necessary.

Figure 1. Photograph of Site with Existing Building



The selected site accords with the team’s commitment to New Urbanism, which calls for “[c]oncentrations of civic institutional and commercial activity...embedded in neighborhoods and districts, not isolated in remote, single use complexes” (New Urbanism Principle 16).¹

Downtown Santa Monica is a vibrant mixed-use downtown. The site is in close proximity to office spaces, movie theaters and retail stores, and apartment buildings.

Figure 2. Photograph of New Building Exterior



Phase 2: Selecting the Design Team

NRDC developed an ambitious set of goals for its request for qualifications (RFQ) and request for proposals (RFP). As a leader in the green building movement, NRDC’s RFQ/RFP stipulated achieving a LEED Platinum™ Rating, the highest green building certification

¹ New Urbanism Charter

possible. In addition to the Platinum goal, NRDC initially wanted to be “off the grid” in terms of energy and water use. NRDC’s Southern California office was intended to demonstrate national leadership in the five principal areas of green design and sustainability:

- Building Site
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality

Clear and unambiguous goals were critical to the project’s success. NRDC worked with GBP and Edison’s Showcase program to develop the performance criteria. The original specification stated, “The office should be a legitimate contender for ‘greenest office in the country.’” A sampling of performance specifications follows:²

- Energy Budget: 40,000 kBtu/square foot/year or less of primary energy, including plug loads.
- The space shall consume 0.5 watts/square foot or less coincident peak load (including allowances for controls) of electrical energy for ambient and task lighting. Ambient light levels consistent with IES guidelines for the Office occupancy must be maintained.
- “Alternative Energy Technologies: One goal of the project is to be “off-the-grid” or even a net energy producer. Building-integrated photovoltaic, wind energy and fuel cells are strongly being considered for the project.”
- “While the project objective will be to minimize or eliminate the need for either sewer out flow or city water, all plumbing and utilities shall meet the current plumbing and building codes of the municipality within which the facility is located.”

As a result of the RFQ and RFP process, NRDC selected Moule & Polyzoides and Syska and Hennessey to serve, respectively, as the project architect and project engineer. In addition to impressive qualifications their responses reflected a clear commitment to executing an innovative green building project via a fully integrated partnership.

Phase 3: Designing the Building

With the project team on board, a two-day intensive workshop, or charrette, was held at Edison’s CTAC facility. The group quickly determined that the desire to be 100 percent off the water and energy grids was impractical given the site and the occupancy. The team then worked together to identify a new set of goals that integrated building science with the principles of New Urbanism, to which all parties were committed.

The charrette participants developed three alternatives, including two that required substantial demolition of the existing structures. The third design, which adapted the existing structure to the desired energy and indoor environmental quality goals, was selected.

² See Appendix for a detailed list.

After reviewing available sustainability and energy opportunities, it became clear that this project could go beyond innovative solutions and apply brand new technologies. The new criteria sought to design a building with the smallest possible energy and water footprint.

Key areas in which new technologies were employed include:

- Water
- HVAC
- Lighting

In addition, the team worked to ensure that systems were fully integrated with the principles of New Urbanism.

Water

The team agreed on aggressive water efficiency strategies, some of which had previously been pursued in Santa Monica. These included water-free urinals, dual-flush toilets, PEX flexible piping, systems for storm water collection and reuse, and a gray water recycling system.

Figure 3. Water Efficiency Building System

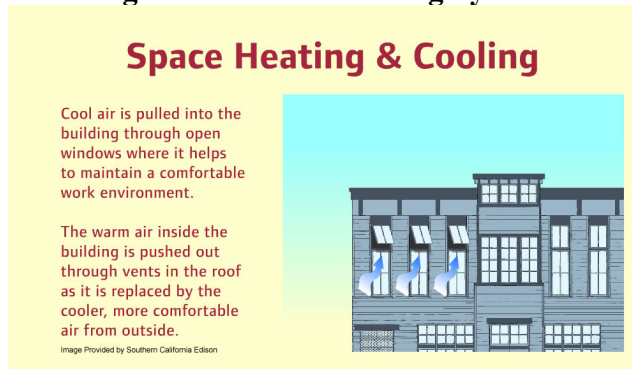


Natural Ventilation and Mechanical Systems

The team specified and designed operable windows that are interlocked with perimeter convection heaters controlled by the building users. Daylight monitors and shafts drive daylight deep into the building and act as rooftop relief air paths that allow the natural ventilation to exit the building through stack effect.

The team also incorporated off-the-shelf, high-efficiency, residential-scale split-system air conditioning units that use an environmentally friendly refrigerant to temper the building during peak heating and cooling periods. The units are used in a slightly different configuration with 100 percent outside air and displacement ventilation diffusers that provide comfort cooling at floor level and allow the warmer air to stratify above the occupied level and exit the space at ceiling level.

Figure 4. HVAC Building System³



Lighting

The team designed lighting systems that incorporated passive features, depending on occupants to control lighting levels. For example, while daylighting sensors dim the artificial lighting in response to natural light levels, building occupants can set the lighting levels in their workspaces according to their personal preference with simple manual dimming controls. Since the building has many individual offices, the use of occupancy sensors to shut off lights in unoccupied rooms is one of the building's most effective energy efficiency measures.

Figure 5. Photograph of Lighting Building System⁴



³ Image from NRDC's real-time metering exhibit by SCE

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New Urbanism

New Urbanism is chiefly concerned with integration of buildings into their environment, in terms of placement, appearance, and conservation of resources, and function. The building form, with its landscaped side yards and three interior light wells, express the best aspects of integrated design, combining new urbanism and building science.

Figure 6. Building Interior with Light Wells



The light wells organize the interior space into a pedestrian-scaled street. They provide the daylight and ventilation, and enable the occupants to socialize in a series of small atria. The side yards admit daylight, and the xeriscaped landscape both receives and stores the reclaimed water. In addition, the roofscape serves as an outside room for occupants and also as a safe haven for the weather station and the photo-voltaic array.

The mixed-use nature of the building (which contains a public education center as well as offices), also expresses New Urbanism principles.

Placement. The NRDC building was designed to use an existing structure in a high-density urban infill environment close to public transportation and within walking distance of many other amenities and attractions (residential areas, shops, offices, entertainment, and the Pacific Ocean). The Environmental Action Center with a storefront and retail space promotes neighborhood walkability.

Appearance. The three-story, clapboard structure was designed to reflect the building's Santa Monica surroundings, and to take visual cues from nearby California beach bungalows. Among its more striking features are three multi-level atria with rooftop monitors that diffuse sunlight and fresh air throughout the building, and evoke the local lighthouses. Although the building demonstrates sustainable techniques, it uses California vernacular design to avoid appearing technologically imposing or didactic. The structure feels light, airy, comfortable and

approachable. Sustainable components of the building were designed to merge with the architecture.

Conservation of Resources. The NRDC building reclaims water and generates electricity from sunlight, is built from recycled or recyclable materials, and makes the most of natural light and the sea breeze to minimize the need for artificial lighting and cooling. And, in contrast to a building on a green field, the building reuses already urbanized land in a part of the city that encourages pedestrian activity and public transit. The building was designed with bathrooms that include showers for commuters using human powered vehicles.

Phase 4: Testing the Design

While the original schedule called for the building to be occupied in early 2001, various delays in finalizing the purchase of the space and subsequent field evaluation of the structure that uncovered unforeseen conditions that led to rebuilding almost the entire existing structure, negotiations with SANTA MONICA, as well as the complexities of balancing all of the different project objectives in a very small and unforgiving lot, resulted in delay of project completion until late 2003.

The City of Santa Monica was challenged by its role as green building advocate and at the same time a municipality required to enforce existing regulations. The building design, permitting, construction, and inspection processes exposed contradictions between regulations and sustainability goals that the City was motivated to remove.

Water Efficiency

Prior to the NRDC project, no private building in Santa Monica was allowed to install waterless toilets or urinals. The Plumbing Code prohibited installation of any plumbing fixture without a water connection. While several waterless urinals had been installed in city buildings as part of a demonstration project by the Environmental Programs Division, no conclusions had yet been drawn their performance.

As a result of negotiations facilitated by the Department of Environmental and Public Works Management between NRDC and the City's Building and Safety Division, a satisfactory resolution was achieved. It was agreed that waterless urinals could be installed in new City facilities and in the NRDC building as long as a water supply was stubbed out behind the wall. The water supply will be used should the innovative fixtures fail and need to be replaced by standard fixtures.

City staff is now planning to seek a change to the City Code to allow new construction to install waterless urinals without an available water supply.

Gray Water System

A system was designed to collect rainwater and mix it with gray water from the building's sinks and showers. The water would flow to a holding tank, undergo tertiary-level treatment, and then be used for irrigation and toilet flushing.

The City of Santa Monica had adopted the State of California's gray water ordinance, but this ordinance has no provision for rainwater collection. The City's Building and Safety

Division required that the State or County of Los Angeles Health Department first approve the system that NRDC wanted to install. The City's Utility Manager and Industrial Waste Services Coordinator worked with the County Health Department to negotiate a solution.

Ultimately, modifications were made to the proposed system and the Building and Safety Division agreed to sign off.

Recycled Plastic Pipe

The NRDC building was designed to use recycled plastic pipe for potable and recycled water. The pipe had previously been approved for use in San Diego and is considered a proven technology, but the City of Santa Monica's Code only allows copper piping. Nonetheless, the City's engineer approved the plans.

After the pipe was installed, the City's Plumbing Inspector stopped further work at the site. After considerable discussion and negotiation, the Building and Safety Division allowed the pipe for the NRDC project with certain modifications.

The City must now reevaluate its Code to determine whether it should be modified to allow use of the recycled plastic pipe.

Photovoltaics

The City's Zoning Code prohibits rooftop or ground-level solar PV or solar thermal systems to be visible from the street and required NRDC to install a railing around their 7.5 kW rooftop system. The railing casts a shadow on the panels and reduces power output. The City is currently planning to promote solar installation city-wide and must address its outdated Code requirements for screening photovoltaic generation from public view.

Conclusion

The partnership to create this successful building did not end with the developers and designers. Cooperation was also required from municipalities, regulators, and other stakeholders. Finally, a new partnership continues to unfold between the current occupants and their building. Although mechanical equipment exists, technology has been minimized to allow the building occupants to control their local environments. They can open their windows, adjust their window blinds, dim their own lights rather than relying on a high-tech mechanical system.

The long-term monitoring equipment installed by Edison in the NRDC building will continue to measure the effectiveness of this lasting partnership, and suggest how energy costs can be reduced not only by technology, but by changes in user behavior.

Appendix: NRDC Building Performance Criteria

- to provide building environmental systems that would provide superior thermal comfort in accordance with ASHRAE Standard 55 – Thermal Environmental Conditions for Human Occupancy
- indoor air quality that far exceeds the requirements of ASHRAE Standard 62 – Ventilation for Acceptable Indoor Air Quality
- overall building energy consumption that exceeds ASHRAE Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings and the California Title 24 Energy Standards by more than 65 percent and water consumption 60 percent less than a conventional building.
- Energy Budget: 40,000 kBtu/square foot/year or less of primary energy, including plug loads.
- The space shall consume 0.5 watts/square foot or less coincident peak load (including allowances for controls) of electrical energy for ambient and task lighting. Ambient light levels consistent with IES guidelines for the Office occupancy must be maintained.
- HVAC chiller size should not exceed one ton per 1200 square feet.
- “Alternative Energy Technologies: One goal of the project is to be “off-the-grid” or even a net energy producer. Building-integrated photovoltaic, wind energy and fuel cells are strongly being considered for the project.”
- “While the project objective will be to minimize or eliminate the need for either sewer out flow or city water, all plumbing and utilities shall meet the current plumbing and building codes of the municipality within which the facility is located.”
- Comfort parameters:
 - The indoor surface temperature of opaque wall surfaces shall not be less than 70°F. when the outdoor temperature is 20°F.
 - The indoor relative humidity shall not exceed 45 percent during the cooling season at established design conditions.
 - The indoor relative humidity shall be no less than 35 percent during the heating season at established design conditions.
 - The ventilation system must provide indoor air quality where indoor carbon dioxide levels do not exceed outdoor levels by more than 530 parts per million at any time during hours of occupancy.
 - The indoor surface temperature of glazing shall not be less than 62°F when the outdoor temperature is 20°F. Glazing choice shall optimize the balance between thermal resistance, shading coefficient and visible light transmittance as indicated by energy and daylight modeling analysis.
 - An enclosure which provides natural ventilation and daylighting with high performance glazing and glare control for at least 25 percent of the surface area and provides the interior surface temperatures as specified.
 - The users shall have individual control of their indoor environmental quality.
 - The recycling plan goal is to recycle or reuse at least 75 percent of construction and demolition debris by weight.

- The building shall emphasize the use of materials and furnishing that are non-toxic, low-VOC, sustainable, contain high post consumer recycled content and are recyclable. Preference is given to products that substitute for the use of wood. Where wood is to be specified, FSC-certified sources must be used.
- Sustainable site development, including the use of indigenous plantings with low water requirements. Reduce urban heat islands.
- It is the obligation of the INTEGRATED TEAM to provide professional design services to integrate all aspects of the project with the overall approach to integrated building systems and high performance sustainable design.
- Commissioning plan shall be adopted by the INTEGRATED TEAM during the design phase and carried through post-occupancy evaluation to measure and verify building performance. Functional testing of equipment and systems will be performed by the contractors to help determine whether the equipment meets operational goals or requires adjustment to increase efficiency and effectiveness. The primary goal of the commissioning agent is to identify system deficiencies as early in the project as possible and track their status until they are corrected. The commissioning agent is to assist the construction team by providing input regarding building systems prior to occupancy. Building commissioning procedures as outlined in the LEED green building rating system shall be considered the baseline for commissioning activities.

References

[Edison] Southern California Edison. 2000. *Page Title*. Available online: http://www.sce.com/SCE/002_save_energy/002e_show_engy_eff. Los Angeles, Calif.: Southern California Edison.