

## Charles David Keeling Apartments

### Project Overview



*View of west facade from  
Torrey Pines Road - Photo  
Credit: Tim Griffith*

The Charles David Keeling Apartments are located on the southwestern edge of the UC San Diego campus overlooking the coastal cliffs of La Jolla. Named for the scientist whose research first alerted the world to the possibility of the human impact on global atmospheric carbon, the apartments employ a suite of tactics to address Southern California's pressing environmental challenges of stormwater management, water scarcity, and carbon emissions.

The location offers remarkable views to residents as well as access to refreshing onshore breezes. The apartments are situated to provide expansive views of the ocean and mountains from all interior spaces, and from exterior walkways and the large roof terrace, which have become popular gathering spaces. The buildings and landscape promote the active use of exterior spaces, encouraging interaction among students with outdoor circulation that leads to chance encounters, convenient spaces for individual and group activity, and spaces conducive to congregating.

The apartments are instrumental in the revitalization of Revelle College, the founding college at UC San Diego, by bringing students closer to their core academic buildings. The goal was to provide each student with a distinctive, human-scaled home within a large research institution, at a location where they can more fully engage the academic community. This community was created out of the College's existing components, building on its heritage, and establishing a new gateway at the west edge of the campus.

Three apartment buildings are arranged in a C-shape around a courtyard that creates a new social zone and unites it with the existing 1960s Fleet Residences to the east. They adopt elements from the classic campus buildings; exterior walkways, repetitive sun control elements, and a warm color palette, but are firmly rooted in a 21st century aesthetic that unites form and performance. Great lengths were taken to construct the buildings with high quality, cast-in-place white concrete to visually tie them to the existing architecture.

**Location:**

10280 North Torrey Pines Road, Suite 470  
La Jolla California 92093  
United States

**Project Owner:**

University of California San Diego

**Submitting Architect:**

KieranTimberlake

**Project Completion Date:**

August, 2011

**Project Site:**

Previously Undeveloped Land

**Project Type:**

Education – College/University (campus-level)

**Project Site Context/Setting:**

Suburban

**Other Building Description:**

New

**Building or Project Gross Floor Area:**

147,000 square feet

**BOMA Floor area method used?:**

No

**Hours of Operation:**

24 hours, 7 days a week

**Total project cost at time of completion, land excluded:**

\$46,000,000.00

## Design & Innovation

Sustainable design was a primary driver for the design of the project. Owner and architects saw this project as an opportunity to capitalize on the favorable climate while addressing Southern California's pressing environmental challenges of stormwater management, water scarcity, and carbon emissions. The design response was to tune the design to capitalize on the favorable environmental features, while moderating or eliminating the undesirable ones. This led to a building envelope that uses thermal mass to buffer temperature changes, minimizes solar gain, and naturally ventilates.

Water scarcity is managed through a comprehensive strategy of conservation and reuse, including on-site wastewater recycling, a first for the UC system. Stormwater flow into the Pacific Ocean, which at the time of design was eroding a fragile coastal canyon, is remediated with a system of landscape bioswales and retention basins that reduce stormwater quantity, delay peak water flow, and control flooding in this region of the campus.

The project also extended the life of a neighboring building slated for demolition. Careful planning for the new complex spared the cost and environmental impact of replacing the lost housing elsewhere.

## Regional/Community Design



*Students move closer to academic buildings, eliminating commuter miles driven*



*New recreational area - Photo Credit: Tim Griffith*

Before the Keeling Apartments were completed, second-year students were housed in two separate locations, removed from Revelle College. This discouraged students from using the main dining and other facilities, or attending extra-curricular events which required a long trek across campus. With the project's completion, second year students relocated to Revelle College, where they now engage the greater college community.

The higher density that results from this project—and the benefit of attractive housing, views, and location—has the additional benefit of enabling students who would otherwise live off-campus to reside on-campus, further solidifying the campus community and reducing the vehicle miles driven by commuter students.

### **Metrics**

**Estimated percent of occupants using public transit, cycling or walking:**  
100%

## Land Use & Site Ecology



*Stormwater management and habitat creation - Photo Credit: Lenska (top) and Tim Griffith (bottom)*



*Bioremediation via green roof and bioswales - Photo Credit: Tim Griffith*

Rain events at UC San Diego are infrequent, but are often dramatic downpours that produce high volumes of runoff which, from this position atop the Pacific coastal bluffs, cause erosion to the fragile coastal scrub arroyos, a particularly threatened ecosystem. To counter this damage, the apartments use the natural slope of the site to provide limited natural infiltration, reducing the quantity of water and increasing the quality of the water released into the ocean. Water from the roof and a nearby parking lot is channeled and daylight through retention basins and bioswales.

A vegetated roof, an unusual feature in this dry climate, absorbs and evaporates rain that falls on that portion of the building, with overflow directed to the courtyard retention basins. Within the basins and bioswales, native vegetation slows runoff, allowing sediment and pollutants to settle before water leaves the site. During a major rain event, basins fill with water, then overflow their concrete weirs and pour into the bioswale, providing students with a real-time lesson in the bioremediation of water through soil, rock and plant material. The native planting of the courtyard and roof not only moderates runoff-induced erosion, but preserves the existing ecosystem by creating much needed habitat.

## **Bioclimatic Design**



*Psychrometric, wind and solar analysis informed the design*



*Comparison of energy savings with different shading and massing options*

The building functions as a selective environmental filter, enhancing the best components of the regional climate to address heating, cooling, and ventilation needs, while rejecting the elements that jeopardize occupant comfort. The coastal location experiences highly regular afternoon breezes. To optimize the cooling effect, the building mass and window openings were shaped and sized to best capture the breezes based on landscape-scale CFD modeling. To ensure occupant comfort, an easily ventilated single-loaded corridor scheme was generated and a scale model was wind-tunnel tested, with the resulting pressure differentials on the envelope used to inform the interior layouts and ensure adequate interior ventilation.

This analysis, coupled with the operability of nearly every window, proved that the passive strategies work effectively. The massing scheme has the added benefit of maximizing sun in the interior courtyard during times of student use. To reduce the buildup of heat inside the apartments, solar radiation is moderated through an extensive network of integrated shading and railing panels and highly efficient low-e glass on the west facades, while the exterior walkways, located on the south or west of the buildings, provide additional protection from peak solar radiation.

## **Light & Air**



*Single loaded corridors for passive cooling - Photo Credit: Tim Griffith*



*90% of all regularly occupied spaces receive daylight coverage of 25 foot-candles - Photo Credit: Tim Griffith*

The design maximizes the occupants' exposure to the best qualities of their environment. The location, on a bluff located above the Pacific Ocean, offers remarkable views as well as ready access to refreshing onshore breezes. The building is situated to provide expansive views of the ocean and mountains from all interior spaces, and from exterior walkways and the large roof terrace, which have become popular informal community gathering spaces.

There are nine or ten operable windows within each apartment, which are single-loaded to offer the occupants ample flow-through natural ventilation and daylight. Each apartment has both an ocean side and a courtyard view. The shading devices and railings have a permeable design to maintain views while minimizing the effect of solar radiation.

The net effect is a smooth transition from exterior to interior, incorporating the exterior becoming as an integral living space of the building.

## **Metrics**

**Daylighting at levels that allow lights to be off during daylight hours:**

90%

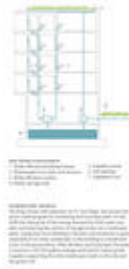
**Views to the Outdoors:**

98%

**Within 15 feet of an operable window:**

90%

## Water Cycle



*Wastewater recycling schematic - Photo Credit: Tim Griffith*

Water conservation was a top priority for this project, as it is both a scarce resource in Southern California and requires a significant amount of energy to transport from its distant source. The design response was two-fold, first focusing on conservation, and second on recycling. The conservation measures included water-efficient landscaping and a full suite of efficient plumbing fixtures, such as low-flow toilets.

While conservation is effective, the project sought to net a larger benefit, leading to the integration of on-site grey water recycling. Recycled water, while regionally available and used elsewhere at UC San Diego, was not available on this end of the campus and the cost to extend the system was prohibitive. Instead, the project incorporates its own wastewater recycling system to provide landscape irrigation water at grade at for the green roof. The integration of onsite water recycling was a pilot project for the UC system, providing a legal and technical template for future projects to follow.

### **Metrics**

**Percent reduction of regulated potable water:**

37%

**Is potable water used for irrigation:**

No

**Percent of rainwater from maximum anticipated 24 hour, 2-year storm event that can be managed onsite:**

100%

## Energy Flows & Energy Future





*The cast-concrete structure  
from the outside, and a  
double-height lounge - Photo  
Credit: Tim Griffith*

The most significant reduction of energy on this project comes from the elimination of air conditioning based on scientific validation of the effectiveness of the proposed design. Both building mass and envelope are designed to manage solar gain and nighttime cooling and to ensure effective natural ventilation.

The design incorporates single-loaded corridors, exterior walkways, operable windows, and a building orientation aligned to best capture cooling breezes from the Pacific Ocean. Heating efficiencies are achieved by thermal mass, and an innovative “backwards constructed” rain screen and air-barrier exterior wall that reduces heat loss and water vapor infiltration. Any mechanical heating needed is provided with a localized arrangement of individually controlled radiant panels. The lighting energy demand is largely met by daylighting, which satisfies LEED daylight and view requirements. Daylighting is complemented in public spaces with occupancy-controlled lighting systems.

On-site renewable energy comes from a PV array that supplies 6% of the building’s total energy. The PV system, funded through a local utility lease agreement, is the first at UC San Diego. The policy changes and contract negotiations that were worked out for this pilot project will provide a roadmap for other projects in the UC system to follow.

## **Metrics**

### **Total pEUI:**

31 kBtu/sf/yr

### **Net pEUI:**

29 kBtu/sf/yr

### **Percent Reduction from National Median EUI for Building Type (predicted):**

54%

### **Lighting Power Density:**

0.61 watts/sf

### **Upload Energy Data Attachment:**

 [Energy Data Upload\\_Keeling Apartments, UCSD.pdf](#)

## **Materials & Construction**





*Materials and Construction -  
Photo Credit: Tim Griffith*

Materials used in the building are robust and long-lasting, with an 80-year life span. In addition, most surfaces are unfinished, eliminating the need for carpet, vinyl tile, or mastics.

As the exterior and interior walls, floors, and ceilings are exposed concrete, a high level of care was taken to generate the most aesthetic concrete with intense focus on batch composition, formwork, and craft. To withstand the salt air, the project incorporates aluminum windows and doors and stainless steel hardware for exposed elements. An innovative architectural use of industrial fiberglass grating for sunshades and railing systems was specified for its durability in marine environments.

The long-term benefit of these material selections will be less maintenance and longer replacement intervals, resulting in reduced costs and associated energy. Environmental considerations were carefully examined with regard to the use of concrete, and particularly fly ash additive. The team carefully reviewed the scientific literature about the health aspects of the latter concluding that fly ash is not an issue in either the short term or the very long term. Fly ash was incorporated primarily in the foundations where color was not an issue. In addition, all of the concrete wood formwork was recycled after use.

## **Long Life, Loose Fit**

The Keeling Apartments repair several pervasive campus problems, and demonstrate a long-term strategy for addressing them. The project is a pilot for future campus development on a number of fronts, establishing methods for leasing energy-saving equipment from an outside entity, managing stormwater, recycling water, specifying materials that will not deteriorate, and providing engineered natural ventilation that is proven to work. It introduces green roof technology, uncommon in this area due to water requirements.

This new building gave new life to the existing residence halls, and retained one in lieu of demolition, providing great economic value to the University. On a social and planning level, the project remakes UCSD's founding college, which over time had been left by the wayside, and makes it whole again.

## **Collective Wisdom & Feedback Loops**

Early in the project the building owner and the students conducted workshops to identify their collective priorities, which were critical for the design of the units. A programming process was set up so that the architects could incorporate aspects from the collective knowledge of the owner and the experience of the students.

Success will be measured after one year of occupancy when owner and occupants and architect are scheduled to discuss how the building has functioned. Owner and design team are dedicated to collecting feedback on the building's performance, and will monitor energy and water uses with the goal of applying the lessons from the project's many pilot features to other building projects. Both are equally interested in student feedback about the comfort of their units, and will conduct a post-occupancy evaluation of occupant satisfaction.

The project was modeled in BIM for 3D coordination, enabling efficiency during construction and a model for use in operations. Extensive construction phase mockups and testing yielded several lessons learned particularly about the "backwards constructed" rain screen wall, and the means of achieving high quality performance and superior appearance of exposed concrete. The project has been fully commissioned, including advanced commissioning.

## **Other Information**

### **Cost and Payback Analysis:**

At one point in the project the budget was reduced, but the same number of students needed to be accommodated. In addition, the cost estimate had to be reduced by 25%, while maintaining same level of high performance and quality living spaces. Natural ventilation was found to cause a 38.3% reduction in energy consumption. The photovoltaics were afforded because of a lease program with SDG&E, otherwise they would not have been within the budget.

The prohibitive cost for water transport and sewage fees was a major motivation for on-site water recycling. The fiberglass sunshade material met the design objectives, with the added benefit of being inexpensive, durable, and long-lasting. This project increases the density of the site and has both a cultural and fiscal benefit for the campus.

### **Process and Results:**

UC San Diego was developed through a master planning process in the 1960s, a very innovative practice at the time. The client remains invested in its master planning process and this project grows out of that tradition. Working with an array of University representatives including facilities, housing services, housing work group, a building advisory committee, and a design review board, we developed a programming and feasibility study. Prior to design we conducted a thorough analysis of the project's various physical, climatic, geographical, economical, and technological factors. Ultimately the project is very much designed for its particular microclimate and campus culture.

### **Rating System(s) Results:**

#### **Rating System:**

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LEED  
Rating Date:  
2012  
Score or Rating  
Result:  
Platinum

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## Additional Images



*Site and campus context -  
Photo Credit: Lenska (top)*



*View looking south on Torrey  
Pines Road - Photo Credit:  
Tim Griffith*



*Site Plan and views - Photo  
Credit: Tim Griffith*



*Plans and elevations - Photo Credit: Tim Griffith*



*Courtyard - Photo Credit: Tim Griffith*



*View entering plaza from the south - Photo Credit: Tim Griffith*



*View of courtyard and north tower - Photo Credit: Tim Griffith*



*Outdoor circulation promotes social interaction - Photo Credit: Tim Griffith*

## Project Team and Contact Information

### Primary Submission Contact:

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### Project Architect (if different from submission contact):

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United States

### Project Team:

Role on Team	First Name	Last Name	Company	Location
Construction Manager	Glen	Bayliff	Swinerton Builders	San Diego, CA
Structural Engineer	Richard	Lawrence	Inertia Engineers	Stevenson Ranch, CA
Mech, Plumbing and Fire Protection Engineer	John	Gautrey	IBE Consulting Engineers	Sherman Oaks, CA
Electrical Engineer	Dale	Franchak	ILA Zammit Engineering	San Diego, CA
Civil Engineer	Steven	Nasland	Nasland Engineering	San Diego, CA
Landscape Architect	Martin	Poirier	Spurlock Poirier	San Diego, CA
Acoustics Consultant	Steve	Fiedler	Kimley-Horn & Associates	San Diego, CA
Lighting Designer	Sage	Russell	Lumia Light Studio	San Diego, CA

Code Consultant	Kelly	Eisenstein	Rolf Jensen & Associates	San Diego, CA
Environmental Design	Claire	Johnson	Atelier Ten	San Francisco, CA
Cost Estimator	Michael	Funk	International Consultants Inc.	Philadelphia, PA
Specifications Consultant	Paul	Simonsen	Technical Resources Consultant Inc.	Spokane, WA

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