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Going for Green, Heading for the Light

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Jean Nouvel
Jean Nouvel obtained his degree from the Ecole Nationale Supérieure des Beaux-Arts in Paris in 1972. Soon afterwards, he became a founding member of the "Mars 1976" Movement and was a founder of French Architecture Union. His works have gained world-wide recognition. In 2000, Nouvel received the Lion d'Or of the Venice Biennale. In 2001, he received the Royal Gold Medal of the Royal Institute of British Architects (RIBA), the Premium Imperial of Japan's Fine Arts Association and the Borromini Prize for the Lucerne Culture and Congress Centre in Lucerne. Nouvel was the recipient of the prestigious Pritzker Prize in 2008.

Bertram Beissel
Beissel joined Ateliers Jean Nouvel in 1998 and became a partner in 2002. He has directed a variety of European and international projects, including 53 West 53rd Street in Manhattan and the Guthrie Theater in Minneapolis, Minnesota. Both of these projects are featured in the selected works of the Pritzker Prize, which was awarded to Jean Nouvel in 2008. Beissel recently completed the design and construction of One Central Park Towers in Sydney, Australia. This project achieved the highest Green Star rating and takes a unique approach to urban solar power and organic shading. Currently, Beissel is AJN's US Project Director and is overseeing the construction of the 53W53 residential tower until its planned completion in 2018.

One Central Park was developed as a response to growing demand for residential accommodation in downtown Sydney. Its developers and designers used the opportunity to make a powerful and visible green statement with a tall building that is environmentally responsive on multiple levels. The project challenges the Modernist resistance to surface accretion, both with a planted veil that cleans the air, provides shade, and speaks of a naturally-integrated urban vitality, and a technologically-assertive apparatus that guides the sun's rays where they are most needed.

Global Overview

The United Nations predicts that the world's population will increase by 2 billion between today and 2050, and the number of people living in cities will rise from 50 to 75%. Inevitably, rural populations will be shrinking, and almost every urban center in the world will be growing. Twenty-first-century Australia is not exempt from this trend: Sydney could grow from 4.6 million inhabitants today to 7 million by 2056, Melbourne from 4.1 to 6.8 million, Brisbane from 2 to 4 million and Perth from 1.7 to 3.4 million. In this demographic scenario, all these cities will have to house one million or more new people within the next 20 years, or 4,000 per month. Australia's natural resources, arable land area and economic outlook make such a population increase very possible. The Australian government welcomes foreign real estate investments to cope with the existing shortage of 300,000 homes nationwide. Simultaneously, it encourages the immigration of wealthy retirees, students, and highly skilled workers from abroad. The steady influx of funds and knowledge has given Australia one of the world's top 10 GDPs per capita. Four Australian cities have recently risen into the top 10 of *The Economist's Global Liveability Ranking of 2014*.

One Central Park (OCP) near Central Station in Sydney is one development that demonstrates how Australia's urban growth is materializing (see Figure 1). Until recently, rapid new construction and short housing supply fueled a conservative culture of cheap and fast projects that favored minimal risk over design quality. But this tradition is being challenged by three factors: political pressure to invest in Sydney's future, international developers willing to invest in higher quality architecture, and buyers' growing demand for signature design. OCP benefits from all three of these drivers. It is classified as a "State Significant Development" under the direct approval authority of the Minister of Planning, and as such has become a public quality benchmark.

As an indication of new buyers' confidence in innovative design, 90% of OCP's initial

Figure 1. One Central Park near Central Station in Sydney. © Atelier Jean Nouvel / PTW Architects

Figure 2. One Central Park, Sydney – overall view of tower from northwest.

apartments sold off-plan within a three-month record time, and the project was completed on schedule and on budget at AU$ 5,400 (US$4,743) per square meter.

Planning and Design

One Central Park (see Figure 2) is the first stage of the AU$2 billion (US$1.76 billion) Carlton & United Brewery site redevelopment near Central Station in Sydney. The master plan was created with the understanding that Sydney's population will keep growing and that residential towers near inner city traffic

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Figure 3. The vertical gardens maintained by the hydroponic system.

nodes are a more viable lifestyle choice than suburban sprawl, because they waste less energy, consume less farmland, and incur lower costs for infrastructure and transportation. The development's massive size drives economies of scale that allow investments in a 30-MW central thermal plant (CTP), a 2-MW tri-generation system and a 1-ML/day blackwater treatment plant. The recovered thermal energy and power make the overall development more energy efficient, and the recycled water can be used for the thermal plant, irrigation, and domestic residential needs. These planning choices are consistent with the targets set out by the Green Building Council of Australia (GBCA) in its Green Star rating system for retail and multi-unit residential projects, and all individual projects of the master plan adhere to it. Since traditional residential high-rises in Sydney's climate have a record of poor energy performance, all outdated design criteria have been reconsidered. As a result, OCP achieves a rating of five under the Green Star system. This success came with the sobering realization that the project's compliance alone would have been barely perceptible to the public. Strategic planning decisions – building high density in the right location – go unnoticed or are taken for granted. The most important sustainable features – on-site power and recycling plants – are underground or out of sight. Exposure control, self-shading, high-performance glass, and natural ventilation are all crucial for a superior energy performance, but don't result *per se* in anything architecturally distinctive.

After finally having begun to acknowledge and address climate change with sustainable design in our cities, it still doesn't really seem to "show." Perhaps the challenge here is to communicate the importance of an invisible gas that we shouldn't emit. We cannot see or feel CO_2, and this invisibility alone translates poorly into architecture. As a result, there is an abysmal gap between the collective idea of "green" buildings and the built reality. The clichés of green roofs and parks instantly suggest sustainability, but account for no more than 4% of obtainable Green Star credits, and depending on irrigation, maintenance, and purpose, may be entirely unsustainable. Without background information or expertise, it can be difficult to distinguish a zero-net-energy project from the most wasteful buildings standing right next to it.

So, in order to transform environmental commitments into visible architecture, it seems that the design approach has to widen, to go beyond the rating checklists, and invent new technical solutions that may not yet get credited, but still push the performance beyond the requirements and are clearly visible to anyone. These technologies have to work with the popular culture of our time, and use this recognizability to the advantage of the project: they have to be useful and produce a better human experience than the engineered box.

Figure 4. Heliostats on roof top and the cantilevered heliostat reflectors. © Simon Wood Photography

One Central Park integrates two such technologies – hydroponics and heliostats (see Figures 3 and 4) – deep into its design and infrastructure, and then deploys them in direct relation to the site. Hydroponics allow using the recycled water from the blackwater treatment plant to irrigate plants that can grow on tower façades in very shallow slab-edge planters or on thin vertical green walls. Heliostats make it possible to bring programmable amounts of direct sun into shaded areas of the project for light and heat. Both of these technologies have a long ecological history and, via mass fabrication over the past 20 years, have turned from exotic experiments into commonplace methods of sustainable agriculture and energy generation. The proven performance and affordability of these systems is therefore a readily available resource for architecture, but haven't found their application yet.

The central focus of the master plan is a public park that branches out into smaller green pockets in each individual development and stands as a powerful popular symbol for the overall sustainable design goals of the development. This open green space materializes the conviction that any major new increase in urban density should in turn be matched by a significant new public space for recreation. In order to make room for such a park where there was none before, some building mass has to be lifted off the ground and concentrated along Broadway on the north border of the site. This configuration keeps the development low on the south side, where it would otherwise overshadow the adjacent small-scale residential neighborhood of Chippendale (see Figure 5). The tall massing on the north side of the site, however, creates the double challenge of obstructing the park's visibility from the city's main approach and overshadowing it with tall buildings.

The new park is relatively modest compared to Sydney's Hyde Park or Botanical Garden, but the local residents are proud of it, and its

Figure 5. One Central Park public park. © Simon Wood Photography

visibility is important to them. The primary design challenge is then to give a small neighborhood park a big citywide presence. The most effective way to do this is to bring its vegetation up into the sky along the tower façades, where it will be visible in the city from afar. Since the project needs to address two very different adjacent neighborhoods, this verticalization of the park takes two forms. On the north, east, and west sides, the greenery takes on a continuous veil-like appearance with green walls, linear planter bands and climbing vegetation on cables spanning vertically over several floors (see Figure 3). This monolithic landscape appearance is the downtown façade of the project, facing the University of Technology's tall inner-city campus and Broadway's intense traffic. On the south side, facing Chippendale's small-scale residential neighborhood, the park rises in a sequence of planted plateaus and randomly scattered puzzle pieces across the façades, giving them texture and depth. The planted shelves and balconies of each apartment appear as private islands, breaking away from the monolithic mass of the public park (see Figure 6). From close up, they form a cascade of individual garden fragments, but from further away, they converge into a pointillistic vertical landscape.

Two other design challenges that arise from the tall massing along the north side of the site are the towers' shadow and the lightless depth inside the podium block. In order to remediate the lack of direct sunlight south of the building, the volume is broken up into a shorter and a taller tower on a five-story podium. On the roof of the lower tower, 40 sun-tracking heliostats redirect sunlight up to 320 reflectors on a cantilever off the taller tower (see Figure 7), which then beam the

Figure 6. View from southwest. © Richard Braddish

Figure 7. View looking up at the heliostat reflectors hanging from the cantilevered sky garden.

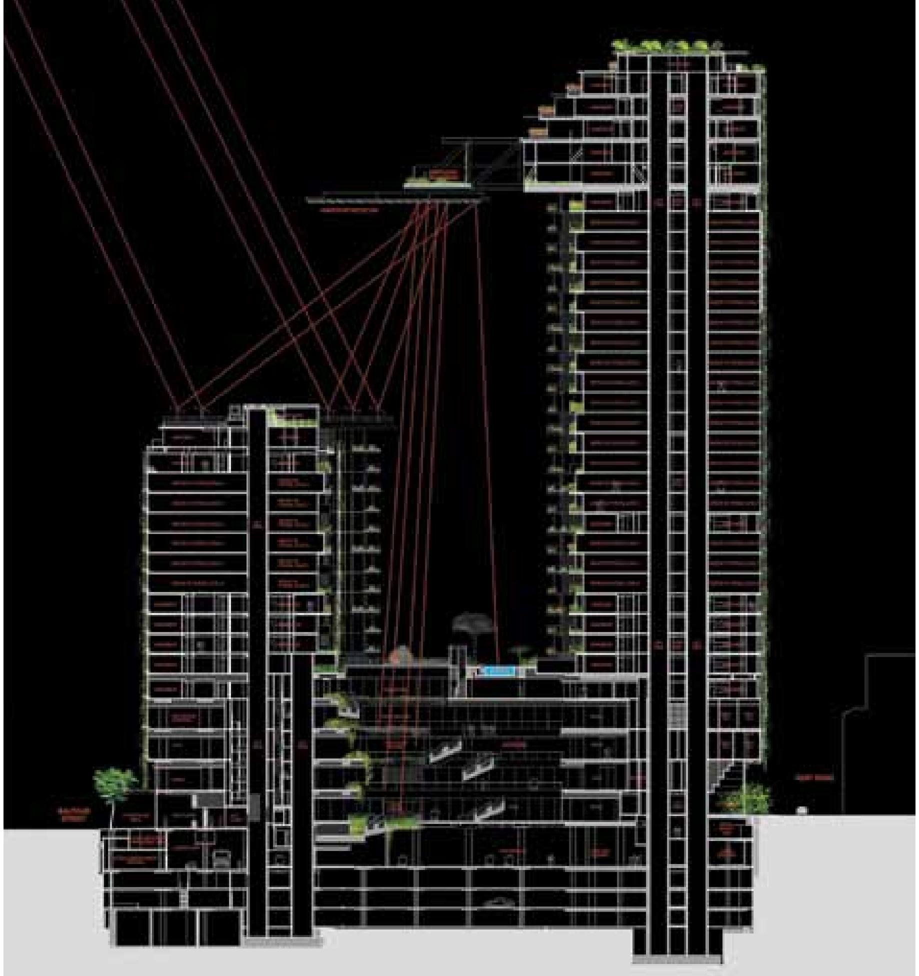

Figure 8. Typical section

light down into an atrium, onto a pool deck and into the overshadowed areas (see Figure 8). Because of the project's massing, the atrium would normally receive no more than a few minutes of direct sunlight in the summer. With the heliostats however, it can be naturally lit all year, for any amount of time, as long as the sun shines. The motion controls of the heliostats are programmed to adapt hourly and seasonally to the needs for brightness and warmth in each place, so that the dappled lights can follow their daily choreography across the site in the most useful way. At night, LED lights on the 320 reflector facets create a monumental urban chandelier (see Figure 9) that simulates reflections of glittering water from the nearby harbor. On a full-moon night, the heliostats redirect 40 reflections of the moon and make them visible in the park.

Sustainable Strategies

OCP's overall planning intent is to follow and exceed the highest design standards of GBCA under its Green Star rating system for retail and multi-unit residential projects. The project's innovative use of hydroponics and heliostats showcases the vision of an environmentally ambitious future for Sydney. In order to meet this agenda, OCP's planning and design revolves around six core strategies.

1. **Urban Density:** OCP creates apartments where they're really needed. If Sydney's population is to grow by 4,000 new inhabitants per month, residential towers near inner-city job and transportation centers will be more sustainable than planless sprawl with no adequate public transportation in Sydney's Inner Western suburbs. OCP is within a 10-minute walking distance from Sydney's Central Business District (CBD) and two of the three major universities. It is also located near Central Station, one of Sydney's busiest public transportation nodes. In line with Green Star recommendations, OCP's underground resident parking is limited to state-required minima.

2. **City of Parks:** Sydney was once conceived by its founders as a city of parks. Today, this wise decision benefits the urgent need for pockets of decompression and decongestion in increasingly denser inner-city blocks. OCP continues to work in this direction by creating a new park and amplifying its presence in the skyline.

3. **Exposure:** Sydney's climate type is temperate bordering on subtropical, with mild, wet winters and very hot summers. Because of the summer sun's intensity, OCP's massing is designed to minimize thermal exposure without sacrificing façade transparency. The two largest façades are running east-west, so that one of them faces south and receives almost no direct sun, while the other one faces north and can be easily protected from high noon sun, with 600-millimeter-deep horizontal shelves that immediately reduce the heat gains by 20%. The podium-plus-two-towers configuration maximizes self-shading between the towers in the morning and afternoon.

   A 40-meter cantilevering sky garden and giant faceted reflector function as a "baseball cap" to provide shade for the upper west façade of the taller tower (see Figures 7 and 10), where it can't be overshadowed by the lower one. The overall volume concedes greater block depth to reduce the façade area and thereby the heat gains, which in turn allows for more glazing. Deep vertical slots are carved into the mass to allow light and air far into the block, as well as sporadic views from the main circulation on every floor.

   The intentional massiveness of the project is an expression of its thermal behavior and relates proportionally to the park and nearby UTS campus. It matches the much smaller scale of its distant residential Chippendale neighbors in its façade texture, rather than its overall proportions.

4. **Green Star:** OCP improves the usually poor energy performance of residential high-rises to meet a rating of at least five under the Australian Green Star standards, and achieves a 26% reduction in energy consumption compared to the average in New South Wales. During planning, this performance is tracked through a Building Sustainability Index (BASIX) energy model and the Green Star compliance checklist.

After completion, the as-built conditions are recorded and filed for final certification.

5. **Organic Shading:** OCP reduces its cooling energy load with a five-kilometer-long system of linear slab-edge planters that function like permanent shading shelves and reduce thermal impact in the apartments by about 20%. Additional shading from the plant foliage itself can further diminish heat gains by an additional 20%. As opposed to fixed mechanical shades, foliage cover can't easily be predicted and quantified, and it therefore can't be accounted for in the BASIX calculations or Green Star checklist.

   By contrast to metallic louvers, the plants trap carbon dioxide, emit oxygen and reflect less heat back into the city. Instead of maintaining and cleaning kilometers of external louvers, the body corporate of the towers' residents employs a gardener who prunes and cares for the vegetation. The choice of the species is critical for the success of the system, because some of the façade's microclimates have extreme levels of sun and wind exposure. Since the plants climb on vertical steel cables from slab to slab, their leaves are ideally positioned for shading even on western exposures, and they can be custom-tailored to the thermal needs of each resident. The plants grow in Polyethylene planter boxes that are roto-molded into proprietary double-wall containers to assure proper drainage and avoid bacterial and fungal buildup in the substrate. Polyethylene can be recycled, processed back into oil or biodegraded by *pseudomonas fluorescens* bacteria.

   The plants are grown hydroponically in a substrate for mechanical root adhesion and are irrigated with water from the on-site storm water collection tanks and the central recycling plant. A central mixing unit then adds minerals and fertilizers to the water, and distributes it according to the specific needs of each façade area, based on its microclimate and the selected species. Programmable solenoids regulate the released water amounts at local control centers based on weather data like air humidity, wind, temperature, and presence of sun.

   Overall, the towering veils of plants on OCP turn the green cliché of sustainability into a functional and conceptual part of the infrastructure: the building organically grows its own shading with its own recycled water and saves cooling energy.

Solar Energy: OCP's passive solar power system is comprised of 42 sun-tracking heliostats, each of which targets 42 of the 320 individual fixed mirrors in the Fresnel reflector cantilevered off the taller tower, which are associated to specific target zones on the ground: the park, the swimming pool, and the glass roof of the atrium.

Figure 9. Heliostat reflectors at night.

Figure 10. Cantilevered sky garden and reflectors.

Figure 11. Deep vertical slots carved into the building to allow light and air.

These shifts can change from hour to hour, season to season, to fit the specific thermal needs of each target more precisely. When the atrium receives direct sunlight, the system can direct half of its power to warming the swimming pool, and the other half into the shaded courtyard south of the building. Two hours later, half of the power may move to the atrium, with all of the reflected light shifting in the evening to the atrium, to bathe it in sunset colors.

A layer of water on the atrium glass roof functions as a heat sink. It absorbs the infrared spectrum of the direct sunlight in the summer. In the winter, when the heat gain is desirable, the water can be drained, and the glass roof works like a greenhouse where the incoming light is always precisely controllable.

The system redirects up to 200 square meters of direct sunlight, along with approximately 40 to 60% of its corresponding power, during Sydney's 2,600 annual sunshine hours. However, because it does not generate electricity, the performance of this system could not be empirically accounted for in the NSW's BASIX and Green Star calculations.

Conclusions

The plants growing on One Central Park's tower façades (see figure 11) are neither a romantic, nor a picturesque reference. If anything, the project displays an unsentimental intention to keep architecture and nature in a dialogue. The Modernist separation of the two appears forced in Sydney's climate, and it's difficult to understand why so many high-rises in this city still imitate the generic curtain-walled skyscrapers from America's cold north. In this context, the contamination of architecture's rigid framework with nature's living complexity appears to be a risk worth taking. Beyond the mere function of shading apartments, the towering green presence of the building's 180,000 plants is also a universal sign of life on earth. The knowledge that vegetation means "life" is so deeply ingrained in human consciousness that parks and gardens have at all times been the most desirable places to live next. In their absence, the potted plants on lonely city balconies, so dreaded by the modern purists, have long born witness to a human preference for the company of living flowers to that of concrete and glass.

The heliostats and grand Fresnel reflector at the tower top take direct solar energy to places the sun can't reach and showcase the technology of remote thermal solar power plants in this inner-city neighborhood. The monumental scale and beauty of this apparatus advertises clean energy, and at the same time brings it to town in innovative ways. As it transforms into an urban chandelier with 25,000 LED lights, it remains present in the city throughout the night.

One Central Park is a State Significant Development with a strong presence in its neighborhood and the city because of its scale and exposure. It naturally assumes the role of a signal and possible model for future projects of similar scale, location, and program. As Sydney develops many more new high-rises to cope with its growth, the attention turns to what this city's destiny is and how each new development can contribute to realizing it. Where and how should new towers be built, and what new kinds of life quality can we expect from them? OCP's design tries to address these questions with technical innovation, and at the same time subvert them, with a hedonistic and optimistic outlook on life. ■

Unless otherwise noted, all photography credits in this paper are to Murray Fredericks.

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Project Data

Completion Date: January 2014
Height: 116 meters
Stories: 34
Total Area: 67,626 square meters
Use: Residential
Owner/Developer: Frasers Property Australia;; Sekisui House Australia

Architect: Ateliers Jean Nouvel (design); PTW Architects (architect of record)
Structural Engineer: Robert Bird Group
MEP Engineer: Arup
Main Contractor: Watpac Construction
Other Consultants: AECOM / Davis Langdon (cost); AIK (heliostat lighting); Arup (environmental); Aspect Oculus (landscape); Device Logic (heliostat programming); Jean-Claude Hardy (landscape); Jeppe Aagaard Andersen (landscape); Kennovations (heliostat design); Patrick Blanc (green walls); Surface Design Pty Ltd (façade); Transsolar (Energy); Turf Design (landscape)