Sustainability and Modernism: Design Research at Cornell NYC

SUSTAINABILITY is now replacing Modernism as the main discourse for socio-economic, technological, architectural and urban development. However, the architectural legacy of Modernism remains an inherent part of our built environment. While some tenets of Modernism align with principles of sustainable design, many are in conflict, thus creating both a tension and an opportunity for creative reinvention of existing buildings and neighborhoods. *Greening Manhattan's Modernist Legacy* was a seminar taught at Cornell University's school of architecture that investigated these questions. The seminar explored an analytical approach to retrofitting Modernbuildings that prioritized environmental responsibility while critically reinterpreting the Modern aesthetic.

By Ilana Judah and Daniel Kaplan

IT can be argued that many Modern buildings are incompatible with environmental values, and are unsustainable over the long term. This presents a quandary for both preservationists and architects who seek to improve the state of our planet, yet deeply value the contribution of the Modern legacy.

Despite this perception, the Modern Movement and the current imperative for sustainable design have numerous commonalities. Indeed, many of the values touted by sustainable design are fundamentally rooted in Modern ideals. Modernism sought to re-imagine social and organizational principles through a new vision for cities and buildings. The built environment was foreseen as a place that was efficient, egalitarian and healthy. Space was democratized, with access to light, air and nature albeit often through a controlled indoor climate. Architects such as Le Corbusier saw the importance of liberating cities from the pollution and disease of the Middle Ages and Industrial Revolution [figure 1]. Construction processes favored efficiency of materials and fabrication and shunned superfluous adornment.

Modernism was also the era of the renowned environmentalist and designer R. Buckminster Fuller, who was seemingly clairvoyant in his projections of population growth and planetary limitations. Eco-Utopias such as the Biosphere 2 Project by Space Biosphere Ventures, and Arcosanti by architect Paolo Soleri evolved from Fuller's science fiction-like warnings about the looming challenges to the human race [figure 2].

While many lessons have been learned from the great architects and designers of that period, the utopian promises of Modernism have been dispelled. Today, buildings consume 40 percent of energy in the United States, and upwards of 70 percent in high-density urban areas such as New York City[1]. Those constructed after the World War II are noted to be the highest consumers on average[2]. Moreover, cities and suburbs developed during the post-war era have favored sprawl, decentralization, and the predominance of the automobile over all other forms of transportation. In addition to increased energy consumption, hermetically sealed buildings that rely almost exclusively on mechanical conditioning have in some instances resulted in problematic indoor air quality (sick building syndrome) and unreliable thermal comfort.

Global climate change, population growth, increasing urbanization, and augmented severity of drought and storms are all evidence that we are at the cusp of an environmental crisis. In this context, what then is the place and role of our Modern icons? Do they merit being demolished, are they merely vestiges of an optimistic yet wasteful era, or are there valuable lessons we can glean from their conception and construction? Most importantly, can we re-evaluate and reinvent them to be responsible citizens of a sustainable society?

These issues and questions spawned the development of a design seminar for the New York program at Cornell University's School of Architecture. Entitled *Greening Manhattan's Modernist Legacy*, the course sought to reveal the synergies between Sustainability and Modernism, and draw upon their incongruities to stimulate innovative design solutions.

The seminar was an introduction to students on the preservation of Modern buildings, as well an initiation into an environmentally integrated methodology when approaching an architectural problem. While not a comprehensive design studio, it encouraged students to develop an iterative design process informed by both quantitative and qualitative analysis, clear problem definition, creative resolution of the defined problem, followed by post-design testing and analysis.

Students were tasked with selecting and studying an existing Modern high-rise in New York City, and proposing a specific intervention to improve one aspect of the

< Figure 1. **Le Corbusier** sketch for La *Ville Radieuse*. Image from *Fondation Le Corbusier*, Paris.

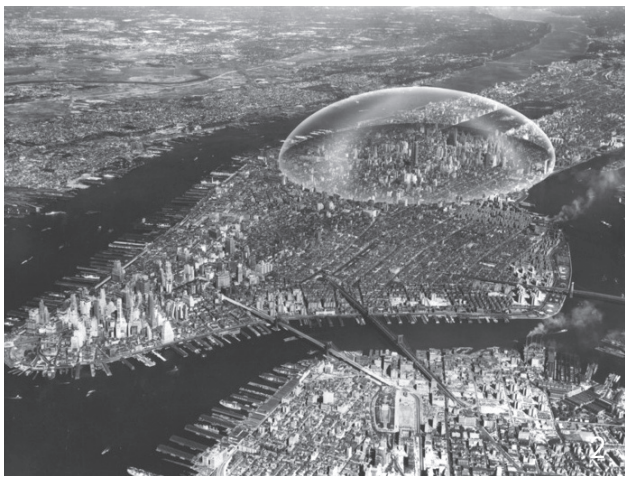


Figure 2. **R. Buckminster Fuller**, Shoji Sadao Dome over Manhattan, ca. 1960. Silver gelatine print, 34.9 x 46.7 cm. Courtesy of The Estate of R. Buckminster Fuller.

Figure 3. Visibility and incident solar radiation analysis for the Seagram Building to determine potential retrofit strategies. **Yeung Shin**, architecture student at Cornell University. 2011. Courtesy of Cornell University.

Figure 4a. Jacob K. Javits Convention Center – Existing Building. **Pei Cobb Freed** Architects, 1986, New York, NY. Photo by FXFOWLE Architects.

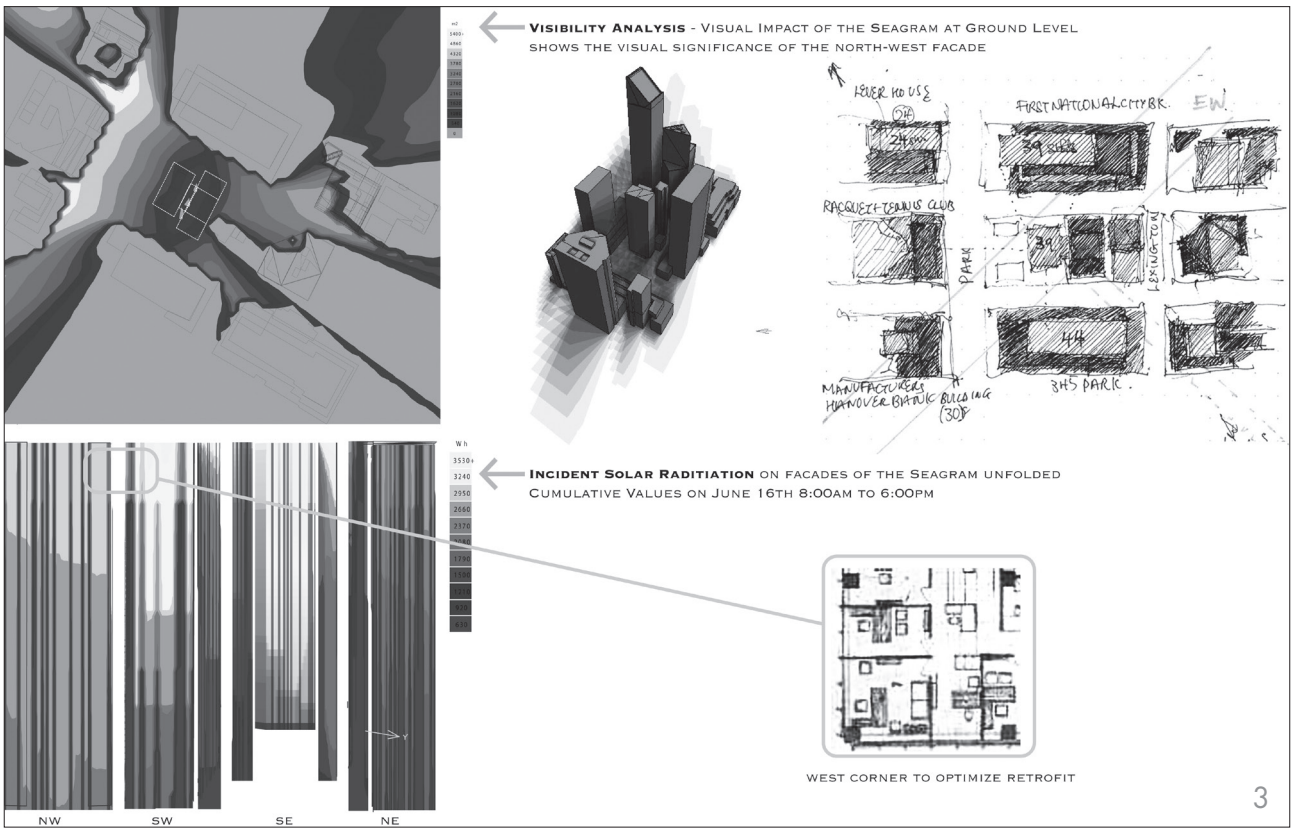
Figure 4b. Rendering of proposed renovation for the Jacob K. Javits Convention Center. FXFOWLE | **Epstein** Architects, 2010. Courtesy of FXFOWLE Architects.

Figure 5. Rendering of proposed design for the Jacob K. Javits Convention Center. **Pei Cobb Freed** Architects, ca. 1980. Courtesy of FXFOWLE Architects.

building's environmental performance. Buildings selected were of significant renown, including the Ford Foundation (Roche Dinkeloo, 1967), the Seagram Building (Mies van der Rohe, 1958) [figure 3], One Liberty Plaza (Skidmore Owings & Merrill, 1973), the WR Grace Building (Skidmore Owings & Merrill, 1973), and the CBS Building (Eero Saarinen, 1965). Throughout the semester, critical thinking was emphasized with respect to establishing the correct balance between environmental performance and architectural integrity. A pure restoration approach was not required, but a clear argument and justification of the proposed intervention on the existing building was essential.

While the trend towards retrofitting existing buildings can help support the mandate of preservationists, there are legitimate concerns about the manner in which a retrofit can respect the integrity of the original architecture, while simultaneously improving performance. This is particularly challenging in Modern buildings, which, for the first time, introduced vast expanses of glazing and non–thermally broken curtain walls.

The seminar introduced the principles of Modern preservation to students, particularly how the approach differs somewhat from the preservation of buildings of earlier eras. Here, conserving the vision of the original architect becomes significant in addition to the preser-



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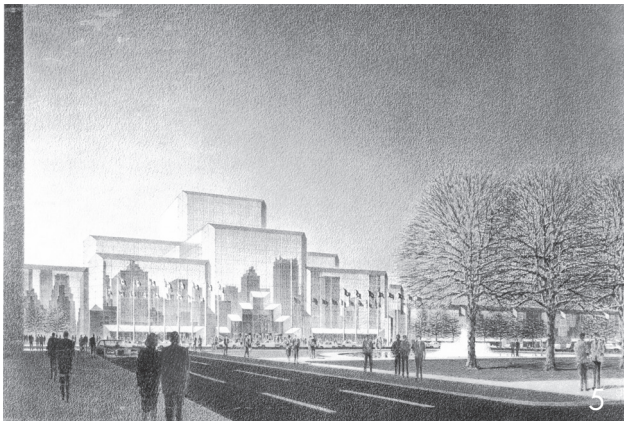

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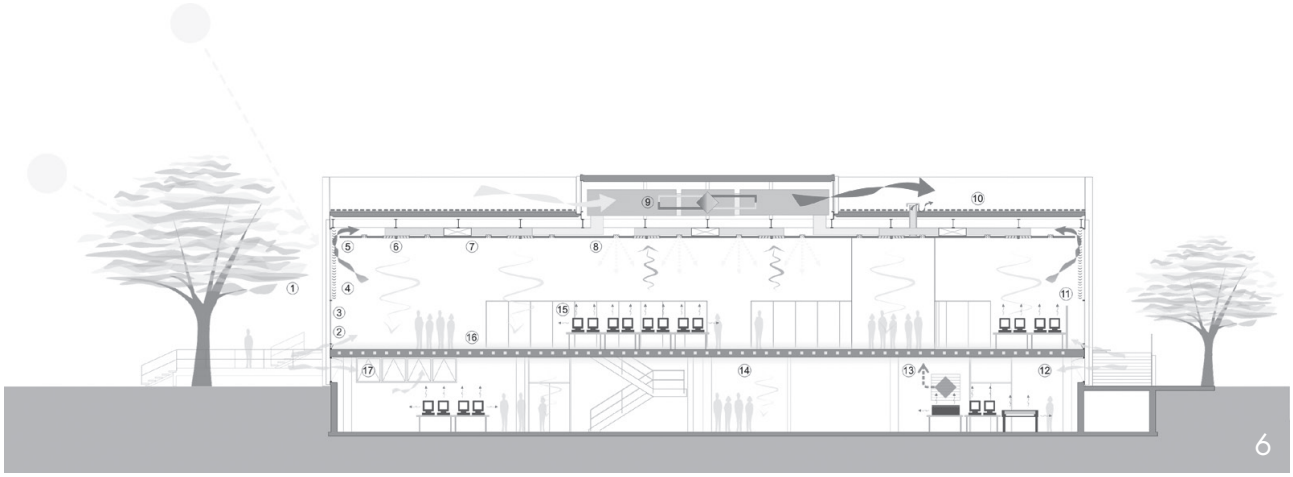
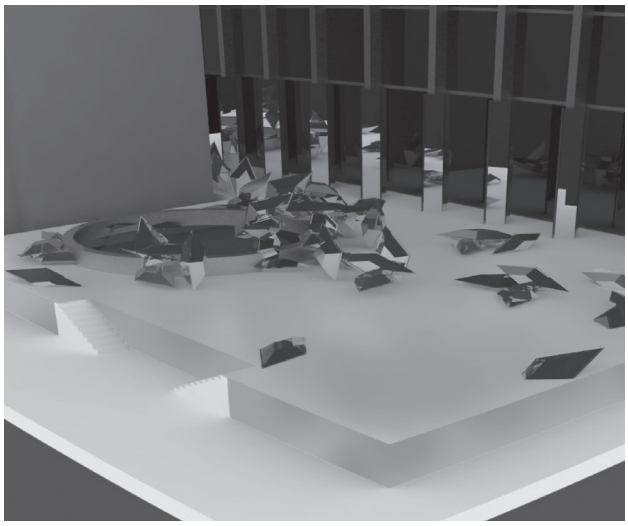
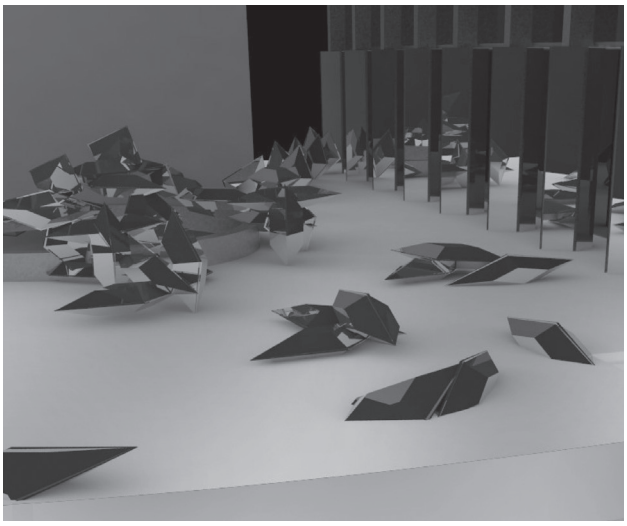
vation of the structure itself.[3] Advancements in building materials and technologies since the date of the original construction also reveal a complex dilemma involving authenticity, intent and performance. Many Modern buildings incorporated technologies that were early in their development, such as curtain wall systems, which have now seen significant performance and aesthetic improvements. Is it more justifiable to replace a system in–kind, or more appropriate to upgrade as per the design intent of the architect?

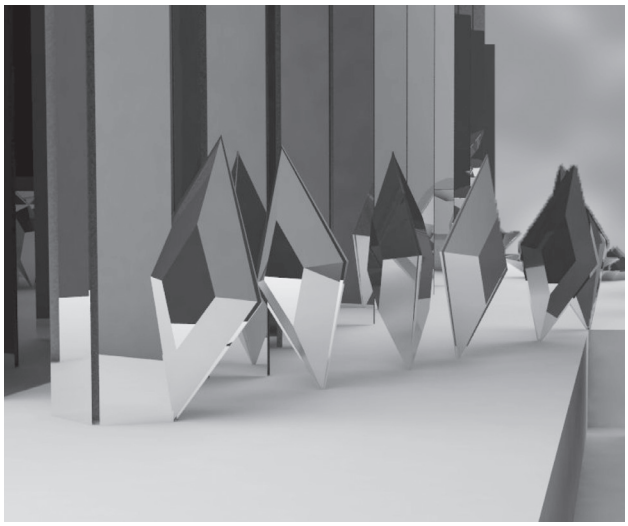
Students had the opportunity to explore several project case studies, including a visit to the Jacob K. Javits Convention Center, designed by Pei Cobb Freed Architects and currently being renovated by FXFOWLE in collaboration with Epstein [figure 4]. Though originally built in the 1980s and not purely Modern, the process by which the architects of the renovation replaced the original curtain wall is a pertinent example of an approach to retrofitting Modern buildings. As revealed in the original renderings, Pei Cobb Freed's vision for the space frame structure was one of greater transparency and visual connection of the interior to the surrounding city [figure 5]. However, due to the energy code requirements and available technologies at the time, the glass selected was much more opaque in appearance in order to meet the necessary shading coefficients. FXFOWLE determined that adhering to the original idea of the project as a 'Crystal Palace' was more appropriate and would better add to the value of the building, both architecturally and within the greater urban context.

Other projects presented demonstrated instances where Modern buildings were designed with careful consideration of environmental factors, but where subsequent alterations had obfuscated these elements. Atelier Ten presented their study for the restoration of Crown Hall at the Illinois Institute of Technology as an example [figure 6]. Their analysis revealed that Mies van der Rohe









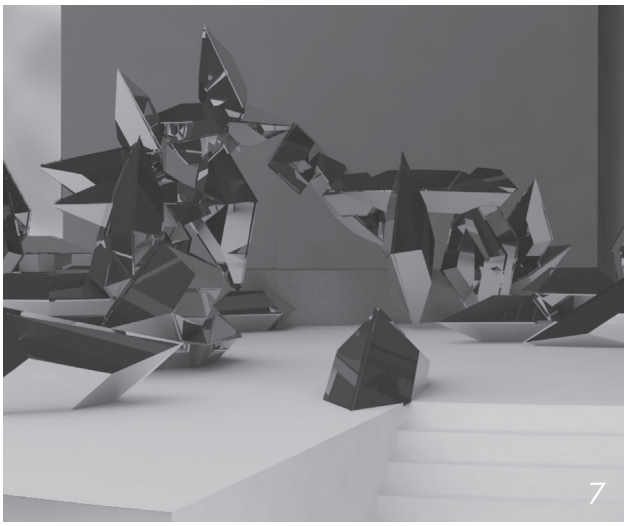


Figure 6. Crown Hall Environmental Section, Proposed Improvement Measures. **Atelier Ten**, 2004.

Figure 7. Design for improving thermal comfort on the exterior plaza at One Chase Manhattan Bank, New York City. Goal was to expand daylight and thermal comfort to permit lunchtime use of the plaza during the Spring. **Lauren Jordan**, architecture student at Cornell University, 2011. Courtesy of Cornell University.

Figure 8. Daylighting studies for One Liberty Plaza using Radiance software. **Daniel Marino**, architecture student at Cornell University, 2011. Courtesy of Cornell University.

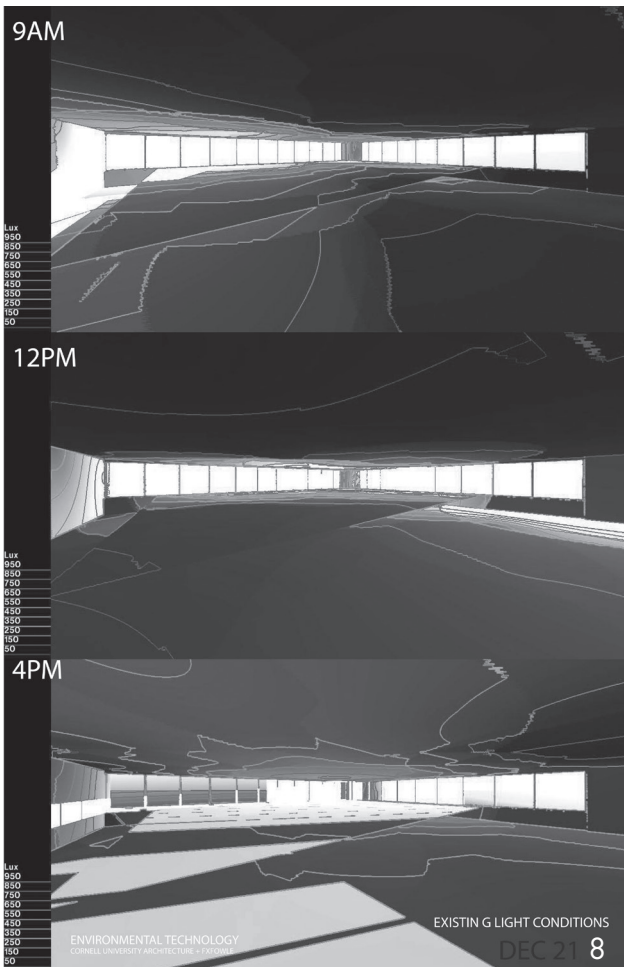
incorporated several passive strategies into the design of the school of architecture. For example, the original site plan incorporated a significant density of trees along the south façade, providing shading and reducing solar gain. Unfortunately, many of the trees were removed over the decades. Operable hopper windows at the base of the main floor and roof vents allowed for natural ventilation, and a careful distribution of clear and frosted glazing coupled with operable blinds helped harvest daylight and control glare. Over time, many of these elements stopped functioning as originally intended due to increased student population and the advent of computers in the design studio.

Investigation of these case studies informed students of the issues inherent to retrofitting Modern buildings, and helped guide them in the development of their respective projects. They were first tasked with visiting their project site and creating a qualitative study that included environmental, architectural and urbanistic observations. This was followed by an analysis of the original building's history, program and parti, as well as an exploration of building tectonics.

Once this initial study was complete, students then focused on a specific area of interest, and developed an appropriate problem statement that set both environmental and architectural objectives. Many of the students chose to look at the question of harvesting daylight and controlling glare, while others studied reducing mechanical heating and cooling loads through passive design strategies. One student chose to study how to improve thermal comfort on the exterior plaza of One Chase Manhattan Bank with the objective of transforming it from a minimally occupied podium to an active public space [figure 7].

Building performance modeling was a fundamental component of the retrofit studies. Using software such as Eco-Tect and Radiance [figure 8], students created a baseline model of their existing building, which included the surrounding context, local climate data, material properties and programmatic assumptions. Once baseline performance had been determined and understood in relation to their qualitative observations, students set specific performance goals. For example, in the case of the Ford Foundation, the student's goal was to increase the number of hours of passive thermal comfort in the atrium to reduce dependence on artificial heating and cooling [figure 9].

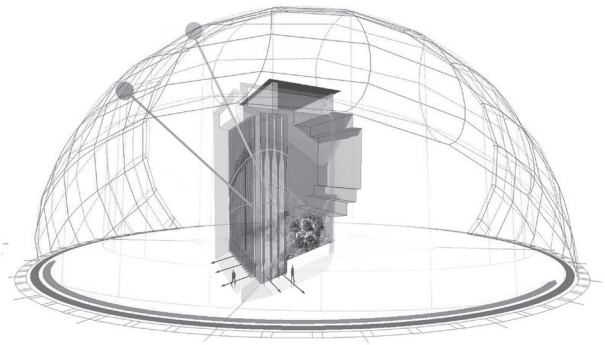
Multiple design solutions were tested against the proposed performance and architectural goals. Students were encouraged to use performance-modeling tools in conjunction with other media to understand the differences in information revealed by each. Full-scale mock-ups

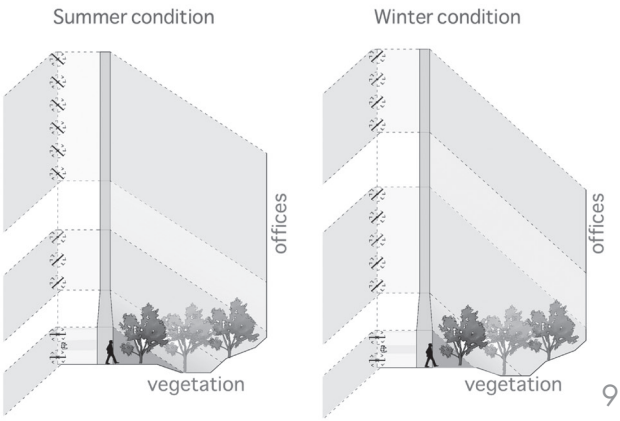


and dynamic daylight simulations [figure 10] exposed behavior that was not directly apparent from the numerical outputs of computer simulations. Students were also encouraged to oscillate their analysis between macro scale urban context to the micro scale of the curtain wall detail to hone their understanding of performance and preservation issues.

The students developed some very innovative solutions that yielded significant environmental benefits. In the case of the Ford Foundation proposal, a combination of re-glazing, shading and zoning reduced the number of hours the atrium required mechanical conditioning by almost 50%. In the WR Grace Building study, the student's proposed glazing retrofit yielded daylighting increases on a typical office floor from very low levels (under 100 lux) to a usable range (175-550 lux) fifteen feet from the perimeter [figure 11].

The students took various positions towards preservation of the building's original architecture. In cases such as the Seagram Building there was a clear intent to keep the original façade intact and intervene solely from the interior. In other instances such as the WR Grace Building there was a desire to conserve the original parti while





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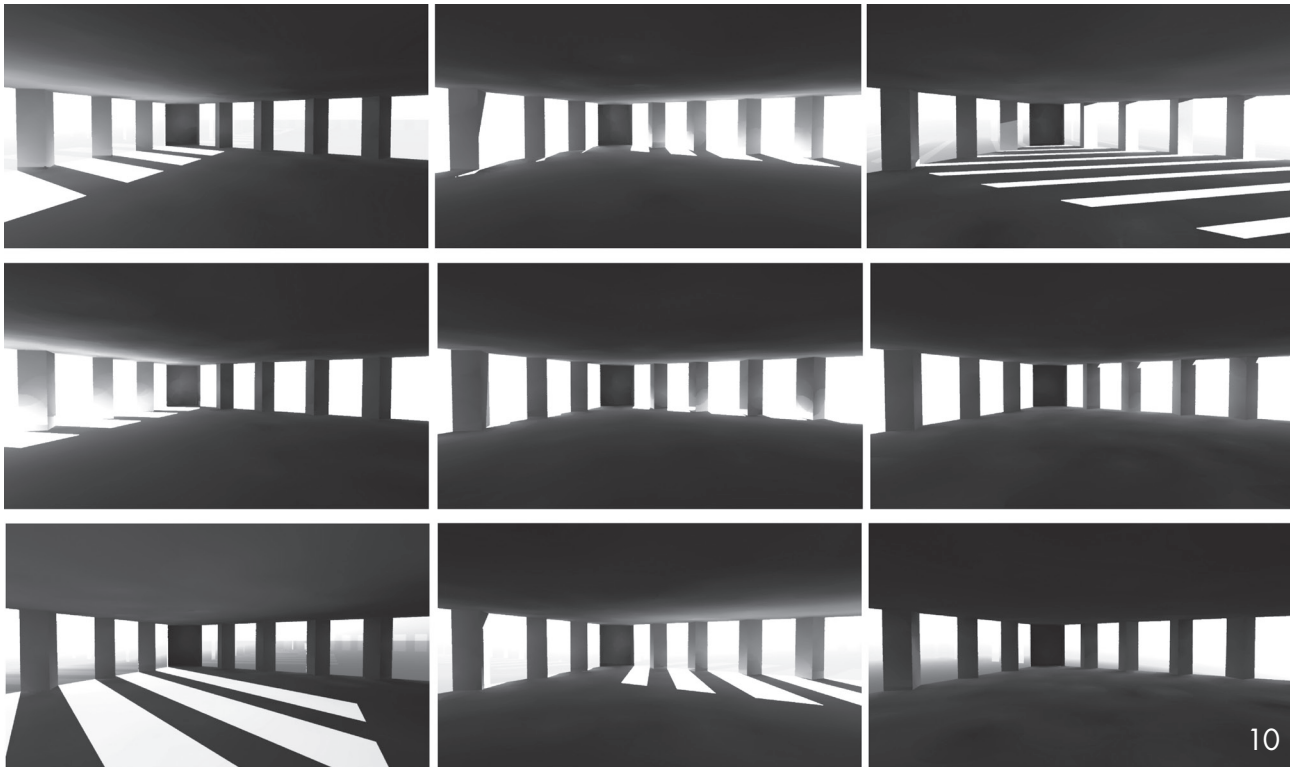

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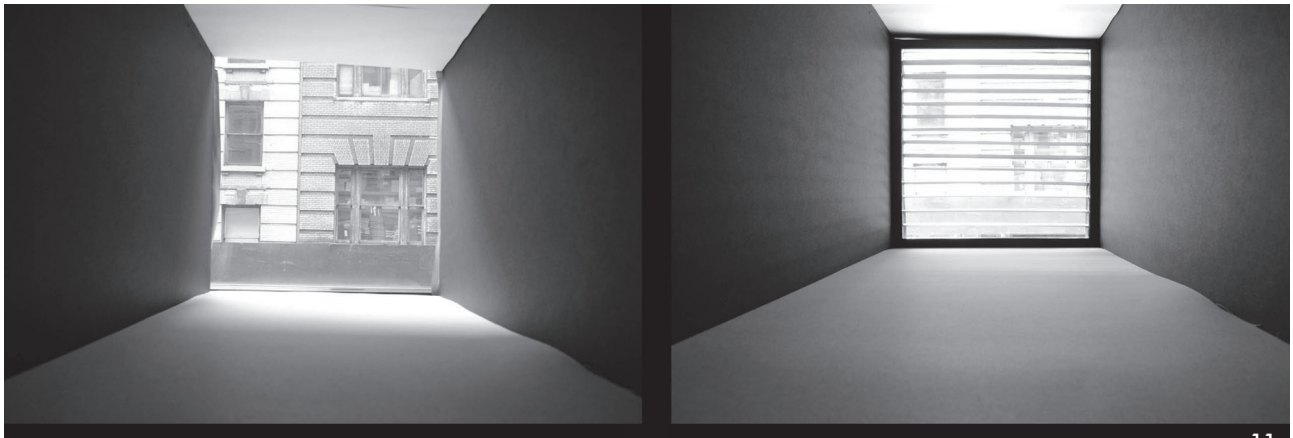

Light Box with a double pane Window

Light Box with Invention Window

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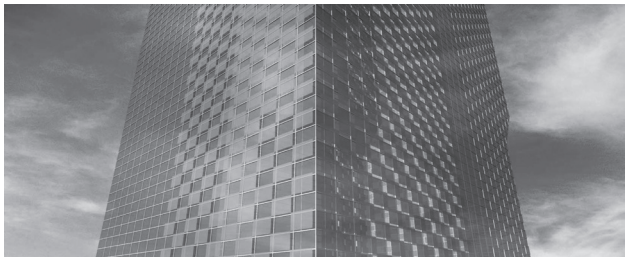
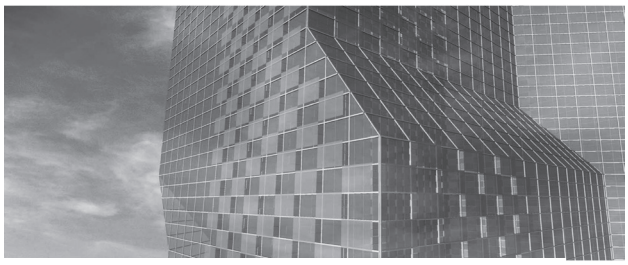
at the same time reinvent façade components to improve performance. A third approach, seen in the UN Plaza buildings [figure 12] saw a reinterpretation of the building where the proposed intervention expressed itself as a clear and distinct overlay.

The design solutions developed by the students demonstrate a variety of objectives and approaches, all of which point to the delicate relationship between respecting the architectural and cultural value of a Modernist icon and responding to increasingly urgent environmental imperatives. In attempting to reconcile them, returning to the underlying ideals of Modernism provides a meaningful framework that goes beyond the question of preserving aesthetics to one that revisits fundamental values. Ultimately, a successful retrofit intervention not only addresses both issues, but goes beyond to provide a critical reinterpretation of the Modernism within a contemporary context.



South–West Corner Render – Option 1



North–East Corner Render – Option 1 12

Figure 9. Study for increasing passive comfort hours in the atrium of the Ford Foundation, New York City. Goal was to eliminate need for artificial conditioning in the atrium using multiple strategies such as dynamic shading. **Nicolas Martin**, architecture student at Cornell University. 2011. Courtesy of Cornell University.

Figure 10. Dynamic daylight simulations of a typical floor of the CBS Building, New York City. Goal was to achieve even daylight and minimize glare on a typical office floor. **David Temidara**, architecture student at Cornell University. 2011. Courtesy of Cornell University.

Figure11. Mock–up and daylight model of proposed façade component for the WR Grace Building. **Alicia Trujillo**, architecture student at Cornell University. 2011. Goal was to maximize the usable daylight on a typical office floor and reduce reflection and glare onto the park. Courtesy of Cornell University.

Figure 12. Study for incorporating operable windows at One and Two UN Plaza, New York City. Goal was to minimize artificial cooling during the spring and autumn seasons through the use of natural ventilation. **Vincent Lim**, architecture student at Cornell University. 2011. Courtesy of Cornell University.

Notes

1. Loper, Joe, Ungar, Lowell, et al. *Building on Success: Policies to Reduce Energy Waste in Buildings*, Washington, Alliance to Save Energy, 2005.
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3. Prudon, Theodore H.M., *Preservation of Modern Architecture*, Hoboken, NJ, Wiley, 2008.

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