Sustainability as a Driving Force for Design

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Based on a presentation by Devon Patterson, AIA, LEED of Solomon Cordwell Buenz

Introduction

The Richard J. Klarcheck Information Commons at Loyola University in Chicago (Figure 1) was created through collaboration, connectivity and community. Designed by Solomon Cordwell Buenz, the development of the 69,000 square foot project embraced sustainability as an interdisciplinary endeavor and employed energy modeling tools as a design catalyst. The knowledge generated from cross communication led to the development of a double glass façade and radiant concrete ceilings for heating and cooling, architectural systems seldom used in the United States, as well as a variety of ventilation strategies. The end product, a habitable, useful, and sustainably conceived building, is thoroughly representative of sustainability as a driving force for design.

The client, the architect, and the program

In 2004, Loyola University employed Chicago based architecture firm Solomon Cordwell Buenz to design a new information commons for their lakeshore campus north of downtown Chicago. A new program type, birthed by the development and maturation of the digital revolution, an information commons is essentially a digital library developed to enhance information exchange through technological media. As early meetings between client and architect ensued, the dean of libraries, Bob Seal, insisted that the Information Commons be founded on the philosophy of the three C’s: collaboration, connectivity, and community. Solomon Cordwell Buenz would not only use the philosophy of the three C’s to inform the final building artifact, but arguably more importantly, to shape the process of design as well.

The site, already chosen by Loyola University, was an existing lakefront green space used heavily by students throughout the spring, summer and autumn. On the shores of Lake Michigan, the site is sandwiched between two historic 1930’s Art Deco buildings, the Cudahy Library to the north (Figure 2) and the Madonna della Strada Chapel to the south (Figure 3). The client wanted the new, stand-alone building to serve as a link between the two existing structures. As Solomon Cordwell Buenz was initially hesitant to build on a site that was already heavily utilized, with great eastward views of the lake, they eventually conceptualized the Information Commons as a link that would knit together a bifurcated campus and create a cohesive institutional environment for students, faculty and staff. For the sake of ‘green space preservation,’ the architects would move the existing space westward, towards the heart of the campus, hoping to maintain and increase the utilization of the area (Figure 4).

The president of the institution approached the
architects with sketches depicting the desired form of the new edifice. The client felt that the classical style suited their agenda, but the architects were reluctant to introduce a modern program into such a traditional looking building. At the time, the two parties were not in agreement about the project’s visual representation, so how was it possible to reach consensus? In any given architectural endeavor, the role of the architect is not to pursue personal interests in a self-gratifying manner, and the role of the client is not to imprison the architect in a type of modern day indentured servitude. The role of the architects is to listen to the client’s thoughts and needs and then to use their personal expertise to help the clients achieve those goals in the best possible way.2

As the architects inspected the client’s sketches more closely, they were able to decipher two main concerns that Loyola University had in regard to the Information Commons. First, the university did not want a building that was alien in nature, but rather one that blended with the surrounding context. Since the Information Commons was to connect two historic structures, a misdirected gesture could actually detract from the beauty and elegance of the existing Art Deco buildings. A traditional building would ensure that this elegance remained intact. The university’s second concern dealt with connectivity. With the new building sited on former open space, the university wanted to maintain a visual connection from the interior of campus out towards Lake Michigan (Figure 5). An opaque building would essentially turn its back on the surrounding environment, failing to capture the innate, natural beauty of the lake. Transparency, on the other hand, would create the potential to embrace the environment, maintain visual connections between the interior of campus and the lake, and enhance the experience of the surroundings.

Solomon Cordwell Buenz used these two concerns as the impetus for the schematic design of the Information Commons. The initial proposal depicted two traditional “book-ends” pulled apart to create an area that would...
house the modern program. The bookends would serve as transitional buffers between the library and the chapel, while the space occupied between, described as a flexible, transparent bridge, would provide the transparency desired by the university. Loyola University approved the proposal, but also raised another concern: they wanted a transparent building without exorbitant utility bills, and they wanted it in twenty-two months. Solomon Cordwell Buenz would soon realize that the traditional linear and segregated process of building development would not allow them to meet these goals.

At this point in time two paradigms of sustainability were introduced, ultimately becoming the driving force for the building’s design: an interdisciplinary approach and energy efficiency via technological means.

Interdisciplinary collaboration as a driving force for design

When commenting on the failed Modernist pursuit of utopian ideals in the 20th century, Hubert-Jan Henket suggested that we are at the threshold of a new era, one with new facts and requirements, one that requires “a new spirit, a new dynamism, an integrated effort of science, technology, the arts and ethics.” If we accept these new facts of environmental degradation and the resulting need for sustainability, then his proposition of required integration would be fulfilled through green building. In *The Social Construction of Green Building Codes*, Steven A. Moore and Nathan Engstrom describe four types of logic that are implicit in the types of green building programs studied: restrictive, strategic, adaptive, and expansive. These logics “prefigure a specific range of technological choices and seek to associate such choices with the general public welfare on grounds of protection to environmental and public health.” Each logic has a different, local approach to sustainable design, “consistent with the spatial habits and stories told by its citizens.” In this case the citizens are the students, faculty, and staff of Loyola University, for they are concerned with the collective good of their local environment. Taking local knowledge from local citizens into consideration, makes it possible for professionals to invent “new and successful urban typologies to solve universal problems.” Incorporating knowledge from the Loyola University community orchestrates cross-communication between professions, citizens, and all other actors involved. Cross-communication is vital in addressing sustainability issues, because it breaks the typical linear paradigm of construction and shifts it towards an integrated, cyclical paradigm in which knowledge and values can freely be exchanged. The steps taken by Solo-

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**Integrated Design Team**

Loyola University Chicago

- Pepper Construction
- SCB
- Climate Engineer
- HVAC Engineer
- Structural Engineer
- Architect

**Climate Engineer Integration**

Client / Contractor

- HVAC Engineer
- Structural Engineer

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*Figure 6: Diagram of the integrated design team*

*Figure 7: Diagram of interdisciplinary collaboration*
mon Cordwell Buenz after the initial meetings with Loyola University fostered this exchange and eventually culminated in a building that not only is energy efficient, but also exemplifies the free knowledge and cross-communication value exchange inherent in the program.

The collaborative effort began once the design was approved. In addition to the integrated design team including the architects, client, and construction company (Figure 6), another collaborative effort was pursued during the development of the design. Other important players who contributed unique ideas, critical to the development of the Information Commons were climate engineers Transsolar from Stuttgart, Germany; MEP engineers Elara Energy Services Inc from Hillside, Illinois; and structural engineers Halvorson and Partners from Chicago (Figure 7).

Transsolar, in particular, did extensive environmental studies on the site, evaluating solar radiation, heat gain, mean temperature, natural ventilation patterns, shadows and dew points from annual data sets (Figures 8, 9, 10). These studies led to four main conclusions about how the building should respond to the natural conditions:

1. Effective shading of the east façade is important during summer months until 10AM, when the sun was no longer shining on the façade.
2. Use of internal shades in winter will allow a degree of passive solar heating.
3. Shades on west façade can be raised in cooling season as neighboring buildings cast shadows.
4. Wind could be harnessed to naturally ventilate the building.

These four conclusions pushed forth the idea of an integrated design strategy, in which passive systems could work in unison with active systems, controlled by a building management system (BMS). Two major sustainable systems were developed that employed a hybrid of passive and active strategies: the double glass façade and the radiant slabs.

Technological means as a driving force for design

Since Loyola University did not want to write a blank check for energy utilities, Solomon Cordwell Buenz introduced an integrated design strategy that combined active and passive systems. The western façade is a double glass exhaust-air façade, consisting of a non-load bearing second layer situated in front of the external wall. The cavity between the two envelopes acts as a thermal buffer and air...
3.4 Sustainability as a Driving Force for Design

Air blows through the building from the lakeside and is exhausted into the double façade, where it is dispelled at the top of the glass parapet through the natural suction produced by the Bernoulli effect. Wind hitting the west façade creates negative pressure on the opposite side of the parapet, literally pulling air out of the cavity. A damper located at the bottom of the façade brings in wind and ventilates the cavity.

Double glass façade systems display various functional characteristics that are superior to those of single glass facades. According to the Façade Construction Manual, the following are qualities of double glass facades from which the Commons benefit:

- Natural ventilation options in windy locations.
- Avoidance of sick building syndrome due to better opportunities for user-controlled natural ventilation.
- Enhanced comfort because of the higher surface temperatures inside the façade during cold weather.
- Improvements to the energy balance due to the option of nighttime cooling for buildings with exposed thermal masses. The exposed vaulted radiant slabs in the Commons act as thermal masses and aid in cooling and heating operations.
- Better use of and protection for sun shading devices. In the Commons, sets of blinds controlled by a BMS provide passive solar heating, which helps create temperature differences and therefore increases interior ventilation flows (Figures 11, 12).
- Better sound insulation.
- The opportunity for storey-height glazing to optimize daylight utilization, as seen in the western façade of the Commons, which spans three stories, inviting daylight into the building.

The Information Commons uses a radiant slab system for both heating and cooling (Figures 13, 14). Water circulates through PEX tubes embedded in the vaulted concrete slabs. Depending on the desired interior comfort levels, the water temperature fluctuates. By varying the temperature, the radiant system takes advantage of the slabs thermal mass. For a warmer interior climate, the water temperature in the tubing is increased, thereby warming the slab. The slab then radiates that heat out into the interior space. Cooling works in a similar
manner: cold water leads to a cool slab, which leads to a cooled interior. Overall, utilizing the thermal mass of the concrete for heating and cooling purposes is much more energy efficient than typical air conditioning systems.

**Four modes of operation**

Coupling the double ventilated façade with the radiant slab system and controlling both in tandem results in four modes of operation:

1. The natural mode operates approximately 52 days per year without running any mechanical systems. Natural ventilation is drawn through the space from the operable transom windows on the east façade, then into the double cavity where it is exhausted out the top (Figure 13).

2. The hybrid mode operates 62 days per year. When the air outside is cool enough, ventilation is drawn through the space from the east façade. Once the air outside has become too warm, the BMS closes the windows and fills the tubing in the concrete slabs with cold water, cooling the slabs and the space. The slabs account for 90% cooling of the interior space (Figure 15).

3. The cooling mode operates 50 days per year. All windows are closed, but the double façade remains open to exhaust warm cavity air. The radiant slabs cool the space and work in tandem with displacement ventilation mechanisms to dehumidify the air and provide ventilation for the interior space (Figure 14).

4. For the remainder of the year, 202 days, the building operates in heating mode. The radiant slabs are now heated with hot water to warm the thermal masses. The slabs radiate thermal energy into the space, providing a comfortable interior temperature. No natural ventilation occurs during heating mode and the double façade is closed to preserve an insulating layer of warm air. (Figure 16).

Developing hybrid systems through cross-communication and collaboration allowed the Information Commons to achieve a 52% reduction in energy over ASHRAE 90.1-1999. As the building management system analyzes data, it will learn how to best control the building and respond to environmental conditions adequately, thereby further reducing energy consumption. This interdisciplinary effort successfully addressed the three main concerns of Loyola University. First, the building blends into its surroundings and context by means of the transitional bookends. Second, the
building achieves a high level of transparency, maintaining views to the lake and strengthening the visual connection between campus and environment. Finally, Loyola University had a monthly operating budget of $7400 for this building. In its first year of operation, the building averaged $7300 per month in operating costs, and as the system is tweaked to respond to changing scenarios, it is anticipated that this will decrease further.

The two most important variables in the sustainability equation

What if these two paradigms of sustainability, the interdisciplinary approach and energy efficiency via technological means, had not been pursued when designing this project? It is quite possible that if Transsolar had been omitted from the equation with a typical linear approach to design, the four conclusions mentioned above would never have materialized. If that had been the case, passive systems might have been completely eliminated from the design, and the contributions of solar heating and ventilation would have been replaced by typical active systems. This would have compromised the technological paradigm of sustainability as well. If only active systems had been used, the double glass façade would have been of little use and would likely have been replaced by a monotonous curtain wall. Furthermore, without the pursuit of energy efficiency, the radiant slabs could easily have been replaced with typical slabs, thereby sacrificing heating and cooling means, as well as compromising light displacement. In sum, if neither of the two sustainability paradigms had been pursued, Loyola University would either be paying excessive utility bills to run a typical, unsustainable building, or they would not have been able to pursue the design ideas that they valued. Clearly sustainability was a driving force for designing The Richard J. Klarcheck Information Commons.

Conclusion

Overall, the collaborative, communicative, and connective effort put forth by all parties involved produced a building that has become a catalyst for changing the Loyola Campus. The process of interdisciplinary design allowed the architects to experience a shift in paradigm, where the attitude of "doing things just because that is the way they have been done for thirty years" is no longer relevant. This was not an atypical project for which the architects were forced into collaborative circumstances due to an advanced program, quite the contrary. It was a learning experience, in which new knowledge gathered from cross communication will have a place in all future projects.
One need look no further than the drawing boards at Solomon Cordwell Buenz. Now, during the design of the Loyola University Chicago School of Business Administration, Transsolar and other consultants have been brought in from day one. Perhaps the linear development process is now a thing of the past and interdisciplinary communication headed by architects is the wave of the future.

Notes
6. Ibid. 198.
9. Ibid. 188.

Figures
Figures 1, 4-18: Patterson, Devon. "Sustainability as a Driving Force for Design." Lecture, University of Texas at Austin. 15 September 2008.

Biography
Devon Patterson, AIA, LEED, is involved with the design and planning of numerous large-scale projects at Solomon Cordwell Buenz, including high and mid-rise residential, institutional, laboratory, office and retail buildings. As Chair of SCB’s Sustainability Committee, Mr. Patterson leads a number of the firm’s sustainable design initiatives. This includes ensuring that all design projects are assessed for certification under the US Green Building Council’s Leadership in Energy and Environmental Design program (LEED). In addition, Mr. Patterson oversees the in-house LEED professional development program along with an environmental design lecture series.

Mr. Patterson was part of the design team that submitted the winning entry for the Sun Wall Design Competition sponsored by the US Department of Energy in Washington, DC. More recently, Mr. Patterson was involved in the design of Loyola University Chicago’s Information Commons and Digital Library, which employs numerous passive and active systems, including a naturally ventilated double-skin façade and the United States’ first hydronic-radiant floor heating and cooling system.

Since joining the firm in 1994, Mr. Patterson has been involved in the design of Loyola University Chicago’s 180,000 square foot Quinn Laboratory Life Sciences Education and Research Center and the school’s 25-story, 628-bed Baumhart Residence Hall. In addition, Mr. Patterson was involved in the design of the 48-story Parkview residential tower for MCL Properties in Chicago and various multi-use projects in Washington DC and Las Vegas.

Mr. Patterson is a graduate of Pennsylvania State University and a member if the American Institute of Architects and the US Green Building Council.