The Maplewood Police and Court Building was built as a response to a longstanding need for increased and improved space for police and court functions, replacing an outdated structure from the 1930s. It is the first LEED-Certified municipal building in New Jersey. The Goldstein Partnership, an architectural firm with experience with municipal and public safety buildings, was chosen to design the facility. The green design of the building coincided with the stated goals of township officials to make Maplewood an example of a green community. Maplewood is a 2008 EPA Environmental Quality Award Winner, a partner in the Cities for Climate Protection campaign of ICLEI Local Governments for Sustainability, and in 2009 was named winner of the Sustainable New Jersey™ award for leadership.

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Maplewood Police and Court Building
Maplewood, NJ

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"Although our firm has been designing energy-efficient public buildings for more than 50 years, until recently, the only people who seemed interested in them were plant engineers and others involved in their day-to-day operations. What surprised me the most on this project was how elected officials who previously might have been reluctant to spend anything extra up front, were taking the long view, committed to any reasonable upgrades in the initial construction that would pay for themselves over time. Public buildings have almost always been built to last for several generations. It was great to finally have a consensus that their operating systems should be designed for the same time horizon as their envelopes." - Eli Goldstein

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Location of Project: Maplewood, NJ

Overview

The Maplewood Police and Court Building was built to replace an 80-year-old facility in order to provide increased and better quality space for police and court functions, including infrastructure to support advanced telecommunications technology. In addition, the space was intended to provide facilities for public meetings as well as support redevelopment efforts in the town. The building includes a courtroom, training room, conference rooms of various sizes, locker and shower rooms, a fitness center, jail cells, an indoor firing range, a 9-car garage, a 'Sally Porte', and police and court offices and storage rooms. The top floor is currently unused, but was provided to accommodate the future needs of the police department.

The facility operates 24 hours a day, 365 days a year though has a relatively low occupancy level at most times, accommodating about 20-30 people, but is also designed for up to 200 people when court is in session (once a week) and police shifts change. Still, it functions roughly four times as many hours per week (168) as a conventional office building (40). In general, investments in energy-efficiency pay for themselves more quickly the more hours a building is occupied.

The building was registered and subsequently certified under LEED-NC 2.1, achieving 33 points and earning a Silver rating. It received Sustainable Sites credits for its infill site selection, access to public transportation, bike racks and changing rooms, and storm water management. It earned Water Efficiency credits for water-efficient landscaping and efficient plumbing fixtures. It earned Energy & Atmosphere points for energy-efficient lights and HVAC, a solar photovoltaic array, green power purchases, additional commissioning, and use of non-ozone depleting refrigerants. It earned Materials & Resources credits for diverting construction waste from the landfill, specifying materials with a high recycled content, and buying locally. Indoor Environmental Quality credits included carbon dioxide monitoring and control, use of low-emitting materials, and extensive daylighting and views.

Site Selection and Transportation

The Maplewood Police and Court Building site is approximately 1.5 miles from the Maplewood NJ Transit Train Station which features frequent trains to Hoboken and New York Penn Station; a jitney service provides bus access to and from the station during morning and evening weekday rush hours. There are nearby NJ Transit bus stops for buses that run along Springfield Avenue east to Irvington and Newark and west towards Millburn. The station has a public bike rack space for 10 bikes. The site plan provided a reduced number of new surface parking spaces through the shared parking arrangement with the neighboring church. A smaller separate lot within a secure fence is provided for staff.

Project Team

Architect(s): *The Goldstein Parnership | Eli Goldstein, AIA, PP, LEED AP, Principal-in-Charge & Lead Designer*
Laura Berwind, AIA, Project Manager

Structural Engineer: *Brian Falconer, PE, Principal-in-Charge | Severud Associates*

Mechanical/Electrical Engineer: *Milton Azous, PE, Principal-in-Charge | Omdex Incorporated*

Technology Consultants: *Khaled Nassoura, PE, Principal-in-Charge | Nassoura Technology Associates*

Site/Civil/Geotechnical Engineer: *Richard Adelsohn, PE, Project Manager | Frank H. Lehr Associates*

Acoustical Consultant: *Kring Herbert, FASA, Principal-in-Charge | Ostergaard Acoustical Associates*

Landscape Architect: *Jan Saltiel, ASLA, Principal-in-Charge | Edgewater Design LLC*

General Contractor: *Seacoast Builders Corporation | David & James Schulz, Partners-in-Charge*
David Black, Superintendent

Commissioning Agent: *Michael Dooley, Project Manager | Horizon Engineering Associates*

Landscaping

Due to its location in a compact urban site, there is a relatively small amount of landscaping. The vegetation used is indigenous to the area, comprised of groundcovers, shrubs and trees that would require little to no watering nor pesticides and fertilizers. The fact that the plants will only need to be watered after they are established, and that there will be no need for automatic sprinklers, translates into energy and water conservation for the project.

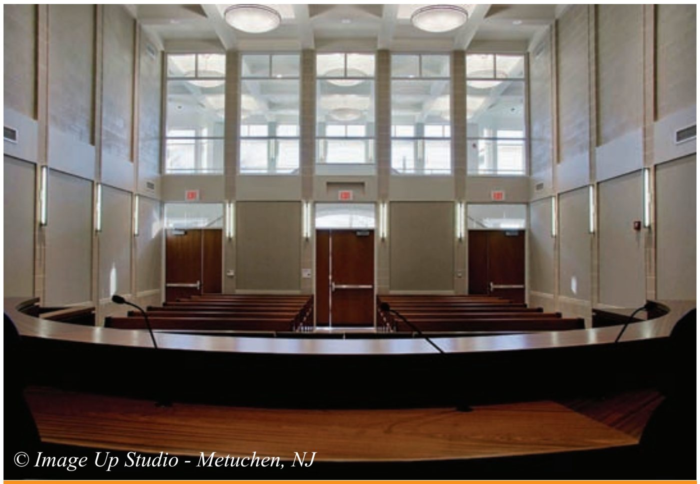
Building Design

The building faces south onto the street. Offices on the north side, including the main conference room, have a view overlooking a park, which not only offers attractive green vistas for those inside the building but also provides added security for park users. This steel-framed brick-faced building includes three floors above grade and one below with a total of 41,850 square feet.

The building was designed to harmonize architecturally with the 1920s historical revival style of other township buildings.

Building Materials

The building uses steel-frame wall construction. Eight-inch steel stud walls are filled with 8" fiberglass insulation blankets. The insulation value for the walls is R-21 with a U-factor of 0.097 (R-13, U-factor = 0.124 was required by ASHRAE-90.1-1999).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Ratings and Awards

LEED Silver under LEED/NC, v.2.1

The roof insulation has an R-30 value with a U-Factor of 0.034 (compared to ASHRAE-90.1-1999 minimum R-15, U-factor 0.063).

The building uses double-pane solar control low-e glazing with a U-value of 0.27 to 0.29 (ASHRAE 90.1 U = 0.57). The solar heat gain coefficient (SHGC) ranges from 0.24 for vision glass and 0.38 for daylighting glass (compared to 0.39 allowed by ASHRAE 90.1).

HVAC

The building is heated by natural gas-fired boilers that deliver hot water to coils in rooftop air handling units and a variable air-volume (VAV) air distribution system. The cooling plant includes a wet cooling tower to discharge heat outside the building, a condensing water loop connecting the cooling tower to two two-stage reciprocating chillers, and a chilled water piping system that connects the chillers to cooling coils in the rooftop air handling units.

The boilers are both modulating (each from 100% to 20% in sequence) and the chillers were designed to come on in four stages so that its output can be scaled according to need. The cooling plant has a total cooling capacity of 100 tons (400 sq. ft./ton) for the purpose of reliability. It is programmed to run variable loads from 0 to 100%.

Process

Design

When the project started, a site had not yet been selected for it. After developing the building program, the architect worked with the township to do so. Several sustainable criteria were considered, including:

1. Whether the site had previously been developed,
2. Whether it was convenient to mass transit, and
3. Whether it would have a relatively unobstructed southern exposure.

The final site has all three of the above characteristics, which helped to achieve LEED certification.

Even though the original goal was simply to achieve LEED certification, near the end of construction, it became apparent that the project had enough credits to achieve a Silver rating.

A police and court building has a number of strict security requirements that affect the building's internal organization. While respecting those constraints, the team organized the building to be as green as possible. Among its green architectural features are the following:

1. Spaces which are used only occasionally (the firing range) and/or which are only partially conditioned (the garages) are clustered along the north side of the building.
2. Interior glazing is used around the lobby, to bring daylight into adjacent interior spaces which would otherwise have none (interior windows bring daylight into the courtroom; glass block floors bring daylight into the fitness center below).
3. The building footprint is roughly square, to make the building's ratio of surface area to volume relatively low, thereby reducing heat losses and gains through the building skin.
4. Light shelves outside south-facing windows help distribute daylight deep into the interior.
5. A revolving door at the front entrance minimizes air exchange with the outside.
6. Floor-to-floor heights were minimized, through careful coordination of ductwork with building structure, reducing the building's surface area and, therefore, the volume of natural resources needed to build it. In addition, a smaller surface area means less heat gain/loss through the building envelope, all else being equal.

Construction

The considerable effort spent on designing a green building is of value only if the design is faithfully constructed. Among the steps taken during the construction of this project, to assure that it would be as green as possible, were the following:

1. **Recycling of construction waste:** The contractor implemented a waste management plan during construction and diverted 75 percent of the construction waste material from landfills through reuse or recycling.
2. **Sealing of the building envelope:** To be as energy-efficient as possible, the building envelope must be tight. This requires that the workmanship be good and that joints in the building envelope be appropriately sealed.
3. **Using regionally-sourced materials and/or those with considerable recycled content:** Twenty percent of the materials were sourced and manufactured in Vermont and Pennsylvania. The steel was locally produced in New Jersey. Materials used with recycled content included recycled rubber floor tiles in the fitness area, while the wood veneer finish used in the courtroom originates from a Forest Stewardship Council (FSC) certified forest in California.

Operations/Maintenance

The Township has committed itself to cleaning the building using green cleaning products. Also, the Township has committed itself to run the building with "green power" (to purchase power from an approved green power provided, in the quantity needed to run the building).

Commissioning

Both initial and enhanced commissioning were conducted at the Maplewood Police and Court Building. Commissioning involves reviewing design documents, performing field visits to the building, operating building systems in their various modes, and monitoring the resulting performance of the building. Initial commissioning is intended to confirm that building systems are performing as designed. Following operator reports of mixed performance for the heating and cooling systems, enhanced commissioning was undertaken to see if performance could be improved. Continued efforts to fine-tune the building are warranted.

Post-Occupancy

The Rutgers Center for Green Building (RCGB) conducted a two-year post-occupancy evaluation (POE) of the building commissioned by the New Jersey Chapter of the U.S. Green Building Council (USGBC-NJ). The study analyzed the physical performance of the building in such areas as energy and water consumption, and construction and operation costs. Surveys were conducted to assess occupant comfort and satisfaction. This work includes the following:

1. Descriptions of the building's green features in seven key areas: site selection and planning, construction management, landscaping, building design, building materials, building systems, and other features.
2. Interviews and questionnaires with the building owner, design team, engineering team, facility manager, and others to gather information on energy and water use, indoor environmental quality, occupant satisfaction, and avoided infrastructure costs.
3. Analysis of actual energy performance and economic assessment of the building through a Life Cycle Cost (LCC) analysis.
4. Assessment of environmental impacts of energy and water use.

Finance

In general, the township chose to proceed with green features which were expected to pay for themselves over a reasonable period of time (on the order of 15 years or less). For example, they did not agree to include photovoltaics in the project until they were confident that they could secure a large enough rebate for that system to assure a reasonable payback.

Of course, all payback projections are speculative, in that they are based on assumptions of future energy costs and equipment lifespan. The projections prepared for this project assumed that energy costs would remain constant. By the time the project was finished, energy costs had risen considerably, shortening the previously anticipated payback period. There is no way of knowing whether that will continue to be the case.

The construction cost premium for all of the building's green features was about $315,000 or about 2 percent off the total construction cost of the building ($16.2 million). These enhancements as designed were expected to outperform a modeled conventional building by 18% for electricity consumption and 68% for natural gas consumption. Actual electricity consumption was as expected, outperforming a conventional building by 18%, though natural gas consumption was either similar to or as much as 37% higher than a conventional building depending on assumptions. There are several possible reasons for this discrepancy which are discussed below in the section on building performance.

To better understand the cost-effectiveness of these green features, a Life Cycle Cost (LCC) analysis was performed by the RCGB for the energy-related characteristics and equipment. LCC

analysis considers the total costs associated with a building from its initial construction costs, its lifetime operational costs, and demolition costs. LCC analysis is especially useful in the context of green building because energy-efficient features characteristically have higher up-front costs but recover some or all of those costs through lower utility bills.

This LCC analysis compares the as-built, green building with a conventional building or "budget" case. The heart of an LCC is a Net Present Value (NPV) analysis, which calculates the discounted difference between (net) the total costs and benefits from each time period of the building's lifetime, brought back to the present and aggregated into a single number. A positive NPV relative to the budget case represents a net savings by the energy-efficient building over its lifetime.

The Net Present Value (NPV) analysis of the Maplewood Police and Court Building found that the lower operating costs fully offset the higher construction costs, yielding a small, positive net benefit of $0.42 per square foot as compared to the conventional, or budget case, assuming a 30-year building lifespan, a 7.0% discount rate, and current energy prices. The following table provides a summary of the primary NPV analysis.

Changes in the discount rate changed the direction of the relative NPVs of the buildings in one out of three sensitivity cases. The as-built building remained more attractive than the budget case under low and normal discount rates, but not at the higher discount rate.

Projected lifespan of the buildings also had a significant impact on the relative NPVs. Here, the relative NPV of the as-built building was worse than that for the budget case for a 15-year lifespan and better for 30-year and 50-year lifespans. This emphasizes the importance of ensuring that the building lasts long enough to pay off its increased construction cost.

Firing Range
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Building	Initial Cost (selected features) per sqft	Initial Cost per sqft Relative to Budget Case	Discounted Operating Cost per sqft	Discounted Operating Cost per sqft Relative to Budget Case	Net Present Value (NPV) per sqft	NPV Relative to Budget Case
As Built	-$7.48	-$7.48	-$33.85	$7.90	-$41.32	$0.42
Budget Case	$0.00		-$41.74		-$41.74	

If Solar Renewable Energy Certificates (SRECs) were not being awarded for the energy production of the photovoltaic array, the NPV of the as-built building would turn negative, costing $3.72 per square foot more than the budget case. If the photovoltaic array had not been built at all, the NPV of the as-building would remain negative, costing $2.41 per square foot more than the budget case. However, given the uncertainty about the actual natural gas costs associated with the modeled budget case, it might be better to take natural gas consumption out of the calculation altogether. In that case, the NPV of the as-built building becomes positive, costing $2.32 per square foot less than the budget case.

The NPV of the as-built building relative to the budget case building is sensitive to assumptions regarding future energy prices, discount rates, and building lifetimes. In order to capture some of the uncertainty of future predictions, a sensitivity analysis was conducted. Future energy costs were set to 75% and 150% of their projections from the DOE Annual Energy Outlook 2009 (tables A8 and A13). Three different values for the discount rate were used: 4 percent, 7 percent, and 12 percent. Building lifespan for the primary NPV analysis is assumed to be 30 years, and 15-year and 50-year lifespans are considered in the sensitivity analyses.

The energy escalation rate did not change the direction of the relative NPV of the as-built building, and in every case the as-built building performs better than the budget case, increasingly so at higher energy prices. This makes sense, because the more energy a building consumes, the more it will be affected by changes in energy prices.

Performance

As mentioned above, the RCGB conducted a two-year post occupancy evaluation of the Maplewood Police and Court Building. What follows is a brief discussion of the results of the building performance found in that study.

Water Consumption

Water bills for the Maplewood Police and Court Building since it opened were collected and analyzed. Over the 322 day period, 334,000 total gallons of water were consumed for an average of 1,037 gallons per day (GPD). In order to compare this consumption to other office buildings, water consumption can be normalized on a per square foot or per capita bases. The water consumption for the building is 0.025 GPD/square foot or 35 gallons GPD/person (assuming 30 users) whereas a typical office building consumes between 0.03 – 0.16 GPD/person (Dzeigielewski et al, 2000), putting the Maplewood Police and Court Building at the low to normal range of water consumption.

Energy Consumption

The RCGB collected utility bills from the municipality from January 2008 and the electricity generated by the solar array was tracked separately by Solar Energy Systems from March 2008 forward and their website provided access to those data. The study team forward visited the site several times to conduct interviews with key actors, including the architect, building manager, building users, and township representatives.

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The energy use of the new building was compared to that of the old police and courthouse building as well as the computer modeling completed and submitted for the LEED application which included two scenarios: the "green" design case representing the proposed design, and a conventional building "baseline" or "budget" case. The average performance of similar buildings in the Mid-Atlantic region is based on the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey (CBECS) 2003.

Annual energy intensity comparisons show that the Maplewood Police Department and Court used about 15.5 kWh/year/sqft in 2008 and about 15.7 kWh/year/sqft in 2009. The 2009 consumption rates were about the same as expected during design (16.0 kWh/year/sqft), about 16% less electricity than a modeled conventional building (19 kWh/year/sqft), about 16% less than the old municipal building (19.5 kWh/year/sqft) and about the same as comparable buildings in the Mid-Atlantic region (16.1 kWh/sqft/year).

Actual natural gas usage in 2008 was about 53.2 kBtu/sqft/year and in 2009 was about 39.0 kBtu/sqft/year. The 2009 consumption levels were 400% higher than predicted by the modeling (9.0 kBtu/sqft/year) and about 34% higher than a modeled conventional building (29.0 kBtu/sqft/year), about 55% lower than the old municipal building (63.6 kBtu/sqft/year), and 30% lower than comparable buildings in the Mid-Atlantic region (54.9 kBtu/sqft/year).

There are several possible explanations for the discrepancies between the models and actual usage: the Maplewood Police and Court Building may be experiencing operational challenges during its startup period; the building may be operating under dramatically different conditions (especially regarding climate or schedule) than the modeling performed during the design process assumed; the modeling results included in the LEED submission incorporate unusual or inappropriate assumptions; or some combination of these factors has affected the results.

Startup problems could also play a role in increasing natural gas usage above expected amounts. For example, if the economizer controls are not operating properly (perhaps because items such as carbon dioxide sensors need calibration or an improved control logic), much more outside air than needed might coming into the building during the winter, requiring heating.

Regardless of modeling and startup issues, the actual natural gas consumption of the Maplewood Police and Court Building, per square foot, is better than the previous police building, and somewhat better than other public safety buildings, suggesting reasonably energy-efficient performance, though not up to expectations. Improvements between 2008 and 2009 suggest that startup issues are being resolved.

Green Strategy Performance

Daylighting strategies largely seem to work well. Daylight reaches into the courtroom during the daytime and most exterior offices and conference rooms have their lights turned off. However, window blinds are closed in some offices with computer screens because of glare.

The solar PV system is working in line with pre-construction modeling, reducing electricity purchases by about 2-7 % annually. The CO_2 sensors in the courtroom and conference rooms appear to function well. The building manager does not report any "stuffiness" complaints in these rooms although the architect worries that more outside air than necessary may be delivered to these rooms. The air filtration system seems to work well, as does the notification feature that alerts the building manager to replace filters.

The shooting range, which requires 100% outside air and frequent air changes, has a heat recovery system that extracts heat from the exhaust air and uses it to pre-heat the incoming fresh air. The system appears sound but is rarely used because the shooting range itself is used only a few hours per week. Because of this infrequent use, the heat recovery system will take a long time to pay off.

There are several issues affecting the startup period of this building that are worth mentioning.

A detailed independent engineering study and re-commissioning of HVAC systems was underway at the time this report was completed. This case study does not attempt to anticipate the results of that more detailed effort. There appears to be a cycling problem with the chilled water system. Chilled water is supplied by a two two-stage reciprocating chillers cooled by a wet cooling tower located in the parking lot. The four-stage design accomplishes two things, first, it allows efficient part-load operation, and second, it provides redundant, backup capacity for cooling the police station, which is a 24/7 activity. The building management system (BMS) shows that most of the time just a single stage of one chiller needs to run to satisfy the cooling load, confirming the value of the multi-stage technology.

However, that single stage cycles on and off quite frequently, and the temperature rise across the cooling coils is smaller than they were designed for, leading the control system to throttle down the amount of chilled water going to the cooling coils and open a bypass valve to shunt the excess chilled water back to the chiller. Some possible reasons for the cycling problem include operational decisions, the low capacity factor of the building (i.e. the demand for cooling fluctuates widely between low occupancy for most hours and large crowds during a few hours); the third floor of the building is currently unoccupied and uncooled; the server room in the operations center might once have been designated to be air conditioned from the central system (it instead has its own dedicated AC system); or the building envelope is tighter than expected so that the cooling load is lower than planned.

It is worth noting that even with this problem causing inefficiencies in use of the chiller (and similar issues with the boiler that were addressed in the summer of 2009), the analysis of energy bills suggests that electricity use still was at or below predicted levels for most of the life of the building to date and natural gas use is in line with similar buildings in this geographic region.

The control system is divided into three parts provided by three vendors: major equipment auto-controls are from the manufacturer of the mechanical equipment; some local controls within the boiler room are provided by another vendor; and the building management system came from a third vendor. Either these systems are not fully interoperable or the BMS is not performing properly.

Domestic hot water for hand-washing and showers comes from one of the boilers rather than a dedicated water heater. Thus, one of the boilers has to run all summer. It is possible that a dedicated water heater might save money and reduce greenhouse gas emissions. The current configuration is the result of modeling during the design phase, which rejected use of a separate domestic hot water boiler.

The cooling tower, located in the parking lot because of the expanse of solar collectors on the roof, is positioned to be as far as possible from neighboring buildings because of the noise it generates. Its current position, however, is underneath several oak trees, and leaves and twigs from these trees get entrained into the water that circulates between the chillers and cooling tower, thereby causing clogging problems. The building manager has added a screen on the blower intake and plans to add a cap to mitigate this problem.

Occupant Satisfaction

Based on qualitative research conducted by RCGB, including individual and group interviews, supported by surveys, occupants seem pleased with this facility, although with some concerns. They generally are happy to be in a bright, attractive, and spacious new facility. This appears to be in large part because of the quality of the new facility, but the positive feelings are also attributable in significant measure to the contrast with the previous police and court building, which was widely perceived as dated and too small for the number of people and functions. This building is considered a huge improvement over working in the old facility on all counts.

In addition to the quality, appearance, and amount of space in the new building, occupants were particularly pleased with the availability of the exercise/weight room, locker room with showers, and shooting range. Many were appreciative of the appearance, with particular emphasis on natural lighting and views.

Occupants have a mixed perspective on the daylighting. On the one hand people like the availability of daylight, and during daytime hours exterior room electric lights were left off, suggesting that the daylight provided sufficient illumination for work. The daylighting is also a highly valued feature that seems to affect occupant mood positively. On the other hand, some occupants were displeased with the daylighting because glare has been a problem in some areas and steps were taken to mitigate this issue. Workers in the interior, open space with little privacy, windows, and views were less pleased with the building than other staff members with more private office space and exterior windows.

The most common complaint concerned the functioning of the HVAC systems. The operation of these systems has been problematic since opening, and remains an issue two years after opening. Patience with attempts to fix heating and cooling systems is wearing thin. From the perspective of the building's users, the problems are:

- Poor temperature control ("it's often too hot or too cold");
- Variability in rooms on the same thermostat (with the thermostat set at 69oF one room can indeed be at 69oF while another room a short distance away, on the same thermostat, is 80oF);
- Difficulty making adjustments in order to increase thermal comfort. New thermostats are perceived to be irresponsive and windows do not open. The only recourse is to contact

the building manager who operates several other buildings to supervise as well.

The attempted fixes, such as modifying the control programs for the heating systems, seem to have had a positive effect. Several people indicated that the heating was less problematic in the winter of 2009-10 than in the previous winter. Cooling remains a problem, however, with common staff complaints that rooms are too cold or not cold enough.

Occupant concern with the level of adjustability of thermal comfort seems related both to perception of lack of responsiveness of thermostats and the inability to open windows. The absence of operable windows makes everyone more sensitive to temperature and ventilation issues. One of the major discussions and points of contention prior the design stage of the building was over operable windows – user representatives wanted windows they could open, but engineering concerns for HVAC efficiency won out.

Lessons and Trade-offs

1. Daylighting is a valuable and appreciated feature but issues relating to glare that can impact productivity need to be addressed in architecture and interior design.

2. Make sure all documentation is acceptable before green building materials are ordered. Early on in the construction process, the owner decided to change the species of wood for the wood paneling on the walls of the courtroom. When the LEED paperwork was submitted at the end of construction, it was discovered that the veneer did not qualify as certified wood. Had this been known at the time of the change, a different veneer that qualified for LEED credits could have easily been substituted.

3. There are concerns about the accuracy of energy use predictions that were part of the LEED submittal, which may suggest a broader issue about reliance on such models.

4. The life-cycle cost effectiveness of a green building is diminished if it suffers from an extended startup period of suboptimal performance. Designing for partial and widely variable plug loads is a challenge of buildings like this and needs to be better addressed.

5. The financial viability of adding green features is not a given and in some cases depends heavily on financial subsidies, such as SRECs.

6. Do not limit green building strategies to those that qualify for LEED credits. A number of green features were included in the project that are not addressed in LEED. For example, the layout of the ductwork was coordinated with the layout of the floor beams, minimizing the floor-to-floor heights, thereby reducing the building's surface area and using fewer natural resources in its construction. Secondly, the owner entered into a long-term agreement with the church next door to use its parking lot on weekdays, thereby reducing the need for on-site parking and the impervious surface associated with it.

7. Decisions to make use of sophisticated HVAC and control systems need to consider the skill/training level, availability and cost of personnel needed to adequately maintain these systems. The success of a sustainable building is largely a function of the performance of its HVAC and control systems. The programming of these control systems is a key to occupant comfort and energy efficiency. The software for these systems is often capable of performing a much wider range of tasks than any single user is ever likely to require. Without properly trained personnel, this can make them difficult for the building owner to use.

8. When possible, use green strategies that achieve multiple objectives. Many green features achieve single objectives such as low-flow toilets which reduce water use. However, one's investment in sustainability can go further when used for features which achieve multiple objectives simultaneously. For example, waterless urinals save water and eliminate the need for supply piping.

List of Green Strategies

Design

- Energy Modeling
- Transit Oriented Design (TOD)
- Native and Adapted Plants
- Water Efficient Landscape Design
- Low Flow Fixtures and Fittings
- Integrated passive/active solar strategies by building orientation
- Highly insulated building envelope
- High-Efficiency Lighting Systems
- Properly Sized HVAC and Dedicated Mechanical Systems
- Demand Control Ventilation & Energy Recovery Systems
- Smart & Sensor Controls
- Photovoltaic Systems
- Construction and Demolition Waste
- Low-Emitting Materials
- Views and Operable Windows
- Sense of Place
- Crime Prevention Through Environmental Design (CPTED)

Build

- Construction & Demolition Waste Recycling

Operate

- Green Cleaning
- Green Power purchasing
- Floor-to-floor heights in the building were minimized reducing building surface area.
- Entered into a long-term arrangement with an adjacent property owner to enable the public to park in their lot on weekdays, reducing the need for additional parking.