FRIENDS CENTER
A Sustainable Renovation of a National Landmark

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INTRODUCTION

The renovation of Friends Center in downtown Philadelphia began in 2003 as a modest capital improvements project to address outstanding maintenance issues in the Friends' historic Race Street Meetinghouse and the attached ca. 1970 office building. Through a consensus-based process of mission-driven discernment, the Friends and the members of the project team refined a vision of sustainable design, construction, and use practices. Ultimately, the project achieved LEED Platinum certification and the highest number of points awarded for any LEED NC 2.0 project within the state of Pennsylvania. However, the enduring contribution of the project to sustainable design and construction practices has been to advance accepted standards for best practices in design and construction. The project exemplifies the way that successful sustainable projects influence the definition of best practices and raise the bar for clients and designers. While the Friends Center facility does tread lightly on the land and does not emit any CO_2, its most significant societal and ecological benefit has been a transformation of expectations regarding sustainability during design, construction, and occupancy.

The intent of this article is to describe the sustainable design technologies that were planned and incorporated into the Friends Center renovations, to explain how decisions were made to embrace sustainable design strategies, and to explain how the sum of these parts has been a transformation of expectations regarding current design strategies, construction practices, and building occupancy as they relate to sustainability.

HISTORY OF THE SITE

The Friends Center campus has been a locus of Quaker worship and action for 150 years. Its stately façade stands proudly at the corner of 15th and Cherry Streets in downtown Philadelphia, just two blocks from City Hall (Figure 1). Friends Center spans 1.26 acres and comprises a central courtyard surrounded by three buildings—the historic Race Street Meetinghouse; a 56,000-square foot office building built in 1972; and a smaller building that once formed part of the Friends Central School.

The site's significance in history began with the construction of the Meetinghouse in 1856 for the Philadelphia Yearly Meeting and what is now called the Central Philadelphia Monthly Meeting. Since that time, it has not only served the needs of its congregation but it has been at the heart of movements to end slavery, promote the rights of women, call attention to the human costs of war, and reconcile communities. Lucretia Mott, Hannah Clothier Hull, and Alice Paul are among the prominent women's rights activists closely associated with the Meetinghouse. In recognition of its role in the abolition of slavery, women's suffrage, and the civil rights movements, the Race Street Meetinghouse was designated a National Historic Landmark in 1993. It is also listed as a Philadelphia historic site. Given this history of peacemaking, the City of Philadelphia frequently turns to Friends Center to host and support some of its most difficult and fractious groups in an effort to find resolution and accord.

The Friends' complex developed into a center for the work of the Religious Society of Friends in response to a group of Friends seeking a physical space where Quakers could gather for thought and action. They envisioned a campus where service organizations could be housed together to take advantage of shared resources and synergies. Dedicated in 1974, Friends Center is now home to a total of 22 nonprofit organizations and provides meeting

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FIGURE 1. Friends Center Campus. (Paul S. Bartholomew Photography)

and conference facilities for numerous Quaker and non-Quaker grassroots groups. Among them is the American Friends Service Committee, an international aid and development organization and Nobel Peace Prize Award winner, which was founded on the campus in 1917. The American Friends Service Committee along with the Philadelphia Yearly Meeting and Central Philadelphia Monthly Meeting comprise the joint partnership of Friends Center Corporation, which owns and manages the complex.

EVOLUTION OF PROJECT

In the late 1990s, Friends Center began to prepare for the first major renovation and restoration of its facilities since 1974. The notion that "peace and justice depends upon restoring the Earth's ecological integrity" is a tenet of the Friends' beliefs and the basis for many policies woven throughout the non-profit organizations housed at Friends Center. In keeping with its tradition of environmental stewardship, the Board of Friends Center adopted the goals of green building design when it began planning for the rehabilitation. Among the first steps were a Needs Assessment, which was followed by a comprehensive Master Plan intended to "minimize operating costs, maximize 'green' operations, and provide for the future growth and needs of Friends Center."

It is important to note that prior to implementing the Master Plan, the Financial Strategies Committee analyzed other options, which included selling the campus. But after careful consideration, the equity partners decided that the best financial and programmatic choice was to remain in their current location and invest in their facilities. Recycling their existing buildings as opposed to selling them to a developer was perhaps one of the "greenest" decisions the Friends made. As they embarked on the project, there was a certain intention of using the renovation as a means of becoming more environmentally responsible, though there was not a deep understanding of what that might realistically entail.

The subsequent Request for Proposals issued for the project stipulated that the design team have experience with green architecture to assist the Friends in developing a sustainable building design and plan for operations using the U.S. Green Building Council's LEED program as a measure of performance. Ueland Junker McCauley Nicholson, now UJMN Architects + Designers, was hired as the architect in October 2003. To assess the full environmental impact of its facilities and to study the green potential of its campus, Friends Center applied for and received the first "Green Initiatives" planning grant from the Kresge Foundation in 2004. The activities funded by the grant included green building tours, green goal setting, a green design charrette, energy modeling, daylight modeling, and post-charrette follow-up and design refinement.

The charrette, in particular, proved to be a significant turning point for the project. Owners and users of the buildings came together with designers, engineers, and green specialists, totaling nearly 50 participants from across the country, to envision a project that embodied the highest aspirations for sustainability. The two-day interactive workshop involved a substantial educational component that introduced participants to green technologies through presentations on geothermal heating and cooling, vegetated roofs, water management, energy efficient lighting, and photovoltaic panels.

As the planning proceeded, the Friends gained an understanding of the tremendous impact buildings have on the natural environment and how their own buildings participate in the global competition for energy resources. Recognizing that 21st century wars already concern energy and water resources further strengthened their commitment to demonstrating the responsible use of those resources. As a result, the Friends began to see a clearer connection between environmental responsibility and traditional Quaker concerns for peace and justice. Ultimately, two overarching goals for the project emerged: to become fossil fuel free, and to protect the watershed from further degradation by reducing the Center's water usage and stormwater runoff.

The Friends were committed to a high level of sustainable design from the outset of the project, yet they were unsure for a long time about whether to pursue LEED certification from the U.S. Green Building Council. As their awareness and commitment increased, they began to see an opportunity to use the project as a teaching tool and to take a stand on the climate crisis—one of the major social issues of the day. They eventually decided to pursue LEED certification as it provided both performance metrics and third-party recognition of the project's environmental impact and responsibility.

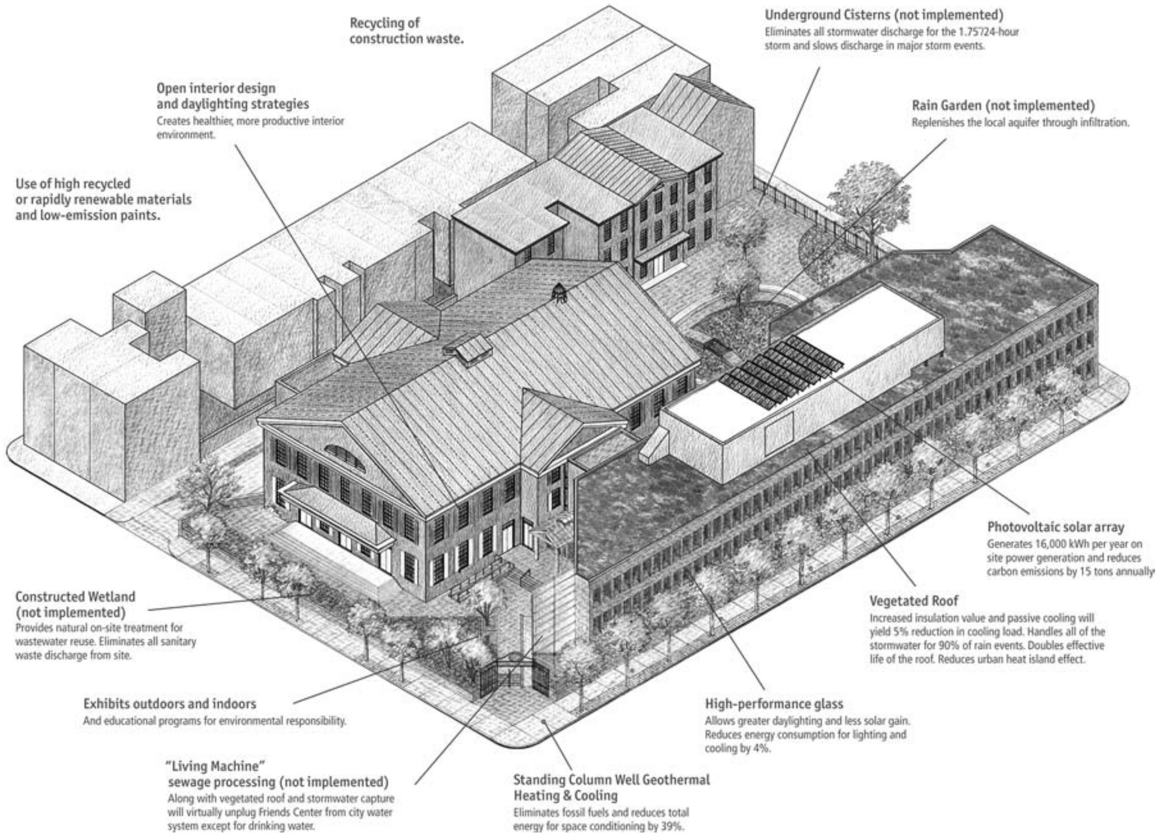
SUSTAINABLE DESIGN IMPLEMENTATION

The sustainable design elements integrated into the Friends Center renovation (Figure 2) stemmed largely from work accomplished during the Green Design Charrette and subsequent analysis of recommended strategies. This finding reinforces the value of bringing the full range of users, facility managers, designers and stakeholders together at the outset of a project to develop a shared understanding of the project objectives. In particular, two overarching goals for the project emerged: being fossil-fuel free and protecting the watershed. These ultimately governed the consideration, evaluation, and selection of the sustainable strategies that were implemented.

Establishing a Road Map: Green Design Charrette

The Green Design Charrette spanned two days of sessions and included both smaller groups of stakeholders focused on specific aspects of the project and larger meetings of all stakeholders. The small groups included a "Systems Team" focused primarily on mechanical systems and electricity use; an "Interiors Group" that addressed how spaces would function, and established the design issues that were important to occupants; two "Architectural Teams" that addressed coordination of sustainability objectives, architectural changes to the historic Meetinghouse and adjacent office building, systems coordination, water use considerations, and programming objectives; a "Daylight and Envelope Group" that considered the impact of modifications to the building envelope; an "Entrance Group" that addressed

FIGURE 2. Sustainable Design Strategies. (UJMN Architects + Designers)



programming issues associated with the building entrance sequence; and a "Water Group" that analyzed issues of sustainable design and water use strategies.

In addition to many specific, practical design strategies that will be discussed in detail below, the charrette changed the project approach significantly. Sustainability became a driver for the project and informed decision making rather than being one of a number of objectives. Sustainable design came to be seen as "best practice" and synergies between design strategies were identified. For example, increasing the amount of daylight penetration would reduce electrical loads, facilitate interaction among building users, and create a pleasanter and healthier work environment for occupants.

The discussion that follows regarding sustainable design strategies considered and those incorporated into the project, is organized according to three broad categories: Mechanical and Electrical Systems, Architectural Considerations, and Water Management.

Mechanical and Electrical Systems

The impetus for the renovation of Friends Center was in part the age and condition of its mechanical and electrical systems, and also the cost of the steam used to heat the campus. Principal mechanical and electrical system components had exceeded their median service lives and were no longer operating. Parts for the chiller and VAV units were no longer available. There was no backup for the chiller, which used CFC-11, an ozone depleting refrigerant that was no longer available. Both the chiller and the air-handler were significantly oversized. The steam supplied by Trigen Philadelphia to heat the campus and provide some hot water was sufficiently expensive that only an estimated four-year pay-back period would have been required to recoup the cost of new natural gas fueled boilers. Panel boards lacked spares and the building emergency and area lighting was insufficient.

Sustainable Design Strategies

Charrette participants were able to think in the broadest terms about energy optimization approaches because so much of the existing mechanical and electrical equipment was in need of replacement. It was acknowledged that a lifecycle cost/payback analysis would be an essential decision-making tool. Mechanical strategies discussed during the Design Charrette included ground-coupled geothermal heating and cooling, photovoltaic water heating, instantaneous water heating, utilizing FPVAV's in lieu of perimeter heating, individual HVAC controls, installing modular chillers and boilers to optimize efficiency, using chilled beams and underfloor air distribution, providing radiant cooling panels, and providing chillers with ice storage tanks.

Electrical strategies discussed included reconsidering interior load allowances (lighting < .8 watts/SF; plug loads < .80 watts/SF), daylight harvesting, providing occupancy sensors and photo sensors for lighting, implementing individual lighting controls (including use of task lighting), and installing a photovoltaic array.

The strategies ultimately incorporated into the project owed much to the work done during the Design Charrette and follow-up study of the recommended strategies. In the end, Friends Center chose to utilize geothermal heat pumps for heating and cooling and to obtain electricity to operate the system using a combination of rooftop mounted photovoltaic panels and wind-generated electricity purchased from a utility. It had been assumed at the time of the charrette that there was insufficient room on Friends' constrained urban campus to permit installation of a closed-loop vertical well field, and it was later determined that approximately 96 of these shallower wells would have been required (Figure 3). The project was able to proceed with geothermal heat pumps by drilling the first standing column well field in the City of Philadelphia. Seven 8" wells varying in depth between 650' and 1500' were drilled under the sidewalk on 15th Street adjacent to the office building (Figure 4). Water is drawn from the bottom of each well and piped to a heat exchanger in the lower level of the Friends Center office building (Figure 5). Water loops circulate from the heat exchanger to water-to-water heat pumps located in the penthouse of the office building and to water-to-air heat pumps serving the historic Meetinghouse (Figure 6). A rebuilt custom air handler in the office building is used to provide air to new VAV boxes in the office building. The new system meets the heating and cooling requirements

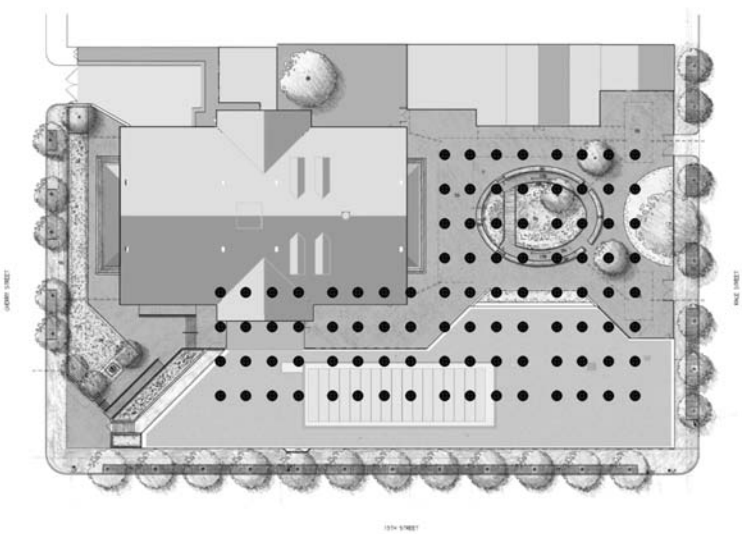
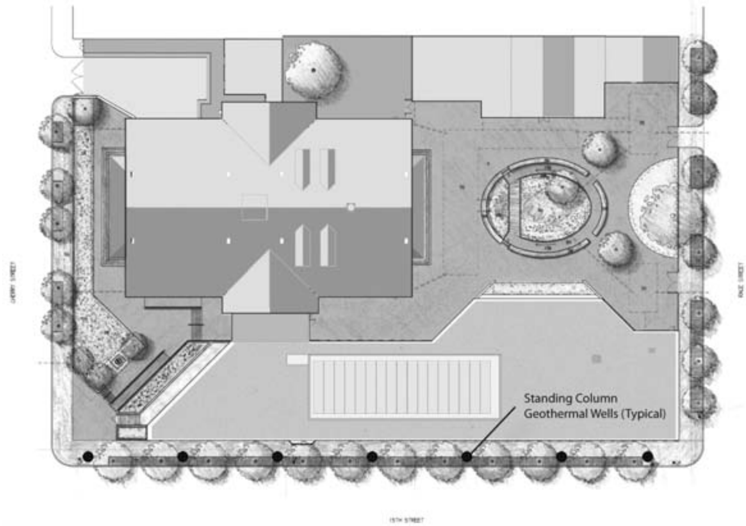


FIGURE 3. Diagram of Closed Loop Well Field. (AKF Engineers)

FIGURE 4. Diagram of Standing Column Geothermal Wells. (AKF Engineers)



for the campus and the existing oversized chiller and cooling tower have been removed.

Once the technical problem of how to fit a geothermal well field onto the campus had been solved, questions of cost had to be addressed. A thorough life cycle cost analysis demonstrated that the installation of geothermal wells was not only a financially sound path forward, but that over time it would be less costly than fossil alternatives. The analysis projected that Friends Center would realize an approximate 9% net savings over a 20-year period, taking into account reduced energy costs as well as the increased expense of drilling wells and installing the geothermal system. Since the time of that study, fossil fuel costs have increased significantly, and the net energy cost savings the Friends will achieve is anticipated to be even greater than the original conservative life cycle cost analysis had predicted.

Electrical strategies incorporated into the project included all of those discussed at the Design Charrette. A detailed Plug Load Analysis formed the basis of a Plug Load Policy. Sub-metering for plug loads was installed to measure actual usage. Occupancy and photo-sensors were installed to control artificial lighting, and task lighting was provided in order to reduce area lighting footcandle requirements. Photovoltaic panels were installed on the office penthouse to generate 10 kilowatts of electricity.

The Plug Load Analysis and Policy are the most ambitious of the above initiatives and have had the most significant impact on the way that building users think about conserving energy and reducing CO_2 emissions. Inefficient equipment was wasting energy and increasing the building cooling load. In addition, duplicate equipment (e.g., coffee makers, microwave ovens, printers, copiers, audio-visual equipment, refrigerators, etc.) throughout the office areas of the facility increased plug loads.

Interviews with the building users identified energy requirements associated with their work. This information formed the basis for the Plug Load Policy that limits electrical use to .75 watts/SF and 20 watts per occupant for aggregate plug loads. Locating energy-efficient equipment cen-

FIGURE 5. Well Manifold Piping and Heat Exchanger. (Paul S. Bartholomew Photography)

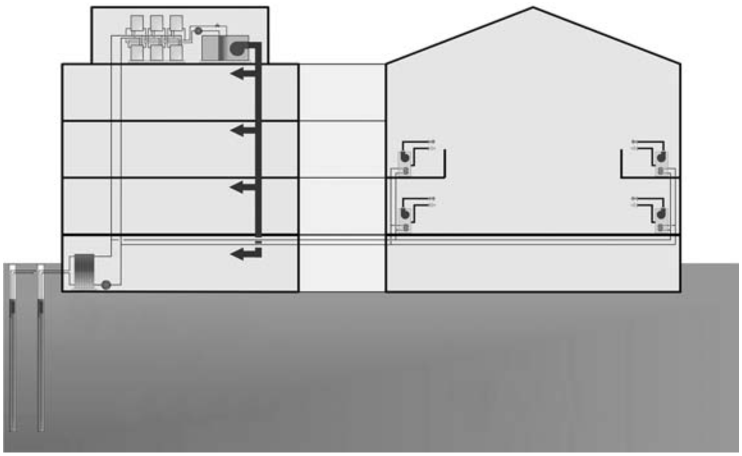


FIGURE 6. Diagram of Geothermal System. (AKF Engineers)

trally fosters sharing of resources and reduces energy consumption. These changes required the purchase of new equipment and a dramatic change in the attitudes, habits, and expectations of building occupants. The Plug Load Policy stipulates that tenants may use only ENERGY STAR®-rated equipment. Improvements to the building systems and the building envelope made space heaters unnecessary while daylight harvesting reduced the need for area lighting. Energy-efficient appliances replaced the existing kitchen equipment. As a result of the policy, there has been a significant plug load reduction as well as a dramatic change in tenant behavior in support of the Center's environmental stewardship. Fostering the necessary dialogue between Friends Center programs and offices to effect these changes has actually facilitated the mission of Friends Center.

Architectural Considerations

Both the condition of the existing building envelope and the interior design of the office building presented excellent opportunities for energy optimization and water management improvements. The uninsulated built-up asphalt roof system was failing and scheduled for replacement with a PVC membrane and insulation. A total R-value of 27 was projected for the new roofing system. Opaque wall surfaces were constructed of single-wythe uninsulated prefabricated brick panels with single-glazed punched openings. The thermal performance of this wall assembly was poor. Expanses of curtain wall on the west elevation were constructed of non-thermally broken members with 1" tinted insulated glazing extending to light wells at the lowest level of the building.

The partition design inside of the office building created a dense mazelike "rabbit warren" and resulted in a number of occupied spaces that did not receive daylight or fresh air. Friends Center occupants characterized the air quality as "poor." Little daylight was harvested from the curtain wall on the west elevation. For daylight to reach interior spaces the Friends Center's tenants had to agree to move from numerous closed offices and suites to an open office plan.

It is interesting that 1515 Cherry Street, a beautiful 1856 Quaker Meetinghouse, incorporated passive and active cooling strategies that were innovative in their day. A central stair functioned as a chimney that drew hot air from all floors by stack effect and exhausted it at roof level. Additionally, wooden ducts led from the men's and women's meeting rooms to what are believed to have been fireboxes located at the roof level. It is thought that hot air was drawn up the ducts from floors below, used for combustion and exhausted with the combustion gases—an early form of centralized air cooling.

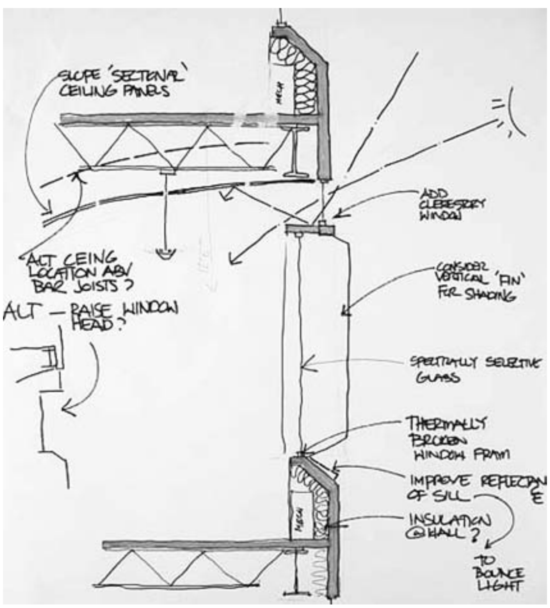
Sustainable Design Strategies

Green Design Charrette participants generated numerous ideas for changes to both the building interior and exterior. Improvements to the building envelope included installation of high-performance glazing to increase daylighting and reduce solar heat gain; building insulation to comply with and/or exceed the envelope requirements of ASHRAE 90.1, 2004; and the addition of a vegetated roof to protect the new roof membrane and extend its life.

A number of daylight harvesting strategies were discussed beyond installation of high-performance glazing with 50%–60% visible light transmittance. Section studies (Figure 7) demonstrated that the curtain wall expanses and north-south orientation of the building made it a good candidate for daylight harvesting. The Friends welcomed the idea of an open floor plate as equitable access to daylight was a concern coming into the charrette. Studies examined options for glare control and for bouncing light to interior spaces; light shelves were studied in building sections. Additional openings above windows in the prefabricated brick panels on the east elevation were considered, although this option proved to be structurally infeasible. Finally, it was suggested that trees be planted at the east elevation to control solar heat gain and glare.

Commenting on the building's interior, charrette participants expressed a desire to "tear down the silos" the workspaces had become and explore how shared resources might be accessed and used by building occupants. The idea of "hotel" workspaces was explored. Concerns were aired that an open floor plan might compromise privacy or expose occupants to irritations such as noise at the elevators, though these concerns later proved to be unfounded. A desire was expressed to improve air quality and to have better thermal control in all spaces.

FIGURE 7. Section Study from Design Charrette.



In addition to improvements to the building envelope and addition of light shelves, several architectural solutions were proposed. These included adding a communicating stair to facilitate resource sharing, reduce elevator traffic, and energy use; installing underfloor air distribution; and constructing private meeting rooms that could be shared by tenants. Ultimately, only the private meeting rooms were incorporated into the project. The communicating stair was not pursued due to requirements for structural modifications, cost, and code challenges. Underfloor air distribution, which would have significantly raised ceiling heights and facilitated daylight harvesting and thermal control, was not pursued due to structural limitations and the need for ramping throughout the building, particularly at existing stairs and elevators.

Finally, concern was expressed that a high level of design attention be devoted to the appearance and finish of shared or in-between spaces. The quality of these spaces was understood to be critical to the success of implementing an open office plan with shared resources (Figure 8).

Water Management Considerations

The project stakeholders entered the Green Design Charrette with a broadly expressed desire to conserve water and "tread lightly on the land." These goals were refined and expressed as "syncing with the water cycle" (i.e., precipitation → storage via groundwater recharge and runoff → return to the atmosphere via evaporation, evapotranspiration, and sublimation → condensation in the atmosphere → precipitation, etc.). Obstacles to this goal included the significant extent of impermeable groundcover on the Friends Center campus and the use of a combined sanitary sewer and storm drain system in the City of Philadelphia. While sanitary sewer and storm piping within the campus is piped separately, both systems discharge into a common municipal sewer. All stormwater and effluent within that line

FIGURE 8. View of Shared Meeting Room. (Paul S. Bartholomew Photography)

is processed at sewage treatment plants and discharged into the Schuylkill River. During heavy storms unprocessed sewage is sometimes discharged directly into the river.

"Syncing with the water cycle" would require strategies to reduce overall domestic water consumption and discharge, facilitate groundwater recharge, and divert as much water volume as possible from the City's combined sewer system. An incentive for the Friends was that water conservation measures are often highly visible because they can include cisterns, urban agriculture, constructed wetlands, and vegetated roofs. These types of opportunities to educate by example were consistent with the project objectives and the Friend's mission.

Sustainable Design Strategies

A number of significant sustainable water management strategies were discussed at the Green Design Charrette and later refined in partnership with the Philadelphia Water Department. The participants' aspiration to "sync with the water cycle" required a fundamental change in attitudes toward water management. Water generated by precipitation and even sanitary use was considered as a resource rather than a byproduct of human habitation that had to be removed from the site. For example, precipitation was discussed as a source of non-potable water to flush toilets, as irrigation for a vegetated roof, as irrigation for a rain garden used to recharge groundwater, as a model of urban agriculture and return water to the atmosphere via evapotranspiration, and as a source for a cistern that might function as a public amenity. Wastewater from toilets was discussed as an irrigation and nutrient source for a constructed wetland. Treated water generated by a constructed wetland and graywater from sinks and showers could be reused to flush toilets or even provide process water for mechanical systems. Finally, the water use of existing and new plumbing fixtures was discussed. Low-flow sinks and lavatories were considered as were waterless urinals and dual flush toilets.

A number of specific water management strategies emerged from the Design Charrette. First, a vegetated roof on top of the office building was proposed. This option offered opportunities to return water to the atmosphere, reduce run-off, and improve the quality of stormwater that might otherwise be discharged into the City's combined sewer. A vegetated roof offered the additional benefits of increasing the R-Value of the roof assembly, extending the life of the roof membrane, and affording a visible example of the Friends commitment to sustainability. Analysis following the charrette determined that the existing roof structure required little reinforcement to support growing medium and plant materials. The analysis also revealed that the existing deteriorated roof membrane needed to be replaced. The planned white thermoplastic replacement roof was suitable for use beneath vegetated roof plantings. This strategy was ultimately implemented.

To treat sanitary water on site, the design team proposed a constructed wetland. This option offered opportunities to reduce the volume of discharge into the City's combined sewer, reduce the amount of potable water purchased and supplied to the campus, return water to the atmosphere, afford a teaching opportunity, and provide an amenity in the form of a greenhouse. Although the design team completed preliminary design work, this strategy was not implemented for reasons of cost, concerns regarding ongoing maintenance, and logistics of permitting.

Rainwater harvesting at various scales was proposed as a means to provide non-potable water for toilet flushing, process requirements, to create a water garden with cisterns, and to recharge groundwater via infiltration from a cistern beneath the courtyard. Potential sources of harvested rainwater included the roofs of the office building and

FIGURE 9. View of Vegetated Roof. (Paul S. Bartholomew Photography)

Meetinghouse, and the vast expanse of impermeable ground cover on the campus. In the end, a vegetated roof was installed on the office building, reducing runoff by approximately 35% (Figure 9). Ideally suited for rain water harvesting, the pitched standing seam Meetinghouse roof is also utilized for rainwater collection. It proved financially infeasible to rework the campus drainage to divert rainwater collected at grade to a rain garden or exterior cisterns.

The rainwater storage and collection system (Figure 10) can collect an estimated 20,000 gallons of stormwater per month, which is stored in a series of six 660 gallon cisterns located in the basement of the Meetinghouse (Figure 11). Multiple tanks were required because it was not possible to fit a single cistern in the basement. Treated with ozone, the water circulates continuously between the tanks to prevent growth of biologicals. It should be noted that while this strategy saves potable water that would otherwise be obtained from municipal sources and diverts the same volume of stormwater from the City sewer, increased energy is required to operate the pumps that move the water. In addition, significant new rainwater collection and plumbing infrastructure had to be provided to supply fixtures using graywater. Diverters were added at the bottoms of rainwater conductors (Figure 12), and separate water supply piping was installed in the office building.

IMPACT OF SUSTAINABLE DESIGN ON PROJECT COST

As with most projects, managing costs was a key concern for the Friends. The potential of added expenses associated with new green technologies frequently raises further questions and concerns despite studies showing no difference in the average cost of a conventional building versus a green building of the same type, size, and quality. (See Davis Langdon's report "Cost of Green Revisited: Reexamining the Feasibility and Cost Impact of Sustainable Design in the Light of Increased Market Adoption," July 2007.) Cost implications had a tremendous impact on the Friends Center renovation throughout the

FIGURE 10. Diagram of Rainwater Storage + Collection System. (AKF Engineers)

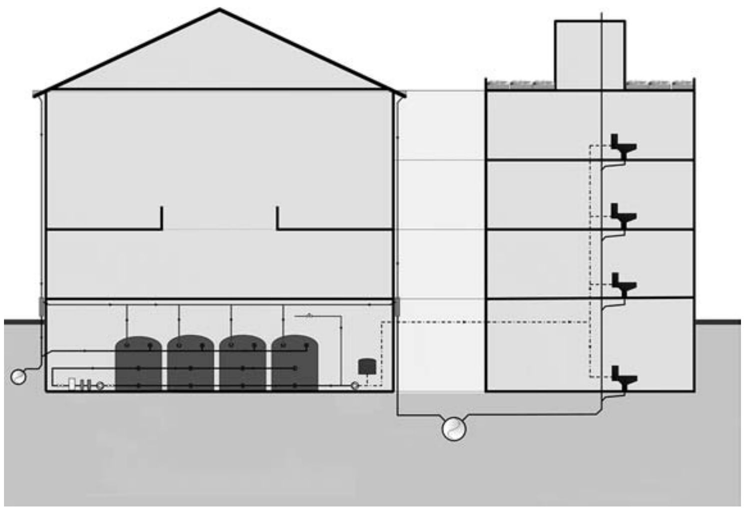


FIGURE 11. Cisterns in Meetinghouse Basement. (Paul S. Bartholomew Photography)

FIGURE 12. Diverter on Rainwater Conductor. (Paul S. Bartholomew Photography)

planning and design process. The scope of the project was limited from the outset to the Meetinghouse and office building, excluding the third building in the complex due to the extent of the work required and the restricted budget. (The historic building at 1520 Race Street will be renovated as funds permit.)

The initial Needs Assessment and development of the Master Plan established a projected budget for the renovations of $5.9 million, which was outlined in the Request for Proposals. This figure did not take into account an extensive green rehabilitation; rather it involved replacing the major mechanical systems and completing basic renovations in the greenest manner possible.

The next major milestone, the Green Design Charrette, added clarity to the project. The charrette educated the Friends as to how to minimize the environmental impact of their facilities and increase the overall efficiency of the campus by exploring viable strategies at tighter grain. The charrette also underscored the urgency of the environmental crisis. As a result, the majority of the stakeholders approved of moving forward with a sustainable design that went beyond merely replacing the existing equipment and systems. However, the fiscal leaders still had reservations with regard to the potential for added cost, which stalled the project for a considerable length of time.

Ultimately, the fiscal leaders were swayed by a more extensive Life Cycle Cost Analysis, comparing a renovation of the facilities using conventional building strategies to a renovation integrating the full extent of the green strategies, including the geothermal system, over a period of 20 years. The analysis indicated that by using conventional strategies, the cost of operating the buildings for 20 years would be $50.5 million. In contrast, the cost to borrow funds to install the energy efficient strategies and operate the facilities over 20 years would be $45 million, including debt service. By taking a long view of their investments, those in charge of the purse strings felt it was both fiscally and environmentally prudent to proceed with a sustainable, energy-efficient renovation, including the use of a geothermal exchange system.

As part of the planning process, the Friends launched a Capital Campaign. An initial analysis of the project's funding potential, prepared by a fundraising consultant prior to the green charrette, was not optimistic given the fact that at that point the project was a rather straightforward capital improvement. Interestingly, when the Friends met with the same consultant again after the charrette as the green vision was taking shape, his outlook was much more positive, suggesting that the Friends could raise at least $1.5 to $2 million. In the end, the sustainable aspect of the project had a significant impact on the fundraising effort. The "Turning Quaker grey to Quaker Green" campaign raised over $4 million. $1.3 million was donated for the geothermal wells alone.

INTEGRATED DESIGN PROCESS

The final LEED scoresheet for the Friends Center project reveals a project that is an exemplar of integrated design and, as significantly, of an integrated design process. Successful integrated design begins with careful consideration of the natural resources delivered to a project site, existing infrastructure and construction, users' expectations, and how a building project will be occupied, operated, and maintained. As sustainable design strategies are considered and ultimately incorporated, the much discussed "synergies" between different strategies become apparent. For example, if stakeholder buy-in is obtained for a maximum plug load of .75 watts/SF and 20 watts per occupant aggregate, improvements to the building envelope will be required to eliminate the need for space heaters, and daylight harvesting and associated floor plan changes will be needed to reduce reliance on area lighting. Careful energy modeling is necessary to demonstrate that daylight harvesting will reduce heat loads from artificial lighting and, in turn, cooling requirements. Increased thermal loads will impact the appropriateness of geothermal heating and cooling for the project. At Friends Center, ultimately it was the combination of an aggressive plug load policy, envelope improvements, and efficient lighting and daylight harvesting that made a geothermal system feasible in the face of limited financial resources and site area. Successful, sustainably designed projects must be thoughtfully engineered at all levels to make sure that measures required to achieve one goal do not render it difficult or impossible to achieve other goals.

A Green Design Charrette is critical to the success of sustainably designed projects in several respects. First, at the charrette, project specific planning, budgeting, programmatic, and technical background information is provided by all stakeholders and made available for participant use. The intent of this exercise is to insure that members of the project team are working with the same detailed knowledge of all aspects of the project. Second, the charrette provides an opportunity to bring a diversity of expertise to the table and to educate the team. This education concerns not only sustainable design strategies but also the particulars of operating, maintaining, and using the facility in which the project will be located. It is not unusual for a Facilities Manager or staff person to point out specific technical particulars or details of institutional history that significantly shape an integrated design. Third, informed by project background information and sustainability expertise, stakeholders can choose design strategies together that are appropriate for the project. As a team they may also establish green objectives for reference throughout the design and construction process to weigh and ensure adherence. As demonstrated by the Friends Center project, the combination of effective preparation for the charrette, stakeholder participation, and availability of expertise make it possible to refine the vision for the project, secure "buy-in" from all participants, establish specific objectives, and even "front end" design work.

CONCLUSION: TRANSFORMING EXPECTATIONS AND BEST PRACTICES

Through the work of numerous organizations, governments, and professionals, tremendous strides have been made in raising awareness of the impact of the built environment and in exploring alternative design and construction practices to tread more lightly on the Earth. Yet much work remains. The completed renovation of Friends Center and the achievement of LEED Platinum has afforded project stakeholders an opportunity to consider the significance of their effort and investment, and to examine the potential impact of their work on the individual, the larger public, and on public policy. At every level, it is apparent that the Friends Center renovation and other projects like it transform building users' baseline expectations regarding sustainability and establish new definitions of best design and construction practices. With each successful sustainably designed project, "building green" becomes less something special that a project team "does" and more a matter of accepted practice.

At the level of the individual, the most obvious impact of the Friends project has been a dramatic improvement in the quality of the indoor environment. Users are pleased with the transformation of their workplace (Figures 13 and 14) and note that the open office plan and shared resources have facilitated collaboration and positively affected the character of working relationships. Ninety percent of the work stations enjoy expansive views outdoors while daylight harvesting, improved ventilation and thermal comfort, and low-emitting construction materials also have made the workplace visibly healthier and happier. Other amenities such as safe bicycle storage and changing facilities increase the quality of the work environment and foster more sustainable behavior.

FIGURE 13. View of Office Building "Rabbit Warren" (BEFORE). (UJMN Architects + Designers)

Walking through the campus, there is now a tangible sense that the users are part of a larger mission. They radiate a clear sense of pride as well as a growing understanding of and commitment to sustainability. The project obviously required the support of the tenants to go forward. Through education and some convincing, the three Friends Center equity partners secured project buy-in and participation from all but one of the 22 tenant organizations. This achievement is especially significant because it required adoption and adherence to the Center's newly published Building Standards. The Standards make it clear that the integrated design of the building systems and materials must be preserved for the campus to comply with the Friends' sustainability objectives (and the associated cost savings). Accordingly, the Standards regulate a range of features of the interior environment including electrical equipment selections, plug loads, daylight harvesting concerns such as file cabinet heights and window

FIGURE 14. View of Open Office with Extensive Daylighting (AFTER). (Paul S. Bartholomew Photography)

treatments, room finishes, and recycling practices. The equity partners champion adherence to the Standards and have found that despite a history of working together for over 30 years, the exercise has increased collaboration. Going forward, it will be the Friends' standard to adhere to the principles of sustainable design when making improvements to their other properties.

Let us also not forget the Quakers themselves who worship in the Meetinghouse and occupy auxiliary spaces for a variety of uses. Participating in the planning charrette, the decision-making process, and the campaign to turn Quaker Gray to Green strengthened their resolve to live by example, peacefully and equitably with regard to the right sharing of resources.

Completed in the fall 2009, the Friends Center project already has exerted influence at the level of the general public—neighboring business and residents, visitors and the larger community of downtown Philadelphia. Occupants of surrounding buildings comment on the tranquility and beauty of the vegetated roof at 1501 Cherry Street and the quiet of the campus. The low-lying roof serves as a visual oasis and model of water management for high-rise neighbors (Figure 15).

Recognizing the importance of sharing their experience with the broader public, the Friends commissioned three outdoor interpretive panels that describe the project's environmental objectives and the strategies employed. The panels are situated in the front courtyard to reach even the casual passerby. A street-level video display and signage throughout the Center elaborates further on the project's sustainable features. Even low-flow urinals and dual-flush toilets are labeled with signage explaining their purpose.

In keeping with a tradition of forward-thinking social awareness, Friends Center now hosts programs and lectures geared toward sustainability by numerous organizations including the U.S. Green Building Council, Delaware Valley Green Building Council, and the Philadelphia Chapter of the American Institute of Architects. Friends Center is now recognized as an exemplar of sustainable design principles, and this past fall its steps served as the podium for an announcement by Governor Edward Rendell regarding Pennsylvania's Climate Change Action Plan.

FIGURE 15. Aerial View of Friends Center. (UJMN Architects + Designers)

At the level of public policy, projects such as the Friends Center renovation raise expectations regarding construction practices and building performance. These higher expectations are reflected in changes to building codes and other regulatory requirements governing the built environment. One example of this is found in the adoption, and perhaps more significantly the enforcement, of the International Energy Code. Prescriptive requirements now apply to the thermal performance of building envelopes, and plans are reviewed for compliance by authorities having jurisdiction.

Stormwater management regulations are also being revised to more closely align with sustainable water management practices. In an effort to address the problem of its combined sewer system, the City of Philadelphia adopted strict stormwater management requirements on January 1, 2006. The regulations stipulate that, at a minimum, water from a one-year storm event falling on new impervious construction may not be discharged from a building site. One inch of water at all impervious cover must be infiltrated. In urban areas where the majority of groundcover is impervious, the most practical strategy for meeting these requirements is the installation of some area of vegetated roof on new construction and subsurface detention. Friends Center chose to scrutinize its stormwater management practices and successfully demonstrated its ability to reach a stricter level of treatment. For new construction, such close scrutiny is now a requirement.

As all members of the project team step back from the completed work at Friends Center it is apparent that the benefits of sustainable design are not only ecological and social. They are practical as well. At bottom, sustainable design is careful and efficient use of water and energy as naturally occurring resources on a site. It is an informed response to the environment rather than a costly resistance that ultimately exhausts resources. As society and the construction industry are influenced by sustainable design practices, the cost of the technologies to achieve these efficiencies will come down even as the cost of naturally occurring resources increases. And as time passes it will only become clearer that sustainable design is the best practice.

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Robert Diemer, PE, LEED® AP, is a founding partner of In Posse, a subsidiary of AKF Engineers, LLP. Mr. Diemer was an influential member of the design team, lending particular expertise to the feasibility and design of the geothermal system.