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## INDUSTRY CORNER



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# THE WISTER EDUCATION CENTER AND GREENHOUSE

## Uniting Program and Process, History and Mission, Architecture, and Sustainability on the Swarthmore College Campus

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### INTRODUCTION

*Swarthmore College honors its Quaker principles by educating students to be responsible world citizens and through good stewardship of its land and building resources. Today this tradition of citizenship and stewardship is reflected in the College's purchasing of sustainable power and construction choices. The new 5,200 square foot Wister Education Center and Greenhouse for The Scott Arboretum of Swarthmore College is the most recent and far-reaching green building on campus and serves as a model for integrating sustainable design with the function, mission, and architecture of the institution.*

### KEYWORDS

green architecture, bris-soleil, greenhouse, American Arts & Crafts, sustainable technology, organic growth

### INSTITUTION

Located eleven miles southwest of Philadelphia, Swarthmore College's bucolic, 399-acre campus is a designated arboretum, complete with rolling lawns, creek, wooded hills, and hiking trails. As the college has grown over the years, buildings were thoughtfully positioned to form quads or to frame views. The landscape has been designed to draw the parts together into a coherent whole with formal and informal paths and settings.

On this Quaker campus, founded in 1869 on a tract of former farmland, history and institutional values have been maintained and expressed through architecture in various periods of its development. In the beginning, simple, well-made buildings reflected the values of the founders to inspire, humble, and instruct the students. In the 1920s, Gothic architecture promoted the principles of faith, modesty, and a life of purpose through learning. In the 1940s, the modern campus emerged, formed on the ideals of equality, accessibility to all, and the ability of good, clean design to guide modern man to a better way of life. In materials and the subtle use of architectural

language, even the modern architecture on Swarthmore's campus blended with the horticultural context. Each of these distinct building periods showed a reserved and respectful use of local materials and a commitment to permanence. In its day, this was responsible design. Today, the College has greater expectations: construction projects on campus must be actively sustainable and energy efficient.

These eclectic yet complementary buildings are linked by the College's idyllic landscape, which is purposeful, well-planned and composed, and beautifully maintained. This is the setting that had to be respected and reflected in the College's new Education Center and Greenhouse (Figure 1).

### BUILDING TYPE

What is the greenhouse as a building type? How did it become what we recognize today as a greenhouse? Northern Europeans, wanting to have their citrus in the winter, adapted it from the house form with more and larger windows. As greenhouse architecture developed, architects integrated classic architectural forms and language with the needs of

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**FIGURE 1.** The new Wister Education Center of Scott Arboretum at Swarthmore College in Swarthmore, Pennsylvania is expected to earn LEED Silver or above. *Photo Credit: Jessica Fogle of Archer & Buchanan Architecture, Ltd.*



a glass house. By the 1850s, when industrialization was taking hold, we see more of what we think of as today's greenhouses. In Joseph Paxton's Crystal Palace we see the repetition of units, which was the advantage of industrial manufacturing (Figure 2).

Over time the technology so improved that we had the ideal greenhouse—spectacular buildings of glass with repeated modules that go on forever. Soon, architects wanted to combine the efficiency of engineering with the proper language of architecture. Figure 3 shows an excellent example, the Biltmore Estate greenhouse in North Carolina designed by Richard Morris Hunt. That tradition grew and became more formalized. Some of the nicest examples of this tradition are near Swarthmore, in the Morris Arboretum's Fern House and Kennett Square's Longwood Gardens.

With this rich history in mind we began to design the new Education Center and Greenhouse. We started with the institutional values of Swarthmore College, the functional needs of the Scott Arboretum, and the clues and opportunities offered by the site.

## RELATIONSHIP OF BUILDING TO LANDSCAPE

It is hard to imagine a landscape that is simpler in appearance and beauty yet more complex in its rich variety of interrelated settings than this location. We developed multiple site plans (Figure 4). Each drawing studies the relationship between the

**FIGURE 2.** In Sir Joseph Paxton's Crystal Palace (1851) the repetition module of glass and structure provides scale, character, and style. *Photo/Publication Credit: The Glasshouse by John Dixon, Phaidon Press Ltd., London/New York 1996, Pg. 5.*



building and the location, as well as how program components within the building relate to each other and the site. These studies were being done while we were developing the building space program.



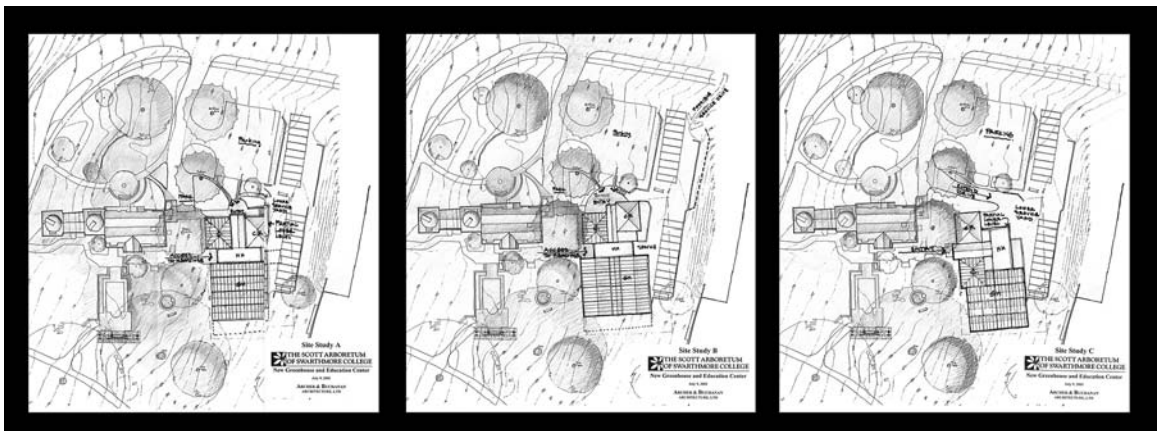
**FIGURE 3.** Greenhouses adopted the architectural vernacular; for example, the Biltmore Estate (1895) in Asheville, North Carolina, Richard Morris Hunt, architect. *Photo/Publication Credit: Crystal Palaces Garden Conservatories of the United States by Anne S. Cunningham, Princeton Architectural Press, New York, 2000, Pg. 42. Photo of Biltmore Estate, Asheville, NC.*

We examined the position of the greenhouse and the over-wintering room, the work room, classroom, public entrance, service entrance, and so forth. To access the most sun, the greenhouse always stayed to the south, naturally. At the same time we looked at how to put more than 5,000 square feet of space onto this tight site.

What clues would the particulars of this site present? One was the variety and beauty of the

landscape vignettes that surround the adjacent structures. This suggested that the building might be viewed as small landscaped moments rather than as a whole building. This helped us to understand what should be the appropriate scale of the building to the site. Then we observed the small details on nearby buildings that suggested how building detail could contribute to the scale and context of each vignette.

**FIGURE 4.** Multiple site plans for the Wister Center were developed. Each drawing studies the relationship between the building and the site, as well as how program components within the building relate to each other and the outside environment. *Photo Credit: Archer & Buchanan Architecture, Ltd.*





## INSPIRATION

An excellent example of how small, creatively composed, landscape vignettes can affect perception is Fairsted in Brookline, Massachusetts (Figure 5). This is the home of Fredric Law Olmstead, the father of American landscape architecture. Artfully, the scale and character of each landscape setting changes as one walks around the house and grounds. Some settings are secluded, intimate, and private; others are open with broad views; some are paths, places for movement; while others are for pause and reflection. Some settings relate to the neighborhood

**FIGURE 5.** Fairsted (1883) in Brookline, Massachusetts, the home of Fredric Law Olmstead, is an excellent example of how small, creatively composed, landscape vignettes can affect perception. *Photo/Publication Credit: Fredrick Law Olmsted Designing the American Landscape by Charles E. Beveridge and Paul Rocheleau, University Press, New York, 1998, Pg. 123. Photo Credit: 1998 Paul Rocheleau.*



street and some to the house. This all occurred in a very small area, a residential lot in suburban Boston. A number of sites on Swarthmore's campus are similar, in that the building and the landscape are unique from different perspectives.

In conversations with the leadership of the Arboretum, we learned that they had a definite aesthetic leaning; they had a refined eye for the American Arts & Crafts period. Also, the scale, materials, and texture that are characteristic of that style work well with the landscape strategy mentioned earlier.

Exploring the building aesthetic with the client and showing examples of early and contemporary Arts and Crafts work, we identified the design strategies that were appropriate to this project. These included:

- Sheltering roofs
- Recognizable entrances
- Trellises and exposed framing that form transitions between inside and outside
- Spaces that are both indoor and outdoor
- Material scale, texture and composition

With regard to the interior of the building, again the style seemed to accommodate what we wanted to achieve. The client was drawn to these Arts and Crafts elements:

- Long views through multiple spaces to give the feel of greater building size
- One space opening to the next to allow expanded use
- Spaces that were detailed to feel intimate for small group use yet big enough for large group functions
- The ability to frame views from inside to out

Interestingly these design features address many of the sustainable strategies promoted by the USGBC LEED® program. The requirements for natural daylight to offset the need for artificial lighting, for windows to provide views to the outside for building occupants, and trellises and the like to provide sun shading are aspects of traditional design and construction that are re-emerging today for their sustainable design benefits.

Today's standard greenhouse components do not easily fit into a particular architectural style, at least



**FIGURE 6.** The simple gabled roof form and the standard two-foot glass module provided a modestly scaled greenhouse component. An additional bay or module can be easily added to expand the greenhouse without disruption to the established building scale. *Photo Credit: Jessica Fogle of Archer & Buchanan Architecture, Ltd.*

not without prohibitively expensive customization. Our strategy was to take the simple gabled roof form and make it a repeating element. This along with the standard two-foot glass module provided a modestly scaled greenhouse component. A component or module can be easily added in order to expand the greenhouse without disruption to the established building scale (Figure 6).

Along with the aesthetic considerations we, the design team, very closely studied and tested the Arboretum's programmatic requirements. Accommodations had to be made for more than 100 volunteers and approximately 35,000 visitors annually. We simultaneously studied floor plan arrangements and their effect on massing and scale. It was through this process that we determined that the building program could not fit on the site in a single floor building. Here is where the topography of the site provided a solution.

The sloped aspect of the site allowed us to design a more compact building footprint and appropriately segregate building activities. The public programs and greenhouse horticultural activities were designed to occur on the first floor. The service, storage, and grounds activities were designed to occur at the lower level. This included separate vehicular access, trucks, skids, equipment, bulk material storage deliveries all occurring without conflict to public parking and building access at the first floor.

## GREEN AESTHETIC

Along with the big picture we tested the details. We studied individual rooms like the work room or "head house" (Figure 7). We listed each item, including furniture, counter, sink, storage cabinet, work table, soil bench, and so forth, and tested a variety of arrangements until we found the one that provided optimal advantage for how Arboretum staff planned to operate the greenhouse.

While the building was evolving, the consultant team worked with College facilities personnel, Arboretum staff, and the architect to define utility

**FIGURE 7.** The Greenhouse work room with natural lighting and movable work tables. *Photo Credit: Jessica Fogle of Archer & Buchanan Architecture, Ltd.*



and system requirements and sustainable design opportunities. While it may be true that “form follows function,” in the case of green design this is not always desirable. Sustainable technology and innovation has a way of taking over—of supplanting location, culture, and history.

In fact, the original Wister Greenhouse reflected this. It was a 1970s aesthetic of what green design should look like—cutting edge for its time. It had a steep-sloped south roof, small and relatively useless north clerestory windows above the workroom, and large, intrusive hydro tubes inside that were intended to capture solar heat by day and provide warmth by night. The technology led the design, making it more functional than well-formed.

We took a more subtle approach. We wanted a very green building without it necessarily looking green. We wanted a holistic method that allowed quantifiable measurement of energy savings, material conservation, recycling, and responsible waste tracking. It was agreed that LEED (as promulgated by the U. S. Green Building Council [USGBC]) provided the guidelines and tracking system that we wanted. Swarthmore is well-versed in the program and, for example, maintains approximately 14,300 square feet of green roof on campus, with plans for more.

In the case of the Wister Center, the project is certified under the criteria for LEED for New Construction, version 2.2. This point-based system has a maximum allotment of 56 points, although there is now a newer version based on a 100-point system. To attain LEED certification a project must meet some basic prerequisite points plus a minimum of 26 points. If the project gets a minimum of 33 points, it will be certified LEED Silver; 39 points—LEED Gold; and 52 points—LEED Platinum. As of this writing, the Wister Center is between 37 and 40 points; it will achieve LEED Silver and possibly Gold.

## MAKING THE GRADE

The LEED process is guided by a checklist that represents a holistic approach to planning, design, and construction. It addresses pre-design decisions such as site selection, design decisions such as material and system selections and engineering, construc-

tion issues like tracking and recycling construction waste, and post-construction evaluation such as building system commissioning. It tracks, assesses, and quantifies the entire process. LEED for New Construction addresses six areas of sustainable design focus:

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Innovation and Design

The design team first looked for the “low hanging fruit,” those “green” design features that are easy and cost effective to implement. Many of them are quickly becoming best design standards and include energy efficient light sources, motion detection light switches, and low flow plumbing fixtures. In consultation with College and Arboretum representatives, we worked through the cost to benefit relationship of more sophisticated sustainable design approaches such as rain water harvesting, ground coupled heat pumps, and a green roof. We carefully balanced energy efficiency, first costs, and long-term payback.

To provide examples of the variety of point categories that are included in these six categories, I will use specific sustainable design features found in the Wister Center.

The **Sustainable Sites** category guides the design team in making sustainable choices and decisions related to the building site. The Wister site takes advantage of:

- Existing infrastructure, including municipal water and sewer, and public utility gas and electric service.
- Proximity to public transportation. Also, bicycles and fuel-efficient cars are encouraged through the availability of bike racks, a shower changing area for bike riders, and designated parking spaces for fuel efficient cars.
- The site is not virgin land, but reused land having had a building previously on the site.
- The contractor maintained storm water management controls throughout the construction phase, that is, by keeping storm



water run-off on the site, and keeping silt run-off from entering the sewer system.

The **Water Efficiency** category rewards the design with points when water use is minimized and water conservation maximized. At the Wister Center we achieved a number of points in this category by integrating the following:

- A green roof on the flat roof portion of the building and an underground cistern to the south of the greenhouse to collect rain water. As rain falls, it passes through the green roof soil medium, and the gutter and downspout system conduct it into an underground rainwater cistern. The “grey” water from this 7000-gallon cistern will be used to irrigate the neighboring Terry Shane Teaching Garden. When the cistern is full, excess rainwater is conducted into an existing bioswale that effectively slows the rate of runoff and allows the rainwater to percolate back into the groundwater system. (Figure 8). Pictured here is the installation of the cistern. There is a lot below ground that one does not see or perceive is there that supports sustainable aspects of the design.
- The green roof above the workroom and rain gardens at the building’s north entrance are

**FIGURE 8.** The 7,000 gallon rainwater harvesting tank being lowered in place. There is a lot below ground that one does not see or perceive is there. *Photo Credit: Michael Bonacci, W.S. Cumby, Inc.*



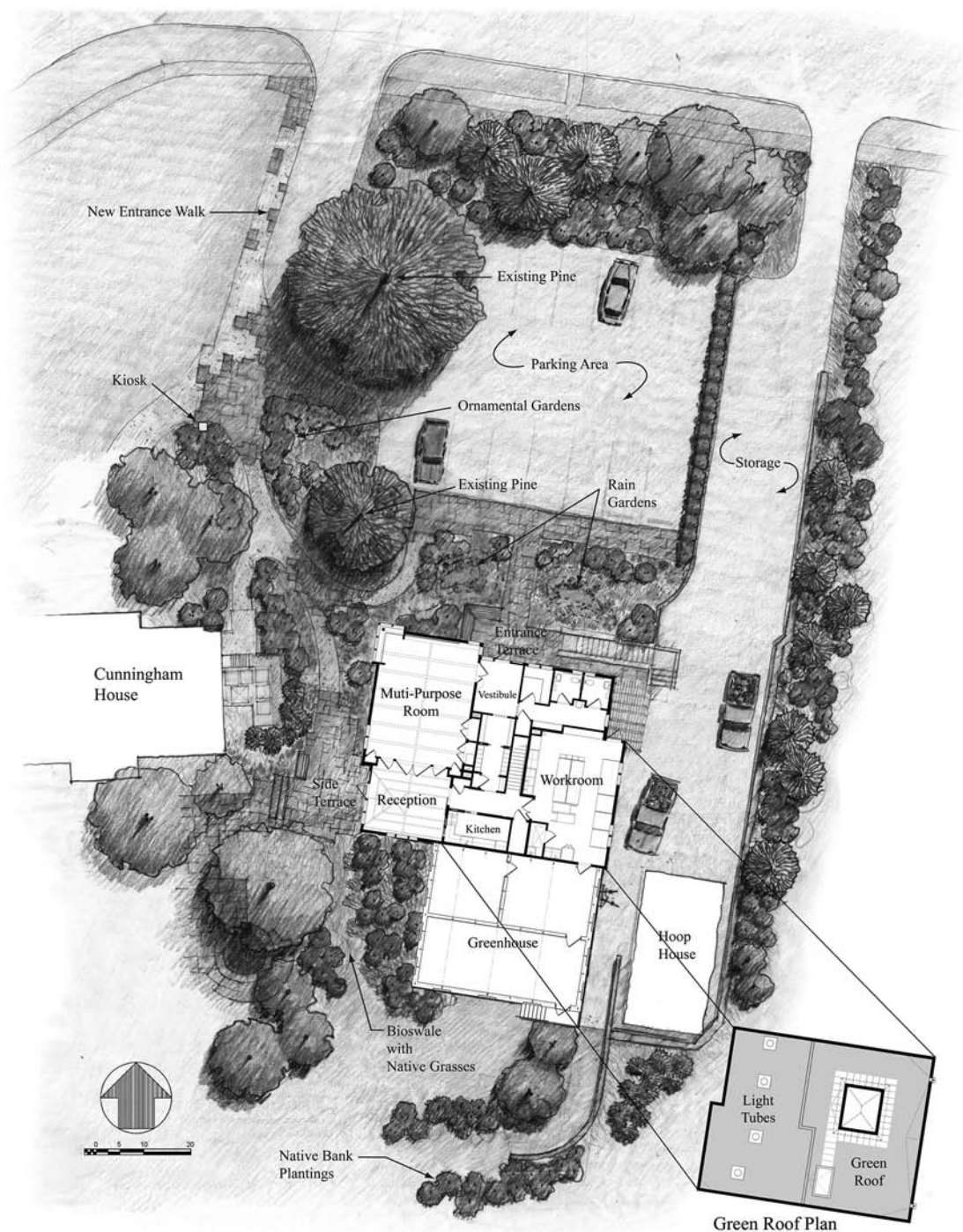
planted with drought resistant native plants that have the ability to “scrub” or filter impurities from the water before sending it to the cistern or recharging it back into the ground (Figure 9). This figure shows a drawing prepared by the landscape architect showing the planting design, parking, paths, and green roof.

- The light-colored gravel pad area to the east of the building reflects the sun’s heat rather than absorbing it like asphalt. This reduces the “heat island effect” common to paved and urban areas. There are plantings providing shade that contribute to this as well.
- Low-flow plumbing fixtures contribute to reduce water use in the building.

The **Energy and Atmosphere** category provides point incentives for maximizing building system efficiency and minimizing energy use. The engineering consultants in cooperation with the College’s facilities group were extremely innovative.

- The systems designed for the building reduce energy use by 21% below minimum code requirements (Figure 10).
- The building takes advantage of green power purchased by the College through public utilities.
- The design team originally considered a ground coupled water source heat pump system for the building. A cost analysis for drilling deep wells and running pipe proved prohibitive for such a small building. It was the College’s facilities chief who suggested using the central chilled water loop as the heat exchange source instead of the ground. The College operates the chilled water loop year-round. The water source heat pump system uses the campus central chilled water loop as a heat exchange medium. There are pipes that run from the Wister Center to McCabe Library. In the basement of the library there is a heat exchanger connecting the Wister mechanical system and campus chilled water system. Depending on the season, the Wister system is either drawing heat from the chilled water loop or transferring heat into it. This exchange of heat allows the Wister heating and cooling system to operate more efficiently, as it

**FIGURE 9.** This drawing shows the planting design, rain gardens, parking, paths and green roof. *Drawing Credit: Jonathan Alderson Landscape Architects, Inc.*



**FIGURE 10.** The use of high efficiency systems and creative heat exchange arrangements reduces energy use by 21% below minimum code requirements. *Photo Credit: Steve Bolinger of Archer & Buchanan Architecture, Ltd.*



does for all of the campus buildings connected to the water loop (Figure 11).

The **Materials and Resources** category encourages the prudent use of building materials and natural resources. In this category the Wister Center took advantage of several strategies.

- A number of dawn redwood trees (*metasequoia glyptostroboides*) were cut down when the College was building new residence halls. The Arboretum harvested the trees and had them cut and fabricated into shingle siding by a local mill. The shingles were stored on campus for a few years in anticipation of being used on this building. They make up about 40% of the building siding (Figure 12). Other wood products used on the building are either Forest Stewardship Council certified product or product that is non-threatened wood species or from sustainably harvested forests.
- There are a variety of specified products that contain recycled content, such as concrete with fly ash.
- During the construction, the contractor monitored waste and directed 75% of that construction waste to be recycled rather than directed to a landfill.

The **Indoor Environmental Quality** category awards points for strategies that enhance the environmental quality of the space. Points in this category really promote environments that support the health and well-being of building occupants. The Wister Center fared well in this category by:

- Specifying paints, caulks, insulations, adhesives, etc., that emit minimum volatile organic compounds (VOC).
- All occupied spaces provide direct views to the exterior and maximize the use of natural daylight. Interior spaces that do not have the benefit of windows have light tubes that bring daylight from outside through the roof and fill these spaces with natural light. Typically during the day this building functions quite well without the use of artificial light.
- Prior to the occupancy of the building the contractor performed air testing to verify that there were no pollutants in building systems, and that the air quality met established minimum standards.
- The College has instituted a “green” cleaning policy, meaning cleaning agents and products used by housekeeping staff in this building are not toxic and do not contribute to pollution when disposed of.

The sixth category, **Innovation and Design**, offers the project team the opportunity to explore other creative ways to promote sustainable design. Some points obtained in this category include:

- Education courses for construction workers and subcontractors (called the Green Advantage training program).
- The creation of educational pamphlets, tours, and descriptive materials regarding the building and the LEED process.

There are more than twenty sustainable design features in the Wister Center (Figure 13). Several additional features include the following:

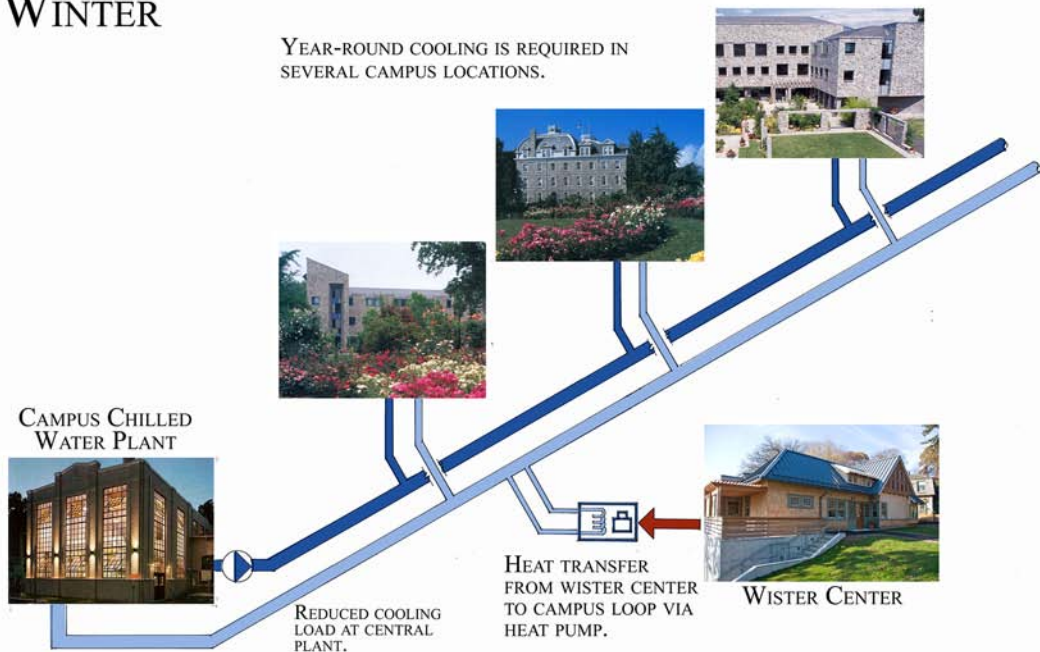
- Energy efficient light fixtures and lighting control system
- Motion detector light switches in selected spaces
- Recycling centers within the building



**FIGURE 11.** The water source heat pump system uses the campus central chilled water loop and a heat exchange source. Drawing Credit: Archer & Buchanan Architecture, Ltd. & Bruce E. Brooks and Associates.

## WINTER

YEAR-ROUND COOLING IS REQUIRED IN SEVERAL CAMPUS LOCATIONS.



## SUMMER

CAMPUS BUILDINGS SERVED BY THE CHILLED WATER LOOP. FULL COOLING REQUIRED.





**FIGURE 12.** Metasequoias, or Dawn Redwood trees, were cut down when the College was building new residence halls. The Arboretum harvested the trees and had them cut and fabricated into shingle siding by a local wood mill. *Photo Credit: Jessica Fogle of Archer & Buchanan Architecture, Ltd.*



- Exterior daylight sensors that control exterior lighting
- Rooftop light monitor for maximizing daylight

## ORGANIC GROWTH

In the end, the success of any work of architecture depends on how many issues, some in direct conflict with others, are reconciled and brought together to form a cohesive whole—a design that satisfies the owner's expectations, achieves the architect's vision, and respects the context of the campus. This entails an understanding of the values of the institution, the history of the building type, the character of the campus, the architectural precedents, the complex-

ity of the program, the technics of construction, and the rigors of sustainable design. These are quite a few conditions to be placed on one small building.

We tried to keep it simple, allowing a modest material palette to provide texture, scale, and form. The walls are Douglas fir panels. Douglas fir has a straight and even grain yet modulation of color and warmth. It is a wood that tends to be used where the structure and natural finishes are exposed to view (Figure 14). These materials, details, and scale are very much related to the context of the site, and this contiguity is apparent whether viewed by day or at night.

**FIGURE 13.** Interior of the Wister Education Center. *Photo Credit: Jessica Fogle of Archer & Buchanan Architecture, Ltd.*



**FIGURE 14.** The walls are Douglas fir panels. Douglas fir has a straight and even grain with a modulation of color and warmth. *Photo Credit: Jessica Fogle of Archer & Buchanan Architecture, Ltd.*



The Wister Center is detailed to give it a feeling of being hand-crafted, nurtured into being like a garden. As the landscape plan is implemented and the vegetation matures, pieces of the building will become part of the smaller landscape vignettes that give the site its character. Raw materials like the concrete foundation walls of the greenhouse were given color and depth with simple details like the arched niches. Natural lighting and the flexibility of movable work tables, potting benches, and soil mixing bins make the space very user friendly.

The interior and exterior of the building share common details. The vibrant color of the site was picked up in paint and tile colors. The fly ash concrete floor was stained, then ground again and polished to give it a deep, earthy, almost leathery appearance. The depth of the finish was controlled by how many coats of stain were applied. It will wear well over time but it really is simply an environmentally-safe concrete floor.

The introduction of color, decorative light fixtures, and furniture selection were not afterthoughts or left to chance. Color palettes were carefully selected and coordinated among paint colors, floor finish colors (whether concrete, ceramic tile, or vinyl tile), wood species, and other building accessories. The color scheme works with the fabrics on the furniture and the whole is intended to recall the colors of changing seasons and natural elements like water and flowers (Figure 15). The building provides a setting that displays art and flower arrangements well.

Even in the more technology-rich spaces like the classroom, the man-made is underplayed and the natural world is emphasized. Elements from the exterior are recalled on the interior, such as the wood slatted bris-soleil in the gable. The inspiration for that detail is the traditional greenhouse slat house. Wood slats let light in while protecting plants from the sun. At night the building glows from within (Figure 16) providing, in modern terms, a reverse slat house effect.

The design of the building includes dedicated sorting and recycling areas for trash, plastics, glass, metal, and paper. As with most buildings on Swarthmore's campus, these areas are planned to be integral to the building from the onset to ensure continued management of recyclable materials. Similarly, the cleaning and maintenance of the building

**FIGURE 15.** The color scheme works with the fabrics on the furniture and the whole is intended to recall the colors of changing seasons. *Photo Credit: Jessica Fogle of Archer & Buchanan Architecture, Ltd.*



will include the use of “green” detergents and cleaning agents.

Lastly, the Wister Center will be largely powered by renewable energy: a large portion of the electricity consumed by the College is “green” power generated by renewable energy facilities. These are all College-wide programs that ensure this facility will encourage ongoing conservation of natural resources.

## CONCLUSIONS

It was important to the design team, the Arboretum, and the College that the new Wister Center be a building that continued the respectful traditions and strong values of the organization and the institution. It had to be a Swarthmore College building in service to the needs of the Arboretum.



**FIGURE 16.** At night the building glows from within. Photo Credit: Steve Bolinger of Archer & Buchanan Architecture, Ltd.

Being green was important, looking green was not. The LEED checklist provided a very good means to tracking and weighing green choices. We were able to attach first-time and life-cycle costs to various sustainable design options, compare the beneficial use of products with high recycled content vs. the practicality of reduced quantities of other finish materials. We studied how doing things the old fashioned way might produce the same results as engineered systems with movable parts. Building

budgets, green initiatives, and architectural design were brought into balance. Sustainable design features were integrated into the architecture rather than the reverse. This was a process that allowed the driving force behind the intangibles—history, traditions, values, mission, and context—to dictate the desired outcome, and the outcome to be achieved by using the tools—architecture, engineering, landscape, and horticulture—to create a program of sustainability and holistic beauty.

*Wister Education Center and Greenhouse has been selected as a Green Building of America Award-winning project and will be featured in the upcoming Real Estate & Construction Review—Northeast Green Success Stories edition. Planned for late 2010, the Green Success Stories edition will include interviews with owner, architect, and contractor to explain how the team worked together to design and build one of the region's most innovative sustainable facilities.*

**Client:** Claire Sawyer, Director of the Scott Arboretum

**College Representative:** Janet Semler, Director of Planning and Construction

**Architect:** Archer & Buchanan Architecture Ltd., West Chester, PA

**Structural Engineer:** George Weaver, PE, West Chester, PA

**M/E/P/FP Engineer:** Bruce E. Brooks & Associates, Philadelphia, PA

**Civil Engineer:** Gilmore & Associates, New Britain, PA

**Landscape Architect:** Jonathan Alderson Landscape Architects, Inc., Wayne, PA

**Greenhouse Fabricator and Design Consultant:** Rough Brothers, Cincinnati, OH

**General Contractor:** W.S. Cumby, Inc., Springfield, PA

**Construction Cost Estimator:** Becker & Frondorf, Philadelphia, PA

**Specifications:** Conspectus, Tuckahoe, NJ