Office of the
Federal Environmental Executive

Fall - Winter 2002
Issue 28

Closing the Circle News

Sustainable Federal Buildings

We've chosen sustainable, or green, buildings as the theme of this Closing the Circle News. *Sustainable building is now one of the OFEE's priorities because buildings – in their design, construction, use, and removal – are such an important part of, and can have significant impacts on, our indoor activities, our energy use, our communities, and our environment.*

Sustainable design is a growing movement in the U.S. and across the world, in both the private and public sectors. The Federal government has many leaders in the field already, although our success has been made with little fanfare. Through this and other forums, we hope to bring some more recognition to those efforts and encourage even greater progress. For example:

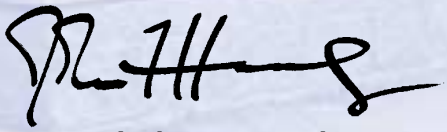
- Over 116 Federal buildings have achieved an ENERGY STAR® label.
- Executive Order 13123 requires agencies to "[apply] sustainable design principles... to the siting, design, and construction of new facilities."
- GSA's facility standards direct all GSA buildings to be certified through LEED, and encourages certification to the Silver level. The Navy and the Army Corps of Engineers have similar standards.
- More than 50 Federal buildings are undergoing the LEED certification process, and four already have been fully certified.
- Ten Federal facilities are participating in a U.S. Green Building Council pilot to establish LEED criteria for existing building operations and system improvements (three are in the Washington, D.C. area).
- The Federal Inter-agency Sustainability Working Group is sharing Federal successes, compiling sustainable design tools and policies, and developing the business case for sustainable buildings.
- The White House has just installed a nine kilowatt solar electric system at one of its maintenance facilities, along with two solar thermal systems to provide hot water and heat the pool and spa.

The work to date is showing that sustainable design can be operationally and economically viable. Those who have incorporated sustainable design principles and practices into new and existing buildings are seeing improvements – in working conditions and worker productivity, energy efficiency, impacts to the environment and/or costs – and we know we can make even greater progress. Incorporating sustainability principles into buildings is providing people with a better understanding of the vast potential for integrating environmental solutions into other important decision making efforts.

In this issue, we highlight seven outstanding Federal buildings and provide some background information on sustainable building efforts. Our goal is to help build on these successes – and for this, we need your help. For example, we'd like to see building owners and operators develop environmental management systems (EMS) as they design their buildings. We're interested in ensuring that green building is regarded as a key component of "whole building design" (a concept discussed in this issue). And we'd like to see even more collaboration between the private and public sectors on building issues.

We look forward to hearing your thoughts on these important issues, your success stories and lessons learned, your views on how best to accelerate our progress, tools you'd like to see the Federal government provide, information you might need, and any questions you may have.

Please call us at (202) 564-1297, e-mail us at task_force@ofee.gov, and/or join our list serve by going to www.ofee.gov. ■



Federal Environmental Executive

Inside

Unlocking LEED

In 1993, an extraordinary coalition of diverse parties – businesses, governments, building professionals, environmentalists, and others – came together to form the U.S. Green Building Council (USGBC), which today includes more than 2,000 member organizations. To date, the primary focus of USGBC has been the formation of a green building rating system called LEED – Leadership in Energy and Environmental Design. LEED is a sophisticated checklist that allocates points based on a building's performance in five areas: energy and atmosphere, water efficiency, materials and resources, indoor environmental quality and sustainable sites. A sixth category, innovation and design process, offers points for creative approaches to building sustainability. The number of points earned determines a building's LEED rating – Certified, Silver, Gold or Platinum.

The first, most developed and best known LEED rating system to date has been LEED for commercial buildings (new construction and major renovation projects), which is currently in version 2.1. USGBC committees are currently developing or piloting LEED systems for existing buildings, commercial interiors and residential buildings, and looking at other applications for the future. Visit the U.S. Green Building Council's web site, www.usgbc.org, for more information. ■

Federal LEED Certified Buildings

Dozens of Federal buildings have been registered for the LEED program, but so far only five have completed the certification process. While the first four buildings below have received LEED Certified ratings, the Argonne Central Supply Facility was the first Federal building to receive a LEED Silver rating.

Great Lakes Training Center Bachelor Enlisted Quarters
Great Lakes, IL
Contact: Mike Chapman, 202-685-9175, mchapman@navfac.navy.mil

Social Security Administration Annex Renovation
Woodlawn, MD
Contact: John Morrell, 215-446-4614, john.morrell@gsa.gov

U.S. Courthouse and Federal Building
Youngstown, OH
Contact: Pam Wilczynski, 312-353-2496, pam.wilczynski@gsa.gov

U.S. Air Force Air Combat Command - Physical Fitness Center
Barksdale AFB, LA
Contact: Charles Chapman, 318-456-3018, charles.chapman@barksdale.af.mil

Argonne National Laboratory-East, Central Supply Facility
Argonne, IL
Contact: Karen Hellman, 630-252-7808, khellman@anl.gov

Whole Building Design Guide

The Whole Building Design Guide (WBDG) is a complete Internet resource that includes a wide range of building-related design guidance, criteria and technology for incorporating sustainable building design principles in design decisions. The WBDG is up-to-date, knowledge-based and creatively linked to information across disciplines and traditional professional boundaries.

The goal of "Whole Building" design is to create a successful high-performance building. It is intended to encourage a holistic approach to design and construction for use by Federal, military, and private sector architects, engineers, and project managers. Several agencies have implemented elements of the WBDG principles into their facility design standards and master planning process.

The "Whole Building" design approach asks the members of the planning, design and construction team to look at the materials, systems and assemblies from many different perspectives. These perspectives include cost, quality-of-life, future flexibility, security, accessibility, aesthetics, overall environmental impact, productivity and creativity.

Visit the Whole Building Design Guide's web site, www.wbdg.org, for more information. ■

Green Buildings on the Web

The following web sites can tell you more about sustainable buildings in the Federal government and elsewhere:

Whole Building Design Guide:

A comprehensive guide to building-related guidance, criteria and technology from a "whole building" perspective. Maintained by the National Institute of Building Sciences with support from GSA, DOE, the Navy and other public and private agencies. http://www.wbdg.org

DOE – Federal Energy Management Program (FEMP):

The website of DOE's program to advance energy efficiency, renewable energy and related policies at Federal sites includes case studies, software, financing strategies and many more tools and resources. http://www.eren.doe.gov/femp

DoD – Defense Environmental Network and Information Exchange (DENIX):

The Defense Department's environmental website includes a Sustainable Design section with information on military plans and specs to "green" their facilities. https://www.denix.osd.mil/denix/Public/Library/Sustain/sustain.html

GSA – Sustainable Design:

GSA, the Federal government's landlord, has a Sustainable Design web page that can be accessed by typing "Sustainable Design" into the search engine at the GSA home page. Standards, solicitations and guidance are included. http://www.gsa.gov

EPA – Green Building:

This site links to many different EPA sustainable building resources, ranging from Energy Star to Healthy Schools. Click on "EPA's Green Buildings" to find how the Agency is implementing these principles in its own facilities. http://www.epa.gov/greenbuilding

DOE – EREN:

The home page of DOE's Office of Energy Efficiency and Renewable Energy, this site supplies vast resources on how to improve energy performance. http://www.eren.doe.gov

U.S. Green Building Council (USGBC):

This site offers extensive insight on the LEED building rating system and other activities of the USGBC. http://www.usgbc.org ■

The Pentagon Renovation Project

The Pentagon Renovation program is rebuilding the facility's interior by incorporating environmentally preferable building products and services, while meeting or exceeding current building codes. The project is integrating the principles and practices of sustainable design with a leading-edge acquisition strategy.

On the morning of September 11, 2001, hijacked American Airlines Flight 77 crashed into the west face of the Pentagon. The airplane and subsequent blast traveled at a 45-degree angle to the face of the building. It entered already renovated Wedge 1 and traveled into un-renovated Wedge 2 before exiting the Pentagon's third ring of offices (C-ring) into A-E Drive, an internal roadway open to the sky, allowing the force from the blast to escape upwards, leaving the inner rings (B and A) untouched.

Of the 2,600 people in the immediate area of impact, 125 did not survive the attack. Over 100 people were injured. The number of casualties could have been much higher if the Pentagon Renovation Program, or PENREN, had not taken extra measures to enhance the safety and security of Wedge 1. PENREN is a multi-stage program that addresses modernization, building code compliance, and operating efficiency that will proceed in stages, called wedges, throughout the building.

Since the opening of Wedge 1 in March 2001, Pentagon personnel were enjoying the brightly polished terrazzo floors, an easily maintainable product with a long life span. They were taking advantage of the new bank of escalators and eight passenger elevators, which helped ease vertical mobility and made Wedge 1 compliant with the Americans with Disabilities Act. Modern systems furniture and larger office bays promised flexibility never before seen in the Pentagon. Overhead, a new sprinkler system went unnoticed. Automated emergency smoke doors were inconspicuously recessed into corridor walls. Blast-resistant window units, an interlocking structure of steel tubes, and a geo-technical mesh lay hidden behind

drywall inside the Pentagon's outer facade.

PENREN is working with the LEED program to ensure that the renovated Pentagon is sustainable and energy efficient. This is being accomplished in part through PENREN's unique acquisition approach, which rewards the contractor design-build team for meeting LEED criteria, innovative construction and project management techniques and other factors that lead to successfully completing the most complex renovation project ever attempted by the Federal government.

In 1993, PENREN began the construction of a new Heating and Refrigeration Plant (H&RP) to replace an old, coal-fired, obsolete plant. The new H&RP, completed in 1997, is a state-of-the-art computer-controlled facility, using natural gas as its main fuel source. The facility's improved reliability and built-in redundancy has resulted in a 30% increase in efficiency.

The extensive improvement in energy efficiency includes everything from insulation to lighting. In Wedge 1, the first fifth of above-ground office space to undergo renovation, a tighter thermal envelope was created by installing new double pane, thermal insulated, energy efficient (and blast resistant) window units. The new windows conduct much less heat than the old single pane windows, many of which were permanently stuck in an open position or painted shut with lead-based paint. Returning to the open-bay office environment of the original 1940's design has improved air flow and increased natural light.

Wedge 1 construction included the use of wood from sustainably managed forests, low water use plumbing fixtures, low VOC paints and sealants, mineral wool insulation, energy efficient lighting, and 1,282 energy-efficient window units. Of the 83 million pounds of debris removed in the renovation, 70% (or 58 million lbs.) was recycled, and the rebuilding process used recycled content materials, such as recycled steel, ceiling tile, ceramic tile, and concrete masonry units.

The PENREN project is expected to be completed in or by the year 2014. Several projects, with a total value of approximately $4 billion, will be attempting to obtain LEED Certification over the next eight years. For more of the latest information on the renovation efforts, please visit http://renovation.pentagon.mil, or contact Teresa Pohlman, Special Assistant for Sustainable Construction, at 703-693-8954, E-mail: polhmant@army.pentagon.mil. ■

The Metro Entrance Facility (MEF) relocation project is a good example of PENREN's implementation of sustainable design features. Despite impediments to the project caused by the events of September 11, the first phase of the project, the Pentagon Transit Center, opened on schedule in December 2001. The new Pentagon Transit Center receives over 34,000 mass transit users each day. During construction, PENREN recycled existing site materials such as asphalt, concrete, soil and construction waste. Additional contractual requirements included energy efficiency, the use of recycled content products, minimizing polyvinyl chlorides (PVCs), achieving a 50% diversion rate, use of Forest Stewardship Council certified woods or alternates, maximizing use of greenhouse gas reducing materials, planing for erosion and sediment control from the construction site, implementing a pollution control plan, limiting air pollution from the construction site, and controlling debris. ■

Zion National Park Teaches Sustainability

In 1993, the National Park Service (NPS), in conjunction with the National Renewable Energy Laboratory (NREL), set out to create a sustainable visitor center at Zion National Park in Springville, Utah. Completed in May 2000, the project accomplished that goal admirably. The Center provides a wonderful experience for the 2.5 million visitors that Zion receives. It was elegantly built into the natural landscape and yet achieves a remarkable 70% energy savings compared with comparably sized buildings. The success of the project was due in large part to the use of an integrated building design approach and a multi-disciplinary team including architects, engineers, and energy consultants.

The resulting design is a collection of passive solar and energy efficient features that fit beautifully with the Zion environs. An outdoor area that serves as the interpretive center separates the visitor center and the comfort station. This strategy allowed for the downsizing of the facility by as much as 30% at the start. Energy efficiency is enhanced throughout the building by such details as high insulation levels in the walls and roof. Structural insulated panels (SIPs) were used for the roofing and an air space was designed in to allow for unwanted heat to escape from the building. Foam insulation in the concrete block walls also improved energy efficiency.

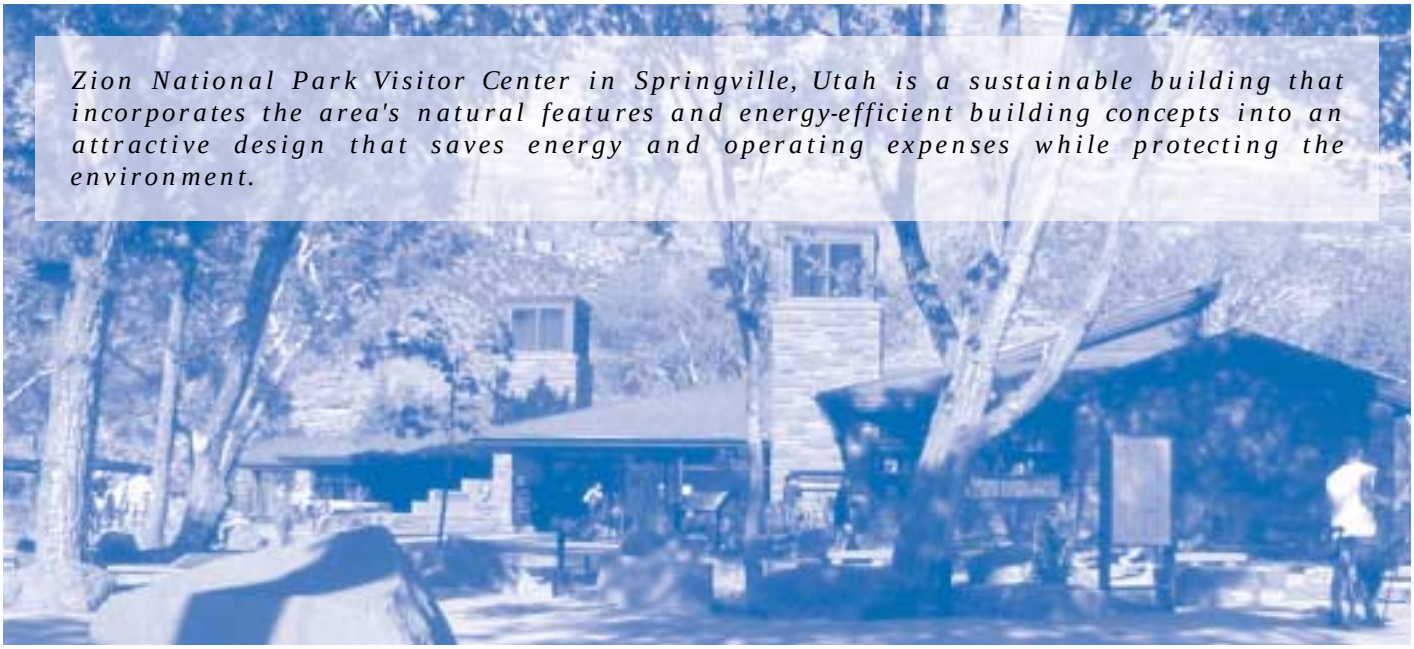
Sunlight provides the visitor center with direct daylighting and heating through high walls on the south wall and clerestory windows positioned high in the building. The west facing windows are shaded to reduce temperature fluctuations during summer and fall. Dark concrete floors and stone-faced interiors absorb and store heat during the day. The south facing windows provide most of the daytime lighting needs, but when more is needed, energy efficient T-8 fluorescent lamps do the rest. Automatic lighting controls adjust the lighting to compliment daylighting.

The passive cooling strategies are also integral to the facility. They feature operable clerestory windows which allow warm air to escape while low windows bring in cool air. The building's energy management system opens and closes windows based on temperatures in the building. When natural ventilation is not enough, two passive down draft cooltowers use evaporative cooling to condition the building. They work by spraying water onto absorbent pads at the top of the tower, allowing outside air entering the top to become cooler and heavier and drop into the building. These towers can generate as much as 8000 cubic feet per minute of conditioned air.

The building has also been retrofitted with photovoltaic (PV) panels which provide as much as 9% of the buildings electrical needs. Although not originally installed during building construction due to budget constraints, the roofing system was designed to incorporate PV when funds became available. The building is also designed to employ net-metering, which allows energy to be sent back to the utility when excess capacity exists.

The performance of the building is exceeding everyone's expectations after two years in operation. As much as 70% of the building's energy needs are already being saved through its design and management. Continuous monitoring by NREL allows the system to operate at peak performance. But the project's most valuable attribute is its educational value. Every visitor that rides one of Zion's alternatively fueled transportation vehicles or stops to hear the ranger talk about the site will learn about ways that they can use these ideas at home without having to sacrifice comfort or beauty.

For more information on the Visitor Center, visit www.nrel.gov/buildings/highperformance/zion.html, or contact Shawn Norton at 202-354-1835, E-mail: shawn_norton@nps.gov. ■



Zion National Park Visitor Center in Springville, Utah is a sustainable building that incorporates the area's natural features and energy-efficient building concepts into an attractive design that saves energy and operating expenses while protecting the environment.

GSA Begins Construction of "Green" Federal Building in Downtown SF

The new GSA Federal Building in San Francisco will feature windows that open, shared spaces between offices, lots of natural light, and many energy saving measures. The building has been designed to reduce energy costs by 45% and is expected to save $500,000 per year in taxpayer dollars.

GSA, the Federal Government's landlord, is constructing a landmark building project in downtown San Francisco. The design by architect Thom Mayne, of the Santa Monica firm Morphosis, was selected in part due to Mayne's expertise in sustainable design and successful track record with energy efficient projects overseas.

It's a $144 million Federal building experiment, which will showcase sustainable design, state of the art building technology, exceptional energy efficiency and indoor air quality, providing a model for private-sector developers of green buildings.

The 240-foot high, 600,000 square foot project will include two distinct buildings that will be separated by a plaza cafeteria and house approximately 1,600 Federal employees from five different agencies. The project entails the remediation and redevelopment of an urban Brownfield site, which had been contaminated by lead bearing rubble from the 1906 earthquake and later on by a Greyhound Bus Station, previously located on the site.

An 18-story glass tower will employ a natural ventilation system in lieu of a conventional heating and cooling system, working in tandem with an adjacent four-story, 100,000 square foot building utilizing conventional systems and enclosed offices. Employees who do not interact with the public will occupy the tower section while those that do will be housed in the four-story building.

The 65-foot wide tower will provide 80% of the interior spaces with sufficient natural day lighting throughout much of the workday, improving indoor environmental quality for workers and reducing the building's lighting needs by an estimated 26%. Other features enhancing the indoor environment of the building are operable windows and horizontal awnings that slide out to admit fresh air. Moreover, there will be minimal painting of surfaces to reduce the potential for "off-gassing."

A stainless steel screen will be mounted on the tower's south side to create a "natural circulation engine" providing the main part of the building's heating and cooling system. A sophisticated building management system will monitor interior temperatures and automatically open and close floor level vents. Offices without separating walls will not impede airflow. This fresh air circulation system will also enhance the indoor air quality, greatly reducing the possibility of "sick building syndrome".

All told, the building will not utilize conventional heating and air conditioning in 70% of its space. These and other resource efficient features — including light sensors, a perforated metal skin acting as a sunshade, and a radiant floor slab to carry heating load for the cooler winter months - will reduce energy consumption by 50%. These and other "high tech" systems add 5% to the building cost, which will be easily recovered over the building's life cycle. The elimination of air conditioning units alone saved $11 million. Moreover, water will be conserved and used efficiently through the use of ultra low-flush toilets and restricted flow fixtures.

Other design features include a three-story sky garden, which will allow employees and the public access to a patio with views of San Francisco Bay. The building will also have a 3,000 square foot plaza level cafeteria to serve the employees and the public. The tower entrance will be a 90-foot high cathedral type passageway and the building will have an 18-foot, three sided tube serving as its crest. Also, the project will utilize many recycled content building materials, including fly ash concrete and recycled content carpet.

According to project manager John Nolte, "(GSA was) willing to spend an extra 5% to test and engineer this building." Morphosis felt the project design must go beyond aesthetics to incorporate social, environmental, political, and urban goals. Thanks to their combined efforts, San Francisco's Market Street area will have an innovative and efficient office building in 2005 to showcase new techniques and demonstrate a new vision of Federal office buildings.

For more information contact Steve Clark at 415-522-3372, E-mail: steve.clark@gsa.gov. ■

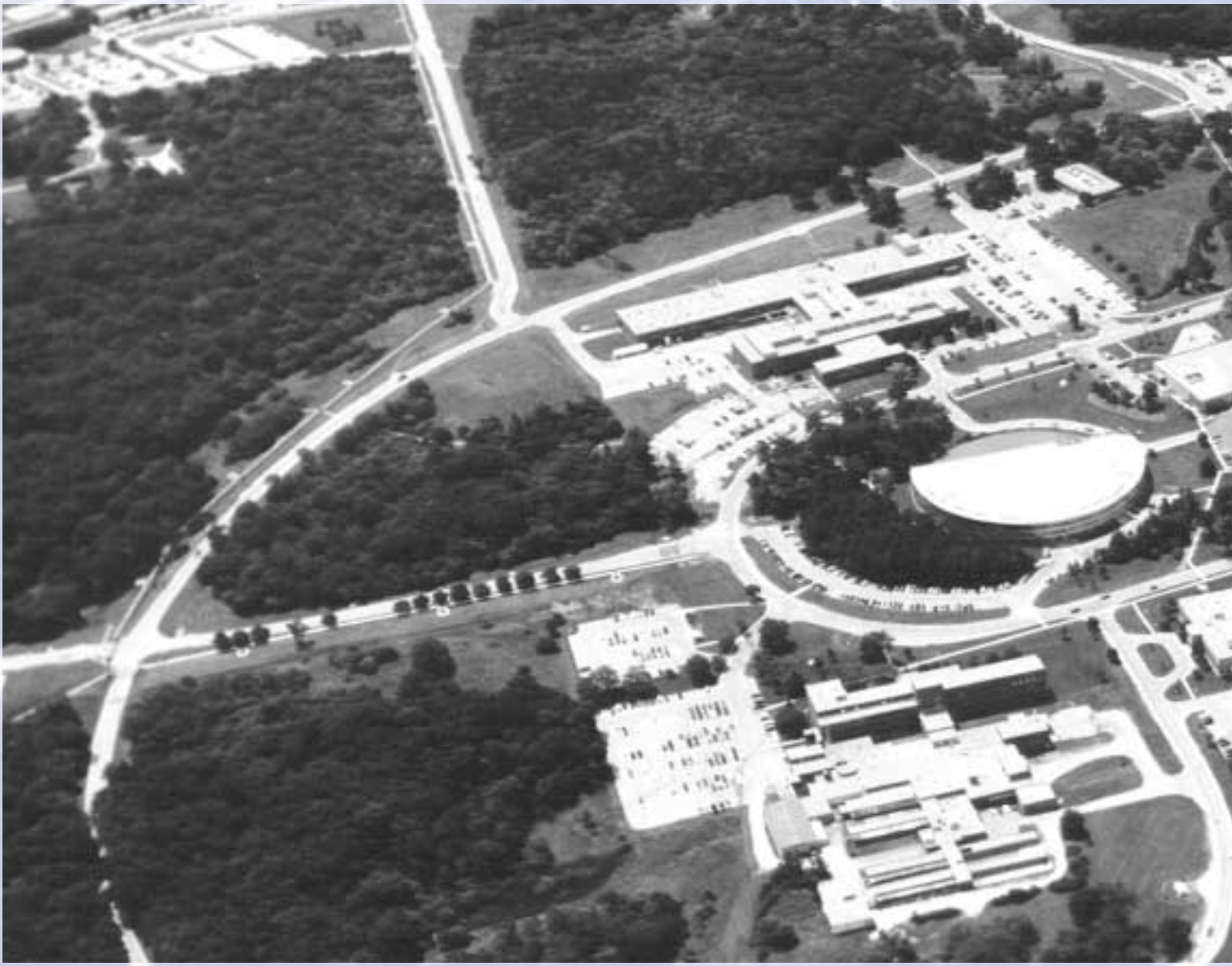
Green Lab on the Prairie

Argonne National Laboratory, one of the U.S. government's oldest and largest science and engineering research facilities, is at the forefront of implementing new approaches to sustainable buildings.

The Department of Energy's Argonne National Laboratory-East, located southwest of Chicago, Illinois, was the first national lab in the United States, dating back to 1946. Recently, it gained another honor: winning a Silver LEED rating from the U.S. Green Building Council for its new Central Supply Facility (CSF).

The CSF was designed and built to achieve this environmental milestone through careful consideration and implementation of green building strategies. Among the environmental factors incorporated in this building are: energy efficiency, water conservation, construction waste recycling, reduced site disturbance, and the use of low-emitting and recycled content building materials. Rather than taking each factor individually, Argonne used a whole building perspective to integrate these diverse elements into a logical and coherent design. The LEED standard was used as a benchmark to generate sustainable design options and compare design proposals.

As the CSF was designed, DOE's building simulation software tool, DOE-2, was used to model energy performance



based on the use of different technologies and strategies. This tool helped the design team optimize glazing, roof insulation, wall, window, and heating, ventilation and cooling (HVAC) systems. In addition, CSF uses several innovative energy efficiency technologies, including a high-efficiency pulse combustion boiler, automatic temperature controls for air handling units, a variable air volume HVAC system in offices, and night setback controls to reduce space heating during unoccupied hours. After construction, Argonne performed a building commissioning to verify energy efficiency performance. These measures have proven effective, reducing the building's electricity consumption from the base case scenario by 20% and natural gas use by 30%.

Argonne has also focused on saving other resources beyond energy. The lab recycled 75% of its construction waste, pulverized and reused gravel, and reused excavated soil and other materials. It also specified numerous recycled content building products, including steel, carpeting, ceiling tiles, toilet dividers, and concrete containing coal fly ash. In addition, the CSF team specified locally-made materials (74% of those used) and low-emitting paints, sealants, adhesives, and carpeting.

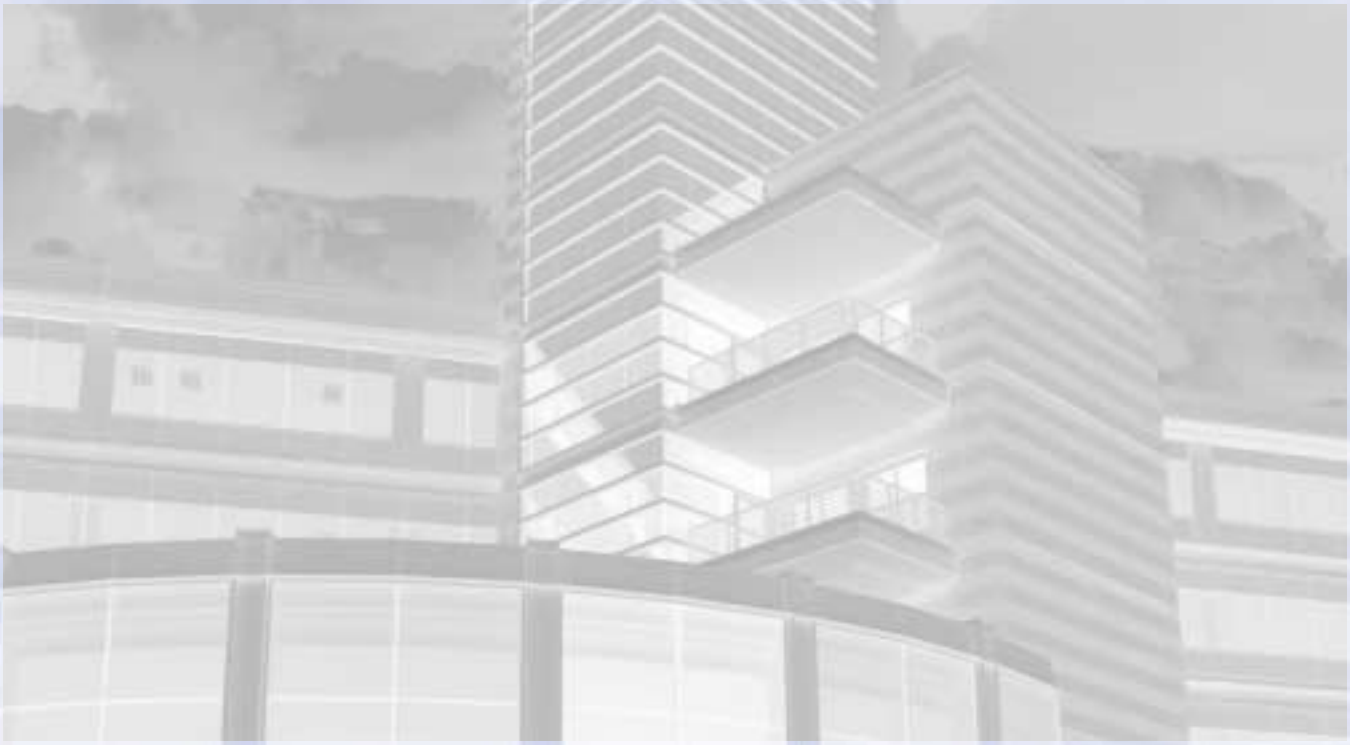
In the interest of employee health and productivity, CSF employs a new conveyer system designed to reduce occupational hazards and increase efficiency. It all points to a successful experiment in sustainability for Argonne – and one the lab is busy working to replicate.

Argonne is using the lessons learned in the building of CSF in the design and construction of the Rare Isotope Accelerator Science Center. But you don't have to be a high-energy physicist to understand the value of a good, solid green building.

For more information about the Argonne National Leboratory, visit http://p2.pfs.anl.gov/sustainable_design.htm, or contact Karen Hellman at 630-252-7808, E-mail: khellman@anl.gov. ■

Moving Toward Sustainability – EPA's New Campus in North Carolina

The new campus at Research Triangle Park provides state of the art labs and offices for the 21st century and also embodies EPA's commitment to the environment. Cost, functionality, and environmental impact were kept in balance when selecting materials and systems. The result is a very green, functional and economical facility.



Visitors arriving at EPA's Research Triangle Park campus immediately see that things are a little different. Seventy photovoltaic street lights dot the edge of the longest stretch of solar-lit roadway in the country. The landscape is covered with native grass meadows and forest instead of mown lawns and ornamental bushes, so there are no sprinklers. And any storm water that falls on the 133 acres is treated by the nine wetlands, four ponds and other plant-based features added as part of the site development.

This is EPA's largest operation outside of Washington, D.C. – home to EPA's air quality standards program, national computer center, and headquarters to two of the agency's national research labs. So the facility needed to match the mission carried out within its walls.

Employees and visitors arrive by carpool, vanpool, regional bus or bike. To help reduce air pollution from vehicles, EPA offers all kinds of incentives to help reduce single occupant commuting – like sheltered carpool parking, bike racks, showers and lockers, rideshare information and even free rides home if an employee is stranded by weather, unplanned work or a carpool partner who goes home with a sick child.

Operated by motion sensors, the building lights flick off when people leave – and the electric meter slows down. With more than a million square feet of labs and offices, EPA's energy bills could really add up. But the building is designed to use 40% less energy than comparable research facilities, helping reduce energy costs by approximately $1 million annually.

The food service area promotes reuse by offering discounts on beverages when employees use their own mugs. It also features biodegradable dishes, flatware, and napkins, and food waste is composted.

The office furniture is ergonomic, contains recycled materials, and emits no or low formaldehyde or other substances. Air quality in the building has been assured by careful selection and testing of wall, ceiling and floor finishes – and when construction was complete, the ambient air inside the building was tested to ensure a

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healthy indoor environment. The building managers even require that vacuum cleaners be outfitted with HEPA filters to keep small particles, like dust and pollen, from recirculating in the air.

The building also features daylight sensors, which adjust indoor lighting as they detect the light from outside. Twenty five thousand control points in the building automation system make sure that the ventilation, humidity, heat, cooling, light and other systems provide only the service that is needed. Fans, pumps and air volume control boxes are "variable," which means the systems are responsive to actual needs rather than constantly running to meet peak demands.

EPA did not spend more to build a sustainable building. The budget for EPA's Research Triangle Park campus design and construction was based on standard costs for standard buildings, and there was no extra funding allocated for green building. The same goes for operations. No extra money was needed to be eco-friendly.

EPA management challenged the campus development and operations teams to maximize quality, economy and environmental performance – all at the same time. Within a standard budget, the Agency achieved outstanding energy efficiency and a greatly reduced ecological footprint. Some solutions were win-win, like on-site concrete production that saved 75,000 miles of truck traffic and cut the cost of the construction. Water-efficiency features saved EPA half a million dollars in sewer connection fees. Other environmental benefits cost a little more up front. EPA thought "outside the box" and made trade offs, such as eliminating 200 unnecessary doors to pay for lighting systems that are 70% more efficient than code.

EPA continues to find surprises. In recycling 80% of its construction waste, about 20 million pounds of material, EPA didn't pay extra. Reducing the amount of land cleared by 50% saved money and helped control solar heat gain. In moving 2,000 people to the new campus with reusable plastic crates rather than corrugated boxes, EPA actually saved money through reduced labor costs.

EPA designed its new National Computer Center building on the same campus to achieve a "silver" rating under the LEED program for energy and environmental design – at a cost that would be average for a building of this type. EPA is quick to point out that this is not just the agency's own special calling. With about one third of our nation's environmental impacts attributable in some way to buildings, we're all in this together. The good news is that environmental excellence doesn't have to cost extra.

For more information, visit the EPA website: www.epa.gov/rtp/new-bldg, or contact Chris Long at 919-541-0249, E-mail: long.chris@epa.gov. ■

Navy's Energy and Sustainable Design Demonstration Facility

Building 850, which houses the Public Works Department in Port Hueneme, California, has been designed to fully demonstrate state of the art technologies with applicability to Navy facilities worldwide. It serves as an example of the importance the Navy has placed on energy efficiency and sustainable practices.

The Energy and Sustainable Design Demonstration Facility (Building 850) in Naval Base Ventura County, Port Hueneme, California, serves as one of the Navy's "Energy Showcase" facilities to demonstrate applications of the latest concepts in energy efficient and sustainable facility design, construction, and operation. The building was carefully designed to take advantage of the mild climate and make use of passive systems that have been integrated with the mechanical, electrical and plumbing systems to achieve maximum efficiency and indoor environmental quality.

The project includes a 10,000 square foot remodel and 7,000 square foot addition. The design concepts and systems include: daylighting, shading, and innovative glazing elements; maximum use of natural ventilation; photovoltaic solar power generation; solar space and domestic water heating systems; T-8 fluorescent lighting systems incorporating direct/indirect fixtures, continuously dimming electronic ballasts and occupancy and photo sensor controls; real-time energy monitoring accessible via the Internet; gray water system for capture and reuse of rain water and lavatory discharge; self-sustaining landscaping and water conserving irrigation system; indoor air quality monitoring; and extensive use of recycled building materials. In addition, the HVAC systems demonstrate prototype natural gas heat pump air conditioning, variable air volume under floor air distribution, and high efficiency pulse boilers.

The Navy used models of daylighting, energy use, and air quality to analyze the impact of alternative designs and equipment. It formed partnerships with research organizations such as California Polytechnic Institute at Pomona and the Lawrence Berkeley Laboratory to conduct detailed analyses of building systems and materials.

The building was designed with future use, energy and water efficiency, resource conservation, and indoor air quality in mind.

The building addition contains a pre-engineered steel frame that is bolted together rather than welded. This will allow disassembly and reassembly of the structure for other purposes in the future. Because the building interior consists primarily of large, well-lit open spaces and is constructed of durable materials, the building could be converted to other uses in the future.

Building 850's energy performance is approximately 55%

more efficient than California's 1995 Title 24 Energy Efficiency Standards. Energy efficiency was achieved through optimization of the building envelope, minimization of internal energy loads, and on-site power generation from renewable sources. The building envelope is oriented to maximize daylighting and natural ventilation, and the roof has a reflective white finish to reduce solar heat gain.

The efficient mechanical system includes premium efficiency motors for pumps and fans, high seasonal energy efficiency rating (SEER) air conditioners with engine-driven direct-expansion reciprocating compressors, underfloor air distribution, and a digital control system. Water heating is provided by solar panels. In addition, the project is equipped with a 30 kW solar array, which provides 68% of the total annual energy cost for the building.

The site now contains xeriscape landscaping, i.e., using native plants that have minimal irrigation requirements. The installed "intelligent" water efficient irrigation system has integrated controls to limit watering in wet weather. Stormwater is collected from the roof to reduce run-off and is used for toilet flushing. Infiltration trenches along the site and porous paving in the parking area allow for groundwater recharge and stormwater runoff reduction. Waterless urinals, low-flow toilets, automatic lavatory faucets and low-flow showerheads reduce interior water consumption by more than 40%. Captured rainwater and reclaimed lavatory gray water are used for toilet flushing, reducing the amount of potable water used for sewage conveyance by more than 90%.

Materials for this project were selected based on recycled content and low-emitting volatile organic compound (VOC) content. Recycled content materials include steel, mineral fiber insulation, concrete with 30% coal fly ash, gypsum, reclaimed aggregate parking base, plastic toilet partitions and clothing lockers, and carpet with recycled plastic backing. Low VOC content materials include adhesives and sealants, paints, and other architectural coatings, furniture systems and carpet.

For more information on the Navy's Building 850, visit www.nbvc.navy.mil/PublicWorks/energy_showcase/bldg850.htm, or contact Tom Santoianni, Energy Manager, Naval Base Ventura County, Port Hueneme CA, at 805-982-4075, or via E-mail: SantoianniTS@nbvc.navy.mil. ■

Building 33, Washington Navy Yard, Piloting the Way in Sustainable Development

The Naval Facilities Engineering Command (NAVFAC) is responsible for providing professional, best value public works support and facilities engineering to the United States Navy. NAVFAC has been a leader among the federal agencies in adopting policies and practices in facility development that promote sustainable development with the integration of building systems and the environment. The focus is to provide the Navy and the country with built environments that reduce our ecological footprint and promote better management of the natural resources on which we depend, at the least cost over the life of the development.

Building 33, the Sanger Quadrangle at the Washington Navy Yard, DC, was a pilot project for the Navy's sustainable development program. The building cluster consists of an "L" shaped main building linked to three smaller courtyard buildings, providing approximately 156,000 gross square feet of office and conference space.

The initial design work did not purposely incorporate "green" technologies. When accepted as a sustainable design pilot project, it was agreed to assess the available green strategies that would be available to the project, and issue a design/build package, based on a "greening study" performed by the design Architecture and Engineering (A-E) firm. The greening study resulted from a sustainable design charrette involving the Navy and a "green" design team including architects, engineers and sustainability experts, selected and coordinated by Dr. Amory Lovins of the Rocky Mountain Institute. From this collaborative, integrated charrette, a list of "greening opportunities" was generated.

A DOE Buildings Load Analysis and System Thermodynamics (BLAST) energy model of the building performed by the first A-E established the target energy budget for the project. Prospective design-build teams were then asked to propose sustainable design strategies in their submittal, including those already in the greening opportunities list, a DOE BLAST energy model of their proposal and any additional recommendations. The selection of the team included consideration of those features.

The strategies implemented in order to save energy included using increased insulation levels in the roof and walls, super windows, high-efficiency indirect lighting and task lighting that reduced ambient lighting levels from 50 fc to 35 fc, perforated blinds to assist in daylighting the space, lighting controls, and borrowed light to help light adjacent spaces. This resulted in a substantially reduced electric load and reduced anticipated plug loads. As a result, the chiller and associated HVAC equipment, piping, ductwork, and HVAC feeder sizes could be reduced.

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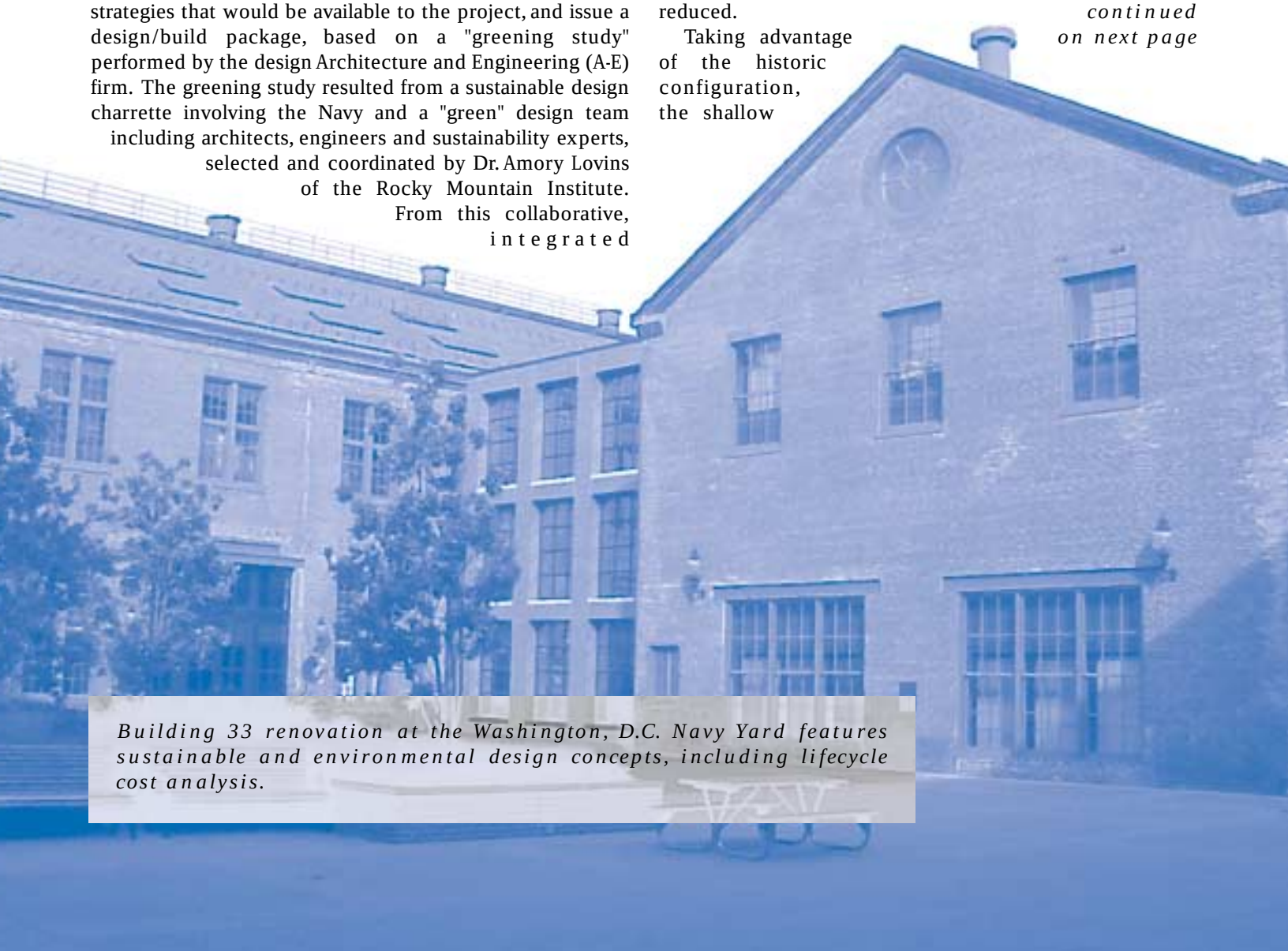
Taking advantage of the historic configuration, the shallow



Building 33 renovation at the Washington, D.C. Navy Yard features sustainable and environmental design concepts, including lifecycle cost analysis.

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crosssection of the building from street to courtyard allowed for good daylight penetration. Also, skylights were installed in the courtyard side of the roof of Building 33. The link building is entirely daylit with a curtain wall of glass on the north, many punched openings on the south and skylights in the roof. The south wall of the link incorporated heat mirror glazing to minimize heat gain. Additional sun control is accomplished with horizontal louver blinds that are perforated to allow for view and some daylight penetration.

Ventilation is accomplished through mechanical means. Because the building is historic, existing windows were retained and repaired when possible to operable condition. The retention of historic fixed windows was leveraged to create a "super window" effect. Double glazed insulating glass was installed inside of the existing glazing creating a high thermal performance with over 12" of overall thickness.

Increased wall and roof insulation was accomplished by constructing new insulated wall and roof assemblies inside the existing historic shell.

Interior office flexibility was designed in through the use of 6" raised flooring throughout the facility, and the minimum use of permanent drywall partitions. Office and conference rooms were enclosed using demountable partitions. These also were kept to a minimum and most of the workstations are constructed with flexible, panelized systems furniture. Wiring to all the workstations, offices and conference rooms can easily be rerouted by lifting the floor panels, rather than by destructive means.

The building uses a combination of lower ambient light and task lighting at individual workstations to save on fixtures, energy consumption and heat gain in the building, reducing the heat generation and cooling load. The reduction in solar heat gain from windows, walls, roof and lighting reduced the requirement for cooling. This reduced the chiller requirements from 500 tons to 300 tons. The duct sizes were increased to reduce pressurization requirements and the fan sizes to further reduce energy demand.

The renovations reduced energy costs, but not as much as anticipated due to differences between expected and actual building usage, heating and cooling needs, and lighting usage. These all combine to impact the building's ability to conserve energy. But the potential is there for greater savings.

The consensus by the users, the designers, and the public who have visited it is that this project paved the way for addressing the issues of sustainable building development, and is a success. Properly maintained, the savings will continue to accrue. The Navy is proud to have taken this course of action and will continue to do so for better environmental performance and greater energy efficiency in all its projects.

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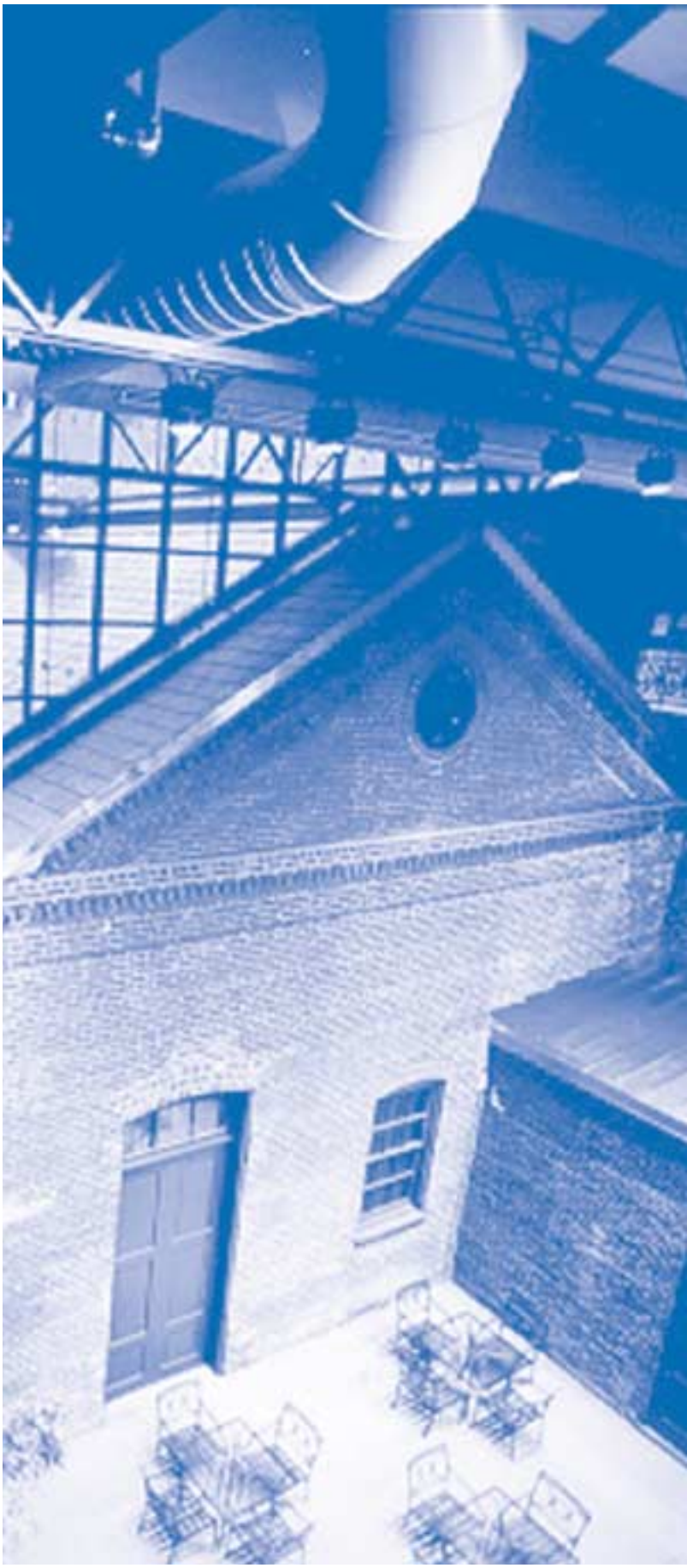

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