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Implementing LEED

Strategies That Work for the Forest Service

Cover Figure—The Sylamore Ranger District office in Mountain View, AK (Ozark-St. Francis National Forests, Southern Region), was the first LEED-certified building in the entire Forest Service. It was built in 2006 through a design-build contract. The design was based on a conceptual site plan, floor plan, and elevations produced by regional staff. This extremely cost-effective structure may be one of the most economical LEED projects ever built by the Forest Service.

Implementing LEED

Strategies That Work for the Forest Service

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Introduction to LEED

Most people have heard of the Leadership in Energy and Environmental Design (LEED) Green Building Rating System by now, but they may not know much about LEED or how it works. This report explains how the LEED process works and provides information that can be used by architects, facilities engineers, contracting officers, and line officers to assure that their LEED projects serve their needs and are cost effective.

LEED was developed by the U.S. Green Building Council (USGBC) to encourage adoption of sustainable building and development practices through generally understood and accepted performance criteria. LEED rating systems are available for new construction, existing building operation and maintenance, commercial interiors, core and shell construction, schools, retail spaces, healthcare facilities, homes, and neighborhood developments.

LEED certification has been mandatory for some new Forest Service buildings since 2005, when an interim directive was issued that required LEED Silver certification for new Forest Service district offices, supervisor's offices, visitor centers, research facilities, and climate-controlled warehouses 2,500 gross square feet or larger. On November 26, 2008, a new section of Forest Service Handbook 7309.11 became effective. The new chapter 70–Sustainable Buildings *(http://www.fs.fed.us/im/directives/fsh/7309.11/7309.11_70.doc)* mandates that all new or renovated buildings that are "energy intense" (such as tree coolers) or larger than 2,500 square feet

- Must be designed using integrated design principles to optimize energy efficiency and use of renewable energy, protect and conserve water, enhance indoor environmental quality, and reduce environmental impacts of materials
- Must comply with the USDA's Sustainable Building Implementation Plan and metering requirements *(http://www.usda.gov/energyandenvironment/facilities/sbip.htm)*

New offices, visitor centers, and research labs 10,000 gross square feet or larger also must achieve LEED Silver certification. Achieving LEED Silver certification proves that Forest Service buildings meet generally accepted standards of sustainability. The USDA Sustainable Buildings Implementation Plan also requires that preference be given to buildings meeting those standards when the Forest Service is acquiring leased space.

Designing buildings that are sustainable (figure 1) is the right thing to do. Well-designed sustainable buildings increase employee productivity, enhance occupant

Highlights...

- The LEED sustainable building rating system was developed to encourage sustainable building practices.
- LEED building practices differ from those most designers, contractors, and Forest Service employees are used to.
- LEED design features, registration, documentation, commissioning, and submittal may add costs to design and construction, but often reduce total costs of operation over the long term.
- LEED projects can be cost effective and will proceed more smoothly when designers, facilities engineers, contracting officers, and line officers use information in this report.

Figure 1—The Shoal Creek Ranger District office in Heflin, AL (National Forests in Alabama, Southern Region), was built in 2005 to LEED standards. It was built mainly with local materials, including siding from southern Alabama cypress trees and rock from a quarry in northern Alabama. Other sustainable features include occupancy-sensing light switches, permeable concrete pavement in the parking lot, and a ground source heat pump that provides energy-efficient heating and cooling.

comfort and health, reduce the impacts of natural resource consumption, lower costs of facilities in the long term, and minimize the strain on local infrastructure from growth and development.

Buildings have a big impact on people and the environment. Statistics from the U.S. Environmental Protection Agency's 2004 report "Buildings and the Environment: A Statistical Summary" *(http://www.epa.gov/greenbuilding/pubs/gbstats.pdf)* show that

- On average, Americans spend about 90 percent of their time indoors. Levels of pollutants indoors may be two to five times higher, and occasionally more than 100 times higher, than levels outdoors.
- Buildings account for 39.4 percent of total energy consumption in the United States.
- Buildings in the United States contribute 38.1 percent of the nation's total carbon dioxide emissions.
- Building occupants use 12.2 percent of the total water consumed in the United States.
- Building-related construction and demolition debris accounts for nearly 60 percent of the nonindustrial waste generation in the United States.

More information about sustainability in buildings is available in the "Sustainability" section of the "Facilities Toolbox" at *http://www.fs.fed.us/eng/toolbox/sus/.*

Five Forest Service-owned buildings have already earned LEED Silver certification. Twenty-six more Forest Service buildings are in the process of becoming LEED certified, such as research stations, the Forest Products Lab, and the International Institute of Tropical Forestry (figure 2). The Rocky Mountain Region is working to certify its standard bunkhouse plan under the LEED for Homes rating system. Units that don't have a LEED project now will likely join the crowd within the next few years.

The Forest Service is a member of the USGBC. Forest Service employees have access to all member benefits, including the members-only sections of the USGBC Web site and discounts on training and publications. Forest Service employees can learn how to create individual user accounts for easy access to these members-only benefits at *http://fsweb.wo.fs.fed.us/eng/programs/facilities/sus_green/usgbc.htm.*

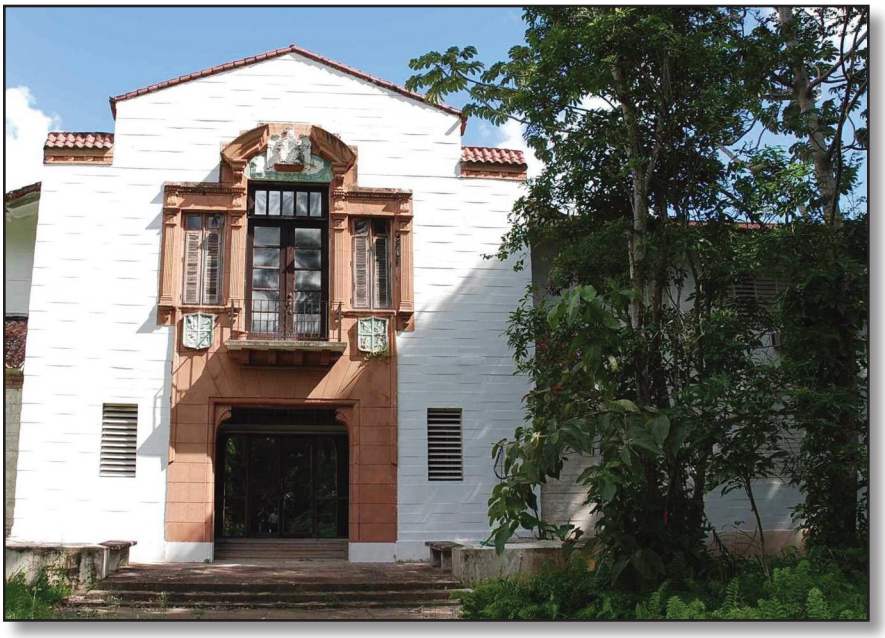

Figure 2—Ongoing renovation of the 1942 Spanish Revival headquarters building for the International Institute of Tropical Forestry in Río Piedras, Puerto Rico, will result in a water- and energy-efficient LEED-certified building. The building is the best-known work of Forest Service architect W. Ellis Groben and is eligible for listing in the National Register of Historic Places. The Puerto Rico State Historic Preservation Office carefully reviewed the renovation plans and approved them because of the care that is being taken to preserve and restore significant historic features.

The LEED Certification Process

LEED certification can be achieved through three basic steps that are incorporated into the design and construction process.

First, the project is registered. Registration *(http://www.usgbc.org/DisplayPage.aspx?CMSPageID=65)* costs $450. Registered projects can take advantage of the resources provided by the USGBC during design and construction, which is why it's important to register the project during planning or early in the design phase. LEED resources include access to credit inquiries and rulings, sample credit templates, and reference documents at *http://www.usgbc.org/DisplayPage.aspx?CMSPageID=75.*

Next, the building is designed (figure 3) and constructed. Successful strategies for LEED design and for working with design contractors on LEED buildings are explained in the "Design Strategies That Work for Forest Service LEED Buildings" section. Information on successful strategies for constructing LEED buildings is provided in the "Construction Engineering Strategies That Work for Forest Service LEED Buildings" section. Costs for assembling LEED documentation and commissioning the building during design and construction can be substantial.

Finally, all the documentation is assembled and submitted online for building certification. Certification costs $1,750 to $17,500, depending on the size of the building. The fee reimburses the USGBC for the cost of reviewing and evaluating the submission. LEED letter templates and additional documentation for the application process are provided at *https://leedonline.usgbc.org/Login.aspx.* More information on templates and documentation is in the "Design Strategies That Work for Forest Service LEED Buildings" and "Construction Engineering Strategies That Work for Forest Service LEED Buildings" sections of this report.

Submissions are reviewed by the independent nonprofit Green Building Certification Institute. Results of preliminary reviews are returned to the applicants so they can submit additional documentation, if necessary, to meet the requirements for the certification level they want to achieve. Documentation review has taken as long as 6 months for some completed Forest Service projects. The USGBC expects the changes implemented in January 2009 to shorten review time to about 30 days for most projects.

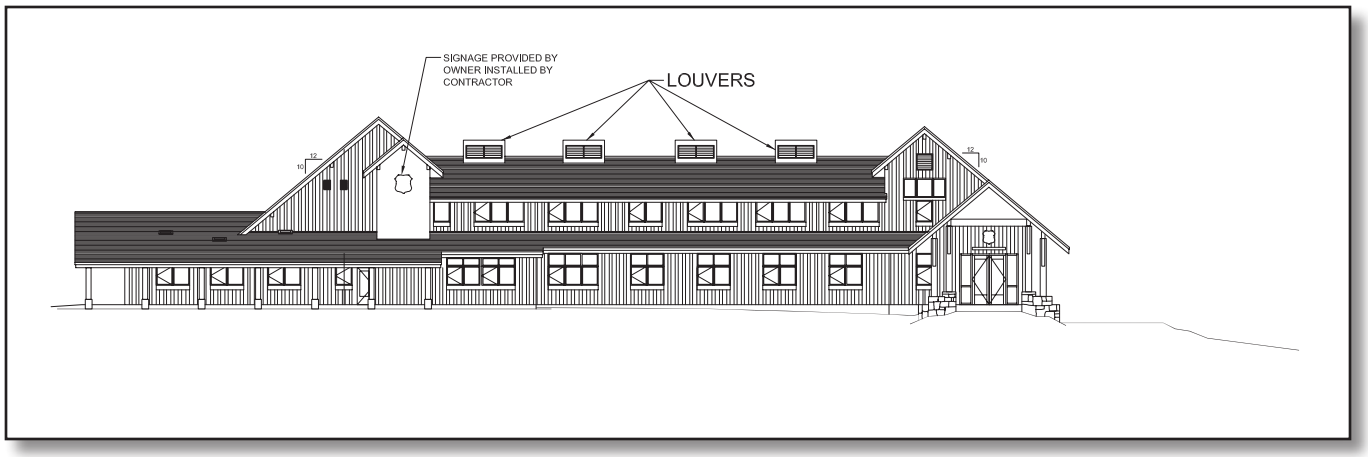

Figure 3—Motorized louvers that vent the skylight shafts when excess heat builds up are visible on the roof ridgeline in this design drawing of the north elevation of the Truckee Ranger District office in Truckee, CA (Tahoe National Forest, Pacific Southwest Region). Other sustainable features that are not visible include durable products, recycled products, locally produced construction materials, and boulders from the site that will be used for landscaping and to discourage vehicles from traveling off the pavement. The 11,535 square-foot building, under construction when this report was being prepared, should achieve LEED Silver certification.

After submittal of any additional documentation, a final review is conducted, and certification is either granted at the Basic (26 to 32 points), Silver (33 to 38 points), Gold (39 to 51 points), or Platinum (52 to 69 points) level or denied. Appeals are allowed and are often necessary to achieve the desired certification. Appeal determinations should take 30 days (each), but can take longer.

To achieve certification, certain prerequisites must be satisfied, and the required total number of points must be earned from among several categories (figure 4). Points are available in six categories in LEED for New Construction, version 2.2.

- Sustainable Sites: 1 prerequisite, 14 possible points
- Water Efficiency: 0 prerequisites, 5 possible points
- Energy & Atmosphere: 3 prerequisites, 17 possible points
- Materials & Resources: 1 prerequisite, 13 possible points
- Indoor Environmental Quality: 2 prerequisites, 15 possible points
- Innovation & Design Process: 0 prerequisites, 5 possible points

The categories, prerequisites, and available points are similar but not identical in other LEED rating systems such as LEED for Homes.

LEED rating systems have changed as technology progresses and the LEED committees refine requirements. The current version of LEED for New Construction, 2.2, has been in effect since January 1, 2006. An updated version is due to be released in mid 2009. More information about the updated version is available in "The Future of Sustainable Buildings in the Forest Service" section of this report.

Figure 4—The White Mountain Supervisor's Office (Eastern Region) is currently under construction. It was designed to achieve LEED Silver certification, but may attain LEED Gold certification. The building and site development incorporate a wide range of sustainable design strategies including recycled and locally produced materials, foam flush composting toilets, a gray water recirculation system, daylighting and automatic electric lighting controls, permeable pavement, solar hot water heating, and a biomass boiler that not only heats the building, but also generates electricity.

Design Strategies That Work for Forest Service LEED Buildings

Some Forest Service Regions have staff architects and engineers who design some or most of their new buildings, but most Forest Service building designs are done by architectural and engineering contractors. Whether a design is done in house or by a contractor, certain design methods and procedures lead to a more successful outcome. Most importantly, the design team must consider LEED certification a means to achieve better, more sustainable buildings, rather than viewing "getting LEED Silver" as an isolated goal to be added to ordinary design and construction practices.

What Line Officers Need To Know

Focus on durable and energy-efficient LEED strategies to maximize cost effectiveness over the life of the building. With better insulation, more efficient lighting and HVAC systems, and finishes and systems that last longer, buildings will have lower operations and maintenance costs. The savings will benefit the unit's budget and occupants will be more comfortable.

Building Performance Goals

Before design can begin, the facility's function, general appearance, and budget must be established. This information should be developed and recorded in a project prospectus. More information about creating and using a project prospectus is available at *http://www.fs.fed.us/eng/toolbox/fmp/fmp08.htm*. In addition to the information that's required in all Forest Service prospectuses, those for LEED buildings should clearly state that the building must be LEED certified and at which level. In addition, the prospectus should contain the LEED and sustainability requirements in Forest Service Handbook 7309.11, chapter 70 *(http://www.fs.fed.us/im/directives/fsh/7309.11/7309.11_70.doc).*

It's a good idea to include information about the LEED strategies that are deemed most appropriate for the particular project in the final project prospectus. This information will guide the design process and save design and review time that might otherwise be wasted by false starts or inappropriate conceptual designs.

A table has been developed using data from 19 Forest Service offices across the country that shows which LEED credits can most likely be incorporated into Forest Service building designs cost effectively. The table also includes information about which specific sustainable strategies are required for Forest Service buildings. See the "LEED Prerequisites and Points for Forest Service Offices" table in appendix A. Of course, not every Forest Service building should incorporate the same LEED strategies, because climate and building function vary significantly. The table can be modified for individual projects to show which LEED credits will be required or encouraged and which are not likely to be practical.

Integrated Design

The most successful LEED designs begin incorporating LEED considerations during the planning stage. Doing so makes achieving LEED much easier and more cost effective than if LEED features are pasted into a design that has mostly been completed (figure 5).

The most effective way to incorporate LEED considerations early in the design process is to use an integrated design approach. Integrated design—a radical departure from the traditional planning and design process—is required by the USDA Sustainable Buildings Implementation Plan *(http://www.usda.gov/energyandenvironment/facilities/sbip.htm)* and Forest Service Handbook 7309.11, chapter 70 *(http://www.fs.fed.us/im/directives/fsh/7309.11/7309.11_70.doc).*

During the traditional planning and design process, the owner and each design specialist make decisions in relative isolation from each other. The owner decides the building's size and location, the budget, and the major functions, hires an architect, and usually tells the architect the general style that is preferred. The architect determines the building layout and tries to make the esthetics please the owner. The architect turns the plans over to the structural engineer, who inserts a structure into the architect's layout and esthetic vision. Then the plans are shipped to the mechanical and electrical engineers, who add heating, cooling, lighting, and electrical systems. Next, the landscape architect is engaged to add plantings and other amenities to the outside of the building. A civil engineer may be hired to design parking areas and access roads. A construction contractor is hired and the structure is built to match the plans.

This process often leads to conflicts, inefficiencies, redesigns, and change orders. Structural, mechanical, and electrical engineers compete for limited space and struggle to design systems that will compensate for incompatible or interfering design decisions by other design specialists. Contractors sometimes balk at details that don't match their preferred methods of construction and may have difficulty integrating the separately designed systems.

Integrated design (figure 6) is a team approach. The building owner still controls the budget and has the final say, but the owner, architect, engineers, landscape architect, building occupants, and sometimes the contractor and building commissioner collaborate on design choices. They

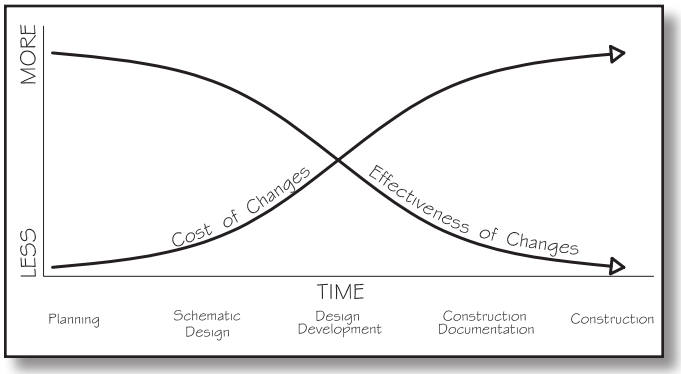

Figure 5—The best time to incorporate nonstandard design elements is at the planning stage. Early in the design process, all options are open. Incorporating changes from standard practices becomes increasingly ineffective and expensive as the design becomes more complete.

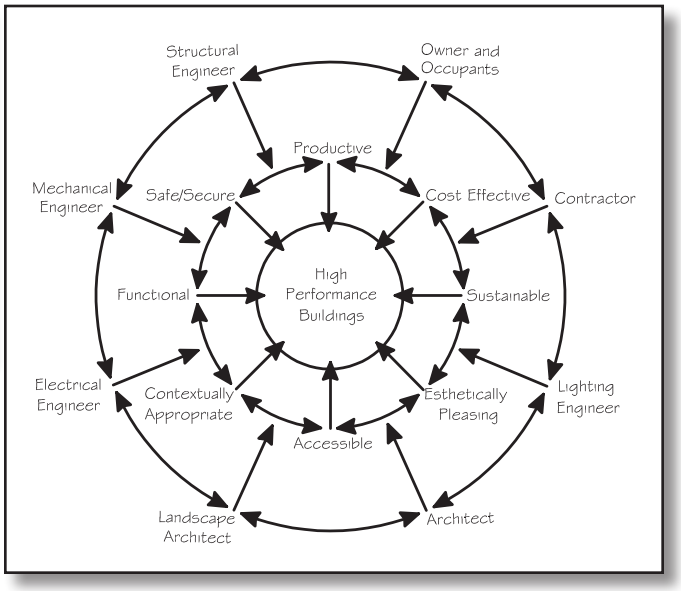

Figure 6—This graphic representation of the integrated design process shows how all members of the design team collaborate on each of the design goals to produce high-performance buildings.

discuss the effects of design choices on building functions and components throughout the design process, beginning with the planning stage. Each team member has different expertise and may devote more or less time to the effort, but each member is integral to the design team.

Using an integrated design process, more time is invested in the planning and conceptual stages of the process with less time spent on design. All of the building's features and systems work together more efficiently and cost effectively. If cost-effective LEED design is important to a project, hire a design firm that routinely uses an integrated design process.

To illustrate the importance of integrated design, consider the initial and long-term costs of heating, ventilation, and air conditioning (HVAC) and electrical systems. Site orientation (landscape architect), building configuration and envelope (architect), and light fixture and daylighting choices (lighting engineer) have bigger effects on the costs of electrical and HVAC systems than the mechanical and electrical engineers' choices of mechanical and electrical systems (figure 7). More efficient buildings that work with the local climate and are configured to allow nonglare daylight to penetrate well into the building need smaller HVAC systems and use less fuel and electricity.

The "Whole Building Design Guide" *(http://www.wbdg.org/wbdg_approach.php)* explains more about integrated design. The American Institute of Architects encourages including the contractor in the integrated design process, which they call "integrated project delivery" *(http://www.aia.org/,* search for *"collaboration: integrated"* and click on "WORDS BY: The Key Is Collaboration: Integrated Project Delivery"*)*.

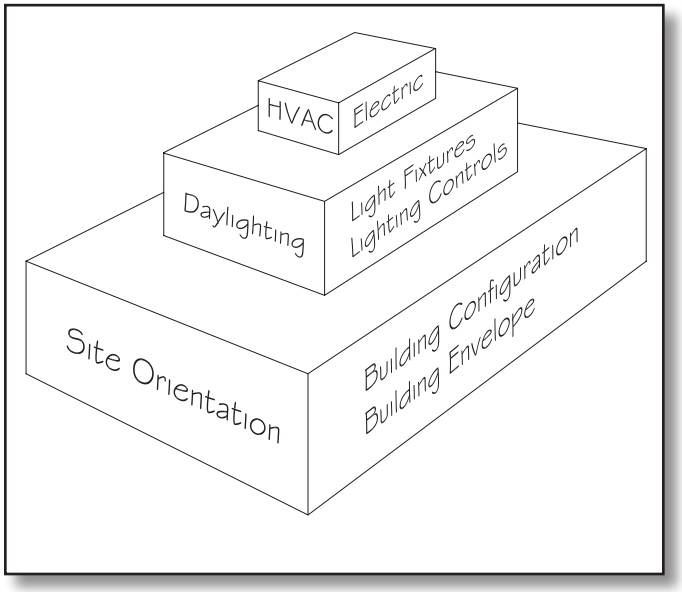

Figure 7—This graphic representation shows the relative amount of influence on long-term energy costs attributable to choices by different design disciplines. Design decisions made by the landscape architect and architect (base of pyramid) have the most effect. Design choices made by the lighting engineer (middle tier of pyramid) also have a substantial effect. The mechanical and electrical systems specified by the mechanical and electrical engineers (top tier of pyramid) have less influence on long-term costs than the other design decisions.

Design Contracts

Requests for proposal and contract language should be a little different when hiring a design firm to produce a cost-effective LEED design. The language should require the design firm to:

- Include LEED-accredited professionals (LEED AP) on staff.
- Demonstrate successful completion of LEED-certified projects of similar size and scope.
- Use an integrated design process.

These factors should also be among the evaluation criteria used to determine the firm that should be awarded the design contract. It is particularly important that the architect and mechanical engineer are experienced LEED APs. Most designers need a few tries to learn the least costly and most effective methods of achieving LEED for each climate region.

Example contract language can be used to develop design contract templates that will work for each region. The Pacific Northwest Region uses language for LEED design contracts (figure 8) that includes requirements that the design firm complete LEED documentation and the certification application after construction is completed. They do not make final payment to the design firm until the certification process is complete. The region's standard contract language will be available to Forest Service and BLM employees by spring 2009 at *http://fsweb.wo.fs.fed.us/eng/programs/facilities/leedspec/.*

What Contracting Officers Need To Know

For LEED projects, the design prospectus and contract should include:

- A requirement that the design will achieve LEED Silver certification if constructed as designed.
- A list of required, preferred, and impractical LEED points, if such a list was developed for the project prospectus.
- A statement indicating whether the design firm will be responsible for LEED documentation just during design or during design and construction.
- A statement indicating whether or not the design firm's responsibilities include completing the LEED certification process after construction is completed.

Figure 8—The Sisters Ranger District office in Sisters, OR (Deschutes National Forest, Pacific Northwest Region), is located at the eastern portal to the Cascade Mountains and the McKenzie Pass-Santiam Pass Scenic Byway. It was designed to achieve LEED Silver certification, but construction has been delayed pending funding.

Some design contracts include performance-based requirements for accomplishing LEED certification and withhold a defined percentage of the design fee until certification is accomplished. The "Whole Building Design Guide" includes the "Federal Green Construction Guide for Specifiers." The Section 00 10 00 (00100) Solicitation *(http://www.wbdg.org/design/greenspec_msl.php?s=001000)* contains language that can be used or modified for specific design requests for proposals and contracts. It suggests using incentives to assure that sustainable design goals are achieved and includes suggested wording for submittal requirements, environmental impacts, short and long-term economic impacts, and social impacts.

Integrated design for LEED buildings can be accomplished effectively using a single contract, called a design-build contract, for both the building's design and construction. Design-build contracts based on conceptual designs created by Forest Service staff have been used successfully in the Southern and Southwest regions. Forest Service engineers and architects can get copies of contract documents for this process from the regional facilities engineers of the Southern Region (currently Randy Warbington) or Southwestern Region (currently Benerito Martinez). Using design-build contracts, funds for both design and construction are obligated together, an advantage when funds must be obligated quickly. Sometimes design-build contracts can be more cost effective than separate contracts for design and construction, while in other situations separate contracts are more cost effective.

Design by Forest Service Staff

If the design is done by Forest Service architects and engineers, they should possess the same knowledge, skills, and abilities that are important for contracted design professionals. Forest Service staff members who are unfamiliar with LEED should take training such as that offered by the USGBC *(http://www.usgbc.org/DisplayPage.aspx?CMSPageID=283).* Forest Service employees who design LEED buildings should become LEED-accredited professionals. Although self-study materials are available, most employees should take training to prepare for the exam to become a LEED AP. The cost per student for each USGBC-sponsored LEED technical review class and a textbook is $470. The LEED AP exam *(http://www.gbci.org/DisplayPage.aspx?CMSPageID=28),* which is administered regularly at sites across the country, costs $300.

LEED Credits That Work for Forest Service Buildings

Some LEED credits are generally more compatible with Forest Service buildings than others. For instance, it's usually easy to achieve the credit for preserving open space around Forest Service buildings. In contrast, it's usually not possible to achieve the credit for public transportation. The reason the open space credit works and the public transportation credit doesn't is because most Forest Service buildings are in remote or rural areas. These areas are blessed with plenty of open space, but usually aren't served by public transportation systems.

The strategies most likely to provide long-term cost benefits are those that lead to a more durable and energy-efficient building. Forest Service Handbook 7309.11, chapter 70, section 71.2 *(http://www.fs.fed.us/im/directives/fsh/7309.11/7309.11_70.doc)* and the USDA's Sustainable Buildings Implementation Plan, section 3.2.2, Guiding Principle 2–Optimize Energy Performance and Use of Renewable Energy *(http://www.da.usda.gov/energyandenvironment/facilities/sbip/elements.htm)* contain a number of requirements for Forest Service buildings (even those that are not LEED certified) that will improve energy efficiency. These requirements include building energy performance targets, increased energy efficiency, measurement and verification of energy use, and use of renewable energy.

Successful Forest Service LEED office buildings usually emphasize reducing energy transfer through the building walls and roof. The buildings are well insulated. Heat or cold that moves more rapidly through framing (particularly metal) than through the adjacent insulation is called thermal bridging. Thermal bridging is minimized or eliminated by using exterior insulation or structural insulated panels. Energy-efficient windows, with low-emissivity glass coatings, inert gas between the double glass panes, and nonmetallic frames also reduce heat loss and gain through the building walls. In addition, many Forest Service offices use air-to-air heat exchangers for their ventilation systems and efficient heating and cooling systems, such as ground-coupled heat pumps.

A table has been developed using data from 19 Forest Service LEED offices across the country that shows how likely it is that each available LEED credit can be successfully incorporated into Forest Service offices. See the "LEED Prerequisites and Points for Forest Service Offices" table in appendix A. The table shows the average likelihood that sustainable strategies including particular points can be incorporated successfully. Because of local conditions and climate, the actual strategies used will be different in different areas.

Life-cycle cost analysis is a great tool for determining which strategies will be most cost effective over the life of the building. More information about life-cycle cost analysis is in the publication "Life-Cycle Cost Analysis for Buildings Is Easier Than You Thought," at *http://www.fs.fed.us/t-d/pubs/htmlpubs/htm08732839* (Username t-d, Password: t-d).

Communicating With the Design Team

Forest Service employees who will make decisions about the design, such as the contracting officer and ranger, should become familiar with LEED requirements and objectives so they will be able to communicate effectively with the design professionals. Design team members who are not design professionals should also understand LEED requirements. If these people are unable to attend training courses such as those included in LEED Level 100: Awareness *(http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1759),* they should at least become familiar with reference materials that explain what LEED is and how it works.

LEED brochures that provide basic information are available from the USGBC. Up to 20 free brochures can be ordered. The LEED reference guides that provide comprehensive advice and information on using the LEED rating system for building projects cost more than $100. The guides contain case studies as well as documentation requirements, recommended design strategies and technologies, potential design synergies and tradeoffs, calculation methods and formulas, and resources for each potential point and requirement. Brochures, reference guides, and other LEED publications can be ordered at *http://www.usgbc.org/Store/PublicationsList.aspx?CMSPageID=1518*.

Because LEED is a fairly new system, there are big differences in design firm competencies. Here are a few tips from colleagues in the Forest Service who have worked with design contractors on LEED projects.

- Thoroughly cover LEED at the start of the design process and at every design team meeting and design review.
- Make sure design team members continually discuss integrating LEED strategies across disciplines.
- If the design team or Forest Service personnel are unfamiliar with LEED, the entire design team, including Forest Service personnel, should meet and receive some basic training about LEED and how LEED projects differ from standard design, contracting, documentation, and construction practices.
- Determine the LEED credits that make sense for the project and assign responsibility to specific design team members for accomplishing specific credits.
- Set up checklists or spreadsheets to track responsibilities, show which LEED credits will be satisfied by which specific design strategies, and confirm when the design and specifications that satisfy each credit are completed.
- Set up a LEED-Online account (*https://leedonline.usgbc.org/)* and make sure that the design templates and required additional documentation are completed during design or before final payment for the design work.

What Line Officers Need To Know

It is critical that the design team understands from the beginning of the project that it must focus on selecting cost-effective methods of achieving LEED certification. For instance, materials such as ceiling tiles with recycled content are available at no cost premium. The same recycled material points could be achieved with materials such as recycled glass tiles, but these tiles cost significantly more than ordinary ceramic tiles. Sometimes, premium materials are desirable. However, don't assume there is no other choice if a member of the design team says an expensive material, construction method, or system is needed to achieve LEED points.

LEED Documentation During Design

Most LEED documentation is accomplished or begun during the design phase, including:

- All the sustainable sites credits (although documentation will also be required after construction for some of the credits)
- All the water efficiency credits
- Energy performance and daylighting modeling
- Onsite renewable energy generation
- Building and materials reuse
- Ventilation and indoor air quality
- Lighting and thermal systems controllability
- Innovation in design

Although LEED documentation used to be submitted on paper, the version of LEED that debuts mid 2009 only allows electronic documentation using LEED-Online. LEED-Online is already the most effective method for documentation.

LEED credits are documented using templates supplied by the USGBC (figure 9) and additional documentation, in some cases. The templates were developed to help project personnel assemble the information they need to demonstrate compliance with requirements for each credit. Sample credit templates are at *http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1447.*

To help others understand how the templates should be completed, Harvard University has posted all the LEED credit documentation for 10 LEED for New Construction projects at *http://www.greencampus.harvard.edu/theresource/leed-submit/nc/.* Although most Forest Service LEED projects will be quite different from these projects, these documents can provide valuable guidance and examples of the sort of documentation that is needed.

Several persons can be granted access to the LEED-Online account that is used to complete the LEED credit templates for a project. Most project teams find that the process goes more smoothly if one person who is primarily responsible for recording the data coordinates with other team members and works with the USGBC. For simplicity's sake, this person should serve throughout design and construction. LEED documentation duties can be handed off from the design firm to the Forest Service or contractor for completion during the construction phase, if necessary.

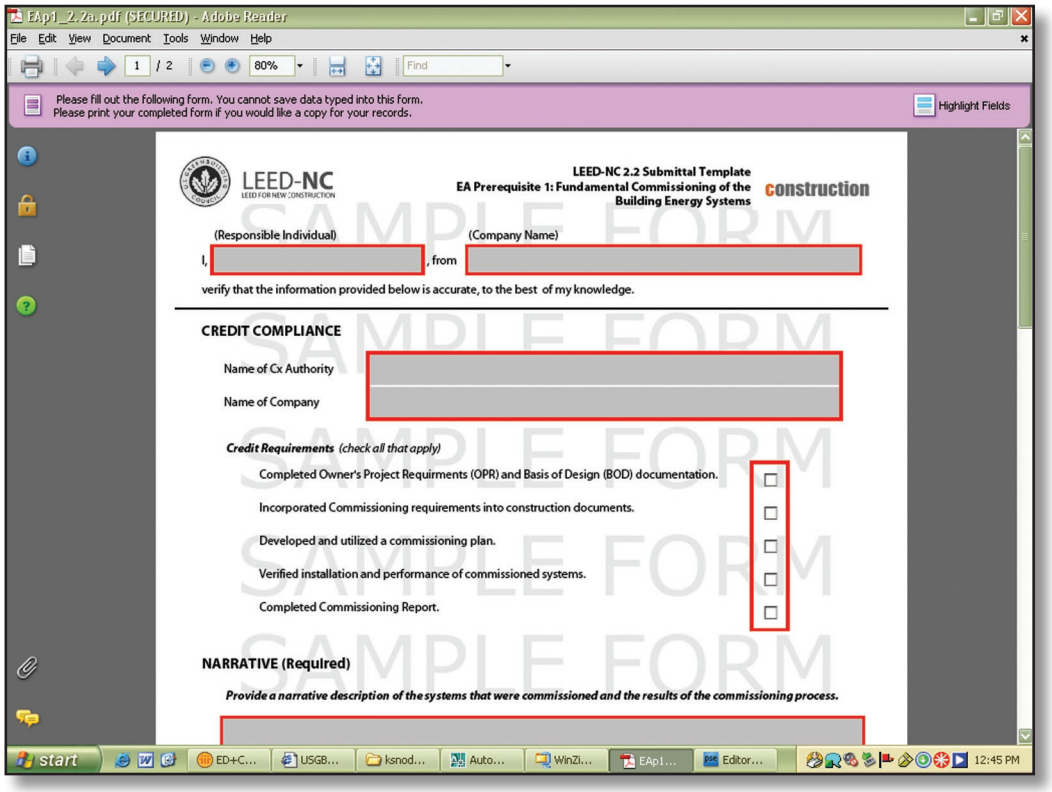

Figure 9—LEED credit and prerequisite documentation templates are available on the Web. This sample template is for Energy & Atmosphere Prerequisite 1, Fundamental Commissioning of Building Energy Systems.

Excellent Construction Specifications Lead to Successful LEED Projects

Specifications can't ensure LEED certification will be achieved, but clear, concise specifications that contain the information contractors need to meet LEED requirements make it more likely the building will achieve the desired LEED certification and help to reduce costs, changes, and disputes.

If a single contractor is responsible for design and construction, the design specifications could simply state the LEED rating that must be achieved. If the specifications are written this way, it becomes the contractor's job to figure out how to achieve the LEED rating. However, if some LEED strategies are more important than others, such as energy efficiency or long-term cost effectiveness, those requirements should be emphasized.

If separate design and construction firms work on the project, it's important to specify materials and explain requirements carefully. Construction will generally be more expensive if specifications are vague or if contractors have to figure out what materials and configurations will meet LEED requirements. The construction specifications should clearly explain requirements for

- The LEED certification level that the finished building must achieve
- LEED documentation, including assigning responsibility for completing LEED-Online credit templates and supporting documents, and for identifying the supporting documents that are acceptable—include checklists or templates where appropriate
- Establishing and implementing plans and procedures for indoor air quality, diverting construction debris from landfills, erosion and sedimentation control, and so on
- Identifying makes and models of equipment, materials, fixtures, and products that will meet LEED requirements such as recycled content or regional materials
- The standards that "or equal" products must meet to be considered the equivalent of the specified makes and models

Forest Service employees who have worked on LEED projects recommend including LEED-related information specific to each type of work within that specification section. Keeping all requirements for the same type of work together ensures that subcontractors will see the LEED requirements alongside all the other requirements for their work.

It's always tough to write specifications that differ from those that are customary. Fortunately, example LEED construction specifications are available on the Web. Specifications for three successful Forest Service LEED projects are available to Forest Service and Bureau of Land Management employees on the Forest Service's internal computer network at *http://fsweb.wo.fs.fed.us/eng/programs/facilities/leedspec/.* Specifications are available in the "Federal Green Construction Guide for Specifiers" at *http://www.wbdg.org/design/greenspec.php.* Specifications for energy and resource efficiency from the California Energy Commission are at *http://www.eley.com/specs/downloads.htm.* Sustainable design guideline specifications for four Division I sections (organized in the MasterFormat structure) are available from BuildingGreen, LLC, a building industry information resource group, in their "GreenSpec" directory at *http://buildinggreen.com/guidespecs/.*

What Contracting Officers Need To Know

Don't include any work to achieve the required LEED certification in "add items"—doing so runs the risk of unduly high costs or not achieving LEED certification.

Do include a provision for liquidated damages on projects that are required to achieve LEED Silver if the required LEED certification isn't achieved due to actions of the contractor. The basis for the liquidated damages is that if the building doesn't achieve certification, the Forest Service will either have to pay for additional work to achieve certification, or accept a building that is worth less than specified and one that might have higher operating and maintenance costs.

Is There a LEED Cost Premium?

The following examples show there is no one right answer to the question "Does it cost more to build to LEED standards?" Generally speaking, over the life of a building, an effectively designed LEED building is as cost effective as standard construction. LEED buildings with more credits in the Energy & Atmosphere and Water Efficiency categories tend to be more cost effective than standard buildings, over the long term. The initial cost for such buildings may be higher than for standard construction, as the following examples illustrate.

The Rocky Mountain Region found that the initial cost for the Bessey Ranger District office (figure 10) in Halsey, NE, was higher than would have been expected with standard construction. The Rocky Mountain Region staff includes several LEED APs, and one was assigned to shepherd the Bessey Ranger District office project. The 7,700 square-foot office, which includes showers and space for containers used to collect materials for recycling, was the first Forest Service building to be LEED certified at the Silver level. Costs for design, energy modeling, commissioning, construction, and LEED documentation were $143 per square foot, about 11 percent higher than the cost would have been without LEED. The region suspects that there is a higher LEED premium as a percentage of the total building cost for smaller buildings.

Figure 10—The Bessey Ranger District and Nursery office in Halsey, NE (Rocky Mountain Region, Nebraska National Forest), was the first Forest Service building to achieve LEED Silver certification. The building achieved four points (the maximum) in the Innovation & Design Process category because the district entered into a long-term contract to purchase renewable energy credits equal to 100 percent of the electricity used by the building, cut potable water use in half, doubled the required amount of preserved and restored open space around the building, and created an exhibit explaining the sustainable features of the building. District employees provide presentations on the building's sustainable features.

What Line Officers Need To Know

Those who haven't kept up with directives and regulations in the last couple of years may be surprised to learn that buildings designed for the Forest Service, whether LEED certified or not, must use many of the sustainable design strategies that earn LEED points. These requirements will result in better Forest Service buildings, but there will be an initial cost premium over other buildings constructed to meet just the minimum building code requirements.

The Southern Region has not experienced any cost premium for design and little if any cost increase for construction of several LEED office projects. The Southern Region has several LEED APs on the Regional design staff, and they often do much of the LEED documentation and commissioning. The Sylamore Ranger District office (cover figure) in Mountain View, AR, was the first Forest Service building to be LEED certified. It is certified at the Basic level because design for the building was completed before the Forest Service required LEED Silver certification. The cost of construction was $175 per square foot for the 4,877 square-foot building.

The Southern Research Station paid 35 percent more than standard construction costs for the Savannah River Forestry Sciences Laboratory (figure 11) in Aiken, SC. Stringent design standards at the County Research Campus, where the lab is located, were responsible for some of the cost increase. The 3,734 square-foot lab building cost $223 per square foot. The facilities engineer in charge of the project is a LEED AP. The contractor, however, was inexperienced with LEED. The station experienced more challenges in obtaining LEED Silver certification for the small, specialized lab than it would have for an office building.

Other than extra costs for LEED certification and documentation, the Southwestern Region probably hasn't

Figure 11—The Savannah River Forestry Sciences Laboratory in Aiken, SC (Southern Research Station), uses operable steel shutters over the insulated, low-emissivity windows to protect the interior from the sun's heat. Other sustainable design features include a ground-source heat pump heating and air-conditioning system, highly efficient light fixtures, minimal storm water runoff and improved runoff water quality, and retention of nearly all the site's existing vegetation. The lab is 33 percent more energy efficient than a standard building. The "rockets" on the roof are actually lab hood vents.

experienced cost increases that are directly attributable to LEED, although the recent huge increase in construction costs makes it hard to tell. The Southwestern Region has two offices under construction at the time of publication that should achieve LEED Silver certification: the 8,300 square-foot Verde Ranger District office (figure 12) in Camp Verde, AZ, and the 10,250 square-foot Sacramento Ranger District office (figure 13) in Cloudcroft, NM. The offices were first advertised locally as design-build projects. There were no bidders because local contractors and architects had plenty of other work at the time and they felt that LEED Silver certification would be too time consuming. When the two offices were advertised as a single design-build project nationally, based on conceptual designs developed by Forest Service staff, 15 firms bid. The region feels that the integrated decisions of the design-build process and a focus on value engineering and cost-effective design choices have been integral to containing costs.

The Northern Region's Sandpoint Ranger District (figure 14) in Sandpoint, ID, will be that region's first LEED-certified building. The region paid about $25,000 extra for the building design and LEED registration. Although

Figure 13—The Sacramento Ranger District office in Cloudcroft, NM (Lincoln National Forest, Southwest Region), was about 68 percent complete when this photo was taken in September 2008. The locally produced wood trusses visible in the photo will be a dramatic feature in the finished entry and lobby area. Other locally produced products that will be used in the structure include gypsum board, carpeting, landscaping, asphalt, and concrete.

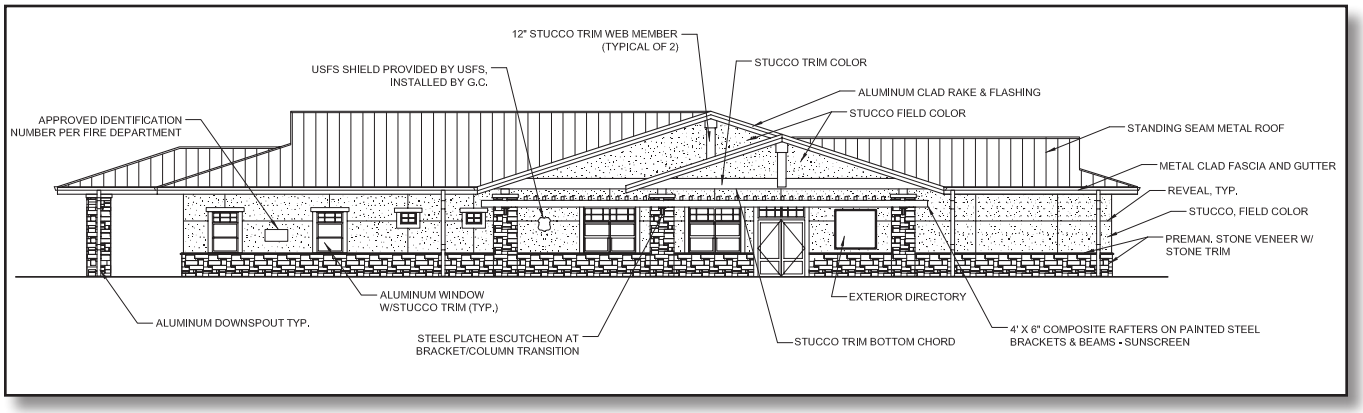

Figure 12—The Verde Ranger District office in Camp Verde, AZ (Prescott National Forest, Southwestern Region), will be water efficient, both inside and outside, and will employ many other sustainable design strategies. Construction began on the steel-roofed building during 2008. Stucco and rock siding and window detailing complement traditional buildings in the area.

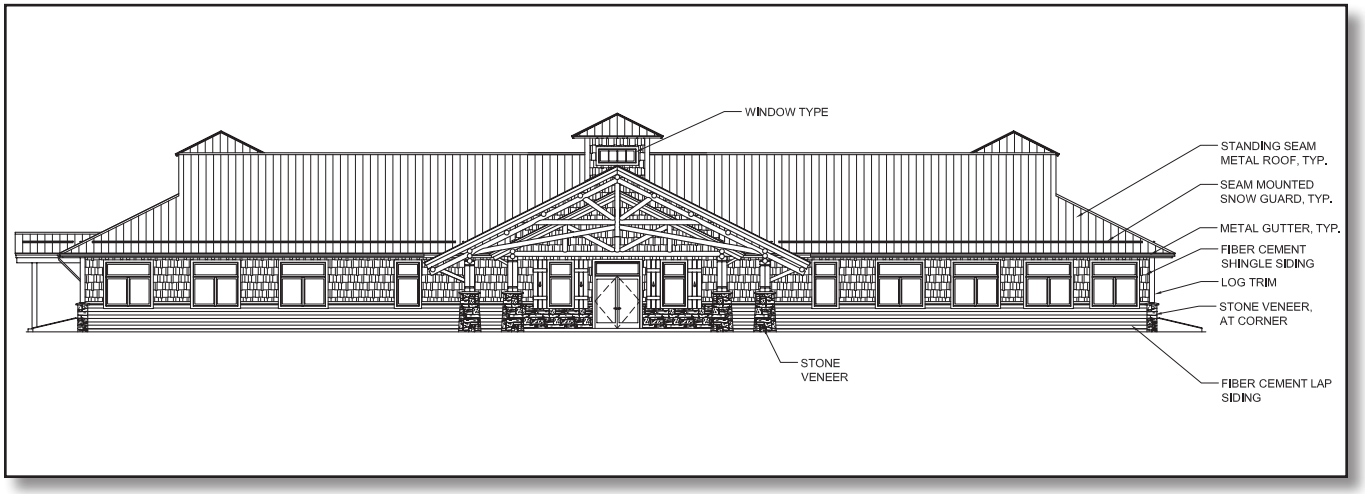

Figure 14—The design for the Sandpoint Ranger District office in Sandpoint, ID (Idaho Panhandle National Forests, Northern Region), includes the use of locally produced small-diameter logs for bundled columns and trusses supporting the porch and lobby area roofs. A ground-source heat pump will supply energy-efficient heating and cooling.

the design firm's staff included several LEED-accredited professionals, the staff may not have been experienced in cost-effective, energy conscious design. Although the region hopes to achieve LEED Silver certification for the building, the design may not have been as effective as it could have been if the designers had been more experienced in LEED and integrated design. The construction contract for the Sandpoint Ranger District office had not yet been awarded at the time of publication. The architect's estimate of about $250 per square foot is a 10-percent initial construction cost premium for the 13,336 square-foot building. Construction on the new office was scheduled to start in early 2009.

Some costs of LEED design are unavoidable, including the costs of LEED registration, documentation, commissioning, and submittal. However, extra construction costs can be avoided in many cases by using cost-effective design strategies (figure 15). It pays (literally) to use designers who are comfortable and experienced with integrated design methods and with LEED design and construction.

A table has been developed using data from 19 Forest Service LEED offices across the country that shows initial costs and life-cycle payback time for each LEED credit. See the "LEED Prerequisites and Points for Forest Service Offices" table in appendix A.

Figure 15—Although not LEED certified, the leased building that the Lincoln National Forest Supervisor's Office (Southwestern Region) shares with several other USDA offices has many sustainable features. For example, the 110 solar panels on the roof provide 15 percent of the electricity used in the building.

Construction Engineering Strategies That Work for Forest Service LEED Buildings

Managing a LEED project is more demanding than ordinary construction engineering. Forest Service personnel who are working with designers and contractors on LEED projects need to know what they're doing. If contracting officer representatives (CORs) aren't already LEED APs, it would be smart to send them to a LEED Technical Review Workshop *(http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1761)*, so they will understand what is required to certify a LEED project. The inspectors also should attend LEED training, if possible.

What Line Officers Need To Know

LEED projects take at least 15 percent more COR and inspection time. Construction engineering time can easily double or triple if Forest Service personnel are doing the building commissioning or LEED documentation. Be sure the construction engineering budget is large enough to cover increased construction engineering time for LEED buildings.

Commissioning

One of the biggest differences between LEED and ordinary construction practices is that commissioning is required for all LEED-certified buildings. Commissioning is a comprehensive, systematic investigation and tuneup process that examines all of a building's operating systems and assures that the building is constructed and will operate as intended and that it satisfies the owner's operational needs. Because of time and cost constraints and competing demands for their attention, even highly competent contractors and CORs can't assure that everything will work correctly in a new building, but a commissioner usually can. Most commissioners are electrical or mechanical engineers and have many years of experience with electrical, HVAC, and plumbing systems. These are the most critical systems and the ones most likely to have problems. LEED refers to the firm that handles commissioning as the "commissioning agent."

Commissioning a building normally costs a little less than 1 percent of the total construction cost. Typically, the costs of the schedule overruns, change orders, and corrections after occupancy in uncommissioned buildings are far more than the cost of commissioning. In addition, a building that is not commissioned usually costs 8 to 20 percent more to operate than a commissioned building. Commissioning is cost effective, but the expense is paid up front and the savings are recovered over time.

In the Southern Region, the Forest Service is the commissioning agent, although the trained personnel who do the commissioning contract out much of the measurement and testing. Most units will need to hire commissioning contractors because they don't have enough staff or construction projects to justify training Forest Service personnel. Forest Service and BLM employees can learn more about commissioning at *http://fsweb.wo.fs.fed.us/eng/programs/facilities/commissi.htm*. BuildingGreen's online specification Section 01 91 00–General Commissioning Requirements *(http://www.buildinggreen.com/guidespecs/Cx_Section_01_91_00.doc)* explains how commissioning works and provides an example specification that can be modified for incorporation into individual project specifications.

What Contracting Officers Need To Know

Unless the commissioning is handled by Forest Service employees, it's best to hire a commissioning contractor who is independent of the design and construction contractors so that the commissioner answers only to the Forest Service. This assures that the commissioner will not compromise quality because of the interests of the design or construction firm. If it's not possible to hire a completely independent commissioning contractor, the commissioning work should be included with the design contract rather than the construction contract.

LEED Documentation During Construction

Another difference between LEED projects and ordinary construction is the need to track and document design and construction decisions, materials, and methods so the information can be submitted for LEED certification. This process starts during project design and continues throughout construction and in some cases after construction is complete. Documentation includes not only design strategies, written explanations, and energy modeling, but such things as specific makes and models of equipment that are installed, invoice or cut sheet (manufacturer's information) evidence that materials meet the LEED requirements, operations and maintenance manuals and training that are more thorough than standard practice, documentation that construction debris has been sorted and the required percentage has been reused or recycled, and evidence of indoor air quality management during construction.

The LEED documentation process, templates, and requirements are explained in the "LEED Documentation During Design" section of this report.

Selecting and Working With Contractors

Contractors who don't have experience with LEED tend to bid high to compensate for unknowns. They may not appreciate the impact that small changes can make on whether LEED points are achieved or the importance of tracking and documenting LEED items. Contractor experience, frequent communication, and meticulous tracking are essential to successful LEED construction projects. Here are a few tips from Forest Service employees who have worked on LEED construction projects:

- Make sure one of the selection criteria for the construction contractor is experience in building structures that are LEED certified.
- Thoroughly cover LEED and commissioning at the prebid meeting, the preconstruction conference, and all progress meetings during construction.
- Confirm how the contractor intends to meet requirements for each LEED credit and that the contractor has assigned responsibility for accomplishing specific credits to specific subcontractors or work teams.
- Use LEED checklists or spreadsheets to track the LEED points that must be satisfied during each phase of construction, when the work has been completed, and when documentation has been completed.
- Make sure that the construction templates and required additional documentation are entered into LEED online *(https://leedonline.usgbc.org/)* during construction or before final payment is made for the construction work.

What Contracting Officers Need To Know

To assure that LEED requirements are accomplished:

- Make sure that the LEED requirements are in the contract.
- Remind the contractor about the LEED requirements during the preconstruction conference and other construction meetings
- Make progress payments and final payments to the contractor contingent on proper, timely submittal of LEED documentation.

The Future of Sustainable Buildings in the Forest Service

Because of the Forest Service emphasis on caring for the land and serving people, requirements for environmentally responsible structures (figure 16) will continue and probably will expand. Sustainability requirements for existing building systems and structures and their operations and maintenance will probably increase. In addition, sustainable building practices may be folded into the Forest Service's environmental management system.

Figure 16—The new furniture inside the Shoal Creek District office in Heflin, AL (Southern Region, National Forests in Alabama), was manufactured from materials that don't emit toxic chemical gasses. The open workstations look out through a glass wall into the forest. The wide overhang and low-emissivity, tinted glass keeps sunlight from overheating the building interior.

Although other sustainable building rating systems are now available, the Forest Service will continue to use the LEED system. At this time, LEED is the most widely recognized and respected sustainable building certification system. As the Forest Service continues to consider how best to assure that its structures don't adversely impact the environment, other changes in policy may be made. For instance, as sustainable building rating systems continue to mature, the Forest Service may add an option to certify buildings under Green Globes *(http://www.greenglobes.com/)* or another system.

LEED will introduce an updated version in January 2009. See *http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1849* for more information about LEED version 3, which will include more emphasis on water use, energy efficiency, human health, and greenhouse gas emissions, and will incorporate regional credits. Future plans for LEED include incorporating life-cycle assessments. More information about life-cycle assessment is available in the "Life-Cycle Assessments Can Help You Make Sustainable Choices" section of the Forest Service publication "Life-Cycle Cost Analysis for Buildings Is Easier Than You Thought" (*http://www.fs.fed.us/t-d/* Username: t-d, Password: t-d).

LEED Can Work for the Forest Service

Designing and constructing LEED buildings requires integrated effort early in the process—a big change from standard practices that have been used in the past. Designs include uncommon features, specifications include new materials and sections, more tracking and documentation is required, and buildings must be commissioned. LEED design features, registration, documentation, commissioning, and submittal may all add costs to design and construction, so it's important to use cost-effective design strategies and contractors who are experienced with integrated design methods and with LEED design and construction.

However, over the long term well-designed LEED buildings can be as cost effective as ordinary buildings (or even more cost effective). The information and tools in this report should make it easier to implement LEED in the Forest Service.

LEED Prerequisites and Points for Forest Service Offices (Based on LEED for New Construction, Version 2.2)

Required for all LEED projects (for other Forest Service requirements, see the Notes column)
Most Forest Service projects will be able to incorporate this credit (38 points)
Some Forest Service projects will be able to incorporate this credit (23 points)
A few Forest Service projects will be able to incorporate this credit (8 points)

Credit	Credit name	Extra initial cost	Life-cycle payback	Notes
	LEED registration	$450	None	
	LEED submittal documentation	$4,000 to $20,000	None	
	LEED submittal	$1,750 to $17,500	None	Cost depends on building size
Sustainable Sites				
SS–P1	Construction Activity Pollution Prevention	None to $1,000	None	Erosion and sedimentation control plans are already required by FS, may need to adjust
SS–1	Site Selection	$0	None	Most FS office sites meet these criteria
SS–2	Development Density & Community Connectivity	$0	None	Most FS offices cannot meet these requirements because they are at rural/remote sites
SS–3	Brownfield Redevelopment	$20,000+	None	Most FS offices are located on uncontaminated sites
SS–4.1	Alternative Transportation: Public	$0	None	Most FS offices cannot meet these requirements—rural/remote sites are rarely served by mass transit
SS–4.2	Alternative Transportation: Bicycle Storage & Changing Rooms	$200 to $20,000	None	Many FS offices need showers for firefighters anyway, so the only extra cost is for bike racks—cost is higher if showers are added
SS–4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles	$80 to $2,500	5+ years	FS usual method: install signs to provide preferred parking, provide electric outlets; fleet vehicles count
SS–4.4	Alternative Transportation: Parking Capacity	- $2,000 to $300	Immediate or none	FS usual method: install signs to provide preferred vanpool parking, reduce parking area
SS–5.1	Site Development: Protect or Restore Habitat	None to $5,000	None	
SS–5.2	Site Development: Maximize Open Space	$0	None	
SS–6.1	Stormwater Design: Quantity Control	None to $10,000	None	Erosion and discharge quantity control already required for FS may need to modify
SS–6.2	Stormwater Design: Quality Control	$2,000 to $50,000	10+ years to none	Requires filtering—check local stormwater requirements—shorter payback time, less extra cost in areas where stormwater regulations are strict
SS–7.1	Heat Island Effect: Non-Roof	None to $20,000	5+ years	FS usual method: vegetation (difficult in dry climate areas)
SS–7.2	Heat Island Effect: Roof	$500 to $500,000	2+ years	$6 to $17/ft^2 extra for green roof, a few cents/ft^2 extra for high-albedo roof
SS–8	Light Pollution Reduction	None to $2,500	2+ years	FS usual documentation: photometric site plan

Credit	Credit name	Extra initial cost	Life-cycle payback	Notes
Water Efficiency				
WE–1.1	Water Efficient Landscape: Reduce by 50%	None to $1,000	Immediate to 1 year	
WE–1.2	Water Efficient Landscape: No Potable Water Use or No Irrigation	$200 to $5,000	1+ years	May conflict with local municipal or development requirements
WE–2	Innovative Wastewater Technologies	$800 to $5,000	2+ years	FS usual methods: WE–3.2 plus onsite wastewater treatment or composting toilets
WE–3.1	Water Use Reduction: 20% Reduction	$50 to $100 per fixture	2+ years	FS usual methods: waterless or pint-flush urinals, dual-flush toilets, low-flow faucets
WE–3.2	Water Use Reduction: 30% Reduction	$50 to $200 per fixture	5+ years	FS usual methods: sensing faucets, low-flow showers
Energy & Atmosphere				
EA–P1	Fundamental Commissioning of Building Energy Systems	10¢ to $2.5/ft^2	1+ years	Focuses on mechanical and electrical systems; **required of FS by SBIP;** some FS units do this inhouse
EA–P2	Minimum Energy Performance	None to $7/ft^2	Immediate to 5 years	**FS already required to comply with ASHRAE Standard 90**
EA–P3	Fundamental Refrigerant Management	None to $1,000	10+ years	FS already advises no use of CFCs (chlorinated fluorocarbons)
EA–1	Optimize Energy Performance (1 to 10 points)	None to $20/ft^2	Immediate to 30 years	**FS already required by SBIP to use 30% less energy than ASHRAE 90** (4 points); FS usual proof method: energy modeling software
EA–2	Onsite Renewable Energy (1 to 3 points)	$3,000 to $12,000/ kW	10 to 40 years	**FS already required to purchase or generate 3% renewable energy (5% by 2010, 7.5% by 2013)**
EA–3	Enhanced Commissioning	None to $2/ft^2 added to EA–P1	2+ years	Some FS units do this inhouse; includes design input, submittal review, O & M manual/training, 6-month operations review
EA–4	Enhanced Refrigerant Management	- $20,000 to $10,000	Immediate to 10+ years	
EA–5	Measurement and Verification	$800 to $25,000	5+ years to none	
EA–6	Green Power	$3 to $20/MWh	None	**FS already required to purchase or generate 3% renewable energy (5% by 2010, 7.5% by 2013)**

Credit	Credit name	Extra initial cost	Life-cycle payback	Notes
Materials & Resources				
MR–P1	Storage & Collection of Recyclables	$1,600 to $10,000	5+ years to none	**FS units already required to recycle by SBIP;** extra heated/cooled space seldom required
MR–1.1	Building Reuse: Maintain 75% of Existing Walls, Floors & Roof	- $50 to $30/ft^2	Immediate or none	Most likely to be used during historic structure renovations
MR–1.2	Building Reuse: Maintain 95% of Existing Walls, Floors & Roof	- $50 to $30/ft^2	Immediate or none	
MR–1.3	Building Reuse: Maintain 50% of Interior Non-Structural Elements	- $20 to $10/ft^2	Immediate or none	
MR–2.1	Construction Waste Management: Divert 50% From Disposal	- 25¢ to $1/ft^2	Immediate or none	**Already required of FS by SBIP "where markets or on-site opportunities exist;"** can be tough in remote or sparsely populated areas
MR–2.2	Construction Waste Management: Divert 75% From Disposal	- 25¢ to $1/ft^2	Immediate or none	70% to 80% of light construction waste is wood, cardboard, and gypsum; cost effective to recycle in many locations
MR–3.1	Materials Reuse: 5%	- $10,000 to $20,000	Immediate or none	
MR–3.2	Materials Reuse: 10%	- $20,000 to $40,000	Immediate or none	
MR–4.1	Recycled Content: 10%	$0	None	FS most common materials: carpet, drywall, ceiling tiles
MR–4.2	Recycled Content: 20%	$0	None	
MR–5.1	Regional Materials: 10%	$0	None	Local lumber counts
MR–5.2	Regional Materials: 20%	$0	None	
MR–6	Rapidly Renewable Materials	None to 10% of material cost	None	
MR–7	Certified Wood	None to 30% of material cost	None	

Credit	Credit name	Extra initial cost	Life-cycle payback	Notes
Indoor Environmental Quality				
EQ–P1	Minimum IAQ Performance	$0	Paybacks in employee productivity depend on employee salary/benefits: 5 to 10+ years; see *http://eetd.lbl.gov/ied/sfrb/performance-summary.html*	**Already required by code or standard FS specifications in most locations**
EQ–P2	Environmental Tobacco Smoke	None to $5,000		**USDA smoking policy meets this requirement;** some units provide an outdoor shelter
EQ–1	Outdoor Air Delivery Monitoring	avg. $2,000 per zone		FS usual method: carbon dioxide monitors in occupied spaces
EQ–2	Increased Ventilation	$3,000		
EQ–3.1	Construction IAQ Management Plan	None to $1,000		**Required by SBIP**—check proposed furnace for suitable filter types if the furnace is used during construction
EQ–3.2	Pre-Occupancy IAQ Management Plan	$100 to $1,000		FS usual method: 2-week flush out of the building
EQ–4.1	Low-Emitting Materials: Adhesives & Sealants	None to 2% of material cost		**FS already required to use low-emitting materials by SBIP**
EQ–4.2	Low-Emitting Materials: Paints & Coatings	None to 2% of material cost		
EQ–4.3	Low-Emitting Materials: Carpet Systems	None to 2% of material cost		
EQ–4.4	Low-Emitting Materials: Composite Wood & Agrifiber Products	None to 5% of material cost		
EQ–5	Indoor Chemical & Pollutant Source Control	None to $5,000		**Most measures are required by SBIP, code, or standard design practice**
EQ–6.1	Controllability of Systems: Lighting	None to $1,500 per zone		FS usual method: individual workstation controls or individually controlled task lighting
EQ–6.2	Controllability of Systems: Thermal Comfort	None to $3,000		FS usual methods: operable windows, controllable registers
EQ–7.1	Thermal Comfort: Design	$0		**ASHRAE 55 & 62.1 already required by SBIP**
EQ–7.2	Thermal Comfort: Verification	$500 to $2,000		
EQ–8.1	Daylight & Views: Daylight 75% of Spaces	$800 to $3,000	2+ years	**Already required by SBIP;** FS usual documentation: simulation software
EQ–8.2	Daylight & Views: Views for 90% of Spaces	$200 to $1,000	5 to 10+ years	

Credit	Credit name	Extra initial cost	Life-cycle payback	Notes
Innovation & Design Process				
ID–1.1	Innovation in Design	Varies	Maybe; depends on the design	FS strategies: doubling amount of protected habitat/open space, 100% green power, 50% reduction in water use, provide public education on sustainability in the building, radon mitigation, green housekeeping, low VOC furnishings, more effective air filtration, integrated pest management plan
ID–1.2	Innovation in Design			
ID–1.3	Innovation in Design			
ID–1.4	Innovation in Design			
ID–2	LEED Accredited Professional	$0	Immediate to 5 years	One-time costs: LEED class/book: $470, LEED exam: $300

Acronyms:

ASHRAE = American Society of Heating, Refrigerating and Air-Conditioning Engineers
FS = Forest Service (an agency of the U.S. Department of Agriculture)
LEED = Leadership in Energy and Environmental Design (sustainable building certification program of the U.S. Green Building Council)
O & M = Operations and maintenance
SBIP = U.S. Department of Agriculture Sustainable Buildings Implementation Plan
USDA = U.S. Department of Agriculture
VOC = Volatile organic compounds

About the Author

Kathleen Snodgrass came to MTDC as a project leader in 2001. She graduated from Washington State University in 1974 with a bachelor of science degree in architectural studies, then worked about 10 years in highway design and construction for the Idaho Division of Highways. She began her Forest Service career in 1984. Kathie worked in facilities, landscape architecture, land line, and general engineering on the Nez Perce National Forest for 10 years and was the forest's facilities architect for about 7 years before coming to MTDC.

Library Card

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