chapter 1

Green Construction and the Contractor

1.1 INTRODUCTION

Concern about the environment and the future of our planet has become the focal point of everyday conversation, political debate, and media coverage in the United States today. The United States currently uses a significant amount of the world's energy and produces a significant portion of the world's greenhouse gases. This debate was focused on the industrial, manufacturing, and transportation sectors in the past, but energy usage and its associated environmental impacts have become a major issue in the building industry. Commercial and residential buildings consume about 40 percent of the energy used in the United States, according to the U.S. Department of Energy's Energy Information Agency [EIA 2007]. In addition, both the amount of energy used in buildings and its percentage of the total U.S. annual energy usage is expected to increase in the coming decades despite conservation initiatives, increased building efficiency, and rising energy costs. As a result, more building owners, including all levels of government, are demanding high-performance buildings and are seeking third-party certification to verify and publicly recognize their commitment to the environment.

All of this change has put the construction industry in a reactive mode as it adjusts to the new technical and administrative requirements that are being imposed by the project contract documents and third-party certification requirements. However, green construction doesn't have to be just another contract requirement and associated risk that the contractor must address.

Instead, the contractor can embrace the principles of green construction and become proactive, which is not only good for the environment but also good for business. This chapter introduces green construction and the role of the contractor in creating a sustainable environment through green construction practices.

1.2 SUSTAINABLE DEVELOPMENT: WHAT IS IT?

The World Commission on Environment and Development (WCED) developed a definition of *sustainable development* that was included in its 1987 report. This report has become known as the Brundtland Report after the chair of the commission, G. H. Brundtland. The WCED's definition has been widely accepted since its publication and is as follows [WCED 1987]:

> Humanity has the ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits—not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activity.

The key phrase in the WCED's definition of *sustainable development* is that sustainable development "meets the needs of the present without compromising the ability of future generations to meet their needs." Buildings constructed and renovated today should have a useful life of 30 or more years. Construction plays an important role in sustainable development because it uses the earth's resources to build the buildings where people live, work, and play. Just like every other industry, the construction industry is responsible for the environment. Contractors can strive to ensure that the construction process is efficient, uses renewable resources, and minimizes resource use and waste within the confines of the owner's construction procurement process and contract documents.

1.3 GREEN BUILDING DEFINED

The term *green building* is defined in the American Society of Testing and Materials (ASTM) Standard E2114-06a as a building that provides the specified building performance requirements while minimizing disturbance to

and improving the functioning of local, regional, and global ecosystems both during and after its construction and specified service life [ASTM E2114]. This definition illustrates the importance of the construction process in the making of a green building. During construction, it is about minimizing the environmental impact of the construction process on the environment through procurement, site layout and use, energy use, waste management, and construction operations. However, the contractor's impact on building sustainability doesn't stop at substantial completion. A project delivery system that involves the contractor in the design process or provides leeway in the contract documents may allow the contractor to use materials and installation techniques based on its expertise and experience that will minimize operation and maintenance (O&M) costs over the life of the building, provide a more durable facility, reduce building-related illnesses that impact the well-being and productivity of building occupants, and maximize the reuse of building materials at the end of the building's life.

1.4 GREEN CONSTRUCTION: REACTIVE OR PROACTIVE?

From a reactive standpoint, green construction only occurs because of the requirements contained in the contract documents. The contractor builds the building in accordance with the project plans and specifications and is only passively involved in sustainable development. This is mainly how the construction industry has approached green construction in the past. However, it is becoming more difficult for the contractor to sit on the sidelines and not be actively involved in green construction. In addition to being socially responsible and good corporate citizens, contractors should become involved in green construction for several reasons, including the following:

- Owners are demanding that their suppliers demonstrate their commitment to the environment and provide environmentally sustainable products and services. This includes the construction services provided by contractors and may offer a competitive advantage for environmentally proactive contractors.
- Many contractors' field and office employees are concerned about the environment and prefer to work for an environmentally conscious firm and feel that they are contributing to the solution rather than being part of the problem.

- Environmental laws and regulations that contractors are subject to are increasing, along with the liability, fines, and cleanup costs associated with noncompliance.
- Overhead costs associated with complying with environmental laws and regulations, as well as insurance premiums for environmental coverage, are increasing.
- The public is becoming increasingly concerned about the environment, and there is increasing focus on all industries including construction that could result in increased governmental regulation and compliance costs for those industries that do not take a proactive approach to the environment.

In order to take a proactive approach to green construction, contractors need to make the environment a key element in both their business strategy and day-to-day operations.

1.5 GREEN CONSTRUCTION WITHOUT GREEN DESIGN?

The owner decides if it is going to build green and the extent to which the project will be sustainable during the early planning stages of the project. The design team then implements the owner's decision during the design process. Whether or not the contractor is involved in the design process, its primary function in the project delivery process is to convert the design team's design into physical reality for the owner for the agreed-upon price and within the agreed-upon time frame.

The contractor's expertise is in planning and managing the construction process and procuring the necessary labor, materials, and equipment to get the job done by either self-performing the work or contracting specific portions of the work to specialty contractors. As a result of its expertise, the contractor has sole control of the construction means, methods, techniques, sequences, and procedures unless limited by specific contract provisions in order to ensure both safe and efficient project delivery. With or without a green design, the contractor has control of the construction process and can take a proactive stance with respect to the environment and green construction. Building green does not have to be just another contract requirement that needs to be addressed during the building construction and commissioning process. The contractor can build green with or without a green design.

1.6 WHAT IS GREEN CONSTRUCTION?

Green construction is defined in this book as follows:

> Green construction is planning and managing a construction project in accordance with the contract documents in order to minimize the impact of the construction process on the environment.

This definition places the contractor in a proactive position with regard to the environment. The contractor bids or negotiates the work in accordance with the contract documents, as it always has, being mindful of selection criteria that the owner will use to select a contractor for the project. Then in planning and managing the work, the contractor's project team looks for ways to minimize the impact of the construction process on the environment, which includes (1) improving the efficiency of the construction process, (2) conserving energy, water, and other resources during construction, and (3) minimizing the amount of construction waste, among other strategies that do not adversely impact its project budget or schedule and may even reduce costs and increase productivity. Being green can be a winning proposition for the contractor.

1.7 GREEN IS LEAN

Lean construction is all about removing waste from the contractor's business and construction processes in order to make it more efficient. Green construction is also focused on removing waste from the construction process and adds an environmental dimension to lean construction. On a renovation or demolition project, the deconstruction of the existing facility can yield a significant amount of material that can be either recycled or reused, possibly creating a profit center for the contractor, diverting waste from landfills, and conserving energy and resources through recycling. When procuring materials and equipment, the contractor can work with suppliers to better package and bundle materials that could both reduce waste and improve productivity. Similarly, off-site prefabrication of materials can reduce waste at the jobsite and improve productivity. When expendables such as sealants and adhesives are purchased, low-emitting materials that can improve the working environment and productivity could be substituted for traditional materials.

1.8 THE GREEN CONTRACTOR

Being green needs to become a way of doing business and part of the contractor's corporate culture. Within the home office, the contractor should investigate ways that will promote and demonstrate its commitment to the environment as well as provide a payback when possible. This could include anything from the use of recycled copy paper to photovoltaics. The existing lighting system could be retrofitted with energy-efficient lamps and ballasts, as well as occupancy sensors and daylighting controls where appropriate. As office equipment and appliances are replaced, the new equipment and appliances could be certified as energy-efficient. Even replacement company vehicles could be hybrid vehicles or run on alternate fuels.

1.9 ADVANTAGES OF BEING GREEN

Improved productivity and reduced costs at the jobsite, as well as reduced home office overhead costs, provide tangible benefits of going green that the contractor can measure. However, other advantages of being green may be more difficult to quantify but may benefit the contractor. For one, by focusing on green construction every day, the contractor's personnel will become more knowledgeable about the possibilities. So that when an actual green construction project comes along, they will have a better understanding of the actual work and costs involved and be more effective construction team members. Similarly, a commitment to being green in both the office and the field will appeal to many of the contractor's employees. Enlisting their help in this initiative will build camaraderie and commitment to the firm. Finally, the contractor's clients are becoming increasingly environmentally conscious and are looking for the same commitment in the firms with which they work.

1.10 OVERVIEW OF THIS BOOK

This book provides a blueprint for becoming a green contractor. This chapter has started the process by defining *green construction* in such a way that the contractor can take a proactive approach to sustainability that should benefit itself, its employees and other stakeholders, and society as a whole. Chapter 2 addresses the elements of green construction that impact both home office and field operations. It also discusses the various green building standards and

rating systems to provide the contractor with an overview of the systems and their requirements.

The key to reducing risk associated with green construction is to thoroughly understand the project requirements. Bidding green construction is covered in Chapter 3. This chapter builds on previous chapters by pointing out where in the construction documents the contractor can expect to find green construction requirements and their possible impact on cost, schedule, and productivity throughout the construction process from mobilization through commissioning. Green construction requirements that address technical and administrative requirements are cross-referenced with both the 1995 and 2004 editions of the Construction Specifications Institute's (CSI) *MasterFormat*™ that are currently in use.

Contracting for green construction and the construction contract's importance in managing the contractor's risk are addressed in Chapter 4. This chapter opens with a discussion of contractual risk and risk management on construction projects and then discusses how green construction requirements can impact the contractor's role and responsibilities under common project delivery systems, including design-bid-build, construction manager agency and at risk, and design build. Typical contract documents and contract requirements that could impact the contractor on a green construction contract are then covered. This chapter closes with a discussion of insurance coverage and bonding requirements on green projects.

The use of design build as a project delivery system by owners is growing in the United States for commercial and institutional facilities. As a result, the contractor that is assuming the role of design builder on a green project needs to understand how to manage not only construction but also the design process. Chapter 5 addresses managing green design on design-build projects. This chapter starts with obtaining the services of a qualified designer for a green project and the role of the designer during construction and commissioning. Topics addressed in this chapter include defining design services needed, soliciting proposals and selecting a designer, contracting with the designer, professional liability insurance, overseeing the design process, using design reviews to ensure that the owner's green requirements are being met within budget and on schedule, and project closeout. This chapter should also be useful to the construction manager in working with the owner and designer during the project planning and design process.

Subcontracting portions of the project work to specialty contractors on green construction projects results in some unique challenges for the contractor. The success of a green construction project depends on subcontractor

performance, which means that specialty contractors must understand their roles and responsibilities. Chapter 6 focuses on the unique challenges faced by the contractor subcontracting work on a green project. This chapter covers subcontractor qualifications and the need to prequalify subcontractors for green projects, defining subcontract scope of work on green projects, educating subcontractors about their responsibilities, training subcontractors to fulfill their responsibilities, green subcontract terms and conditions, involving subcontractors in the planning and scheduling process, building system commissioning, and project closeout.

Materials and equipment are a critical factor in green building construction and the major portion of criteria used to classify or certify a green building. Even though the designer specifies materials and equipment, the contractor and its subcontractors must understand the material and equipment specifications and the characteristics that make the materials and equipment green. This makes material and equipment procurement a critical success factor for the contractor in any green construction project. Chapter 7 addresses procuring material and equipment for green building projects, with a focus on understanding green material criteria and terminology. This chapter will not only help the contractor procure the right materials and equipment for the work it self-performs, but will also help it qualify material and equipment suppliers, review subcontractor material and equipment submittals for contract compliance, provide more effective value analyses and constructability reviews, and better meet project closeout material and equipment documentation and certification requirements.

Chapter 8 addresses constructing a green project and those aspects of sustainable construction that specifically impact the contractor's construction operations. Topics that are covered include using site layout to minimize site disturbance, erosion, and runoff during construction; minimizing the use of fossil fuel and emissions through conservation and alternate fuels; reducing waste through material recycling and reuse; and improving indoor air quality during construction by using low-emitting materials, among other strategies. Also covered in this chapter are the measurement and documentation requirements that may be imposed on the contractor during construction by the contract documents or third-party green building certification process. This chapter should also be helpful to the contracting firm that wants to be more proactive environmentally and incorporate green building methods into its day-to-day construction operations.

Commissioning and closeout of a green construction project is more complex than a traditional building project, particularly if the owner is seeking

third-party certification. Chapter 9 addresses green building commissioning, including understanding the contractual requirements for commissioning, the need for a comprehensive mutually agreed-upon commissioning plan early in the project, working with an outside owner-appointed commissioning agent, typical requirements for system startup and testing, and typical documentation that needs to be submitted. In addition, typical contract closeout requirements for green buildings are also addressed in this chapter, including submitting project documentation such as record drawings, addressing warranties and guarantees required by the contract documents, and training the owner's personnel.

At the end of each chapter short case studies have been included to illustrate the green building topics covered in that chapter. These case studies were provided by AGC members involved in green building construction.

Appendix A provides a glossary of terms and abbreviations used in the green building industry and throughout this book. Appendix B provides a list of references and additional resources for the contractor.

1.11 CASE STUDIES

The Associated General Contractors of America New Headquarters

The Navy League Building

In 2005, AGC moved its new headquarters offices into the Navy League Building at 2300 WIlson Boulevard in Arlington, Va. The building exemplifies ''green building'' advances and received a high ''Silver Rating'' under the Leadership in Energy & Environmental Design (LEED®) Green Building Rating System.

Site

The site meets quality growth principles, which include sensitivity to the following criteria: location, building density, design, diversity, transportation, accessibility, environment and community. This redevelopment project is ''transit-friendly,'' located one block from the Arlington Courthouse Metro station and on multiple bus routes. The building incorporates other transportation alternatives: bicycle storage and changing rooms for the building's occupants,

charging stations for electric automobiles within the four-tier underground parking deck, and preferred parking for car and vanpools. To encourage the utilization of transportation alternatives, parking capacity meets only the minimum local zoning standards.

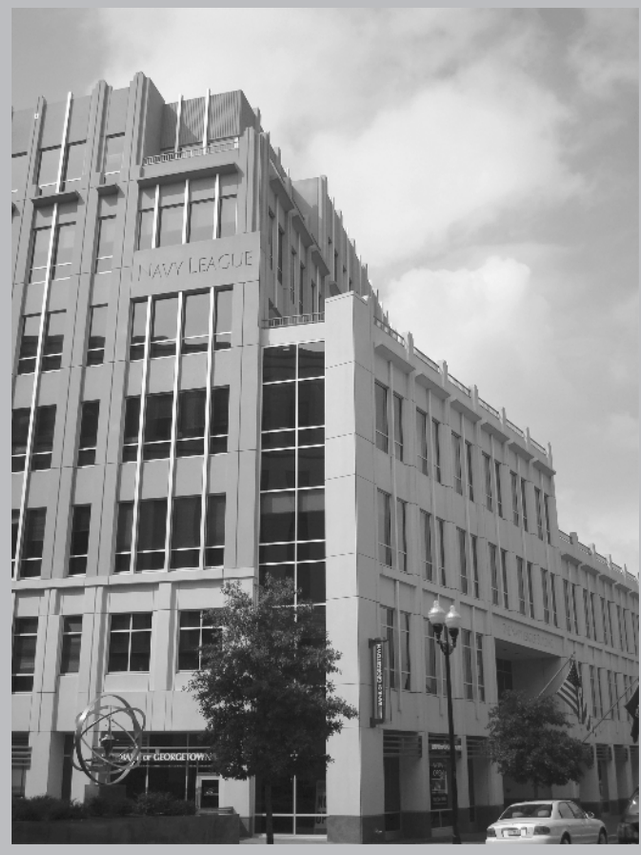

Figure 1-1 Photo courtesy of The Navy League.

Water

The building has a very advanced water efficiency system that aims to minimize the amount of potable water consumed by the project while simultaneously reducing the amount of storm water runoff from the site. A storm water

detainment system catches rain-water and stores it in a large vault at the basement level so that it can be used for irrigating trees and shrubs on the property as well as for flushing the building's toilets. Low-flow fixtures, dual-flush toilets, and using recovered water for chiller re-supply will cut water use by over 30 percent, compared to conventional office buildings. The combination of the storm water reuse system and the high water efficiency plumbing fixtures allows the building to use approximately 60 percent less potable water overall.

Energy

Building HVAC systems will increase heating and cooling efficiency, reducing operating costs and air pollution. Additionally the heating, cooling and refrigeration systems will not use any ozone depleting CFCs or HCFCs. An Energy-Star Rating roofing system will decrease temperatures at the roof level. This roof system helps reduce both the radant heat load of the building and lowers temperature at the roof thereby alleviating the impact of the building on urban heat islands. Exterior lighting will be designed to minimize light pollution and assist national dark sky initiatives. Overall building energy use will be approximately 20 percent less than conventional office buildings.

Green Materials

The contractor—James G. Davis Construction—was required to salvage or recycle 75 percent of the waste from demolition, construction and land clearing. Twenty percent of the building materials had to come from within a radius of 500 miles, and at least 50 percent of the wood-based materials had to be Forest Stewardship Council certified.

Indoor Air Quality

Low-emission adhesives, paints and carpets along with exhaust systems designed to remove airborne particulate matter will improve indoor air quality.

R. J. Griffin & Company

Southface Eco Office, Georgia

When Southface Energy Institute, an Atlanta-based non-profit organization promoting sustainable homes, workplaces, and communities through education, research, advocacy and technical assistance, needed more office space,

it decided to showcase sustainable strategies, materials, and products for commercial construction in its new building.

A unique and nontraditional project delivery method was used on the Eco Office, a three-story, 10,000-square-foot showcase of integrated design and 'state-of-the-shelf' green building products tracking LEED Platinum certification in Fall 2007. When Southface set out to expand its facility as an environmentally-responsible commercial demonstration project, it enlisted the design services of Lord Aeck & Sargent and the construction management services of a Green Building Consortium—five general contractors with LEED experience—DPR, Hardin, Holder, Skanska, and Winter, later assisted by RJ Griffin. This collective contribution, along with dozens of donated products and services, resulted in a model eco-conscious building at half the market cost.

Figure 1-2 Photo courtesy of Lord Aeck & Sargent.

Basing a building program on donated components, however, brought unforeseen challenges to the owner as well as the design and construction teams. As word of the project spread, an increasing number of generous manufacturers and subcontractors offered their products and services, relieving budget constraints, but often impacting design decisions and coordination.

No compromises were made in resource efficiency, however. Scheduled for completion in Fall 2007, the Eco Office is designed to use 60 percent less energy and 80 percent less potable water than a conventional office by incorporating a high-efficiency thermal envelope, daylighting strategies, efficient fixtures, salvaged photovoltaic panels, an extensive green roof and rainwater harvesting to eliminate potable water use for sewage conveyance, the innovative mechanical systems and irrigation.

The Eco Office collaboration has created a valuable exchange of information and ideas on sustainable design, building science, and product development that has strengthened the entire team and influenced the marketplace as a whole.

The best lesson learned by RJ Griffin, besides the fact that we enjoyed working with our competitors toward a worthwhile goal, is that, just like all commercial projects, budget and other obstacles can be overcome with a creative team of all members (owner, design team, and contractors) when everyone is involved early on in the preconstruction process. Green building just adds one more component to the challenge!

1.12 REFERENCES

ASTM International, Standard Terminology for Sustainability Relative to the Performance of Buildings, ASTM Standard E 2114–06a, 2006.

Energy Information Agency, www.eia.doe.com, 2007.

World Commission on Environmental Development, *Our Common Future*, New York, Oxford Press, 1987, p. 43.