# SECTION TWO
# THE BUILDING TEAM—MANAGING THE BUILDING PROCESS

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Since the beginning of time, mankind has been involved in the business of **building.** Technology and construction methods continually evolve: from the Egyptian post and lintel system, the Greek pediment, the Roman arch and dome, the Byzantine basilica, and the new Renaissance perspective to the School of the Bauhaus and the International Style leading us into modern times and the new millennium. Over time, societies change, construction methods change, clients change, and the architect's tools change; however, the excitement and energy inherent in the building process does not change, because of one factor only—the process itself. To begin this process, two elements are necessary: an idea and a client. Creative minds then carry the process forward. With the idea comes the development of a building concept. A sketch or drawing, created through personal interaction with the client, develops the vocabulary for the physical construction of the concept. A builder and labor force turn the concept into reality.

Many processes have been used to manage this interaction. Continual evolution of the management process has turned it into an independent discipline which, coupled with the computer, is a major focus of the building industry today. From the beginning, individuals generating the concepts, preparing drawings, and building the project were considered part of what we now call the ''service industry.'' This section outlines the various complex components and professionals involved in the building process with respect primarily to the architectural profession. Despite the changes that have occurred, the basics of the building team and the building process remain unchanged.

## 2.1 PROFESSIONAL AND BUSINESS REQUIREMENTS OF ARCHITECTS AND ENGINEERS

Management of the building process is best performed by the individuals educated and trained in the profession, that is, architects and engineers. While the laws of various states and foreign countries differ, they are consistent relative to the registration requirements for practicing architecture. No individual may legally indicate to the public that he or she is entitled to practice as an architect without a professional certificate of registration as an architect registered in the locale in which the project is to be constructed. This individual is the **registered architect.** In addition to the requirements for individual practice of architecture, most states and countries require a certificate of registration for a single practitioner and a certificate of authorization for an entity such as a corporation or partnership to conduct business in that locale.

An architect is a person who is qualified by education, training, experience, and examination and who is registered under the laws of the locale to practice architecture there. The practice of architecture within the meaning and intent of the law includes:

Offering or furnishing of professional services such as environmental analysis, feasibility studies, programming, planning, and aesthetic and structural design

Preparation of construction documents, consisting of drawings and specifications, and other documents required in the construction process

Administration of construction contracts and project representation in connection with the construction of building projects or addition to, alteration of, or restoration of buildings or parts of building

All documents intended for use in construction are required to be prepared and administered in accordance with the standards of reasonable skill and diligence of the profession. Care must be taken to reflect the requirements of country and state statutes and county and municipal building ordinances. Inasmuch as architects are licensed for the protection of the public health, safety, and welfare, documents prepared by architects must be of such quality and scope and be so administered as to conform to professional standards.

Nothing contained in the law is intended to prevent drafters, students, project representatives, and other employees of those lawfully practicing as registered architects from acting under the instruction, control, or supervision of their employers, or to prevent employment of project representatives from acting under the immediate personal supervision of the registered architect who prepared the construction documents.

## 2.2 CLIENT OBJECTIVES FOR BUILDINGS

Building types, time schedules, building attitudes, and legal and economic conditions affect relations with the four major client types for whom an architect may provide services. These are known as the traditional, developer, turnkey, and design/build client base.

**Traditional client** is usually an individual or organization building a one-time project with no in-house building expertise. The client, however, possesses the innate excitement for the process of witnessing the transformation of plans into the built environment and seeks an architect to assert control of the process. In most cases, this includes the architect's definition of the client's space needs, program and physical plant requirements. A more sophisticated traditional client might be a large corporation, university or other institutional entity that may or may not have an architect on staff, but still looks to a selected architect to guide the development process. In this case, the client may have more input into the client's program definition based on the in-house capabilities. In both cases, the architect plays the lead role in the management process and normally provides programming, design, construction documents, bidding, and characteristic administration in the role of the traditional architect.

**Developer client** offers building process management that reduces some of the architect's management role in managing the overall project and provides alternative methods for approaching design and construction. Development processes such as scope documentation, fast track, and bid packages are construction methodologies resulting from the developer client's need to accelerate the total process due to fluctuating interest rates and the need to be first in providing space in the marketplace. Through this client base the acceptance of a construction consultant as a necessary part of the design team evolved. The construction consultant enables accelerated schedules to be met, provides for the compression of time, and allows a contractor to be selected by the client to build while the architect is still designing.

**Turnkey client** is interchangeable with the design/build client in concept. Both are based on a complete project being turned over to the owner by a single entity that is responsible for designing and constructing the project. The owner has little input in the process until it is turned over. The turnkey developer or contractor employs the services of an architect, or has an on-staff registered architect, who designs the project in accordance with the owner's program requirements. Bids are usually taken on turnkey developer designs and cost proposals to meet these requirements. Once a turnkey developer is selected, the owner may sell the property to the developer or authorize its purchase from a third party under option. From this point forward the owner has little or no participation in the project; the developer is the turnkey client of an externally employed architect. The architect is then working on the developer team and is not an independent voice for the real owner. All decisions are then made by the turnkey developer relative to the architect's services.

**Design/build client** also has the architect on the developer team and not performing services for the owner. Designers/builders offer to design and construct a facility for a fixed lump-sum price. They bid competitively to provide this service or provide free design services prior to commitment to the project and as a basis for negotiation. Their design work is not primarily aimed at cost-performance tradeoffs, but at reduced cost for acceptable quality.

The design/build approach to facilities is best employed when the owner requires a relatively straightforward building and does not want to participate in detailed decision making regarding the various building systems and materials. This does not mean that the owner has no control over these items. On the contrary, the owner is often permitted a wide range of selection. But the range of choices is affected by the fixed-cost restraints imposed by the designer/builder and accepted by the owner. When the facilities required are within the range of relatively standard industry-wide prototypes, this restriction may have little significance.

A common misconception regarding design/build is that poor-quality work inevitably results. While there is a general benefit to the builder for reductions in material and labor costs, the more reputable designer/builder may be relied on to deliver a building within acceptable industry standards. Facilities where higher-quality systems, more sensitive design needs, or atypical technical requirements occur deserve the services of an independent design professional.

## 2.3 PROGRAM DEFINITION

Usually when the term "program definition" is used relative to an architect, it is understood to mean the client's program for physical space requirements in a building. With the decline in the office market in the late 1980s came the loss of, or minimum use of, the traditional developer and construction management/construction consultant roles. As an outgrowth of the developer client era, certain developers and construction consultants turned their emphasis to "program management." In this process, a firm is engaged by the client to manage the total development process, acting as the client's agent throughout the total process. The program management approach expanded the meaning of the word "program" beyond that normally associated with only the physical space program requirements. The term "program" in this new context defines the process of organizing and executing a project from inception to completion. This process takes into account legal, financial, funding, land acquisition, architecture, engineering, specialist consulting, design administration, insurance, construction administration, and facilities operation and/or management. The client, instead of managing portions of the process as in the traditional client and developer client scenarios, looks to one firm for managing the total process.

## 2.4 ORGANIZATION OF THE BUILDING TEAM

Architecture is a process involving multidisciplinary input by many professionals. Comprehensive design services in the professional disciplines of planning, architecture, landscape architecture, interior design, and civil, structural, mechanical, electrical, plumbing, and fire protection engineering are offered within one organization by some large architect-engineer (A/E) and engineer-architect (E/A) firms. Smaller architectural firms retain these services by contract with consultants. Single-source design responsibility, coordinated via a common, integrated management structure, is a requirement in either case for successful development of a project.

In the performance of professional A/E services on any project, a design team charged with successful completion of the project in a dedicated professional manner is essential. This team provides continuous service to the project from start to finish, establishing and maintaining the quality and integrity of each design. A project leader should be selected to coordinate and manage all the professional disciplines and consultants involved in the project and to act as liaison with the client. This leader should work closely with the client to provide policy direction and set goals and objectives for the professional team. Day-to-day management and direction of the project's technical development should be provided by an individual, usually identified as the architect's project manager, who performs the key administrative duties, establishes and maintains design services budgets and schedules, and coordinates the entire A/E effort. A senior designer supervises daily organization and progress of design development and directs the design efforts of the project team. As a project's specific needs or schedule require, additional architects, planners, engineers, interior architects, and consultants are involved in the project to augment the team or to provide specialized consultation.

### 2.4.1 Architects and Engineering Consultants

The major distinctions between architects and engineers run along generalist and specialist lines. The generalists are ultimately responsible for the overall planning. It is for this reason that an architect is generally employed as the prime professional by a client. On some special projects, such as dams, power plants, wastewater treatment, and research or industrial installations, where one of the engineering specialties becomes the predominant feature, a client may select an engineering professional or an E/A firm to assume responsibility for design and construction and taken on the lead role. On certain projects, it is the unique and imaginative contribution of the engineer that may make the most significant total impact on the architectural design. The overall strength of a dynamic, exposed structure, the sophistication of complex lighting systems, or the quiet efficiency of a well-designed mechanical system may prove to be the major source of the client's pride in a facility. In any circumstance, the responsibilities of the professional engineer for competence and contribution are just as important to the project as those of the architect.

Engineers, for example, play a major role in **intelligent building system design,** which involves mechanical-electrical systems. However, a building's intelligence is also measured by the way it responds to people, both on the inside and outside. The systems of the building must meet the functional needs of the occupants as well as respect the human response to temperature, humidity, airflow, noise, light, and air quality. To achieve the multifaceted goals, an intelligent building requires an intelligent design process with respect to design and system formulation as well as efficient and coordinated execution of design and technical documentation within the management structure.

An intelligent building begins with intelligent architecture—the shape, the building enclosure, and the way the building appears and functions. Optimal building solutions can be achieved through a design process that explores and compares varying architectural and engineering options in concert. Sophisticated visualization and analytical tools using three-dimensional computer modeling techniques permit architects and engineers to rapidly evaluate numerous alternatives. Options can be carefully studied both visually and from a performance standpoint, identifying energy and life-cycle cost impact. This enables visualization and technical evaluation of multiple schemes early in the design phase, setting the basis for an intelligent building.

In all cases, the architect's or engineer's legal responsibilities to the client remain firm. The prime professional is fully responsible for the services delivered. The consultants, in turn, are responsible to the architect or engineer with whom they contract. Following this principle, the architect or engineer is responsible to clients for performance of each consultant. Consequently, it is wise for architects and engineers to evaluate their expertise in supervising others before retaining consultants in other areas of responsibility.

### 2.4.2 Other Consultants

A building team may require the assistance of specialists. These specialty consultants provide skills and expertise not normally found in an architectural or engineering firm. The prime professional should define the consultants required and assist the client in selecting those consultants. The architect or engineer should define and manage their services even if the specialty consultant contracts directly with the client for liability purposes, with the understanding that the client has the ultimate say in decision making.

While several consultants may be required, depending on the complexity of the project, the cost for each may be minimal since their services are provided over short periods of time during the development process, and all consultants are usually not servicing the project at the same time. The following consultant services, most of which are not normally provided by architects and engineers, are provided by various firms:

- Acoustical
- Audiovisual
- Communications
- Exterior wall maintenance
- Fire and life safety
- Food service
- Geotechnical engineering and subsurface exploration
- Graphics
- Space-usage operations
- Independent research and testing
- Landscaping
- Marketing and leasing
- Materials handling
- Parking
- Preconstruction survey
- Schedule
- Security
- Site surveyor
- Special foundation systems
- Special structures
- Specialty lighting
- Telecommunications
- Traffic
- Vertical transportation
- Water features
- Wind tunnel testing

## 2.5 CLIENT-A/E AGREEMENT

Although verbal contracts can be considered legal, a formal written document is the preferred way to contract for professional services to be provided by an architect. Purchase orders are not an acceptable means, since they are not applicable to a service arrangement but rather only provide a financial accounting system for purchasing a product, which is normally required internally by a client. A purchase order should not be used as a client-A/E agreement.

Most professionals use the *AIA Standard Form of Agreement for Architect and Owner* (client). Some larger firms, however, have their own form of agreement which augments or further defines that of the AIA. The basic elements of the agreement establish the definition and identification of project phases and define the specific scope and compensation for the architect's basic services. Flexibility is built into this agreement to accommodate supplementary services that may be considered. In addition, the agreement should define the understandings of the two parties as well as of any third parties that may be involved in the process and stipulate how the third parties are to be managed and compensated.

Furthermore, the client-A/E agreement should define items considered as direct costs that may be reimbursed under the agreement. Other items also to be addressed include project terminology, project terms and definitions, and the architect's status as it relates to the profession such that the standard of care is clearly understood. The definition of additional services, changes, and compensation for such services, as well as the method and timing of payment, reimbursable expenses, taxes, the responsibility for client-furnished information, project budgets, ownership of documents, confidentiality provisions, the use of project databases, insurance requirements, termination provisions by either party, and dispute resolution may also be addressed. A/E agreements may also define the documents to be delivered at the conclusion of each development phase and, in certain cases, the time estimated for completion of each phase of service.

***Compensation for Professional Services.*** A major concern of an architect is to arrive at an accurate assessment of the scope of services to be performed. The nature of the project, the degree of professional involvement, and the skills required should be considered in arriving at an equitable fee arrangement. Types of fees that may be used are

- Percentage of the construction cost of the project
- Cost plus fee
- Multiple of direct personnel expense
- Multiple of technical personnel hourly rates
- Stipulated or lump sum
- Billing rates for personnel classification

For a project requiring what could be described as standard services, the percentage-of-construction-cost fee is a safe standard. Years of experience with the relationship between the scope of architectural services required for various sizes of standard construction contracts provide a basis for such rule-of-thumb fee agreements.

For projects where atypical services are required, other arrangements are more suitable. For example, for projects where the scope of service is indefinite, a cost-plus fee is often best. It permits services to proceed on an as-authorized basis, without undue gambling for either party to the agreement. Under such an arrangement, the architect is reimbursed for costs and also receives an agreed-on fee for each unit of effort the architect expended on the project. Special studies, consultations, investigations, and unusual design services are often performed under such an arrangement.

For projects where the scope can be clearly defined, a lump-sum fee is often appropriate. In such cases, however, architects should know their own costs and be able to accurately project the scope of service required to accomplish fixed tasks. Architects should take care, for the protection of their own, their staff's, and the client's interests, that fees cover the costs adequately. Otherwise, the client's interests will suffer, and the architect's own financial stability may be undermined.

Fee and payment agreements should be accompanied by a well-defined understanding in the form of a written agreement for services between architect and client. The method of payment should also be defined in the agreement. Certain clients may desire a billing and payment schedule while monthly billing and payment is preferred by the architect.

## 2.6 A/E LIABILITY AND INSURANCE

Architecture and engineering firms normally maintain professional liability insurance. This requires payment of annual premiums based on the coverage provided. Architects and engineers should maintain coverage in connection with their foreign operations as well as with their domestic operations. Various types of insurance usually carried by architects and engineers are listed in Table 2.1.

### 2.6.1 "Services" vs. "Work"

The building industry generally recognizes that the professional architect, engineer, or design consultant provides **service,** whereas the contractor, subcontractor, or material supplier provides **work.** In providing work, the contractor delivers a product and then warrants or guarantees the work. These distinctions are important to understand with respect to insurance. In the architect's case, professional liability insurance provides coverage for the judgment the professional provides while using reasonable care and therefore does not normally have liquidated damages provisions. Professional liability insurance does not cover the work itself or items undertaken by the contractor in pursuit of the work but does cover negligent errors and omissions of the architect or engineer. This insurance is a means of managing the risk associated with the architect's judgment; it is not product-related. Most

**TABLE 2.1** Types of Architect and Engineer Insurance

| Type of insurance | Coverage |
|---|---|
| Commercial general liability | According to occurrence and aggregate |
| Commercial automobile liability | Bodily injury and property damage |
| Workers' compensation | Statutory limits |
| Employer's liability | Medical care and time lost as a result of injuries incurred during the performance of the services |
| Professional liability | Errors and omissions |
| Valuable papers | Loss of drawings, models, computer-produced data, etc. |
| Umbrella liability | Provides coverage in excess of professional liability coverage |

claims against professionals in the building industry are made by clients. Fewer claims are made by contractors and workers.

### 2.6.2 Risk Management

So that the architect's or engineer's business goals can be accomplished, professional liability insurance is offered through various underwriters and managed by professionals. Such professionals should not dictate or limit architectural practice, but rather should support it; neither should they tell architects to turn away from risk, but instead they should help manage it.

Insurance allows the architect or engineer to transfer the risk of financial uncertainty to an insurance company for a known premium. The professional should calculate how much risk to assume. The risk the individual retains is the deductible. The risk the insurance company accrues is the limit of liability over and above the deductible. By choosing a higher deductible, the professional retains more risk but pays a lower premium.

Professional liability protection for the architectural and engineering profession has been designed with the help of the American Institute of Architects (AIA) and the National Society of Professional Engineers (NSPE)/Professional Engineers in Private Practice (PEPP). In addition to errors and omissions coverage, the protection incorporates liability coverage for on-time performance, cost estimating, interior design, asbestos, and pollution.

Liability programs vary widely from company to company. In general, the insurance industry recommends that architects and engineers:

- Select a program with flexible limits of liability and deductible options
- Carefully review the insurance coverage
- Compare competitive costs
- Consider the insurance company's experience
- Examine the insurance company's criteria for accepting risk
- Compare loss prevention services
- Assure that the company shares its loss information

The AIA and NSPE/PEPP can also provide architects and engineers with valuable information on what to look for in a professional liability insurance program.

### 2.6.3 Project Insurance

Project insurance permits the architect to be responsive to the client who has particular insurance demands. Suppose, for example, that the client wants 3 times the coverage the architect carries. Project insurance can respond to this requirement. Project insurance costs are often reimbursable costs and considered a common element of the construction cost, similar to the cost of the contractor's insurance coverage and performance bonds. Project insurance can sometimes reduce the architect's policy costs because project billings are not included in the architect's billings when the architect's practice policy premium is calculated. Project insurance may provide long-term coverage guarantees to the day of substantial or final completion and up to 5 years thereafter with no annual renewals. Project insurance permits clients to take control in the design of an insurance package to protect their investment and provides clients with stability, security, and risk management.

## 2.7 DEFINITION OF PROJECT PHASES

The definition of the various phases of development for a particular project from initial studies through postconstruction should be understood by the client and outlined thoroughly in the client-A/E agreement. The most-often-used phases of development include the following:

***Feasibility Studies.*** To assist the client in determining the scope of the project and the extent of services to be performed by various parties, the architect may enter into an interim agreement for services relating to feasibility studies, environmental impact studies or reports, master planning, site selection, site analysis, code and zoning review, programming, and other predesign services.

***Environmental Impact Studies.*** Determination of environmental studies and reports required for a project and preparation of such reports, special drawings, or other documents that may be required for governmental approvals are normally performed under separate agreements. Attention should be given to zoning, soils, and the potential of hazardous materials in any form. If any impermissible hazardous materials are encountered, clients should be advised so that they can obtain the services of a specialty consultant to determine what course of action to take.

***Programming.*** If the architect is required to prepare the program of space requirements for a project, the program should be developed in consultation with the client to help the client recognize particular needs. Space requirements, interrelationships of spaces and project components, organization subdivision of usage, special provision and systems, flexibility, constraints, future expansion, phasing, site requirements, budgetary and scheduling limitations, and other pertinent data should all be addressed.

***Conceptual Design.*** During this phase of development, the architect evaluates the client's program requirements and develops alternatives for design of the project and overall site development. A master plan may also be developed during this phase. The plan serves as the guide and philosophy for the remainder of the development of the project or for phasing, should the project be constructed in various phases or of different components.

***Schematic Design.*** During this phase the project team, including all specialty consultants, prepares schematic design documents based on the conceptual design alternative selected by the client. Included are schematic drawings, a written description of the project, and other documents that can establish the general extent and scope of the project and the interrelationships of the various project components, sufficient for a preliminary estimate of probable construction costs to be prepared. Renderings and finished scale models may also be prepared at this time for promotional and marketing purposes.

***Design Development.*** After client approval of the schematic design, the architect and the specialty consultants prepare design development documents to define further the size and character of the project. Included are applicable architectural, civil, structural, mechanical, and electrical systems, materials, specialty systems, interior development, and other such project components that can be used as a basis for working drawing development.

***Construction Documents.*** After approval of the design development documents, the architectural-engineering team, together with the applicable specialty consultants, prepares construction documents, consisting of working drawings and technical specifications for the project components. These include architectural, structural, mechanical, electrical, hydraulic, and civil work, together with general and supplementary conditions of the construction contract for use in preparing a final detailed estimate of construction costs and for bidding purposes.

***Construction Phase Services.*** Diligent construction phase services are essential to translate design into a finished project. The A/E team continues with the development process by issuing clarifications of the bid documents and assisting in contractor selection (Art. 2.20). Also, during the construction period, the team reviews shop drawings, contractor payment requests, change-order requests, and visits the construction site to observe the overall progress and quality of the work. Architect and engineer personnel involved in the design of the project should be available during construction to provide continuity in the design thought process until project completion and occupancy.

***Postconstruction Services.*** Follow-up with the client after construction completion is essential to good client relations. Periodic visits to the project by the architect through the contractor's warranty period is considered good business.

## 2.8 SCHEDULING AND PERSONNEL ASSIGNMENTS

The effective coordination of any project relies on management's ability to organize the project into a series of discreet efforts, with deadlines and milestones identified in advance. The interdependence of these milestones should be clearly understood by the client and the project team so that the project can be structured yet still be flexible to respond to changes and unforeseen delays without suffering in overall coordination and completion.

Experience is the basis on which architects and engineers establish major project milestones that form the framework for project development. The critical path method (CPM) of scheduling can be used to confirm intermediate milestones corresponding to necessary review and approvals, program and budget reconciliation, and interdisciplinary coordination. CPM consultants can also assist contractors in establishing overall shop drawings and fabrication and installation schedules for efficient phasing and coordination of construction. Schedules can be maintained in a project management computer database. They should be updated on a regular basis for the duration of the project, since critical path items change from time to time depending on actual progress of construction. See also Art. 2.9.

## 2.9 ACCELERATED DESIGN AND CONSTRUCTION

The traditional process of design and construction and the roles and responsibilities of the various parties need not be changed when fast track, an accelerated design and construction process, is required. However, this process can affect scheduling and personnel assignments.

In the traditional process, the entire facility moves phase by phase through the entire development process, that is, programming, design, design development, construction documents, bid and award of contracts, construction and acceptance of completed project (Art. 2.7). With any form of accelerated design and construction, the final phases remain substantially the same, but the various building systems or subsystems move through the development process at different times and result in the release of multiple construction contracts at various times throughout the process.

For any project, basic building siting is determined early in the design process. Therefore, at an early stage in design, a construction contract can be awarded for demolition and excavation work. Similarly, basic structural decisions can be made before all details of the building are established. This permits early award of foundation, below grade utility work, and structural work contracts. Under such circumstances, construction can be initiated early in the design process, rather than at the conclusion of a lengthy design and contract preparation period. Months and even years can be taken out of the traditional project schedule, depending on the scale and complexity of the project. Purchase of preengineered, commercially available building systems can be integrated into the accelerated design and construction process when standard system techniques are employed, reducing time even more.

The major requirements for a project in which design and construction occur simultaneously are

- Accurate cost management to maintain project budgets.
- Full understanding of the construction process by the client, contractor, and design professionals so that design decisions and contract documents for each building system or subsystem can be completed in a professional manner that addresses the requirements of the ongoing construction process.
- Organized and efficient management of the construction process with feedback into the design process to maintain a clear definition of the required contract packages and schedule.
- Overall project cost control and project construction responsibilities, including interface management of independent prime contracts, should also be established.

Often the major purpose of accelerated design and construction is to reduce the effect of rapidly increasing construction costs and inflation over the extended project design and construction period. For projects extending over several years, for example, contractors and subcontractors have to quote costs for providing material and labor that may be installed several years later. In most cases, the costs associated with such work are uncertain. Bid prices for such work, especially when it is of large magnitude, therefore, must be conservative. Accelerated design and construction, however, brings all the financial benefits of a shortened project duration and early occupancy and reduces the impact of cost escalation. Also, bid prices can be closer to the actual costs, thus reducing bidding risk to the contractor. The combination of phased bidding, shortened contract duration, reduced escalation, smaller bid packages, and a greater number of bidders can produce substantial savings in overall construction costs.

A major objection to accelerated design and construction is that project construction is initiated before bids are obtained for the total project and assurance is secured that the total project budget can be maintained. In this regard, the reliability of early cost estimating becomes even more critical. It is the experience of most clients and architects involved with multiple contracts, however, that such contracts, bid one at a time, can be readily compared with a total budget line item or trade breakdown and thus provide safeguards against budget overruns. The ability to design, bid, and negotiate each contract as a separate entity provides optimum cost control.

For accelerated design and construction programs to work effectively, services of a professional construction manager are normally required. This cost, however, can be offset by the overall saving in the total project cost due to the reduction in construction time.

Normally, the client is responsible for entering into the various construction contracts when multiple contracts are used. The construction manager acts as the client's agent in administration of the contracts. If the architect is to administer the contracts, additional compensation will be required beyond that associated with one general contractor who holds all subcontracts, as is the case in the traditional client-contractor relationship.

## 2.10 DESIGN MANAGEMENT

Architects manage all aspects of project design simultaneously, their own internal resources, relations with the specialty consultants, the processes that deliver service to the client, and through that service, the programs of client needs through the development process to the creation of a built environment. The requirement that architects be capable businesspersons is, therefore, far-reaching. The need for good business sense and a thorough knowledge of the architect's own cost is reinforced by the need to manage these costs throughout the duration of the project. Allocation, commitment, and monitoring of the expenditure of resources are of critical importance to the financial success of every project. Only when these are properly managed can quality services, proper advice, appropriate design, and state-of-the-art contract documents be delivered to clients.

As a businessperson, an architect is faced with acquiring personnel, advancing those who are outstanding, and removing those who are unacceptable. The firm should keep records of business expenses, file tax returns, provide employee benefits, distribute and account for profits, and keep accurate cost records for project planning and to satisfy government requirements. The architect must meet legal requirements for practice as an individual, partnership, or corporation. In many of these areas, the architect will be assisted by experts. It is impossible for an architect to practice effectively or successfully without a thorough understanding and complete concern for the business of architecture.

Once the resources required to deliver services are assured, the architect should provide management skills to see that these services are kept timely, well-coordinated, accurate, and closely related to the client's needs. This is especially important for work on large projects, in large design offices, or when dealing with the architect's employees and consultants. The best talent must be secured, appropriately organized, directed, and coordinated to see that the project receives well-integrated and well-directed professional service.

The objective is to produce an appropriately designed facility the client needs, within budget, and on schedule. While the contractor has the front-line responsibility for budgeted construction cost and schedule, the architect's resources and the services provided should be helpful in managing the construction process for the benefit of the client. The architect's management of materials and technology and relationship with the client and contractors will account in good measure for the success of the project.

## 2.11 INTERNAL RECORD KEEPING

Part of good office management is document control and record keeping. Much information is received, disseminated, and collated in an architect's office. Included are project directories, contractual correspondence, client correspondence, consultant correspondence, minutes of meetings, insurance certifications, in-progress drawings, drawing release for owner review, and building permit and construction issues. Also dealt with are facsimiles, e-mail, computer tapes, calculations, shop drawings, specifications, material samples, renderings, photography, slides, field reports, specifications addenda, contract modifications, invoices, financial statements, audit records, and time records. In addition, there are contractor payment requests, change orders, personnel records, client references and more. Certain clients may have particular formats or record-keeping controls they impose on a project in addition to the architect's standard procedures.

A multitude of data is transferred among many parties during the progress of the architect's services. The data should be maintained in an organized manner for future reference and archival purposes. The architect should establish an office procedure for document control, record keeping, and document storage beyond the life of the project to ensure easy retrieval. There are many computerized systems that can aid the architect in catalog filing and information retrieval. Record keeping can typically be subdivided into the following categories: contractual, financial, personnel, marketing and publicity, legal, correspondence, project documentation, drawings, shop drawings, warehousing, and archival records. These should not only be supervised but also controlled, inasmuch as some files require limited access for reasons of confidentiality and legalities.

## 2.12 CODES AND REGULATIONS

Various statutory codes, regulations, statutes, laws, and guidelines affect design and construction of projects. In most jurisdictions, the architect and engineer are required by law to design to applicable building codes and regulations, which vary from one jurisdiction to another and can vary between codes. Some jurisdictions that do not have sophisticated codes usually follow recognized national or international codes, which should be agreed on at the onset of a project so that the client and architect understand the rules for design and construction. All codes are intended for the health, welfare, and safety of the public and occupants of buildings.

***Affirmative-Action Program.*** The objective of equal employment opportunity and affirmative-action programs should be to ensure that individuals are recruited, hired, and promoted for all job classifications without regard to race, color, religion, national origin, sex, age, handicap, or veteran status. Employment decisions should be based solely on an individual's qualifications for the position for which the individual is considered.

Affirmative action means more than equal employment opportunity. It means making a concentrated effort to inform the community of the architect's desire to foster equal employment opportunity. It also means making a special effort to attract individuals to the profession and to engage them in a program of professional development. Furthermore, architects should be committed to a meaningful minority business enterprise (MBE) and women business enterprise (WBE) participation program. Initial contact with local MBE/WBE firms should be pursued for each applicable project to respond to this important requirement. Architects should be prepared to review this requirement with clients to achieve participation targets consistent with client goals and objectives.

## 2.13 PERMITS

Most jurisdictions require a building permit for construction or remodeling. The building permit, for which a fee is paid by the contractor or client, is an indication that drawings showing the work to be done have been prepared by a registered professional and submitted to the governing authority have jurisdiction over design and construction of the project. Furthermore, it is an indication that this authority stipulates that the documents meet the intent of the applicable building codes and regulations. Issuance of a permit, however, does not relieve the governing agency of the right to inspect the project during and after construction and to require minor modifications. In addition, while most locales do not provide for a written permit by the fire department, this agency is involved in the review process relative to life-safety provisions. It also has the right to inspect the project when constructed and to require modifications if they are considered appropriate to meet the intent of the code or the department's specific requirements. Major items reviewed by both the permit-issuing agencies relate to occupancy classifications, building population, fire separations, exiting requirements, travel paths for exiting, areas of refuse, and other general life safety and public health issues.

***Occupancy Permits.*** Many jurisdictions require that a permit be obtained by the client or tenant of a multitenant building indicating that the building or tenant space has been reviewed by the applicable agency and fire department. This permit indicates that the building meets the requirements of the building codes and is appropriate for occupancy for the intended use and classification for which the building or space was designed and constructed.

In addition, elevator usage certificates are issued by certain building authorities. These certificates indicate that the elevators have been inspected and found to be acceptable for use based on the size, loading, and number of occupants posted on the certificate.

Furthermore, certain spaces within a project may have a maximum-occupancy limitation for which a notice is posted in those spaces by the applicable building authority. Examples of this type of usage include restaurants, ballrooms, convention centers, and indoor sports facilities where a large number of occupants might be gathered for the intended use.

## 2.14 ENERGY CONSERVATION

In response to the national need for energy conservation and in recognition of the high consumption of energy in buildings, the U.S. Department of Energy gave a grant to the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for development of a national energy conservation standard for new buildings. The resulting standard, ASHRAE 90-75, establishes thermal design requirements for exterior walls and roofs. It is incorporated in some building codes.

Seeking greater energy-use reduction, Congress passed the Energy Conservation Standards for New Buildings Act of 1976, mandating development of energy performance standards for new buildings (BEPS). Accordingly, the Department of Energy develops such standards, for adoption by federal agencies and state and local building codes. BEPS consists of three fundamental elements:

**1.** Energy budget levels for different classifications of buildings in different climates, expressed as rate of energy consumption, $Btu/ft^2$-yr.
**2.** A method for applying these energy budget levels to a specific building design to obtain a specific annual rate of energy consumption, or design energy budget, for the proposed building.
**3.** A method for calculating the estimated annual rate of energy consumption, or design energy consumption, of the proposed building.

The design energy consumption may not exceed the design energy budget of a new building. Even without these regulations, energy conservation for buildings makes good sense, for a reduction in energy usage also reduces building operating costs. It is worthwhile, therefore, to spend more on a building initially to save energy over its service life, at least to the point where the amortized annual value of the increased investment equals the annual savings in energy costs. As a consequence, life-cycle cost, considered the sum of initial, operating, and maintenance costs, may be given preference over initial cost in establishment of a cost budget for a proposed building.

Energy use and conservation are key elements in an architect's approach to design. Aided by computer simulation, engineers can develop system concepts and evaluate system performance, deriving optimal operation schedules and procedures. During the initial design phase, the computer can be used in feasibility studies involving energy programs, preliminary load calculations for the selection of heating, ventilating, and air-conditioning (HVAC) systems and equipment, technical and economic evaluation of conservation alternatives. Using solar heating and cooling systems for new and existing facilities, modeling energy consumption levels, forecasting probable operating costs, and developing energy recovery systems can be investigated during the early design of a project.

## 2.15 THE INTERIOR ENVIRONMENT

Architects have long been leaders in building design that is sensitive to environmental issues. Several areas of general concern for all buildings are described in the following paragraphs; they support the basic philosophy that the environment within buildings is as critical a concern as esthetics.

***Indoor Air Quality.*** Many factors, such as temperature, air velocity, fresh-air ventilation rates, relative humidity, and noise, affect indoor air quality. The fresh-air ventilation rate has the greatest influence on indoor air quality in many buildings. Fresh-air ventilation rates in a building is the flow of outside air brought into the building for the well-being of the occupants and the dilution of odors and other internally generated air pollutants. The outside air may vary in its ''freshness'' depending on the location of the building, its surrounding conditions, and the location of the fresh-air intakes for the building. Therefore, careful studies should be made by the architect to ensure the optimum internal air quality.

Ventilation is required to combat not only occupant-generated odors, as has been traditionally the case, but also to provide ventilation for materials used and stored in buildings. ASHRAE Standard 62-1989, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, recommends a rate of 20 cfm per person as a minimum ventilation rate for office buildings. Air-handling systems for numerous buildings provide not only this minimum recommended level but also often increased fan capacity (available when outdoor temperatures and humidity levels are favorable) through an air-side economizer control.

***Environmental Pollution.*** In response to current concern for the effect of chlorofluorocarbons (CFCs, fully halogenated refrigerants) on the earth's ozone layer, the refrigerant for mechanical systems should have the lowest ozone depletion potential compatible with commercial building cooling systems.

***Noise Control.*** The acoustical environment within a building is a result of the noise entering the space from outdoors, or from adjacent interior areas, or most importantly, from the mechanical, electrical, and elevator systems of the building. This is in addition to the noise generated within the space by people and equipment. Mechanical systems should be designed to limit equipment noise and to maintain the transmission of noise via mechanical systems to occupied spaces within a range necessary for efficient and enjoyable use of the building. Occupied space noise should normally be limited to NC-35 or less if desired, through the use of state-of-the-art-distribution equipment and appropriate use of materials within the finished spaces.

***Safe Building Materials.*** The technical specifications provided by the architect should be continually updated to eliminate any materials that are potential health hazards to occupants or construction workers, such as materials that give off gas within the occupied spaces. In addition, requirements in local, national, and international building codes to reduce fire and smoke hazards should be met.

***Occupational Health and Safety Issues.*** As discussed in the preceding, architects should exercise professional care in design and specification of all architectural and building systems to create a state-of-the-art building offering a safe, healthy environment for all occupants, visitors, and users.

***Recycled Materials.*** In today's environment, architects should understand that their designs must consider the impact on the ecological health of our society. With this in mind, architects should work together with the client to develop policies and innovative solutions that will reduce waste and promote the recycling of materials.

## 2.16 COST ESTIMATING AND VALUE ENGINEERING

During development of a project the client normally looks to the architect for construction cost estimates. It is advisable to provide a probable cost of construction at completion of the schematic design, design development, and construction document phases. A design contingency is usually carried in cost estimates. It can be reduced as the documents are further developed. At completion of the construction documents, the architect prepares, or has a consultant prepare, a final and most accurate estimate of construction cost, which can be used for comparison with the bids submitted to perform the work.

Value engineering may be performed by consultants and construction managers during the development of the construction documents. (This is a misnomer for cost-reduction engineering, since value engineering should occur before a design has been finalized and construction documents have started. To be effective, value engineering should be undertaken prior to design of any building system.

Value engineering should address operating and maintenance costs as well as first costs, to provide true life-cycle cost estimates for comparative analysis. This can be accomplished as early as the conceptual design phase of the project and should use the expertise of cost consultants, if such service is not offered directly by the architect or engineer.

Cost analysis should be performed concurrently with technical evaluation of the systems proposed by the architects or engineers, to provide the client with proper information to make an informed decision. The architect and engineer should address cost without compromising the building program, building safety, or desired design and performance of the facility and respond to the client in a professional manner regarding cost estimating and value engineering.

## 2.17 TECHNICAL SPECIFICATIONS

Specifications for a building project are written descriptions, and the drawings are a diagrammatic presentation of the construction work required for that project. The drawings and specifications are complementary.

Specifications are addressed to the prime contractor. Presenting a written description of the project in an orderly and logical manner, they are organized into divisions and sections representing, in the opinion of the specification writer, the trades that will be involved in construction. Proper organization of the specifications facilitates cost estimating and aids in preparation of bids. The architect should coordinate the specification terminology with that shown on the drawings.

### 2.17.1 Content of Specifications

It is not practical for an architect or engineer to include sufficient notes on the drawings to describe in complete detail all of the products and methods required of a construction project. Detailed descriptions should be incorporated in specifications. For example, workmanship required should be stated in the specifications.

Contractors study specifications to determine details or materials required, sequence of work, quality of workmanship, and appearance of the end product. From this information, contractors can estimate costs of the various skills and labor required. If workmanship is not determined properly, unrealistic costs will result and quality will suffer. Good specifications expand or clarify drawing notes, define quality of materials and workmanship, establish the scope of the work, and describe the responsibilities of the contractor.

The terms of the contract documents should obligate each contractor to guarantee to the client and the architect or engineer that all labor and materials furnished and the work performed are in accordance with the requirements of the contract documents. In addition, a guarantee should also provide that if any defects develop from use of inferior materials, equipment, or workmanship during the guarantee period (1 year or more from the date of final completion of the contract or final occupancy of the building by the client, whichever is earlier), the contractor must, as required by the contract, restore all unsatisfactory work to a satisfactory condition or replace it with acceptable materials. Also, the contractor should repair or replace any damage resulting from the inferior work and should restore any work or equipment or contents disturbed in fulfilling the guarantee.

Difficult and time-consuming to prepare, technical specifications supply a written description of the project, lacking only a portrayal of its physical shape and its dimensions. The specifications describe in detail the material, whether concealed or exposed, in the project and fixed equipment needed for the normal functioning of the project. If they are properly prepared, well-organized, comprehensive, and indexed, the applicable requirements for any type of work, kind of material, or piece of equipment in a project can be easily located.

The technical specifications cover the major types of work—architectural, civil, structural, mechanical, and electrical. Each of these types is further divided and subdivided in the technical specifications and given a general title that describes work performed by specific building trades or technicians, such as plasterers, tile setters, plumbers, carpenters, masons, and sheet-metal workers, to name a few.

The prime contractor has the responsibility to perform all work, to furnish all materials, and to complete the project within a schedule. The contractor, therefore, has the right to select subcontractors or perform the work with the contractor's own forces. In recognition of this, each specification should contain a statement either in the General Conditions or in the Special Conditions, that, regardless of the subdivision of the technical specifications, the contractor shall be responsible for allocation of the work to avoid delays due to conflict with local customs, rules, and union jurisdictional regulations and decisions.

Standard forms for technical specifications can be obtained from the Construction Specifications Institute (CSI). The CSI publishes a Master List of Section Titles and Numbers, which is the generally accepted industry standard. In it, technical specifications are organized into 16 divisions, each with titles that identify a major class of work. Each division contains basic units of work, called sections, related to the work described by the division title. Following is the division format developed by CSI:

1. General Requirements
2. Site Work
3. Concrete
4. Masonry
5. Metals
6. Woods and Plastics
7. Thermal and Moisture Protection
8. Doors and Windows

9. Finishes
10. Specialties
11. Equipment
12. Furnishings
13. Special Construction
14. Conveying Systems
15. Mechanical
16. Electrical

Language should be clear and concise. Good specifications contain as few words as necessary to describe the materials and the work. The architect or engineer should use the term "shall" when specifying the contractor's duties and responsibilities under the contract and use the term "will" to specify the client's or architect's responsibilities.

Phrases such as "as directed by the architect," ". . . to the satisfaction of the architect," or ". . . approved by the architect" should be avoided. The specification should be comprehensive and adequate in scope to eliminate the necessity of using these phrases. "Approved by the architect" may be used, however, if it is accompanied by a specification that indicates what the architect would consider in a professional evaluation. The term "by others" is not clear or definite and, when used, can result in extra costs to the client. The word "any" should not be used when "all" is meant.

### 2.17.2 Types of Specifications

Technical requirements may be specified in different ways, depending on what best meets the client's requirements. One or more of the following types of technical specifications may be used for a building project.

***Descriptive Specifications.*** These describe the components of a product and how they are assembled. The specification writer specifies the physical and chemical properties of the materials, size of each member, size and spacing of fastening devices, exact relationship of moving parts, sequence of assembly, and many other requirements. The contractor has the responsibility of constructing the work in accordance with this description. The architect or engineer assumes total responsibility for the function and performance of the end product. Usually, architects and engineers do not have the resources, laboratory, or technical staff capable of conducting research on the specified materials or products. Therefore, unless the specification writer is very sure the assembled product will function properly, descriptive specifications should not be used.

***Reference Specifications.*** These employ standards of recognized authorities to specify quality. Among these authorities are ASTM, American National Standards Institute, National Institute of Standards and Technology, Underwriters Laboratories, Inc., American Institute of Steel Construction, American Concrete Institute, and American Institute of Timber Construction.

An example of a reference specification is: *Cement shall be portland cement conforming to ASTM C150, "Specification for Portland Cement," using Type 1 or Type 11 for general concrete construction.*

Reputable companies state in their literature that their products conform to specific recognized standards and furnish independent laboratory reports supporting their claims. The buyer is assured that the products conform to minimum requirements and that the buyer will be able to use them consistently and expect the same end result. Reference specifications generally are used in conjunction with one or more of the other types of specifications.

***Proprietary Specifications.*** These specify materials, equipment, and other products by trade name, model number, and manufacturer. This type of specification simplifies the specification writer's task, because commercially available products set the standard of quality acceptable to the architect or engineer.

Sometimes proprietary specifications can cause complications because manufacturers reserve the right to change their products without notice, and the product incorporated in the project may not be what the specifier believed would be installed. Another disadvantage of proprietary specifications is that they may permit use of alternative products that are not equal in every respect. Therefore, the specifier should be familiar with the products and their past performance under similar use and should know whether they have had a history of satisfactory service. The specifier should also take into consideration the reputation of the manufacturers or subcontractors for giving service and their attitude toward repair or replacement of defective or inferior work.

Under a proprietary specification, the architect or engineer is responsible to the client for the performance of the material or product specified and for checking the installation to see that it conforms with the specification. The manufacturer of the product specified by the model number has the responsibility of providing the performance promised in its literature.

In general, the specification writer has the responsibility of maintaining competition between manufacturers and subcontractors to help keep costs in line. Naming only one supplier may result in a high price. Two or more names are normally supplied for each product to enhance competition.

Use of "or equal" should be avoided. It is not fully satisfactory in controlling quality of materials and equipment, though it saves time in preparing the specification. Only one or two products need to be investigated and research time needed to review other products is postponed.

***Base-Bid Specifications.*** These establish acceptable materials and equipment by naming one or more (often three) manufacturers and fabricators. The bidder is required to prepare a proposal with prices submitted from these suppliers. Usually, base-bid specifications permit the bidder to submit substitutions or alternatives for the specified products. When this is done, the bidder should state in the proposal the price to be added to, or deducted from, the base bid and include the name, type, manufacturer, and descriptive data for the substitutions. Final selection rests with the client. Base-bid specifications often provide the greatest control of quality of materials and equipment, but there are many pros and cons for the various types of specifications, and there are many variations of them.

### 2.17.3 Automated Specifications

For building projects, specification writers normally maintain a library of *master* documents that are used as a basis for creating project specifications with a computer. Typically, they employ the industry-standard Construction Specifications Institute format (Art. 2.17.1). Computers are used to facilitate and speed production of specifications and other technical documents.

Although computer systems can be complex, requiring an experienced person for setup and maintenance, they are cost-effective, saving time and effort. For example, one program used for preparing specifications has a point-and-click graphics user interface with directories and files represented by icons and manipulated by a mouse. Multiple files are viewed and edited on the screen simultaneously, and each file is seen as a full-page display exactly as it will be printed. The graphics and document layout capabilities of the program are suitable for producing technical manuals and for publishing periodicals. Documents displayed on the computer permit the architect to eliminate the editing of drafts on paper or markups. Instead, editing is performed directly on the computer screen, thus reducing the amount of paper filing and printing that would otherwise be required.

## 2.18 UPFRONT DOCUMENTS

The contract documents prepared by the architect, engineer, or client's legal counsel include the contract between the client and contractor; the bidding requirements, which contain the invitation to bid, instruction to bidders, general information, bid forms, and bid bond; the contract forms, which may include the agreement (contract) format between the client and contractor, performance bond, and payment bond and certificates; the contract conditions identified as the general and supplementary conditions; the list of technical specifications; drawings; addenda; and contract modifications. The bidding requirements, contract forms, and contract conditions are sometimes referred to as the upfront documents.

***Bidding Requirements.*** These explain the procedures bidders are to follow in preparing and submitting their bid. They assist all bidders in following established guidelines so that bids can be submitted for comparative purposes and not be disqualified because of technicalities. The bidding requirements address all prospective bidders, whereas the final contract documents address only the successful bidder, who, after signing the client-contractor agreement, becomes the **contractor.**

***Contract Forms.*** The agreement (contract) is the written document, signed by the client and contractor, which is the legal instrument binding the two parties. This contract defines the relationships and obligations that exist between the client and contractor. It incorporates other contract documents by reference.

The contract may require a construction performance bond for financial protection of the client in the event the contractor is unable to complete the work in accordance with the contract. Not all clients require performance bonds, but the architect should review its necessity with the client and prepare the bidding documents in accordance with the client's decision.

The contract usually requires a contractor payment bond from the contractor to ensure that a surety will pay the labor force and material suppliers should the contractor fail to pay them. The use of this bond precludes the need for the labor force or suppliers to seek payment directly from the client, through liens or otherwise, because of nonpayment by the contractor.

Certificates include those project forms that may be required for insurance, certificate of compliance, guarantees or warranties, or compliance with applicable laws and regulations. Contract forms vary, depending on the type and usage of the project.

***Contract Conditions.*** These define the rights, responsibilities, and relationships of the various parties involved in the construction process. Two types of contract conditions exist, General Conditions and Supplementary Conditions.

The General Conditions have general clauses that establish how the project is to be administered. They normally contain provisions that are common practice. Definitions of project terms, temporary provisions, site security, management process required, and warranties and guarantees are among those items addressed in the General Conditions.

The Supplementary Conditions modify or supplement the general conditions to provide for requirements unique to a specific project and not normally found in standard General Conditions.

## 2.19 QUALITY CONTROL FOR ARCHITECTS AND ENGINEERS

To maintain a consistently high level of quality in design and construction documentation, a rigorous internal review of the documents prepared by the architect or engineer, which draws on the full depth and experience of resources available, should be undertaken during the contract document phase. Quality control can begin in the earliest stages of design, when criteria are established and developed as design guidelines for use throughout the project. At each stage of development, a coordination checklist, based on previous experience, can be utilized for the project through an independent internal or external technical checking program.

Computer file management may be used to enable the various technical disciplines to share graphic data and check for interference conditions, thereby enhancing technical coordination of the documents. Quality control should also continue throughout the construction phase with architect and engineer review of shop drawings and on-site observation of the work.

***Quality Management Program.*** To have a truly meaningful quality management program, all personnel must be committed to it. To help the professional staff understand the quality program, quality systems should be developed, updated, maintained, and administered to assist the architect and professional staff in providing quality service to clients. An individual in each office may be assigned to assist in the quality management program. This person should undertake to instill in all personnel the importance of such a program in every aspect of the daily conduct of business.

The quality management program should set quality goals; develop professional interaction for meeting these goals among peers and peer groups; review building systems, specifications, and drawings to ensure quality; and see that these objectives are known to the public. Such a program will result in a client base that will communicate the quality level of the architect to others in the community, profession, and international marketplace. The architect's image is of extreme importance in acquiring and maintaining clients, and the best quality management program focuses on client service and dedication to the profession.

## 2.20 BIDDING AND CONTRACT AWARD

Competitive bidding is one method of determining the least cost for performing work defined by the construction documents. The bid states the price that the bidder will contract for to perform the work based on the work shown and described in the bidding documents. Bids are prepared in confidence by each bidder. They are usually sealed when submitted to the client (or, in the case of subcontractors, to the bidding contractors). At a specified time and date, all bids are opened, competitively examined, and compared. Unless there are compelling reasons to do otherwise, the client (contractor in the case of subcontractors) usually enters into an agreement to have the work performed by the bidder submitting the lowest price.

Before bids may be received, prospective bidders need to be identified and made aware of the project. Sufficient data should be furnished to potential bidders to allow preparation of their bids. The client may or may not wish to prequalify bidders. In those cases where prequalification is required, the architect can have meaningful input in the process based on past experience with potential bidders.

The terms *bid* and *proposal* are synonymous. Although proposal may imply an opportunity for more consideration and discussion with the client, architect, or engineer, *bid, bidder,* and *bid form* are preferable, to prevent misunderstanding by the bidders.

After client approval of the construction documents and selection of a construction bidding method, the architect may assist in the selection of contractors to bid the work; preparation of bid forms; issuance of bidding documents for competitive bidding; answering inquiries from bidders; and preparing and issuing any necessary addenda to the bidding documents. Furthermore, the architect may assist in analyzing bid proposals and making recommendations to the client as to the award of the construction contract. The architect can also assist in preparation of the construction contract.

Bidders may elect to change their bid on the basis of certain conditions, such as errors in the bid, changes in product cost, changes in labor rates, or nonavailability of labor because of other work or strikes. Each bidder is responsible for providing for any eventuality during the period the bid is open for acceptance. Unless provided for otherwise, bidders may withdraw their bid before acceptance by the client, unless the client consents to a later withdrawal. If all conditions of the instructions to bidders have been met, then after the bids have been opened, the bids should be evaluated. The low bid especially should be analyzed to ensure that it reflects accurately the cost of the work required by the contract documents. The bids may be compared with the architect's construction cost estimate that was prepared on completion of the contract documents. The client can accept a bid and award the contract to the selected bidder, who then becomes the *contractor* for the work.

## 2.21 CONSTRUCTION SCHEDULING

Normally, a client asks the architect for an estimate of the construction time for the project. The client can then incorporate this estimate in the overall development schedule.

The contractor should prepare a detailed construction schedule for use in administering the work of subcontractors and the contractor's own forces. The contractor should be requested to submit the schedule to the architect and the client within 30 days of contract award. The schedule will also form the basis for the contractor's development of a shop drawing schedule.

A construction schedule can consist simply of a bar chart for each item of work or a breakdown for the major trades on the project. Alternatively, the schedule can be highly detailed; for example, a critical-path-method (CPM) schedule. This is recommended for large projects for monitoring the critical-path item at any point in time, since the critical path can change, depending on actual construction conditions. The contractor should monitor and update the schedule monthly during the construction phase so that the anticipated completion and move-in date can be verified or adjusted. If the completion date cannot be adjusted and the schedule appears to be of concern, more work time (overtime) may be required to maintain the nonadjusted schedule. This could have an impact on cost, depending on how the client-contract agreement was structured.

The construction schedule is an extremely meaningful tool in monitoring the construction process. It can assist the architect's ongoing role in quality control during the construction phase, when the management of the building process is transferred to, and becomes the responsibility of, the contractor. The schedule also is a meaningful tool for use by all trades involved in the building process. The schedule affects trades in different ways, depending on the size of the labor force, availability of material and personnel hoisting equipment, access to the work, coordination of subcontractors' work with material suppliers, material testing agencies involved, preparation of mock-ups, shop-drawing submittals, and general overall construction coordination issues.

## 2.22 SHOP DRAWING REVIEW

After the construction contract is awarded, the contractor should submit a proposed schedule for submission of shop drawings to meet the construction schedule. This permits the architect to anticipate submissions and plan manpower requirements accordingly, based on the number and complexity of each submission.

As an ongoing part of quality control, the architect should review the shop drawings, product literature, and samples and observe material and mock-up testing. This is considered part of the shop drawing submittal process. The architect should be an independent agent and side neither with the client nor the contractor in acceptance or rejection of a submittal. Rather, based on professional judgment, the architect should render a decision as to whether the submittal is in general accordance with the construction documents and design intent. All submittals should be properly identified and recorded when received by the architect, as part of document control. The architect should review the submittal expeditiously and return it to the contractor with the appropriate action.

The architect's action shown on the submittal usually records that the contractor can proceed, proceed as noted, or not proceed. A copy of the proceed and proceed-as-noted submittal should be maintained in the architect's and contractor's site office for reference. The client should also be provided with the transmittal associated with submittals. This helps keep the client informed regarding the progress of the work relative to the schedule for submission of shop drawings.

## 2.23 ROLE OF ARCHITECT OR ENGINEER DURING CONSTRUCTION

After award of the construction contract, the architect or engineer generally continues to assist the client in relations with the contractor.

### 2.23.1 Site Observation

As part of their ongoing services during construction, and depending on the scale and complexity of the project, architects and engineers may make periodic site visits or maintain full-time representation on site during a portion or all of the construction period. The professional's role is to expedite day-to-day communication and decision making by having on-site personnel available to respond to required drawing and specification clarifications.

Site-observation requirements for the project should be discussed with the client at the onset of the project and be outlined in the architect-client agreement. Many clients prefer periodic or regularly scheduled site visits by the design professional. A provision for additional or full-time on-site representation, however, can be addressed in the agreement, and compensation for this additional service can be outlined in the agreement for discussion with the client later in the development process or during the construction phase. The client and the architect and engineer should agree on the appropriate amount of site visitation provided in the architect's basic services to allow adequate site-observation services based on specific project conditions.

If periodic site observations are made, the architect should report such observations to the client in written form. This should call attention to items observed that do not meet the intent of the construction documents. It is normally left to the client to reject or replace work unless such defective work involves life safety, health, or welfare of the building occupants or is a defect involving structural integrity. If the architect provides full-time site observation services, daily or weekly reports should be issued to the client outlining items observed that are not in accordance with the construction documents or design intent.

### 2.23.2 Site Record Keeping

Depending on contractual requirements for service during the construction phase, the architect may establish a field office. In this event, dual record keeping is suggested between the site and architect's office so that records required for daily administration of construction are readily accessible on site. Contractor correspondence, field reports, testing and balancing reports, shop drawings, record documents, contractor payment requests, change orders, bulletin issues, field meeting minutes, and schedules are used continually during construction. Computer systems and electronic mail make the communication process somewhat easy to control.

### 2.23.3 Inspection and Testing

Technical specifications require testing and inspection of various material and building systems during construction to verify that the intent of the design and construction documents is being fulfilled under field conditions. Testing is required where visual observations cannot verify actual conditions. Subsurface conditions, concrete and steel testing, welding, air infiltration, and air and water balancing of mechanical systems are such building elements that require inspection and testing services. Normally, these services are performed by an independent testing agency employed directly by the client so that third-party evaluation can be obtained.

Although the architect does not become involved in the conduct of work or determine the means or methods of construction, the architect has the general responsibility to the client to see that the work is installed in general accordance with the contract documents.

Other areas of inspection and testing involve establishing and checking benchmarks for horizontal and vertical alignment, examining soils and backfill material, compaction testing, examining subsurface retention systems, inspecting connections to public utilities, verifying subsoil drainage, verifying structural column centerlines and base-plate locations (if applicable), checking alignment and bracing of concrete formwork, verifying concrete strength and quality, and other similar items.

### 2.23.4 Payment Requests

The contractor normally submits a consolidated payment request monthly to the architect and client for review and certification. The payment request should be subdivided by trade and compared with the schedule of values for each trade that would have been submitted with the subcontractor bid if required by the instructions to bidders and bid form. The architect should review the payment request with respect to the percentage of completion of the pertinent work item or trade.

Some clients or lending institutions require that a partial waiver of lien be submitted for each work item or trade with each payment request. This partial waiver of lien can either be for the prior monthly request, which will indicate that the prior month's payment has been received, or in certain cases for the current monthly request. If the latter procedure is followed, the waiver may require revision, depending on the architect's review, if a work-item or trade-payment request is modified. The architect is not expected to audit the payment request or check the mathematical calculations for accuracy.

### 2.23.5 Change Orders

Contractor's change-order requests require the input of the architect, engineer, and client and are usually acted on as part of the payment request procedure. A change order is the instrument for amending the original contract amount and schedule, as submitted with the bid and agreed on in the client-contractor contract. Change orders can result from departures from the contract documents ordered during construction, by the architect, engineer, or client; errors or omissions; field conditions; unforeseen subsoil; or other similar conditions.

A change order outlines the nature of the change and the effect, if any, on the contract amount and construction schedule. Change orders can occur with both a zero cost and zero schedule change. Nevertheless, they should be documented in writing and approved by the contractor, architect, and client to acknowledge that the changes were made, with no impact. Change orders are also used to permit a material substitution when a material or system not included in the contract documents is found acceptable by the client and architect. For material substitutions proposed by the contractor, schedule revisions are not normally recognized as a valid change.

The sum of the change-order amounts is added or deducted from the original contract amount. Then, the revised contract amount is carried forward on the contractor's consolidated application for payment after the change orders have been signed by all parties. The normal contractor payment request procedure is then followed, on the basis of the new contract amount. If the schedule is changed because of a change order, the subsequent issue of the construction schedule should indicate the revised completion or move-in date, or both, that result from the approved change.

### 2.23.6 Project Closeout

Project closeout involves all parties, including subcontractors and material suppliers. It should be addressed early in the construction phase so that the closeout can be expedited and documented in an organized and meaningful manner. At this point in the construction process, the attention of the contractor and architect is focused on accomplishing the necessary paperwork and administrative functions required for final acceptance of the work and issuance of the contractor's final consolidated application for payment and final waiver of lien.

The normal project closeout proceeds as follows:

**1.** The contractor formally notifies the architect and the client that the contracted work is substantially complete.

**2.** From on-site observations and representations made by the contractor, the architect documents substantial completion with the client and the contractor. In some cases, this may trigger the start of certain guarantees or warranties, depending on the provisions of the general and supplementary conditions of the contract.

**3.** For some projects that are phased, some but not all the building systems may be recognized by the architect and the client as being substantially complete. This should be well-documented, since start dates for warranty and guarantee periods for various building systems or equipment may vary.

**4.** On-site visits are made by the architect and representatives of the client, sometimes called a walk-through, and a final *punchlist* is developed by the architect to document items requiring remedial work or replacement to meet the requirement of the construction documents.

**5.** A complete keying schedule, with master, submaster, room, and specialty keys, is documented by the contractor and delivered to the client.

**6.** The contractor submits all record drawings, **as-builts,** testing and balancing reports, and other administrative paperwork required by the contract documents.

**7.** The contractor should submit all required guarantees, warranties, certificates, and bonds required by the general and supplementary conditions of the contract or technical specifications for each work item or trade outlined in the breakdown of the contractor's consolidated final payment request.

**8.** The contractor corrects all work noted on the punchlist. A final observation of the corrected work may then be made by the architect and client.

**9.** If the client accepts the work, the architect sends a certificate of completion to the contractor with a copy to the client. The certificate documents that final completion of the work has occurred. All required operating manuals and maintenance instructions are given to the architect for document control and forwarding to the client.

**10.** The contractor submits final waivers of lien from each subcontractor or material supplier. Also provided is an affidavit stating that all invoices have been paid, with the exception of those amounts shown on the final waiver of lien. With these documents, the contractor submits the final consolidated payment request, including all change orders.

**11.** The architect sends a final certificate of payment to the client, with a copy to the contractor.

**12.** The contractor provides any required certificate of occupancy, indicating that the building authorities have jurisdiction over the project approve occupancy of the space for the intended use.

**13.** The client makes final payment to the contractor and notifies the architect of this.

This process is important inasmuch as it can trigger the transfer of risk from the contractor's insurance program during construction to the client's insurance program for the completed project.

## 2.24 TESTING AND BALANCING OF BUILDING SYSTEMS

It is normal for projects to go through what is known as a *shakedown period* after final acceptance and occupancy by the client or building tenant. The warranty and guarantee period (normally 1 year) is the contractor's representation and recognition that certain building elements and systems may need adjustment or slight modification, depending on actual occupancy conditions or normal maintenance and usage of such systems. The heating, ventilating, air conditioning, and systems unique to a project require testing and balancing and potential minor modifications and adjustments during this warranty and guarantee period, even though they were tested and balanced by the contractor's testing agency prior to project closeout. An independent testing and balancing contractor who was employed prior to final project closeout normally returns on an as-needed, on-call basis to adjust, test, and balance systems during the first year. In addition, the building engineer will become familiar with the systems during this first year of operation and may also adjust and balance systems.

## 2.25 POSTCONSTRUCTION OPERATION AND MAINTENANCE

The technical specifications for a building project normally require that some time be devoted prior to project closeout for instruction and training of the client's building operating personnel and building engineer, who will be responsible for operating and maintaining the various building systems. Manufacturers' operating procedures, manuals, and inventory of spare parts and attic stock should be reviewed with the client, building engineer, and the contractor installing the work. The building engineer should thus gain a general understanding of the individual systems and their interaction in the operation of the building. During the warranty and guarantee period, the contractor or applicable subcontractor may be requested to assist the building engineer further in operation and maintenance of a system, including testing, balancing, and minor adjustment. After the shakedown period and when the engineer thoroughly understands system operation, the client's personnel assume full responsibility and deal directly with the manufacturers of various building components for maintenance. Or the client may subcontract maintenance, a normal procedure for such systems as elevators and escalators where specialty expertise in maintenance is required.

## 2.26 RECORD DRAWINGS

The normal procedure for submission of record drawings rests primarily with the contractor. These are edited drawings and specifications submitted by the contractor that describe actual installed conditions based on the contractor's field coordination of the work.

In some instances, the client may request that the architect revise the original construction documents or prepare new drawings to reflect the as-built conditions. This is normally an additional service in the architect-client agreement. It should be made clear to the client that the architect, if brought into this process, is acting only in a drafting role, inasmuch as the as-built documentation, including dimensions and details, is furnished by, and is the responsibility of, the contractor.

As-built and record drawings are helpful to the client in remodeling, maintenance, building-system modification, or making future additions to the project. The client should retain the drawings with maintenance manuals and operations procedures.

## 2.27 FOLLOW-UP INTERVIEWS

It is advisable that the architect or engineer have follow-up interviews with the client and occupants of the building or tenant spaces to help ascertain the success of the project and learn where certain materials, details, equipment, or systems may be improved for future use in other projects. Good client relations demand this type of exchange. It is also helpful for the architect or engineer to disseminate the interview results throughout the office and professional community, to improve problem solving, design, and construction.

## 2.28 MANAGEMENT OF DISPUTES

Even in the best of relationships, disputes can arise between the client and architect, client and contractor, or architect and contractor, even though the architect and contractor do not normally have a written agreement with each other. Disputes should be quickly addressed and resolved for the well-being of the project and to minimize disruption of the design and building process. If the dispute cannot be resolved by the parties, various methods of resolution are offered that include settlement, mediation, arbitration, and litigation. To maintain insurance coverage and protect appropriate interests, proper notification to insurers or involvement of legal counsel is required.

***Settlement of Disputes.*** Disputes between two parties should be addressed quickly and, if at all possible, a settlement should be rendered and recorded. Settlement can be in the form of monetary adjustments or payments, free services on behalf of the architect to remedy or correct an error, or such other agreement between the two parties. It is recommended that this method of dispute resolution be used whenever possible to avoid time, cost, and anguish, which can occur as a result of mediation, arbitration, and litigation.

***Mediation.*** In mediation, the parties in dispute agree on a third independent party to act as a mediator and hear each side's position in the dispute in an attempt to mediate a resolution. Mediation is not binding on either party but helps resolve certain disputes due to a third party's focus on, and question of, the issues.

***Arbitration.*** This is a method of handling disputes in which an arbitrator or arbitration panel, often consisting of three members, is selected to hear the positions of the parties in the dispute and decide on a potential resolution. The resolution is binding on the parties. Cost and time for arbitration is usually, but not always, less than that required for litigation. The arbitrators usually consist of professionals (architects and engineers), lawyers, contractors, or other parties involved in the building industry.

***Litigation.*** In the event settlement or mediation cannot resolve a dispute and the parties do not wish to arbitrate, the only remaining course of action is to litigate the dispute. This requires that much time and money be expended for depositions, document and other discovery, and preparation for trial. The final results are rendered by a group of individuals (the jury) or judge not involved in the building industry. Therefore, a possession of a thorough knowledge and understanding of issues affecting the architectural and engineering profession and construction industry become the responsibility of each party's legal counsel to establish a true and accurate picture of each party's position and the facts in the case. See also Art. 17.14.

## 2.29 PROFESSIONAL ETHICS

The American Institute of Architects has formulated the following basic principles for guidance of architects:

> Advice and counsel constitute the service of the profession. Given in verbal, written, or graphic form, they are normally rendered in order that buildings with their equipment and the areas about them, in addition to being well suited to their purposes, well planned for health, safety, and efficient operation and economical maintenance, and soundly constructed of materials and by methods most appropriate and economical for their particular uses, shall have a beauty and distinction that lift them above the common-

> place. It is the purpose of the profession of architecture to render such services from the beginning to the completion of a project.

The fulfillment of that purpose is advanced every time architects render the highest quality of service they are capable of giving. In particular, the architect's drawings, specifications, and other documents should be complete, definite, and clear concerning the architect's intentions, the scope of the contractor's work, the materials to be employed, and the conditions under which the construction is to be completed and the work paid for. The relation of architects to their clients depends on good faith. Architects should explain the exact nature and extent of their services and the conditional character of construction cost estimates made before final drawings and specifications are complete.

The contractor depends on the architect to guard the contractor's interests as well as those of the client. The architect should reject workmanship and materials that are determined not to be in conformity with the contract documents, but it is also the architect's duty to give reasonable aid toward a complete understanding of those documents so that errors may be avoided. An exchange of information between architects and those who supply and handle building materials should be encouraged.

Architects, in their investments and business relations outside the profession, should avoid financial or personal activities that tend to weaken or discredit their standing as an unprejudiced and honest adviser, free to act in the client's best interests. Permitting use of free architectural or engineering services to be offered by manufacturers; suppliers of building materials, appliances, and equipment; or contractors may imply an obligation that can become detrimental to the best interest of the client.

Architects may offer their services to anyone for commission, salary, or fee as architect, consultant, adviser, or assistant, provided the architect rigidly maintains professional integrity, disinterestedness, and freedom to act.

Architects should work together through their professional organizations to promote the welfare of the physical environment. They should share in the interchange of technical information and experience.

Architects should seek opportunities to be of service in civic affairs. To the best of their ability, they should endeavor to advance the safety, health, and well-being of the community in which they reside by promoting appreciation of good design, good construction, proper placement of facilities, and harmonious development of the areas surrounding the facility.

Architects should take action to advance the interests of their personnel, providing suitable working conditions for them, requiring them to render competent and efficient services, and paying them adequate and just compensation. Architects should also encourage and sponsor those who are entering the profession, assisting them to a full understanding of the functions, duties, and responsibilities of the architectural profession.

Every architect should contribute toward justice, courtesy, and sincerity in the profession. In the conduct of their practice, architects should maintain a totally professional attitude toward those served, toward those who assist in the practice, toward fellow architects, and toward the members of other professions. Daily performance should command respect to the extent that the profession will benefit from the example architects set to other professionals and to the public in general.