

Construction Documentation—Drawings

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Construction documentation is the bridge between building design and physical building form. A key element of documentation services, construction drawings provide the instructions for transforming design solutions into bricks and mortar.

Summary

CONSTRUCTION DOCUMENTATION SERVICES—DRAWINGS

Why a Client May Need These Services

- ▶ To provide documentation for bidding and execution of construction services

Knowledge and Skills Required

- ▶ Knowledge of construction materials, components, and assemblies
- ▶ Ability to develop construction details consistent with design, performance, and budget objectives
- ▶ Ability to develop specifications to the level of detail required
- ▶ Knowledge of code review processes and procedures
- ▶ Familiarity with procurement of construction services
- ▶ Knowledge of manual and/or computer drawing standards and systems
- ▶ Skill with CAD programs

Representative Process Tasks

- ▶ Assemble team for drafting, specifications writing, and cost estimating
- ▶ Confirm client expectations for content, detail level, and packaging of construction documents
- ▶ Coordinate specs and drawings from all disciplines
- ▶ Prepare construction drawings based on design development drawings
- ▶ Prepare specifications to accompany drawings
- ▶ Submit documents to building code officials
- ▶ Prepare bid packages
- ▶ Prepare sketches and specifications for change orders during construction

▶ **Construction documentation services typically represent 2.4 to 4 percent of construction cost.**

By definition, construction documentation encompasses the preparation of drawings and specifications that set forth the detailed requirements for the construction of a building project. Drawings thus represent the illustrative dimension of construction documentation, while specifications represent the written. The two are complementary, with neither having precedence over the other.

Because the creation of drawings and the development of specifications use different sets of knowledge and skills, they are presented in separate profiles in this section of the Handbook. In addition, the topic Construction Documents Production (13.4) includes a detailed discussion of the methods and procedures used in preparing drawings and specifications.

Within the context of design and construction documentation, design represents an expression of the desired solution, while construction drawings control—to the extent possible—the eventual physical outcome of that expression. To achieve this, construction drawings depict the components of the intended building design in such a way that construction personnel can clearly understand what results are desired.

Although construction drawings for a given building project are normally done by the firm that provides the design services, there are exceptions to the same firm doing both. For example, two firms may team to take advantage of their respective capabilities. One may take responsibility for design—possibly up through design development. The other might have responsibility for the construction documents along with services for construction procurement and construction contract administration. In other instances, a commercial enterprise may seek documentation services when one of their prototypical facilities must be adapted to a specific site.

In the above scenarios, the documentation may be carried out under separate owner-architect contracts, depending on the project's contractual arrangement. In either case, when design and construction documentation services are carried out by different firms, ensuring that the design intent is adequately interpreted within the construction documentation can become a greater challenge.

Several current and emerging factors affect construction drawings. Foremost are the benefits offered by state-of-the-art computer-assisted design and drafting (CADD) programs, which make it possible to create complex documents faster; to easily delineate repetitive elements, and to readily manipulate data and information to make changes. Also, the power of emerging software is allowing for greater integration between separate software applications.

Building delivery is another factor that can affect construction documentation, espe-

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cially from the vantage point of quality. For example, negotiated construction contracts and design-build approaches allow for greater contractor involvement during the development of drawings and specifications. This participation can contribute to the creation of clearer and more integrated documents to help minimize conflicts and misunderstandings among the building trades.

CLIENT NEEDS

Clients developing new buildings or renovating existing buildings need construction documentation in order to obtain building permits. As mandated by law, construction documents must be prepared by licensed architects for most building types. (Some buildings, such as single-family residences and other designated structures, may not require architect-generated drawings. The specific requirements will depend on the laws of the jurisdiction in which the building project is located.)

Client need for construction drawings. Most clients use construction documents on a one-time basis for a single building project. In certain market sectors, some clients may want to use construction documents on a repetitive basis. For example, nationally or regionally based commercial clients may want to build in multiple locations using a prototypical design (e.g., stores, restaurants, car wash facilities, or other retail building types). A school district may wish to adapt a single school design to several locations. A developer or builder may look to construct multiple single-family houses from a given set of plans. In all of these and similar cases, the original construction drawings will require varying degrees of change to adapt the plans for site conditions, orientation issues, code requirements, and other related design considerations.

Client use of construction drawings. Construction documents—regardless of the media in which they exist—are the property of the architect. Contractually, they are considered to be *instruments of service*, which means they are among the many products the architect may prepare in conjunction with services for a given building project. AIA Document B141, however, does allow instruments of service to be used for the purposes of “using and maintaining the project.” This may include using construction documents as a basis for future modifications or facility expansion, for maintaining and operating a building, or in conjunction with facility management initiatives.

Client expectations. Clients expect construction documentation to communicate—as clearly as possible—the components of the structure and the level of quality needed for those components to fulfill the building’s intended use. In doing this, construction drawings are detailed to a level that allows the contractor or builder to price the construction with a reasonable degree of confidence. Although clients would prefer to have no or only a few change orders during construction, the reality and possibility of unforeseen conditions or events may create the need for change orders in which further drawing documentation may be required.

Related needs and services. In addition to building design and interior design, documentation skills can be applied to facility surveys for preparing architectural drawings that delineate existing conditions. Construction procurement and construction contract administration are natural follow-on services for architects who have provided construction documentation for their clients. Who can better interpret construction documents than those who produced them?

Construction documentation skills can also be applied to postconstruction services such as the preparation of record drawings. In buildings with rented or leased spaces, clients or individual tenants seeking space planning or interior design services will understand the advantages of working with a firm that has produced the construction documents for the shell and core of the building. Likewise, architects who have prepared construction documentation can leverage their experience and knowledge of the facility to provide move-in assistance or move management services.

SKILLS

The preparation of architectural working drawings represents one of the major core competencies of architects. The work requires knowledge of principles, conventions, standards, applications, and restrictions pertaining to the manufacture and use of construc-

tion materials, components, and assemblies. In the documentation process, the architect must be able to make technically concise descriptions and execute drawings and other documentation for the proposed design. This knowledge and sets of skills include the following:

- *Detailing.* This is perhaps one of the most crucial skills used in construction documentation. This is because the nature and quality of architectural detailing contributes to how the building is built, what it will look like, what it will cost, and how long it may take to build. For these reasons, staff involved in the documentation process should have a thorough understanding of the methods and techniques used in building construction. This includes knowing how various materials are connected or attached and how they interact when brought together. An understanding of how air, water, and other elements interact with buildings is also crucial to effective detailing.
- *Delineation.* The production of construction drawings is rooted in manual methods that require a facility with pencil or pen. Although CAD systems have replaced manual methods, most of the concepts and principles of effective delineation are still applicable to automated drawing methods. This means that documentation staff should have an understanding of how line weights, lettering, proportionality of drawn objects, and relationships between drawing elements individually and collectively contribute to the overall clarity of a drawing.
- *Drawing systems and standards.* An understanding of drafting conventions and drawing systems for organizing graphical information is important. This includes issues such as sheet naming, drawing sequence, sizes, and layout. For electronically produced documents, knowledge of CAD guidelines and standards is important for producing documents and exchanging them between project team members.
- *Communication and coordination.* The production staff may work with the project designer, project manager, and specifications staff in order to coordinate production issues and decisions. In this process, the ability to communicate verbally as well as in writing is important.
- *Architectural knowledge.* Drafters, CAD operators, and other documentation staff must interpret and make design decisions as they develop detailed working drawings based on design documentation. In doing this, knowledge of design principles and concepts is important. Such decisions balancing functionality, code requirements, and aesthetics constantly come into play in deciding such issues as where to position a clock or a thermostat on a wall or how to proportion and detail a built-in shelving unit.

Equipment used by architectural staff for construction documentation include computer workstations, scanners, plotters, cameras (digital cameras are popular), light meters, and sound meters. Construction documentation teams are increasingly working with electronic transfer of information by e-mail and the Internet. Many teams also use file transfer protocol (FTP) sites to post and retrieve shared information such as drawings.

PROCESS

The scope of construction documentation services will depend on the size and complexity of a project and the number of disciplines involved. However, size itself may not always be a driver. Some small projects containing highly specialized spaces and the need for highly customized design may require a higher ratio of drawings per square foot than a larger project that has many repetitive elements (e.g., high-rises, multiple building units).

The scope can also be affected by client requirements and the project delivery approach used. Some clients have their own requirements for the presentation or hierarchy of construction drawing details. Some may expect standard details to be used, while others may require customized details. Fast-tracking and delivery techniques involving phased delivery and preparation of multiple bid packages may also affect the scope of construction documentation.

Team Considerations

When assembling a construction documentation team, it is prudent to consider the work approaches of the various firms involved. Everyone must agree on the process by which work will be reviewed and approved. All the team members must understand and accept the lead firm's management methods. Also consider whether the team members have compatible equipment and software to ensure interoperability issues and good communication.

Specifications writers and estimators are integral construction documentation team members. The specifications writer brings detailed technical knowledge of available construction products and how they are appropriately used. Specifications writers have expertise in preparing specifications so that product information is conveyed clearly to the contractor.

The project cost estimator helps track the cost of the project and assists the team in budget control. Estimators contribute knowledge of prevailing contractor costs for the project location and the ability to analyze the drawings for cost factors. Some firms separately subcontract specifications writing and bid estimating services. In fast-track or design-build projects where the contractor is brought on board early, it can be productive to have the contractor provide parallel estimating on construction documents before they are bid. As previously noted, contractor involvement in the production process can help the team produce a more complete and effective set of documents.

Usually the designer or project architect will take the lead responsibility for the production of architectural drawings. In small firms the designer may also prepare the construction drawings. In larger firms and on larger projects a team is usually assigned responsibility for producing the drawings. On certain large projects the project architect may have one or more management assistants as well as accounting support.

The documentation team works with all involved disciplines. These may include surveyors; geotechnical and civil engineers; landscape architects; structural, mechanical, and electrical engineers; architects; interior designers; and telecommunications specialists. Depending on the project, other specialists may include acoustical engineers, wind tunnel engineers, environmental specialists, audiovisual specialists, lighting designers, computer specialists, or designers who specialize in particular types of buildings or spaces (e.g., laboratories, detention facilities, auditoriums or sports arenas).

Producing the Drawings

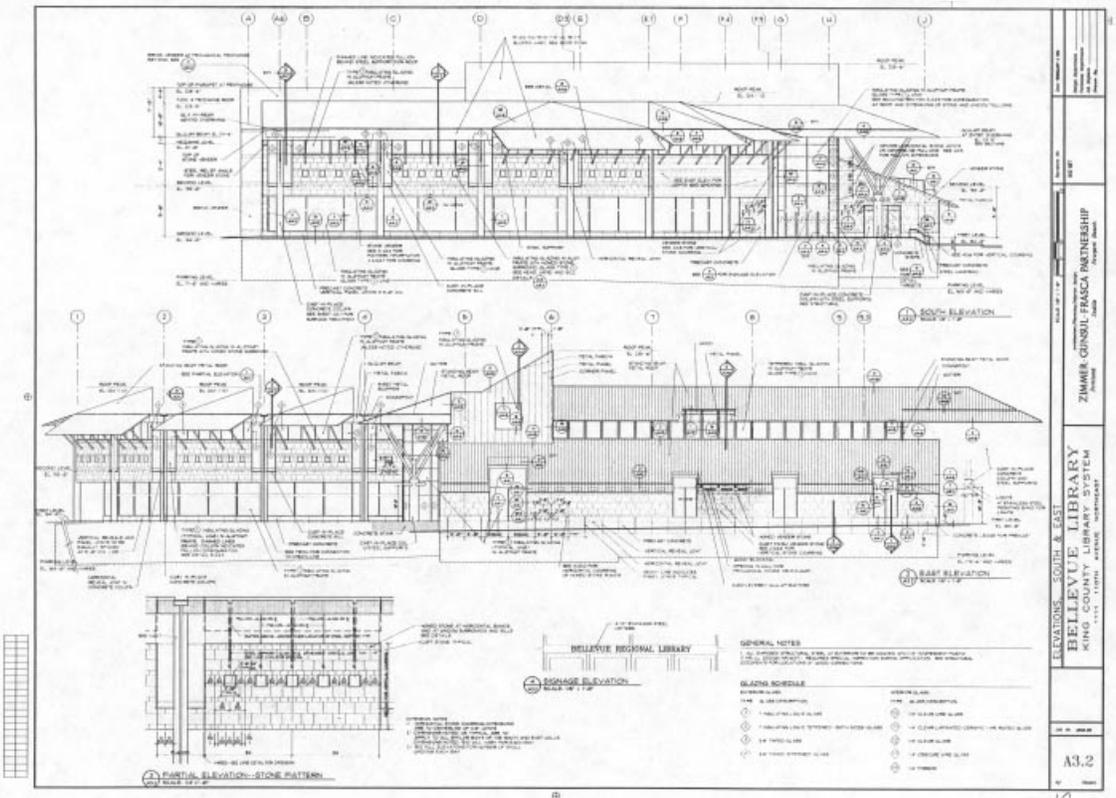
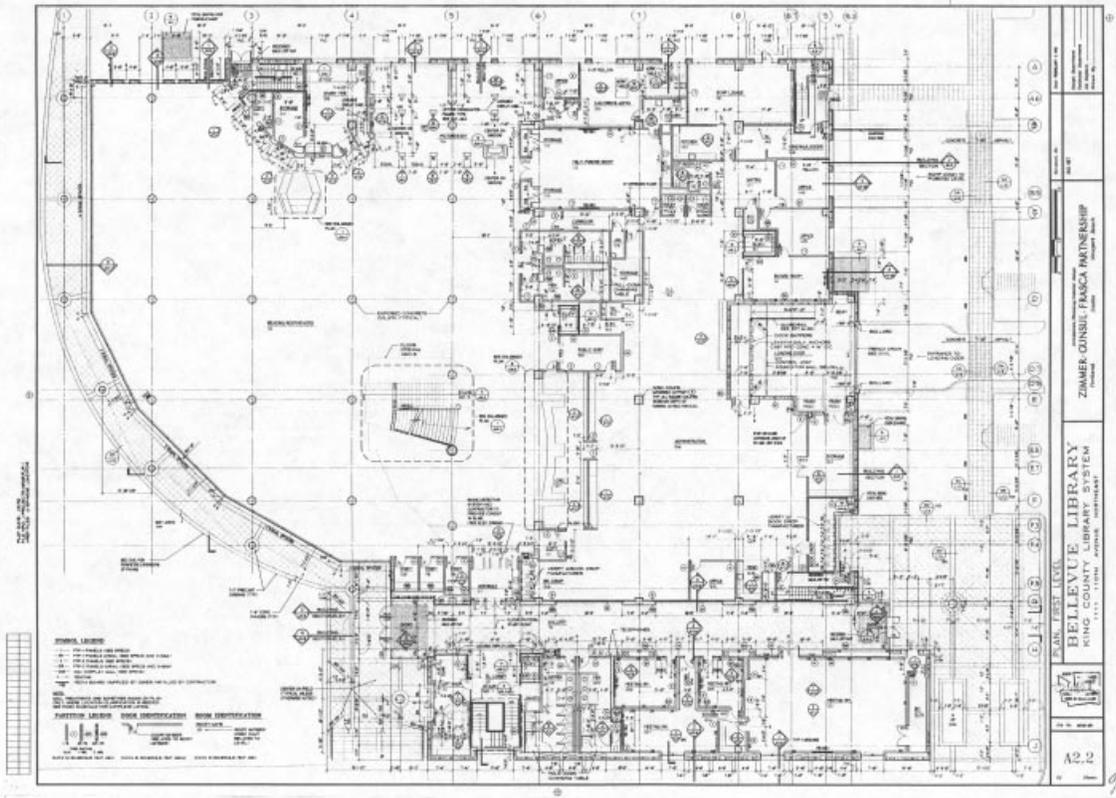
Construction drawings are normally prepared based on the drawings produced in design development. Each discipline involved will prepare a "discipline package" of construction drawings.

Preproduction. There are several important points to address before starting the production process. These include:

- Confirming that the client has approved the design development documents and the preliminary project budget
- Verifying the project delivery approach and project schedule
- Communicating the client's requirements for the content, detail level, and packaging of the construction documents
- Identifying and confirming client-required formats or standards (e.g., sheet sizes, layouts, sequence, numbering, symbols, and abbreviations)
- Confirming that the proposed CADD software is acceptable to the client

Development of drawings. The preparation of construction documents requires a systematic review process to ensure that all discipline packages (e.g., structural, mechanical, electrical, lighting, audiovisual, interiors, etc.) are coordinated and properly integrated. When the documents—including both drawings and specifications—are completed and approved, they provide a basis for preparing an estimated cost of construction. Based on this estimate, the bid packages can be prepared.

During the development of drawings, coordination and review of the drawing packages requires an ongoing process of checking and rechecking. Each discipline will regularly review its own drawings for adherence to the documentation standards and will coordinate with the work



Construction drawings—together with construction specifications—are used to obtain regulatory and financial approvals, to determine cost of construction through bidding or negotiation, and finally to carry out the construction process.

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of other disciplines. Project participants meet with each other and with independent peer consultants to review and coordinate work. Additionally, the entire project team may meet at key points in the process for the same purpose. These review and coordination initiatives are repeated through each step of development, and again when the final documents package is assembled.

Independent peer reviewers are required for document review and checking before documents are released for bidding. Senior staff not involved in the project can be assigned this task, or the client may employ independent consultants for this purpose. The construction drawings must be reviewed and approved by building code officials for compliance with zoning and planning requirements in order for a building permit to be issued. In some jurisdictions design review also is required.

During the bidding and negotiation process, the team that prepared the construction drawings and specifications may provide support to the client by reviewing or confirming cost estimates and perhaps preparing contract modifications, which may involve drawing changes. The team also remains available for consultation during the construction administration phase to assist with preparing revised sketches for addendums and change orders.

 **During the production of construction documents, cost control is an important factor. For a detailed discussion of cost control, see Construction Cost Management**

“Construction Documentation—Drawings” was originally published in *The Architect’s Handbook of Professional Practice*, 13th edition, ©2000 by the American Institute of Architects, published by John Wiley & Sons, Inc.

The AIA provides a contract document designed especially for alternative architectural services.

B102–2007, Standard Form of Agreement Between Owner and Architect without a Predefined Scope of Architect’s Services.

AIA Document B102–2007 is a standard form of agreement between owner and architect that contains terms and conditions and compensation details. B102–2007 does not include a scope of architect’s services, which must be inserted in Article 1 or attached as an exhibit. Special terms and conditions that modify the agreement may be included in Article 8.

The separation of the scope of services from the owner/architect agreement allows users the freedom to append alternative scopes of services.

AIA Document B102–2007 replaces and serves the same purpose as AIA Document B141–1997 Part 1.

For more information about AIA Contract Documents, visit www.aia.org/contractdocs/about

May 2011 The American Institute of Architects