

Construction Documents

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*A maximum of 40 hours of core credit may be earned in this experience area.

exhibits

Construction Documents

Introduction

By completing the activities in this chapter, you will gain an understanding of the activities involved in developing construction documents. The following information is taken from the NCARB IDP Guidelines:

Construction Documents

Minimum Construction Documents Experience: 1,200 Hours

Definition: Includes the written and graphic instructions used for construction of the project. These documents must be accurate, consistent, complete, and understandable.

Tasks

At the completion of your internship, you should be able to:

- Prepare construction documents
- Coordinate construction documents (e.g., architectural, structural, mechanical, civil, electrical)
- Conduct quality control review of project documents
- Apply sustainable design principles

Knowledge Of/Skill In

- 3-D modeling
- Adaptive reuse of buildings and/or materials
- Alternative energy systems and technologies
- Basic engineering principles
- Building design
- Building envelope
- Building Information Modeling (BIM) technology
- Building systems and their integration
- Characteristics and properties of construction materials
- Computer Aided Design and Drafting (CADD)
- Conflict resolution
- Constructability
- Construction details
- Construction sequencing
- Creativity and vision
- Critical thinking (e.g., analysis, synthesis, and evaluation of information)
- Design impact on human behavior
- Design principles
- Designing and delivering presentations
- Engineering load calculations
- Freehand drawing and design sketching
- Furnishings, fixtures, and equipment
- Graphic communication
- Hazardous materials mitigation
- Implications of design decisions (e.g., cost, engineering, schedule)
- Indoor air quality
- Interior materials and finishes
- Interpersonal skills (e.g., listening, diplomacy, responsiveness)

resources

Download the current Intern Development Program (IDP) guidelines at www.ncarb.org/Experience-Through-Internships.aspx.

The American Institute of Architects. Demkin, Joseph A., ed. *The Architect's Handbook of Professional Practice*. 14th ed. Hoboken: John Wiley & Sons, 2008.

- Chapter 12.3 - Construction Documentation

The American Institute of Architects. Demkin, Joseph A., ed. *The Architect's Handbook of Professional Practice*. 13th ed. New York: John Wiley & Sons, 2001.

- Chapter 18.5 - Construction Documentation - Drawings
- Chapter 18.6 - Construction Documentation - Specifications

The American Institute of Architects, *The Architecture Student's Handbook of Professional Practice*. 14th ed. Hoboken: John Wiley & Sons, 2009.

- Chapter 8.3 - Construction Documentation

Knowledge Of/Skill In *Continued*

- Life safety
- Managing quality through best practices
- Manual drafting
- Natural and electric lighting (e.g., daylight, solar control, energy consumption)
- Oral and written communications
- Problem solving
- Product evaluation, selection, and availability
- Project scheduling (e.g., construction document setup, storyboarding, staffing projections)
- Site design
- Space planning
- Spatial visualization and modeling
- Specifications
- Sustainable design
- Team building, leadership, participation
- Technological advances and innovative building products
- Vertical circulation

notes

Take brief notes while reading the narrative and list key resources you used to complete the activities. Note discussion outcomes from meetings with your supervisor, mentor, or consultants. When finalizing the activity documentation (PDF), include your notes and the Emerging Professional's Companion activity description.

Narrative

First and foremost, construction documents (CDs) are a vital, creative, even exquisite instrument of communication: Following the definition of the overall design in the design development phase and its approval by the owner, construction documentation is a natural continuation of the design process—one that sets the parameters for the building process. Comprising legal, procedural, and construction information, CDs outline the key interrelationships, rights, responsibilities, and dynamics that bring a building into being.

In a combination of written and graphic formats, construction documents translate the design of a project from the realm of ideas to physical form. CDs are at once descriptive and prescriptive: They describe, in detail, the components of a project that need to be fabricated and assembled in order for it to be built. To that end, the contributions of myriad consultants are assembled into a coherent, artful whole.

It is essential for clarity, specificity, and completeness of construction documents. Accordingly, they demand thought, time, research, coordination, organization, clear communication and, above all, infinite care: The health, safety and welfare of the public is bound up in the successful completion of this phase of a project.

Context

Long before they come to occupy physical space, buildings are “built” many times over. The act of producing CDs is itself an act of construction. The unique combination of words and drawings that are construction documents is the last iteration of the virtual building—and the first that most nearly approximates its final shape.

The heart of any project resides in its construction drawings and specifications. This is the place where the building succeeds or fails: In the construction drawings, it is possible to express the possibilities of materials, the lyricism of their assembly, and the potential of each to articulate and support the ideas of the larger whole. At their best, construction document drawings balance the architect’s instinct for innovation with the tempering voice of experience.

The Big Picture

Construction document drawings present distinct design challenges, as well as unique potential. The architect is tasked with developing CDs that interpret the client-approved project concept and present it so the building that results is one we safely inhabit and remember. Although many elements of the building are partially defined in the phases that precede construction documentation, it is in the CDs that these take their final form. Construction documents are prepared at a more focused, detailed scale than either the schematic design or design development phases of a project, yet they are the clear next step in that design continuum. In the CDs, every aspect of the larger building is subjected to careful scrutiny:

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What Constitutes CD

Construction documents typically include the following types of information:

- Legal and contractual information
- Contractor bidding requirements (invitation to bid or advertisement; information and instructions to bidders; bid forms; and bid bonds)
- Contract forms (form of agreement between owner and contractor; forms for payment bonds and certificates)
- Contract modifications (e.g., additions or changes after the contract is signed, such as orders for minor changes in the work, construction change directives, and change orders)
- Information available to bidders (e.g., surveys, borings, drawings of existing conditions)

Procedural & Administrative info:

- Contract conditions (general conditions of the contract for construction, which outline the rights, responsibilities, and duties of owner, architect, and contractor, as well as others involved in the construction process, and supplementary conditions particular to the project)
- Architectural and construction information
- Drawings (includes architectural, structural/mechanical/electrical/civil engineering, landscape design, interior design, graphics, and other specialty and shop drawings)

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It is tested, explored, and depicted to ensure it will be constructed correctly on the site. Construction documents describe the products, systems, quantities, configuration, and performance specifications that deliver the overall design intent of the project. It is important to keep in mind, however, that the CDs are not a set of instructions for building. Construction means and methods, coordination among construction trades, construction sequencing, and site safety compliance are the responsibilities of the contractor in charge of building the project.

Among the benefits of working on the construction documents phase of a project is the opportunity for close collaboration with consultants in a broad range of professions and disciplines—including architects who may be employed by outside firms associated with the project.

The Task at Hand

While a series of contractual agreements and project specifications are also considered part of construction documentation, this chapter focuses on the production of construction document drawings and specifications. That said, it is important to understand that once a contract between owner and contractor has been executed, the construction drawings acquire the status of legal documents: They are instruments of the contract, as well as the focal point of the construction process.

Every project has distinctive characteristics that demand unique expression. Nonetheless, each requires its project manager and/or project architect to revisit the industry-wide standards for assembling CDs at the start of construction documentation: Their professional assessment, based on their thorough familiarity with every aspect of the project, will establish the best means for planning and describing the work at hand.

With some exceptions, the architect takes the lead in overseeing and coordinating the work of the full project team during the construction document phase of project delivery. Consultant teams that collaborate to assemble CDs are sometimes large, with members in scattered locations and with different areas of expertise as diverse as landscape architecture; civil, structural, mechanical, electrical, and environmental engineering; acoustics; lighting; interior design; and so on. To guide this complex process successfully, the architect must have a clear understanding of the full project scope, as well as of the responsibilities and contributions of each team member. A thoroughly organized approach to the work, aided by an effective system of communication among project participants, is imperative.

In large and small firms alike, clear standards and procedures for collaboration and communication among team members are vital. These vary depending on the size of the firm and the number of participants, and they also will change from project to project, according to the individual characteristics and requirements of each. For large firms, some sample procedures could include the following:

- Compile project-specific organizational charts with contact information for key participants
- Keep accurate minutes for meetings and conference calls and distribute them in a timely manner
- Collaborate via a project extranet or web based project management system to ease the exchange of project information. (This provides a central clearinghouse in which all up-to-date project data resides, and indicates who did what and when.)

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For smaller firms (and smaller projects), the process is, in effect, the same: Here, too, the identification of key project personnel and their regular inclusion in all relevant communications (and, as appropriate, meetings) are essential. Mechanisms that enable excellent communications are vital if the project team is to achieve an excellent end-product: a thoroughly documented, meticulously coordinated set of construction drawings and specifications that clearly and faithfully communicate the project design while enabling construction to proceed within budget and on schedule.

Construction Drawings

Just as your studies in architecture school prepared you to engage in schematic design and design development, much of what you learned as a student will apply toward your internship experiences in developing, managing and producing construction drawings. As explained by the authors of “Construction Documents Production” in *The Architect’s Handbook of Professional Practice*, construction drawings “show, in graphic and quantitative form, the extent, configuration, location, relationships, and dimensions of the work to be done. They generally contain site and building plans, elevations, sections, details, diagrams, and schedules. In addition to drawn information, they may include photographs, other imported graphics, and printed schedules.” Thus, the proficiency you have acquired in describing projects graphically at a range of scales—from context and site plans to detailed floor plans, sections, elevations, perspectives, axonometrics and digital models—all apply directly to the skills required to generate construction drawings.

However, as an intern working toward professional license, it is important to keep in mind that construction drawings are more than a series of graphics and schedules that describe a project. Termed “instruments of service,” CDs are legal documents that become part of the contract between the owner and the contractor. Errors, conflicting information, or omissions in these legal documents can result in costly change orders and should be avoided if at all possible.

Elements of Construction Drawings

Most two-dimensional construction drawings contain elements with which you are very familiar:

- Plan, section, elevation, and detail drawings produced at different scales
- Dimensions
- Symbols and targets (or “keys”)
- Drawing annotations and abbreviations

They may also contain:

- Schedules
- Information available to bidders, including site or contextual photographs and reference drawings (documentation of existing structures, site surveys)

Although the specifics of proper project documentation may vary from project to project, building type to building type, and office to office, the fundamentals remain largely the same. Principal elements are the scale at

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What Constitutes CD

- Specifications (outlines the levels of quality and the standards to be met in construction of the project)
- Addenda (additions or changes to any of these documents issued by the architect during the bidding or negotiation processes)

which the drawing appears on the sheet; the method in which the drawing is dimensioned; and the targets, or “keys,” that reference drawings on other sheets. Symbols, notes, keynotes, and abbreviations also help describe a project with the greatest accuracy, efficiency, and economy.

Drawing Scale

Choose the scale that is optimal for the information you are presenting. For example, overall building floor plans might be presented at $1/16"=1'-0"$ ($1/8"=1'-0"$ in smaller projects), while enlargements of sections of the floor plan containing a higher level of detail (such as toilet rooms with their accessories and fixtures), might be presented at $1/4"=1'-0"$. Construction details, because they show a great deal of information about a very small element, might be presented at $1-1/2"=1'0"$ or even larger. In the CAD environment, the scale at which the drawings will be plotted must be taken into consideration so the line weight and text size for drawing annotations appear in the correct size on the plotted sheets.

Drawing Dimensions

Proper dimensioning is vital to achieving an accurate representation of the project in the drawings and to avoiding discrepancies and conflicts between drawings. Many professionals consider dimensioning an art form. Architects aim to show only the dimensions required by each particular drawing and to avoid duplication of information in a set of construction drawings.

Firms often establish an in-house set of guidelines for dimensioning drawings. One example is the following set developed by Booth/Hansen & Associates in Chicago and adapted somewhat from how they appear in the 13th edition of the *The Architect's Handbook of Professional Practice*.

- Dimension only from a fixed reference point, such as a column centerline or foundation wall.
- Dimension only those things that really matter
- Do not repeat dimensions, either within a drawing or on more than one drawing
- In general, do not close dimension strings. In a string of dimensions, leave tolerance by omitting the dimension for a non-critical space or assembly. When a dimension is omitted, delete the dimension line as well. Final decision concerning the method of dimensioning resides with the project architect.
- The thicknesses of tile, wood base, wainscoting, trim, and similar applied finishes are not included in room dimensions.
- Vertical dimensioning appears on elevations or wall sections. Dimensions should be to the top of significant structural elements and to window and door heads (rather than sills). They should be from the top of the foundation, finish floor level, or similar fixed reference. Masonry is dimensioned to the top of the masonry unit, not to the joint centerline.
- Ends of dimensions are indicated by short, bold, diagonal slashes. No dots, arrows, or crosses.
- Specific dimensions are not always the best choice. The simple notes “ALIGN” and “4 EQUAL SPACES” are often more appropriate if they relate clearly to information already present.
- Dimensioning and checking dimensions are the responsibility of the job captain alone. The work should not be delegated. All dimensions are to be double-checked by an architect not directly involved with the project.

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CAD software provides automatic dimensioning tools that can be great time savers for the architect. Remember, however, that accurate dimensions in the CAD environment depend on the accuracy with which the drawing was generated. Inaccurate drawings result in inaccurate dimension strings.

Targets

Also referred to as “keys,” targets are used to identify relationships between drawings in the full construction document set. They can interconnect building sections, enlarged floor plans, interior and exterior elevations, wall partition types, and plan and section details.

Symbols and abbreviations. To avoid confusion, symbols and abbreviations used on project drawings are usually defined ahead of time so they can be used consistently throughout the documents (and across disciplines). They save architects time and make it possible to provide more information on a drawing in less space.

Annotations

In most cases, project specifications provide a detailed description of a material or system referenced on a drawing. Drawing notes can thus be kept short and concise to convey design intent, while the specifications provide further information about the system or material.

Schedules

The most common schedules to appear in architectural construction drawings are door, hardware, finish, window, fixture, and equipment schedules. Module 3 of the Uniform Drawing System (part of the [United States National CAD Standard](#)) contains a section of standard formats for the numerous schedules used in construction documents. Once formatted, a schedule may be imported into a CAD drawing, where it may be dynamically linked to the original word processing document so that updates to it will be reflected on the CAD drawing.

A Note on CAD and CAD Standards

Odds are that your firm will use a set of drawing standards that includes specific formats for different types of drawings, drawing sizes, and sheet layouts. Firms also usually have a standard title block that should appear on each sheet.

If construction drawings will be generated using CAD software, the entire project team should agree to adopt a specific drawing standard at the outset of the project. This is especially important for projects in which several different firms may collaborate on and exchange drawings. Many in-house CAD standards are based on the U.S. National CAD Standard, which has been widely adopted by much of the industry. Nonetheless, a project may require you to adopt another CAD standard: The Chicago Department of Aviation, for instance, has its own CAD drafting standard, and all DOA project participants must adopt this, regardless of whether they have a standard of their own.

Using a CAD standard ensures that all team members know how to access project information and everyone will use the same language. Other major

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CAD Standards Content

CAD standards usually include information on the following:

- Directory structure
- Drawing set organization
- Sheet organization
- Schedule formatting
- File naming conventions
- Sheet file size and layout
- Data organization (e.g., data segmentation and/or the use of CAD X-refs)
- Drawing templates
- Dimension styles
- Text styles
- Plotted line weights
- Layer naming standards and guidelines
- Symbolology

benefits of adopting and adhering to a CAD standard include improved communications and graphic quality, reduced time required for review and reworking, and increased coordination among drawings in a set. In short, regardless of what CAD standard is chosen or assigned, it is important for the entire team to agree on a single standard and to enforce its use throughout the project. This saves time and energy that can then be devoted to the real work of the construction documents phase—documenting the project design in an excellent set of construction drawings and specifications. Enforcing use of a standard also makes it possible to share CAD template files, ensuring consistency among project drawings.

Construction Specifications

The relationship between construction drawings and construction specifications is vital, especially the need for close coordination between them, which can enhance their descriptive potential and lessen any possible conflicts between them.

What are construction specifications? *The Architect's Handbook of Professional Practice, 13th edition*, defines them as presenting the “written requirements for materials, equipment, and construction systems, as well as standards for products, workmanship, and the construction services required to produce the work.” Project specifications are usually included in the project manual, along with bidding requirements, contract forms, and conditions of the contract.

Because of the magnitude and complexity of construction specifications—especially for large, intricate projects—many architecture firms employ one or more in-house experts. These individuals specialize in the art and science of specification writing and assist the architects in outlining and developing specifications that best describe each project. Some firms procure the services of an outside consultant for this purpose, while the project architect takes this task on at other firms.

Development of project specifications typically begins during the schematic design phase, with the creation of an “outline spec” for the project. As the design evolves through the design development phase, the specifications are revised and updated to reflect changes in the project. Writing specifications for buildings is important and time consuming work. In them, the architect is asked to stipulate, in full detail, the range of acceptable construction materials, manufacturers, and systems for virtually every aspect of a building project. The project specifications also communicate the architect’s requests for shop drawings and for other submittals from the building contractor.

Specification Programs

How are specifications organized? In the 1970s the Construction Specifications Institute (CSI) developed MasterFormat®, a specification program to encourage the consistent arrangement of all project specifications. In adopting this program, the industry took a major step toward achieving a uniform approach to organizing information in construction project manuals. CSI revises MasterFormat® every five to seven years as construction methods and materials evolve.

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CSI's widely used MasterFormat® has been incorporated into ARCOM's MasterSpec, which is produced by the [American Institute of Architects](#). Both MasterFormat® and MasterSpec establish a master list of section titles and numbers and a format for the organization of individual specification sections.

As an example, Division 1 of MasterFormat®/MasterSpec contains the general procedural and administrative requirements applicable to an entire construction project. Each division is broken down into sections identified by five-digit numbers that relate to specific portions of the work required on a project. Each of these, in turn, is organized into a three-part format: general, products, and execution. This standard format provides a predictable framework for the consultant, the owner, and the contractor. This predictability allows for the easy organization of an often-complex array of information. For more comprehensive information on project specifications, see [Chapter 2G - Material Selection & Specification](#).

Coordinating Drawings and Specifications

Thorough coordination between construction drawings and specifications is critical to ensuring a sound set of construction documents. This aspect of document coordination consists primarily of ascertaining consistency and clarity across the drawings and specifications, particularly in the language used to describe the assemblies, products, and materials of the project. Uniformity and lack of ambiguity in drawings and specifications facilitate the construction process, making requests for interpretation and change orders less frequent.

In smaller or simpler projects, it is not unusual to find that specifications are incorporated directly on the drawings. For larger or more complex work—projects in which materials and assemblies are more voluminous or intricate—the specifications are typically included as part of a separate project manual. No matter where the specifications are found, the need for consistency between the drawn and written descriptions of the component elements of the project remains the same.

Mechanisms for coordination vary. They can be enhanced by an architect's production techniques, as well as use of CAD and other programs for automated drawing assembly. Among the techniques that have been employed with great success is numerical keynoting. Here, the architect generates a standardized, numerical drawing key that includes all the components of a given project. These numbers take the place of descriptive notes on all the project drawings and are cross-referenced in the specifications. The process ensures consistency from drawing to drawing and facilitates coordination throughout development of the project, making in-progress updates easier to complete: The architect need only revise the drawing key to remain abreast of changes in a project.

Automation tools such as CAD can be used to coordinate drawings and specifications in other ways as well, integrating these two sources of construction information for the contractor. For example, standard drawing components can be modified to include project-specific information and links to the specifications document. These, in turn, can be used to check

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Learning About Products & Systems

How does an intern familiarize him/herself with the myriad products and systems available to the architect for specification on a project? Many firms invite manufacturers' representatives to visit the office and present their products or systems, often during a lunch provided by the representative. Frequently, attendance at such presentations can count toward satisfying IDP requirements, fulfilling AIA continuing education requirements, and accumulating learning units (LUs) for the licensed architect. Products and systems presented range widely and include items such as curtain walls, commercial storefronts, and residential glazing systems; insulating glass; interior finishes; flooring systems and materials; roofing systems; waterproofing systems; cladding systems and materials; masonry products; lighting products; paving products; site furniture products; and so on. This is one way in which interns can gain valuable firsthand knowledge in an informal setting where questions can be asked and answered.

Interns may also learn about systems and products from discussions with more experienced design and construction professionals, Internet research, visits to projects both under construction and completed, and product catalogs in their firms' library. Journals and magazines publish information about exemplary and cutting edge practice. All of these sources of information—and many others—offer learning experiences that contribute to an intern's professional development.

whether all project components are covered in the specifications and all specifications referenced in the drawings. The use of these tools for document production can be used for many other tasks, such as materials quantification for cost estimating.

Tools for Drawing Production

As a result of significant advances in the capabilities of computer drawing programs, as well as the widespread adoption of computer drafting by the construction industry, the manual production of construction drawings has become increasingly rare. Although the improvement in quality and productivity introduced by CAD technology is partly offset by its own demands, the benefits provided by using it far outweigh its drawbacks. Notwithstanding, some firms continue to produce construction drawings by hand, primarily using ink and plastic lead on pre-cut sheets of Mylar.

CAD systems provide the architect with tools that make production of construction drawings faster, easier, and more accurate—but also more complicated, especially if a project is not carefully planned in advance. Typical advantages of using CAD technology include the ability to:

- Copy, mirror, and array repetitive elements very quickly
- Scale drawings simply
- Make drawing changes and revisions quickly
- Coordinate drawings more accurately by referencing or overlaying drawings from other disciplines to check for interference
- Automate area takeoffs and quantity takeoffs and create window, door, hardware, and equipment schedules using “out-of-the-box” CAD tools
- Easily exchange CAD files electronically via tape/CD/DVD media or over the Internet via email, a file transfer protocol (FTP) site, or project extranet
- Customize CAD systems with approved custom menus, toolbars, and libraries that provide automated production tools to all CAD users in a firm to ensure compliance with CAD drafting standards. This minimizes inconsistencies and ensures a high level of quality throughout a set of documents.
- Integrate other software applications with CAD systems via custom application program interfaces (APIs)
- Automate production of printed/plotted sets of drawings

The CAD environment has some differences from the manual one. As noted above, careful planning is essential for managing production of CAD drawings. In addition, a CAD drafting standard must be adopted and a common CAD software platform agreed to at the beginning of the construction document phase to ensure consistency among drawings and consultants throughout the project. If CAD file translation cannot be avoided, project participants must establish translation specifications that can be mapped to agreed-upon CAD standards at the outset of the project. This will allow the team to automate the translation process, running batch translations (in many cases overnight), and ensure the highest level of document quality.

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For today's architect, much of the work regarding CAD drafting standards, drawing set organization, sheet organization, CAD layering and attributes, drafting conventions, terms and abbreviations, symbols, code conventions, and notations has been done by other organizations. The [U.S. National CAD Standard](#), first published in 2001, incorporates four different documents:

- [Introduction and Amendments to Industry Publications](#), published by the [National Institute of Building Sciences](#)
- [CAD Layer Guidelines](#), published by the [American Institute of Architects](#)
- [Uniform Drawing System \(UDS\)](#)—Modules 1-8, published by the [Construction Specifications Institute](#)
- [Tri-Service Plotting Guidelines](#), published by the U.S. Coast Guard and the U.S. Department of Defense Tri-Service CADD/GIS Technology Center

Many architecture firms using CAD systems today have adopted a firm-wide CAD standard based on the National CAD Standard. According to the [National Institute of Building Sciences \(NIBS\)](#), major benefits to the architect in adopting and adhering to the National CAD Standard are these:

- Consistent classification, organization, and representation of all CAD data for all projects, regardless of project type or client
- Seamless transfer of information between architects, engineers, and other design team members
- Reduced preparation time for translation of electronic data files between different proprietary software file formats and predictable file translation results
- Reduced training time for teaching staff to use multiple “office standards”
- Streamlined process for document checking drawing
- Automated updating of data files as the standard evolves
- New opportunities for expanded services and revenue beyond building design
- Opportunity to market compliance with the standard as a benefit to prospective clients

Whatever the tool selected to produce construction drawings, adoption of a common drawing standard among all project participants is essential to avoiding drawing rework, conflicts, errors, and omissions. Consistency across the project team will make the production process efficient and comprehensive, and yield results of the highest quality.

Planning And Production Of Drawings

Typically, the project manager or project architect takes the lead in developing a timeline for construction document production and delivery and identifying staffing and other resources required to complete the construction documents.

Production Management and Planning

The capabilities made possible by CAD technology are blurring the distinction between design and documents production. In this environment, most offices find it best to assign a single individual to coordinate production of construction drawings for a project. This task can be assigned to

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Features of Good Production Management

- Careful production planning, scheduling, and oversight
- Documentation standards
- A library of construction information and technical references
- Effective coordination with consultants and others on the project team
- Thorough review and checking procedures
- Approval of the construction documents by the owner (sometimes at various stages of production)

numerous individuals, in larger firms and on larger projects, a technical architect, job captain, or other individual may be assigned this responsibility.

As a project nears the construction documents phase, the production coordinator determines the time, staff, and other resources needed to produce the project documents. He or she plans the needed drawings, details what must be done to develop the outline specifications, and lists the remaining documents to include in the project manual. In some cases, some or all of these decisions will have been made and acted upon, at least in a preliminary way, earlier in the project. Further information about this responsibility can be found in Chapter 3D General Project Management.

An architecture firm may use the same production approach for all of its projects or vary it according to the needs of the project at hand. Similarly, a firm must decide how specifications will be produced, whether separate systems will be used for outline and final specifications, and the extent to which specifications will be integrated with the drawings.

Regardless of the system used, it is especially important for the project manager or production coordinator to plan the organization of the data, as well as the number of drawings, scales, sheet layouts, and so on. Typically, for example, a firm's CAD standards provide guidance on these topics, but almost every project will present certain unique requirements. Sharing CAD data with outside consultants or the client requires additional planning to ensure that all parties can use the data without extensive editing.

In short, many benefits accrue when a project manager thinks ahead, planning carefully from the outset to ensure optimal use of available tools and technology. Adopting a common CAD standard and tweaking it to your project's needs within established guidelines is a critical factor in ensuring consistency and accuracy throughout the construction document phase.

Mockup Sets

A good mockup or cartoon set of the drawings needed for a project assists the team in visualizing the full construction document process from the outset and to anticipate the requirements of the project. A mockup set can be created using CAD or paper or a combination of both. The set should show all required site, plan, section, elevation, and detail drawings, with notations of the scales required for each; pages with general notes; schedules; and any other special drawings required to fully describe the design intent of the project. The title sheet and table of contents can also be generated from this mock-up set. Most important, the set provides the team with a tangible guide to the completion of the work ahead.

Exchanging Data

Before data is exchanged among different organizations, some planning must be done. Addressing the following questions, originally published in *The Architect's Handbook of Professional Practice*, is a good place to start:

- Which organizations are exchanging data?
- What information does each organization need from the other(s)?

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- What format data is required (AutoCAD native, .dxf)?
- What are the project drafting and CAD standards?
- What is the frequency of data exchange?
- How will the data be exchanged (project website, bulletin board, e-mail, CD)?
- How much data preparation is required for each exchange and how long does the transfer take?
- Who is the person in each organization responsible for sending and receiving data?
- Who is authorized to request and release electronic data?
- How will data transfers be logged?

Project Web Sites

Many owners and architects are adopting the use of project-specific websites where project participants may exchange electronic information via a central clearinghouse. One of the simplest ways to do this is to create a password-protected FTP (file transfer protocol) site on a server connected to the Internet. Project data, such as large CAD and specification files, can be uploaded or downloaded from an FTP site using an Internet browser or FTP software.

Increasingly, Web-based project management systems are being implemented on large, complex projects with many participants in many places to facilitate communication and exchange of project data among team members. Whether the system is custom designed or off the shelf, its overall goal should be to provide the following:

- Access (real-time access to all project data and information, typically via the Internet)
- Accountability (tools for specifying and determining who is responsible for what and when it is due)
- Auditability (tools for determining who did what and when they did it)
- Document management (tools for managing data that is uploaded and downloaded from the system—especially CAD data)
- Document viewing (viewers capable of displaying multiple file formats regardless of whether the user has the native application installed on his or her computer)

These robust tools can improve communication, coordination, and productivity when available to and used by the entire team.

Milestone Coordination and Archiving

An important goal of the construction documents phase is a fully coordinated set of documents that are internally consistent within and across disciplines. This goal has its challenges: Plans, sections, elevations, details, and schedules must agree with one another. Materials shown on drawings must be specified, mechanical and electrical systems must fit within the chases and plenums designed for them, etc.

The coordination task is complicated by the reality that more than one person or firm will work on the construction documents of all but the smallest projects. Staff may be in different groups within a firm or in consultant organizations. For CAD systems, it is necessary to develop

resources

Acronyms to Remember

- CD - Construction documentation
- CAD - Computer-aided design
- FTP - file transfer protocol
- .DWG - standard filename extension for most CAD programs
- .PDF - Portable document format
- BIM - Building information modeling
- CATIA - computer aided three-dimensional interactive application

protocols for who has access to what layer or drawings, the exchange of updated files, and regular and frequent backups of all of the work.

As you can see, it is imperative to be organized when working in any environment. Several suggestions for accomplishing this follow:

- If possible, establish a common CAD software application for the project.
- Make sure the entire team conforms to CAD standards, including these:
 - Layering guidelines
 - File naming conventions
 - Folder organization (and access permissions if applicable)
 - Symbology libraries
 - Drawing templates
 - Annotation
- Establish hard deadlines for both in-house and outside team members for completion and exchange of CAD and specification data prior to a milestone issue.
- Especially for larger projects and firms, provide each discipline or consultant with a staging area to which they may copy or upload their sheet files (CAD drawings that will be plotted).
- Establish the file format in which drawings will be submitted, reproduced, and archived (e.g., AutoCAD .DWG, .PLT or Adobe .PDF).

No matter what the firm size, delivery mode, or project scale, it is important to communicate, communicate, communicate! Make sure every member of the project team is aware of his or her responsibilities with respect to quality of work and milestone deliverables.

A key aspect of production planning is recognizing potential bottlenecks that may slow down a project and endanger the schedule. Coordination points, milestone dates when all drawings and specifications are brought to a common level of development for checking, are one common bottleneck. Another is the dates marked for plotting CAD drawings and preparing, translating, and transferring CAD files to outside consultants.

Like all other stages of project development, construction drawings and specifications are typically issued for checking and coordination at major contract milestone intervals (e.g., 30 percent completion, 60 percent completion, 90 percent completion, 100 percent completion, issued for permit, issued for bid, issued for construction), as well as when any construction document changes are issued as addenda or bulletins.

Archiving procedures are important but frequently overlooked. Archiving is distinguished from data backup in that it refers to the production of a complete, unalterable copy (hard or electronic and frequently both) of the project data at a defined point in time. Deciding what and when to archive is a project management responsibility. The archived documents provide a history of the work in a series of snapshots of the delivery process. These can be useful to both the architect and the owner, and they acquire a certain legal standing as the official record of progress in a project.

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An accurate electronic archive of milestone issues ensures that everyone is literally “on the same page.” If a milestone issue is to be plotted for distribution (in hard-copy or electronic format such as Adobe PDF), the plotted drawings should be generated from the archive, not from the live CAD environment. The archive should never be altered and should serve as a record of the project milestone.

Drawing Review and Checking

Drawing review, coordination, and verification—within and across the various disciplines included in a project team—are of the utmost importance during the construction documents phase of project delivery. The complexity of projects, the number of contributors to the development and documentation process, the disparate locations of project consultants, as well as the significant time constraints under which construction documents are often produced, are among the many elements that combine to make review and checking a crucial aspect of the documentation process. Thorough review by an individual who is intimately acquainted with all aspects of the project is absolutely essential to the production of a good set of construction documents.

As are the mechanisms developed by firms to coordinate drawings and specifications, checklists are both generally available and individually generated by professional offices. In addition to supporting the necessary procedures of meticulous review, checklists inform the process of generating and developing project drawings. The following steps may be included among the typical practices developed by professional offices to ensure the quality of the documents they produce:

- Full review takes place at regular intervals throughout the construction documents phase, typically at project milestones.
- Documents are checked by senior professionals not directly connected with the project.
- All important dimensions are verified by a single individual.
- Specifications writers review the drawings, and those responsible for drawings review the specifications.
- Coordination efforts include interdisciplinary review by project consultants.
- The owner contributes a substantive review of the work before construction documents are issued.

Review and approval of the construction documents by the project owner is a key part of this phase of project delivery, as it is the owner who officially issues construction documents and signs all construction contracts. AIA forms of agreement mandate that the owner approve the construction documents.

The architect is the hub around which all project activity rotates. Through careful organization and open communication with all project participants, the business of checking drawings and specifications for completeness, accuracy, and coordination among disciplines can be streamlined: Make sure all team members understand their contractual responsibilities with respect to milestone deliverables. Establish regular meetings for drawing reviews prior to milestone issues. Getting everyone in one room for a face-

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As you research and look for more information on topics presented in the *Emerging Professional's Companion*, remember that a quick internet search of keywords can be incredibly useful to completing your Activities.

to-face meeting, when possible, can save hours of back and-forth time among project participants. Keep logs of all review comments and copies of drawing markups. Distribute these to all project participants after meeting(s), especially if they are spread out geographically and using a project-specific Web site or extranet to exchange information.

The Future

The traditions and conventions of document production are revisited with each new development in the tools we use to generate design and construction drawings. Computer programs and methodologies such as building information modeling and computer aided three-dimensional interactive application (or CATIA) are quickly changing the face of construction documents production. By extension, they are changing the construction process itself.

Building Information Modeling (BIM)

Already in use is what has come to be known in the CAD software industry as building information modeling, or BIM. BIM, which is a significant departure from traditional two- and three dimensional CAD drawings, holds great promise for the architecture/engineering/construction and facility management communities. BIM CAD applications based on parametric modeling, such as Autodesk Revit, among others, are already on the market and available to architects and engineers. The functionality of these programs becomes more robust with each release.

Building information modeling is not a technology but an approach to organizing and connecting data. It is based on a technique known as parametric modeling, which allows CAD software to store and manipulate detailed parameters of building elements, rather than simple graphic representations of them. This approach is also sometimes called object-oriented modeling because the project information is created and defined as a collection of objects rather than a series of lines and planes. The greatest advantages of using BIM include these:

- **Ease of collaboration:** All project participants collaborate on a single building information model, which is essentially a central database that can be translated into a graphic or tabular representation of the project.
- **Flexibility:** Project participants may view the model in ways applicable to their responsibilities. An architect may want to view the model as a drawing, while an estimator might want to view it as a bill of materials in tabular format.
- **Better coordination:** Portions of the model can be “checked in” and “checked out” by the responsible project participants to avoid duplication of effort and creation of conflicting information. Since all project participants collaborate on a single building information model, coordination among disciplines is easier. The entire team has access to the latest information available in the model across all disciplines.
- **Increased speed of delivery:** As portions of the model are updated, linked elements are updated automatically; maintaining consistency among references and reducing the time it takes to update them.

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Construction Documents

- Greater productivity: Since the building information model is a database, information can be extracted from it for use in other computer applications, such as scheduling and estimating software.

All of these advantages can increase the overall efficiency of the documents production process and the comprehensiveness and quality of the work produced. BIM has the potential to revolutionize the design, construction, and facility management industries.

CATIA

Like BIM, computer aided three-dimensional interactive application, or CATIA, is a modeling tool. Originating in the aeronautics industry, it is a methodology that scans three-dimensional physical models and builds numerically controlled virtual models using descriptive geometry. The methodology for generating the virtual model translates directly to manufacturing: Through computer-controlled milling tools, complex forms can be fabricated with an astonishing degree of accuracy and at relatively low cost—directly from the model generated by the architect. The methodology eliminates intermediary steps between designer and builder. The primacy of the relationship between designer and manufacturer also serves to control the costs of manufacturing; without the middle man, costs can be kept down.

CATIA is used in conjunction with conventional CAD drawings to render complex designs for which traditional two-dimensional drawings are insufficiently agile and descriptive. It can be used to achieve repetition of elaborate forms in a cost effective way, making daring proposals feasible. To the extent that—to echo Marshall McLuhan—the medium is, in fact, [a large part of] the message, then tools such as these allow for creativity, freedom, and expansiveness on the part of the architect.

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Take brief notes while reading the narrative and list key resources you used to complete the activities. Note discussion outcomes from meetings with your supervisor, mentor, or consultants. When finalizing the activity documentation (PDF), include your notes and the Emerging Professional's Companion activity description.

Construction Documents

Mock-Ups

Supplemental Experience for eight (8) Core IDP Hours

Producing a mock-up set of the drawings that comprise the construction documents phase (i.e., cartooning) is an excellent way to understand the full scope of a project and the level of effort required for its documentation. A mock-up set allows the project manager to think through the full CD process at the outset and anticipate what is needed to produce all the documents. Mock-up drawings can inform the creation and organization of a construction drawing set.

The mock-up set should include all the drawings required for a comprehensive description of the design intent of a project, including drawings for all the relevant disciplines and specializations. The set should also indicate the appropriate scale for each drawing.

Activity - Core

Produce a mock-up set of the drawings that will be required to describe the project fully. For the mock-up sets use 8" x 11" or 11" x 17" sheets in landscape orientation.

Be sure to complete the following steps:

- Make a list of the drawings, details, and schedules that will be necessary. Refer to similar projects in the office archive, being careful to note the ways in which your project differs from them.
- Determine the most appropriate scale for executing and understanding each drawing, and plan how the drawings should be laid out on each sheet and within the set.
- Speak to the project consultants to ascertain the number of sheets they will need to execute their work, and the content and scale of each of their sheets.
- Devise a preliminary table of contents (TOC) for the set of construction drawings.

Write a narrative that describes how you would explain to a client the importance of construction documents. Be sure to include in the narrative why it is necessary to have the type and number of drawings included in the mock up for their projects.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

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Window Installation

Supplemental Experience for eight (8) Core IDP Hours

In this scenario, a contractor calls after noticing a large pool of water on the floor after a recent storm passes. He tells you that the pool is located near a window that he just installed. You immediately suspect something was left out or done incorrectly during the window installation the day before.

Activity - Core

Using a set of completed construction drawings in your office, review the window details. Create a set of drawings detailing the correct construction system to ensure that the windows will be waterproof.

Write a narrative (500 words minimum) explaining the step by step construction process. Meet with your supervisor or mentor to review your drawings and explain why window details are an important part of the construction documents.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Construction Documents

Comparison of Documents

Supplemental Experience for eight (8) Core IDP Hours

Understanding the components that make up a set of construction documents is important for the entire design team and the client. The potential for and severity of professional liability for errors and omissions are often tied to when they are discovered. An error discovered during the bidding phase can be corrected with an addendum to the construction documents. As the owner has not yet entered into a contractual relationship with the contractor, corrections to errors at this point typically involve limited costs to the project or its consultants. Depending on the amount of documentation affected by the error, the corrected drawing set may be reissued in part or in full. (Less commonly, the addendum may result in an extension of the bidding period or a redefinition of the scope of the project.) Any revisions to the documents after they are sent out for bid could potentially mean more cost to the owner and/or design team.

Activity - Core

Using a set of design development documents from a built project, create a cartoon set of construction documents, including drawings you feel are essential to receive from the M/E/P consultants. Be thorough when creating the cartoon set.

Compare your cartoon set to the actual construction document set that was issued, what did you miss? What did you include that was not in the original set of drawings? How many drawings did you include compared to the original construction document set? Prepare a narrative that explains why you included more construction drawings or fewer construction drawings.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

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Compliance with ADA

Supplemental Experience for eight (8) Core IDP Hours

Compliance with the Americans with Disabilities Act (ADA) is a challenge facing architects in every aspect of architecture practice. This act, which is a civil rights law rather than a code, asserts guidelines for assuring accessibility to building facilities for physically disabled citizens. Architects who fail to comply with accessibility guidelines risk their reputations and their pocketbooks. If a built work is found not to be in compliance and remedial construction is required, the owner may incur fines. Worse yet, owners may be found liable for monetary damages to disabled citizens. Either situation could give rise to potential claims against the architect. Errors and omissions involved with ADA compliance can be serious for architects because the errors tend to be discovered only after construction is complete, a time when costs for remediation are more likely to be assessed as the architect's responsibility.

In this scenario, you are part of a project team designing a large municipal building that contains city offices, a library, and a small museum. After construction is completed and the project is occupied, a local organization of disabled persons visits the building to ascertain accessibility and finds several major areas in which the building is not in compliance. The group has filed a complaint with the city, and the city is looking to the designers for a response to the complaint, including proposed solutions.

Activity - Core

Please reference the following source:

- [ADA Accessibility Guidelines for Buildings and Facilities \(ADAAG\)](#), Department of Justice.

Considering the scenario above, create an ADA compliance checklist that could be used to help ensure that these important design requirements would not be overlooked during design:

- Create an outline of the major issues that affect architectural drawings from the ADAAG section entitled "Accessible Elements and Spaces: Scope and Technical Requirements."
- Prepare a checklist incorporating the major requirements you have identified, differentiating between items that affect drawings and those that affect specifications. ADAAG contains many drawings and sketches that explain layout and dimension requirements. Where appropriate, place reference copies of these in your checklist.
- Using an existing set of construction drawings, review the documents for the items listed on your checklist. Prepare a memo to your supervisors outlining your findings and attach sketches if necessary to communicate any needed design solutions.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Feedback on the Usefulness, or Quality, of Drawings from Contractors/Subcontractors Who Build Architect's Design

Supplemental Experience for eight (8) Core IDP Hours

The primary users of an architect's construction drawings are the contractors and subcontractors who build the architect's design. Talking to people in the field—job superintendents and engineers—can help architects understand the usefulness, or quality, of their drawings.

Choose a project recently completed by your firm or your mentor's firm. To help you remain objective, choose a project you didn't work on. Make an appointment with the job superintendent or one of the engineers who worked for the contractor to meet with you and any other interested interns. This will be a more rewarding experience if several interns join in the exercise and meet with the contractor's representative as a group.

Activity - Core

Before the interview, talk to the project architect or construction administrator who led the project for your office about his or her perception of how the project went during the construction phase. Make notes about any problems that were experienced, including any thoughts the project leader(s) may have about the source of the problems. Discuss the attitude of the owner and contractor toward the architect during the project.

Before the meeting, you may want to provide the contractor with a copy of this assignment and of the narrative for this chapter. At the interview, preface your discussions with several important thoughts:

- You are an intern(s) who arranged the interview to learn about the profession, and you are not an authorized spokesman for your firm.
- You hope to learn from the builder's information that may help you become a better architect.
- Encourage the builders to be candid in communicating their thoughts about the architectural documents so that you can learn from their opinions.

The purpose of these introductory comments, which you may wish to document in writing, is that errors in architecture practice have become the object of conflict and litigation, and many people are reluctant to openly discuss their thoughts about "problems." Your supervisor can help moderate the meeting.

Talk to the contractors about their thoughts regarding the drawings and other aspects of architectural service. Ask questions, and take notes. Do not be defensive. Enjoy the opportunity to learn what others think of the work provided by architects, even if the views seem harsh. Think about how you might use what you learn to be an effective architect. Take advantage of this exercise to frankly discuss errors with the builders.

Write a narrative on the role coordination and document checking played in this project. Be sure to answer:

- Were there any communication problems from what you observed? How were they avoided or what caused them?
- What role did checklists play?
- How would you have improved the coordination of this project between all parties on this project?
- Review the checklists for this project and make changes to them where you think they are needed.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Checking & Coordinating Documents

Supplemental Experience for eight (8) Core IDP Hours

Checking and coordinating documents includes many fundamentals that are not project specific and can be applied repeatedly. This portion of the review process often comes last minute and quite often has items that are quickly overlooked. For instance, did you include a north arrow on every plan that you have drawn on the last set of construction documents you worked on? Developing tools to help with this process such as checklists often cut down on the time it takes to review a construction drawing set.

Activity - Core

Using an existing set of construction documents that were recently completed, review and coordinate the document set to ensure consistency and coordination throughout. Redline all changes that need to be made and note any drawings that may need to be added. Check and coordinate the drawings from the consultants, as well.

Create a checklist of items to look for when reviewing each type of drawing/sheet, plan, section, elevation, and detail. Also, create a checklist to use when coordinating consultants' drawings. Review your redlines with your supervisor or mentor and see if they can add any items to your checklist.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Construction Documents

Construction Document Coordination

Supplemental Experience for eight (8) Core IDP Hours

Coordination is essential to produce a comprehensive and well-integrated set of construction drawings. The process of coordination also presents a unique opportunity to understand the scope of a project, including the contributions of various members of the project team and the multiple, complex interrelationships among project components. Visualizing and understanding these relationships is one of the most challenging and rewarding aspects of the CD phase.

Coordination must take place in a variety of contexts. For example, the work of project participants must be coordinated both within each discipline and among the disciplines. It is also important to coordinate construction drawings with the specifications.

The construction industry has generated drawing coordination checklists to help professionals assemble construction drawings. Many offices have their own checklists as well. Companies that specialize in professional liability insurance are strong advocates for the use of such checklists because they can help architects avoid errors and omissions.

Activity - Core

Just before the 90 percent milestone review, coordinate a set of construction documents for your office or your firm's office if possible (working from hard copy and using CAD). To help you, use a checklist developed by your office for reviewing project documents. Be sure to include the work of all consulting disciplines.

Write a summary of your findings, noting items you missed.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

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LEED Checklist

Supplemental Experience for eight (8) Elective IDP Hours

In this scenario, one of your firm's clients is interested in developing a LEED-certified project, incorporating sustainable design concepts. While the client discusses the matter with some degree of certainty, client representatives indicate they do not really know what is involved in the LEED certification process, nor are they sure exactly how sustainable design will affect the design, construction, or cost of their project. The client asks your firm to develop a checklist of what will be entailed if they decide to proceed with development of a green building.

Activity - Elective

Research what sustainability or green building means and prepare a short summary assessing what is involved in achieving the different levels of LEED certification and how design and construction may be affected. You are also asked to develop the checklist that has been requested by the client.

Once you have created a checklist use it to go over a set of construction drawings from a LEED certified building in your area. Create a report of how your checklist worked with the construction drawings. Where is your checklist different from the building? What changes would you make to the building drawings? To the checklist?

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Construction Documents

Attending an In-Office Product Presentation

Supplemental Experience for eight (8) Elective IDP Hours

One of the easiest ways to learn about new architectural building products and systems is to contact a manufacturer's product representative and schedule an in-office presentation. Invite other architects, interior designers, and engineers in your office to attend. You may want to find out about masonry or paving products; pre-cast stone and concrete; curtainwall, storefront, or commercial/residential glazing systems; plastic laminate or ceramic tile; membrane waterproofing and roofing systems; door hardware; textiles, the list goes on.

Activity - Elective

Once the presentation concludes, sit down with the product representative and review your set of construction drawings that will include their product.

As you review, redline all drawings that need to be updated to reflect the product that was presented. Are there any new drawings that need to be added to your set of construction documents to make them complete? Review all redlines and additional drawings with your supervisor prior to making changes to the construction set.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Developing a LEED-Certified Project, Incorporating Sustainable Design Concepts

Supplemental Experience for eight (8) Elective IDP Hours

Today there are many clients interested in sustainable design, but they may not know what that means for their building. Helping the client understand how sustainability is integrated into the building design adds value to their facility—even if the client does not pursue LEED certification.

Activity - Elective

Select a non-LEED-certified project completed by your firm or a mentor's firm. Review the project's design development (DD) set, construction documents (CDs), and specifications book, if available. Assess the design's potential for LEED certification and select the appropriate USGBC LEED rating system (i.e., LEED for Homes, LEED for New Construction & Major Renovations) under which the project could qualify.

In a report (500 word minimum) identify at least eight key design opportunities to revise the design and make it eligible for LEED certification. Identify relevant LEED credits the project could obtain for the rating system selected and provide sketches to support your proposed rating system and certification level.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Changes Required In Order to Meet Code

Supplemental Experience for eight (8) Elective IDP Hours

In this scenario, a project is almost ready to be released for bid. The work is slightly behind schedule, but everyone is reasonably certain that final deadlines and commitments to the owner will be met. You have been asked to help give the construction drawings a final check. In reviewing the drawings, you note a series of problems that were missed in previous reviews. The emergency egress path must have a certain fire rating to meet the requirements of the code; however, the floor plan you are examining indicates regular drywall rather than Type X. Moreover, the composite thickness of the wall is insufficient to meet the code requirement: The code requires two layers of wallboard, but the drawings indicate only one. In addition, the walls in question do not reach to the underside of the floor structure above them. Changes—some quite time consuming and affecting multiple drawings and details—must be made to meet the code requirements. You give your project manager the bad news.

Activity - Elective

In preparation for your discussion with the project manager and client, respond to the following questions in a memo addressed to the client:

- How do you weigh the necessity to meet project deadlines against the need to revise multiple drawings to meet the code requirements?
- Can you suggest an alternative approach to accomplish the necessary changes without affecting the project schedule or opening the firm to liability?
- Explain the purpose and need for the construction documents to reflect this change. Why is it important that they do?

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Creation of CAD Standard

Supplemental Experience for eight (8) Elective IDP Hours

Adherence by all project participants to a common computer-aided design (CAD) standard is critical to the efficient and transparent exchange of information among team members, especially on projects that involve multiple consultants. Standards ensure high graphic quality, less review and rework, and consistency among drawings in the set.

The increasingly common production of schematics, design development, and construction drawings in the CAD environment has resulted in a greater carryover of drawing information from design development into the CD phase. By the time a project reaches CDs, it is likely that folder organization and file naming conventions have already been established and are being used by the team. However, this is a good time to take inventory and make sure your project complies with the chosen CAD standard.

In this scenario, you just started working for a new office, and note that they do not follow a CAD standard. You decide to raise the issue with the project manager or principal and decide to volunteer your services to create one.

Activity - Elective

Create a recommendation for the following items in your proposal for office wide CAD standards:

- Directory structure for organizing drawing files
- Drawing set organization
- Sheet sizes, layouts, and title block information
- File naming conventions
- Data organization such as cross-references, layers, levels, and blocks
- Drawing templates
- Line weights
- Layer/level naming conventions

Prepare a report that explains construction drawings, the efforts needed to coordinate drawings among project team members and how your proposed system will make this easier.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Prepare a Consultant Coordination Plan

Supplemental Experience for eight (8) Elective IDP Hours

Managing coordination of the architect's work with the work of consultants is one of the most important, yet most difficult tasks faced by the project manager. It is not the responsibility of the architect to coordinate the internal work of the consultants. That is the consultants' professional responsibility. The consultants are hired because of their ability to provide specialized services to augment the services provided by the architect when designing a building.

It is, however, the responsibility of the architect to coordinate the architect's designs with the designs provided by the consultants and engineers. This means that the architect is to determine that the consultants' designs fit with, and are compatible with, the architect's designs.

Poor coordination between the consultants and the architect is the source of great consternation and many claims during the construction phase when it is discovered that not all of the work will fit together. Poor coordination can also occur when the contractor fails to coordinate the sequence which the subcontractors will follow when putting the work in place.

Activity - Elective

Please reference the following source:

- *The Architect's Handbook of Professional Practice*, 14th ed. Chapters 12.3 and 14.1

Working with your supervisor, select a project that is in the construction documents phase that will be issued for either bidding or construction in one to two months. Meet with the actual project manager for the project and discuss the manager's current plan for coordinating with the consultants. Review the latest progress prints for the construction documents.

Independent of the project manager; prepare a plan for coordinating with the consultants from the present time through the planned date of issuance for bidding or construction. As you prepare your coordination plan answer the following questions:

- Is it really necessary for a project to be in the final stages of coordinating the designs when it will only be issued for bidding and not for construction?
- Who are the primary consultants and what design disciplines do they represent?
- What meetings might be necessary to facilitate the coordination process?
- What are effective ways to compare the architect's construction documents with the consultant's construction documents?
- Should architects review the consultant's specifications or may the architect rely on the consultant to do so?
- Is software available to augment the architect's efforts?
- How much time should be allowed for consultant coordination?
- What should the project manager be concerned with coordination when the PM does not usually actually prepare the drawings?

Prepare a written report on your views of means and methods of effective coordination with the consultants.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Preparation of Traditional Redlined Check Set

Supplemental Experience for eight (8) Elective IDP Hours

Obtain a set of working drawings for a small project from an architecture firm, preferably the office where you work or your mentor's firm. Optimally, the set of drawings should comprise at least eight to ten architectural sheets, plus drawings from related disciplines such as mechanical, electrical, plumbing, and civil engineering and landscape design. As an alternative, if you are employed by a larger firm that does not work on smaller projects, ask your supervisor or mentor to help you select one or two floors or portions of floors of a larger project, plus related ceiling and interior sheets, and organize a package of 8 to 10 architectural sheets plus the consultant's sheets.

Activity - Elective

Work with your supervisor or mentor to select a construction document phase checklist. Options include checklists used by your firm and those available from web sites and other sources mentioned as resources in this chapter.

Prepare a traditional redlined check set. Work your way through the checklist you've selected, assessing and editing each item for applicability to the project you selected. Then, work your way through the drawings and specifications, reviewing the drawings for errors and coordination issues and redlining them to address each item in the checklist.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Construction Documents

Preparation of Green-Light Check Set

Supplemental Experience for eight (8) Elective IDP Hours

Obtain a set of working drawings for a small project from an architecture firm, preferably the office where you work. Optimally, the set of drawings should comprise at least eight to ten architectural sheets, plus drawings from related disciplines such as mechanical, electrical, plumbing, and civil engineering and landscape design. As an alternative, if you are employed by a larger firm that does not work on smaller projects, ask your supervisor or mentor to help you select one or two floors or portions of floors of a larger project, plus related ceiling and interior sheets, and organize a package of eight to ten architectural sheets plus the consultant's sheets.

Activity - Elective

Work with your supervisor or mentor to select a construction document phase checklist. Options include checklists used by your firm or your mentor's firm and those available from Web sites and other sources mentioned as resources in this chapter.

Prepare a green-light check set. Apply the green light technique to the floor plan and wall section sheets (or at least two other sheets selected in consultation with your supervisor).

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Development of a Tool for Preventive Document Checking and Coordination

Supplemental Experience for eight (8) Elective IDP Hours

Develop a checklist to be used in preventive document checking and coordination for a small project.

Activity - Elective

Develop a “work zone” diagram of clearances required for lights (7”), sprinklers (4”), ductwork (14”), and other items that must be located above the ceiling in the plenum in a small medical office building. The diagram should be configured as a conceptual section through the plenum with structural system members drawn to scale. This diagram will be used to communicate to your consultants your expectations for the location of their designs within the plenum. Consider these issues:

- What building elements other than lights, sprinklers, and ductwork might you expect to find above the ceiling?
- Is it appropriate to plan for future building elements above the ceiling in the absence of a program requiring such elements?
- What is the relationship between elements in the plenum, the floor-to-floor height, and the finished interior ceiling height?
- What logical sequence of construction of the various elements will the design disciplines need to coordinate? (Your supervisor might introduce you to a contractor or consultants so you can ask their advice). Should your drawing reflect your assumptions regarding the sequence of construction (i.e., should ductwork be above or below the sprinkler piping)?

Make a list of the potential consequences of failing to properly establish a work zone regimen for the plenum. Be sure to answer the following questions:

- Where will building elements be located if a design professional fails to leave adequate room above the ceiling?
- Who should pay for the costs of moving building elements if it is determined they will not fit in their intended place above the ceiling?

Write a memorandum to transmit the proposed work zone diagram to hypothetical project consultants. Explain to them why you believe the diagram is useful. Tell them of your logic in arranging the zones for the different disciplines the way you have. Solicit their comments and advice concerning the arrangement.

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Critical Review of Checking and Coordination Procedures

Supplemental Experience for eight (8) Elective IDP Hours

Critically review the checking and coordination procedures used in your office or your mentor's office. Consider several questions:

- What are the basic elements of an effective document checking system?
- How can you tell if a document checking system is effective?
- How does your firm's document checking system measure up?
- What recommendations can you make for improving your firm's checking system?

Many offices may not have formal document checking and coordination procedures. These tasks may simply be practiced by the "seat-of-the-pants" method, as it has been learned by many practicing architects. Other firms may have well-defined procedure descriptions, methodology narratives, and checklists.

If your office or your mentor's office has a plan-checking process such as a peer review system, or a quality management group, meet with a plan checker and discuss how they check a set of drawings.

Activity - Elective

Using what you have learned, and any changes you made use your plan checking process on a copy of a document your office is working on currently. Write a summary of your findings showing what changes need to be made to the document? Compare your checklist to another checklist used on a previous project, how effective was your checklist?

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

Preparation of a Check Set Error Analysis

Supplemental Experience for eight (8) Elective IDP Hours

Architects commonly create check sets, but preparing an error analysis for the mistakes found in a check set is less frequently done. This exercise involves both recording the errors and forming an opinion of what caused them and how they could have been prevented.

Activity – Elective

Using the check set you prepared in the earlier exercises, do the following:

- Make a list of each mistake or coordination problem you discovered. (You should have not fewer than 40 or 50 items in your list. (If you have fewer, either you have checked an exceptional set of drawings, or you should go back through your checklist again.) A slang term for an error in architectural drawings is a “bust.”
- Describe each “bust,” and write a comment about what kind of problem the error might have caused during construction. Write a comment about what might have been done to prevent the error from creeping into the drawings in the first place.
- Create a written report to be presented to the architects and engineers who prepared the drawings. (What you are creating is essentially a peer review).

Share your work with your IDP supervisor or mentor and make suggested changes. Document the final version as a PDF.

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