CHAPTER ONE

PHASES OF THE CONSTRUCTION PROJECT

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I. Introduction

Construction is an art, not a science. In delving into all of the steps that occur at each phase of construction — from the owner’s planning and budgeting phase, through the design stage when the drawings and plans are created, to the contractor selection stage, and through the physical construction phase of the project when the project is complete and turned over to the owner for use — it is clearly an art of coordination and management that must occur at every step to keep any construction project on schedule and on budget.

Andrew Carnegie stated, “Teamwork is the ability to work together toward a common vision. The ability to direct individual accomplishments toward organizational objectives. It is the fuel that allows common people to attain uncommon results.”

Indeed, taking mere ideas and turning them into end products of well-built, useful structures is a remarkable feat. It requires coordinated teamwork among all the players involved, throughout all the phases of the project, to attain the successful delivery of a completed construction project.

This chapter describes and discusses the many steps that occur in each phase of the construction project. While the construction project phases are broken into three main sections, simply described as Pre-Construction, Construction, and Post-Construction, the activity that occurs during each phase of a construction project is anything but simple.

We hope that this chapter’s overview of the construction project phases will provide the reader with a better understanding of the many processes and elements of teamwork that must be coordinated on every construction project in seeking a project’s successful completion.
Recognizing the uniqueness of every construction project, this chapter describes the phases of a typical, general building project, focusing on state/local public works rather than private or federal projects. Where appropriate, the chapter adds comments related specifically to private or federal works.

II.
Pre-Construction Phase

A. Planning, Budgeting, Permitting

Every project starts with a conceptual plan and budget. The planning process for major development projects can often take years and be very complex, especially when public funds are involved. The process will often involve the preparation of a lengthy feasibility or development report. Thus, frequently a public agency will contract with planning firms to help with this process. For major projects, the process will typically start with a facility or needs analysis to forecast future demand against current supply. For example, a school district forecasts the need for a new grade school in a community based on enrollment projections and availability in existing surrounding schools. The planning process will typically involve many public agencies, including building officials, public utility engineers, planners, and elected officials, as well as community participation.

In the planning process, the planner will also investigate site constraints, which may dramatically affect the usefulness or the cost of the project. For example, in selecting the site for a new school, the district determines that the school needs to be near multiple modes of transportation such as automobile, bicycle, and bus lanes but away from industrial or commercial zones. The planners also need to weigh the effect of the development on the local community such as noise, traffic, aesthetics, use of local utilities, cultural/historical impacts, and future growth.

Budget constraints often limit the planning of a major development project. In the public arena, a governmental agency will often place major projects on a priority list, which will then involve legislative approval before funding. Governmental agencies will often set the budget before they arrange for the production of detailed designs. Therefore, to perform an accurate cost estimate, the planners need to include an adequate contingency fund in their preliminary budgets. Frequently, because of budget constraints, the governmental agency needs to completely redefine the basic conceptual plan. Therefore, it is uneconomical to proceed with
environmental permitting or architectural design until the agency sets the conceptual plan and budget.

While the first stage of any project involves planning and budgeting, environmental constraints are becoming an increasingly limiting factor in development. For many projects, the environmental review process can take years, sometimes longer than the actual design and construction process. In addition, the environmental review process often will set the design constraints for the project, such that no detailed design can take place until after the process is completed.

Typically, an environmental consultant performs the management of the environmental review process. That process could include studies on the impact on local endangered species, traffic studies, impact on cultural or archeological sites, erosion or sediment control, visual impacts, and tourist and local business impacts. The goal of the study is to prove that the project has little or no impact on each of the areas of concern, or, if it does have some impact, to offer offsetting mitigation factors. For example, if the study finds that the project will impact a cultural resource, the impact report may propose an offsetting benefit to the community in terms of environmental, visual, tax base, or other gain. In some cases, the study will recommend a mitigation of the impact. For example, if the report finds that the project will impact a certain habitat, the developer may offer mitigation by converting another site into one that will support the lost habitat. The proposed mitigation is typically at equal or greater size and at the developer’s expense.

Typically, the developer/applicant prepares an Environmental Impact Review (EIR) or Environmental Impact Statement (EIS) for the local governing agency’s review. An EIR is, basically, a simplified version of an EIS. The jurisdiction for the governing agency is determined by legislation, and could include local review (such as a city or county environmental/planning board); state review (such as a state environmental review board); federal review, such as the Environmental Protection Agency (EPA) or U.S. Army Corps of Engineers (USACOE); or special jurisdictional review, such as a coastal commission or regional planning commission. The magnitude and anticipated impact of the project determines whether there needs to be an EIR or EIS.

1. **Design Phase**

   The selection of a designer is a major factor in a project’s success and takes place once the project’s design criteria are established. The owner creates the project design criteria once it knows its budget, environmental restrictions, and other needs. The project design criteria describes the
project's purpose, architectural goals, applicable codes, and special requirements. See Exhibit 1 for an example of a project design criteria.

These project design criteria govern the architect and engineer in their project design and often determine the final project budget. Upon the owner's approval of the design, the designers formalize the design into plans and specifications suitable for construction.

Designers are typically engineers or architects, and they are often involved through final completion of the project. The quality of their design, preparation of contract documents, and assistance in the construction management process is critical to a project’s success. The decision as to whether to have an architect or engineer to lead the design effort is a function of the project’s needs. If the project is a building, an architect often takes the lead. If the project is service-based, such as a road, bridge, or treatment plant, typically an engineer takes the lead.

Because of the increasing complexity of modern projects, a multi-discipline approach to design is required. Therefore, several specialty designers or sub-consultants will also be required to perfect the design. As illustrated in below chart, an architect will contract with engineers, including structural, mechanical, and electrical, as well as consultants to assist with interior design, landscaping, lighting, acoustics, and waterproofing.
In contrast, illustrated below is a typical organization chart for an engineering project such as a bridge.

The selection of a design firm is typically proceeds through a Request for Proposal (RFP) process. Interested firms will prepare proposals, which will include their proposed sub-designers, their experience, and an estimate of their costs and fees. The RFP may also request the perspective designers to include a write-up of their design approach to the project or request the designers to provide preliminary sketches.

The selection process could also involve an interim step, known as a design charrette. In a design charrette, the owner asks a short-listed group of designers to present their preliminary designs before a selection board. The selection board will then combine the best ideas from all groups and make a final selection for the designer.

The selection of a designer is a time consuming and laborious process that can often take months to complete. However, it is an important process in determining the success of the project. The owner must weigh the experience, creativity, as well as cost of the designers’ services, in making its final selection.

Once the owner selects a designer, the owner enters into a contract for services with the designer. The most common, standard contract utilized between the designer and owner is the AIA (American Institute of Architects) contract documents. Typically, the determining factor for the type of contract is the method of payment for the designer. Payment
methods include lump sum, time and material (T&M), or percentage of cost of construction. Because the owner does not typically know the ultimate project scope at the time of contracting with the design firm, it is often difficult to determine an accurate lump sum price. As a result, most design contracts are either T&M or percentage of cost of construction. In a T&M contract, the designer will bill the owner, pursuant to a pre-determined rate sheet, the actual staff hours spent on the project. In addition, the designer will also bill the cost of materials provided to the project. In some contracts, there is an established cap or not-to-exceed (NTE) amount. When the designer reaches its cap, it cannot continue to bill for services rendered under its contract.

Alternately, on a percentage of cost of construction contract, the designer bases its fee on the ultimate cost of construction. However, because the owner does not know the ultimate cost until project completion, the parties estimate an amount based on the contract value and then add allowances for adjustment when they know the ultimate cost.

For a designer to fully meet an owner’s needs, the design process will need to involve close interaction between the designer and the owner. It is important that the owner fully understand the proposed design as changes during the construction phase are orders of magnitude more expensive then changes during the design phase. As such, it is vital that the designer present the design in such a manner that the owner can visualize the designer’s intent. To facilitate this interaction and provide opportunities for focus on specific issues, the design process itself is often broken into phases. During each phase, the design team will develop more evolved drawings, which will then allow for the owner’s further review and modification. As phasing can vary by project, the design contract typically spells out the phasing specifics in the design contract.

A common project approach involves three phases:
1. Schematic Design Phase
2. Design Development Phase
3. Construction Drawings Phase

The purpose of a phased design approach is to clearly layout the procedure for which the designer will complete intermediate design presentations to allow for owner comment and interaction.

2. Schematic Design Phase

The schematic design phase, also called the preliminary design phase or 20% design phase, as these drawings represent the project at 20% into the design effort. In this phase, the designer and owner will formalize and
document the program requirements, develop a site survey (or an as-built drawing set if the project is a remodel of an existing structure), complete the review of local building code restrictions, and conduct preliminary meetings with local planning commissions. The designer will develop drawings and/or sketches, which will include a preliminary site plan, a preliminary exterior elevation, a preliminary floor plan, and preliminary building sections. The sketches will include only approximate dimensions, usually detailed to the nearest foot. The designer typically develops these drawings to a level by which it can determine parameters, such as coverage, building height, floor area, and overall architectural concept. The designer may even present a physical model. The design contract should spell out the specific details of the expected work product of the designer.

Upon completion of this phase, the owner will review and comment upon the work product produced. In order for the project design phase to stay on schedule, the design contract should set clear deadlines and milestones that outline when the designer will complete each design phase, and the allowable time for the owner to provide comments.

3. Design Development Phase

In the Design Development phase, the designer will incorporate the comments from the owner received during the schematic design review. The designer will then develop detailed site plans, floor plans, and building sections. Incorporated into these drawings are the structural, electrical, and mechanical requirements, as well as interior design and lighting, as designed by various sub-consultants or designers. In addition, the designer will propose and incorporate preliminary material and color selections.

Upon completion of the design development phase, the designer will have produced a more detailed drawing set, which should include floor plans, exterior elevations, a site plan, interior elevations, furniture layout plans and preliminary electrical, mechanical, foundation and structural framing plans. The designer develops these drawings to a stage to allow the preparation of a preliminary construction estimate.

The design development phase will also include a draft specification. “Specifications” outline submittal requirements, allowable products and materials, installation constraints, allowable tolerances, inspection and testing requirements, and warrantee requirements. The specifications should cover every item of work that the contractor will encounter. The specifications will also reference applicable standards that a contractor must follow.

Well-written specifications should divide the work into chapters or divisions in the same manner that trade subcontractors would logically
divide the work — a work breakdown structure. A good division of work defined in the specifications will allow for clear communication of issues between the design team, contractor, subcontractors, and suppliers. The Construction Specification Institute (CSI) has set standards for the construction industry of how to prepare specifications and the breakdown the work. For the past 40 years, CSI has set a standard in the United States, breaking down the work into 16 divisions. CSI has recently recommended a change to that system which will break down work on a construction site to 50 divisions. See Exhibit 2 for an example of a work breakdown structure for a building project that follows the 16-division system.

In some cases, color renderings and/or three-dimensional computer graphic representations accompany the completion of the design development phase. These drawings are the 50% design drawings.

As in the completion of the first design phase, the Schematic Design Phase, the owner will review and comment on the work produced during the Design Development Phase. Again, the design contract should define the work product that the designer will produce upon completion of the Design Development Phase. In addition, the design contract should specify the timeline for both completion and the owner’s review.

4. Construction Drawing Phase

Upon inclusion of the owner’s comments, the designer will then develop the final construction drawings and final specifications. The construction drawings will include complete and accurate dimensioning on the site plan, floor plan, and elevations; complete and detailed selection of materials; and complete mechanical, electrical, lighting, foundation, and structural drawings. The final specification book will detail materials, inspections, and level of workmanship.

The goal of the construction-drawing phase is to develop drawings and specifications that are thorough enough for a contractor to both accurately estimate the cost to construct and actually construct the project. These drawings are the 100% drawings.

The designer typically first transmits these construction drawings in draft form — the final draft drawings. Upon the owner’s review and acceptance, the designer produces the final construction drawings.

The completion of the final construction drawing is not the end of the designer’s involvement with the project. At a minimum, the designer will need to be involved through the construction process to answer questions and provide interpretation. In addition, state or local statute often requires the designer to provide a final certification. In some projects, the owner
will also retain the designer to manage the project, approve monthly payment applications/requisitions, approve change orders, conduct claims review, and/or provide inspections. The design contract should detail the designer’s involvement or construction administration services during the construction phase.

B. Engineering

During the design process, the owner will often incorporate pre-construction consulting activities in an attempt to minimize future construction problems. These activities include preliminary cost estimating, constructability reviews, and value engineering. The owner sometimes adds these tasks to the designer’s scope; however, a separate design or construction professional should handle these tasks in order to provide for an impartial review of the designer’s work. Construction or cost engineering consultants often perform these reviews or, in some cases, another architectural or construction firm will perform them.

1. Preliminary Cost Estimating

The goal of performing a preliminary cost estimate is to determine the approximate project cost early in the process so that the owner can either make adjustments in the design or allow for budget changes. The owner or its design professional typically performs the preliminary cost estimate upon completion of the Design Development Phase, but they can perform the estimate upon the completion of the Schematic Design and Construction Drawing Phases. The advantage of performing a cost estimate upon completion of the Construction Drawing Phase is that the owner has at least one benchmark to determine if a bid is reasonable if it is the only one received.

2. Constructability Review

A constructability review addresses the practicality of building the project as designed. When performed early in the design process, a constructability review can help identify trade coordination issues, potential logistical challenges, or material use problems. For example, the project may include in its preliminary design, the use of pre-fabricated large span beams. However, a constructability review may reveal that the site may be constrained such that erection of such large beams is impossible or economically unfeasible. In that the parties discovered the problem early in the process, the designer can then research alternative solutions, such as a cast-in-place concrete beam, field welding, or adding a column.
3. **Value Engineering**

The purpose of value engineering is to evaluate the design on a cost-benefit basis. When executed properly during the pre-construction phase, the value engineering process can yield the greatest savings to the owner in terms of both time and money.

In the value engineering process, a third-party is called upon to evaluate the design and determine whether certain items may be designed differently to achieve the same or similar goals, but in a more cost efficient manner. For example, the designer may have specified a poured-in-place concrete retaining wall; however, a more cost-effective solution may be concrete block, given the local market.

The use of value engineering in construction has proven so effective to achieve cost savings for owners, that some have provided incentives to contractors who achieve value engineering. An example is the United States government, which on some contracts will allow the contractor to keep 50% of the cost savings on approved value engineering proposals they propose.

Both the designer and the owner need to review the acceptability of a value engineering proposal. As the designer is still typically responsible for the overall design, it needs to assure that the proposed change will not have an adverse effect.

C. **Contractor Selection**

After the selection of the designer, contractor selection is the next most important step for an owner to assure a successful project. The contractor selection process can vary greatly depending upon the project and legislative constraints.

1. **Contracting Method**

First, the owner will need to decide on which method of contracting to use. This decision is best made early in the design process, as the method will often alter the design process itself. For example, if the owner decides to use a design-build approach for some elements of the project, then the designer can stop work on those elements at the design development phase. At a minimum, a public owner must finalize the form of contract and make it a part of the bidding documents prior to bid date.

Contracting options are as follows:
- Lump Sum Contract
• Unit Price Contract
• Cost Plus (T&M – time and material)
• Multi-Prime
• Design Build

2. **Potential Contracting Constraints**

In addition to the selection of the contracting method and form of contract, the owner will need to decide on several other contracting constraints prior to selection of the contractor. These include:

• Time for Completion
• Liquidated Damages
• Insurance Requirements
• Bonding Requirements and Bond Form
• Union vs. Open Shop
• Prevailing Wage Restrictions
• Minority and Women Owned Contracting Incentives or Requirements (MBE/WBE)
• Minimum Experience and/or Qualifications
• Subcontracting Requirements
• Green Building Rating Program (The LEED--Leadership in Energy and Environmental Design--is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. Members of the U.S. Green Building Council representing all segments of the building industry developed LEED and continue to contribute to its evolution.)

The General or Special Provisions section of the Specifications should clearly address these contracting constraints. Several of these constraints are requirements of local, state, or federal statues, such as prevailing wage and minority- or women-owned contracting requirements. The owner should clearly indicate in the bidding documents the statues that apply to the project. In that way, prospective bidders can accurately evaluate and estimate the project.

D. **Bid Phase**

Bidding procedures vary greatly on projects, especially between private and public projects. In the private sector, for which bid collusion statues do not apply, owners have greater flexibility in selecting a contractor and often will simply negotiate with one or several entities. For public agencies, the selection process must follow guidelines and laws developed to prevent favoritism and allow for fair competition.