

CONSTRUCTION MANAGEMENT RESPONSIBILITIES DURING DESIGN

By the Construction Management Committee
of the Construction Division

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ABSTRACT: For the last 10 years it has been increasingly recognized that the level of influence over costs is greatest during the design phase of a project, and that construction knowledge is necessary in this phase. The construction manager can provide this knowledge in many design and design-related functions, listed in this paper. The construction manager is an advisor only on actual design, but takes a leadership role in many of the planning and control functions, such as contract packaging, schedules, site layouts, access, work rules, and labor and safety provisions. With the leadership role there is a potential liability in design review, cost and schedule estimates, and on-site design-related functions. All parties, especially owners, should recognize the use of construction expertise, but also the liability risks that accompany such responsibilities.

PURPOSE

The purpose of this paper is to define the role of construction management in the project design process.

DEFINITIONS

Design.—The term “design” is defined as the creation of plans and specifications that result in the allocation of resources to accomplish a project (Dickerson and Robertshaw 1975). Design consists of three sub-processes: (1) Defining the problem, or the “conceptual phase”; (2) generating and evaluating alternatives, or the “preliminary design phase”; and (3) reducing the best solution to a description for construction, or the “detailed design phase.” In some engineering disciplines, design consists of a test and revision stage; this stage is not generally applicable in construction. On the other hand, construction design must include the revisions and interpretations that occur during construction. Construction design includes those planning, cost, schedule, and quality functions that lead to the specifying of construction conditions.

Construction Management.—Construction management consists of that group of management activities that is distinct from normal architectural and engineering services and is related to a construction program. These services may be provided during one or more of the following phases: conceptual planning, predesign, detailed design, and construction. Such services contribute to the control of time, cost, safety, and quality in the construction of a facility (Tatum 1983).

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Constructibility.—Constructibility is the optimum integration of construction knowledge and experience in planning, engineering, procurement, and field operations to achieve overall project objectives (O'Connor and Tucker 1986).

Value Engineering.—Value engineering is an organized creative approach which has for its purpose the efficient systematic identification of potential cost savings and the elimination of unnecessary cost. Value engineering has the greatest effect on savings during the preconstruction phase. It includes operability and maintainability; a higher investment cost may be prudent when evaluated against future operating costs.

SCOPE

This paper discusses the varied responsibilities of construction managers in the total design process. Many of these responsibilities may be the primary duty of other parties such as owners, or architects and engineers; nevertheless, where construction managers can perform a meaningful role, such functions are identified. Since the construction industry is so diverse, the construction manager's role may vary considerably from one project to another. Therefore, this paper does not assign an organizational or contractual role to parties. Functions are allocated on the basis of the skills, knowledge, and experience of construction managers; general professional practice; and the consequent expectations of owners.

A discussion of liabilities inherent in various roles is included because of the potential limitations such risks impose on the actual fulfillment of the roles discussed.

GENERAL POLICY ON USE OF CONSTRUCTION EXPERTISE IN DESIGN

Construction experience should be available to the owner during all the design phases of a project to achieve maximum cost effectiveness savings. This potential for savings is greatest in the earliest phases of the project, and decreases rapidly as the project progresses (Paulson 1976).

SKILLS OF CONSTRUCTION MANAGERS

In order to be engaged by an owner, construction managers should possess experience and a high degree of competence in the following:

1. Planning, organizing, directing, and controlling construction.
2. The latest construction technology.
3. Materials management, including availability and cost.
4. Quality management.
5. Labor availability, use, and productivity.
6. Cost engineering, including estimating and scheduling.
7. Contracting strategy.
8. Value engineering.
9. Risk management.

GENERAL RESPONSIBILITIES OF CONSTRUCTION MANAGERS

Construction managers' responsibilities can entail the following (Conner 1983; Holton 1983; Lee 1982; Lindstrom 1982):

1. Design constructibility recommendations.
2. Construction contract document packaging and coordination.
3. Cost estimating, budgeting, and controlling.
4. Planning, scheduling, controlling, and coordination of all project work, including design.
5. Layout of construction site, access, and temporary utilities.
6. On-site construction engineering and management to include processing of changes, payment requests, quality management, surveys and geotechnical investigations.
7. Materials management, including procurement and field materials control.
8. Review of contractor submittals related to field methods to determine compliance with the contract.
9. Responsibility for value engineering.
10. Safety programs.

The above list is not intended to be all-inclusive, but to indicate most of the construction management functions having design-related responsibilities. In the design phase, the construction manager performs essentially two roles. This individual assists in the overall formulation of the design by assuming primary responsibility for cost and schedule, and advises the owner or architect/engineer on constructibility, and cost and schedule implications of the design.

CONSTRUCTIBILITY

Constructibility recommendations include contract packaging, construction sequencing, construction cost, access to work, safety, work rule and jurisdictional effects, construction methods, materials, and minimization of construction interferences, as well as design detail improvements. These recommendations should be available in the early phases of design, when site layouts, schematics, and specification criteria are being considered. Such recommendations shall be advisory to the owner. The construction manager should play a major role in preparation of project specifications involving field coordination and control, work simplification, quality management, safety, and labor provisions.

In the review of plans and drawings, the construction manager is expected to assist the owner by identifying patent errors, ambiguities, and omissions. The construction manager is not responsible for checking design calculations or the technical content of specifications.

At no time should the construction manager preempt the responsibility of the architect or engineer for facility design integrity. The construction manager's advisory role is that of making constructive recommendations, and presenting suitable design alternatives when appropriate. Alternate solutions are particularly appropriate whenever design details affect construction feasibility, costs, or schedules (Conner 1983).

In this consultant role, construction experience and responsibilities are closely linked. The leadership role of the construction manager should exist only in those areas where construction knowledge is essential.

THE CONSTRUCTION PHASE

The definition of design and its separation from construction in the field is not always clear. In some operations, design details are not complete or must be amplified during construction, either to assist the performance of the contract, or to amend specifications via the change process. Consequently, the construction manager may perform actual design functions, such as site and soil surveys. Construction managers can also interpret the general contract provisions, and approve or review contractor design operations to assure that workmanship and materials comply with plans and specifications, but they should refrain from interpreting the technical provisions of the contract.

DIVISION OF RESPONSIBILITIES BY TASK

A detailed list of design-related activities is shown in Table 1. Activities are categorized by design phase; the roles of construction managers are listed according to whether it is their function to "perform" the task or to "advise" regarding it. The former implies a service normally expected of a construction manager. The latter responsibilities are those in which construction managers have a secondary role, yet one in keeping with their construction expertise. Many other construction management responsibilities, not related to design, are omitted from the table.

LIABILITY

A major concern of the construction manager who assumes an active role in design is the potential liability incurred. Lee (1982) discusses this dilemma as the conflict between "leadership and liability." In assuming the roles listed in Table 1, the construction manager must be aware of the inherent exposure to liability (Holton 1983; Sandridge 1983; Sneed 1981; Sweet 1985). Liabilities are largely defined by the owner-construction manager contract, and arise in three major areas of responsibility: design review, the preparation of project cost and schedule estimates and budgets, and design on site.

Design Review.—The construction manager is expected to perform the design review services discussed in the section on constructibility. Some construction manager contracts provide for this responsibility, although the AIA and AGC contracts are correct in not permitting assumption of the (architect's) responsibility for design (AIA 1980; Conner 1983). There are several dilemmas in construction managers' review of drawings and materials of construction. If the construction manager takes a *leadership* role in making recommendations on certain materials or methods, and these are adopted, he or she stands exposed to potential liability suits, especially if the decision to adopt the design was based on the owner's reliance on the knowledge and experience of the construction manager (Holton 1983). Courts are likely to examine the con-

TABLE 1.—Design-Related Activities

Project activity (1)	Construction Manager's Role	
	Perform (2)	Advise (3)
<i>(a) Planning</i>		
Preliminary scope definition		X
Site location		X
Project management responsibility matrix	X	
Project plan and procedures	X	
Financial and feasibility studies		X
Program estimate and budget	X	
Coordination with other agencies		X
Master schedule	X	
Selection of design professional		X
<i>(b) Conceptual Design</i>		
Detailed scope definition of project		X
Milestone schedule for entire project	X	
Contract strategy	X	
Control system for design and procurement	X	
Modularization and fabrication studies		X
Owner/contractor material coordination	X	
Overseeing of technical consultants	X	
Site access, support facilities, equipment locations, storage, fabrication	X	
Schematic design		X
Initial cost-benefit studies	X	
Initiation of procurement actions	X	
Design criteria		X
Design and procurement quality program		X
Conceptual estimate and budget	X	
General and supplementary conditions	X	
<i>(c) Preliminary Design</i>		
Detailed site layout and survey control		X
Detailed design schedule and control	X	
Contract/subcontract packaging	X	
Site access schedules	X	
Contractor coordination and interfaces	X	
Construction milestones	X	
Construction cost and schedule control system	X	
Material control system	X	
Construction quality plan and criteria	X	
Coordination with utilities	X	
Specification outline and criteria		X
Initial material takeoffs	X	
Budget estimate and control budget	X	
Permits and licenses		X
Design interferences		X
Equipment locations and connections		X
Labor work rules	X	

TABLE 1.—Continued

(1)	(2)	(3)
Value engineering studies	X	
Expediting of approval of design and procurement	X	
Purchasing specifications		X
(d) Detailed Design		
Detailed site layout		X
Construction schedule	X	
Cash flow projections	X	
Detailed technical specifications:		
Tolerances, test and inspection criteria, certifications, safety, security and storage and handling criteria		X
General and special provisions:		
Submittal requirements		X
Quality management	X	
Safety and labor provisions	X	
Scheduling requirements	X	
Measurement and payment	X	
Owner-furnished items	X	
Liability and indemnification		X
Sequencing and coordination	X	
Changes, claims, and modifications	X	
Liquidated damages	X	
Prequalification of bidders	X	
Administration of bidding	X	
Detailed cost estimate	X	
Contract negotiations	X	
Coordinating contract amendments	X	
(e) Construction		
Review of contractor schedules and methods for conformance to contract	X	
Administration of contractor submittals	X	
Approval of contractor design submittals		X
Site survey checks and control	X	
Geotechnical investigations	X	
Coordination of technical consultants	X	
Design changes (preparation)		X
Design changes (negotiation and supervision)	X	
Field change orders	X	
Quality management	X	

struction manager's role in any questionable design decision.

Preparation of Project Cost and Schedule Estimates and Budgets.—These design-related tasks have potential liability implications, depending on the extent of the owner's reliance on the construction manager. For example, the owner may believe that cost and schedule predictions are accurate in the same sense as professional designs, only to discover later that considerable reevaluation of scope and design are necessary

due to overruns in budgets. In these situations, the construction manager could be exposed to many of the same risks as the architect/engineer, including loss of fee (Sweet 1985).

Design on Site.—There is major exposure of the construction manager on site, affecting both the owner and the contractor. Construction managers may perform many actual design-related functions even though these designs are not a part of the formal specification. For example, they may approve submittals that show contractor working plans; they may administer the quality program, including rejection of nonconforming work, but must be very careful not to alter the contract.

To assist in delineating these responsibilities, one can be guided by the AIA and AGC construction manager contracts: that the construction manager's role in design is *advisory only*. The construction manager must clearly understand the contract risks, and the high standards of professional performance they entail. Owners must recognize these risks and accept the necessity for adequate compensation for them (Holton 1983).

BENEFITS OF EFFECTIVE USE OF CONSTRUCTION MANAGEMENT IN DESIGN

Despite the potential benefits of integrating construction expertise into the design process, this is not practiced widely. The Business Roundtable Construction Industry Cost Effectiveness Project of 1982 discusses the costs and benefits of using construction expertise, and concludes that the benefits far exceed the costs. Although the report is concerned with many facets of constructibility, there are many convincing benefits for owners from the interaction of construction expertise and design:

1. Improving the contracting strategy, i.e., the timely selection of the contracting method.
2. Customizing design packages to fit the subcontracting plan.
3. Adapting the design packages to meet construction needs.
4. Constructibility.
5. Overall project (design, procurement, and construction) schedule integration.

To this list must be added the potential benefits accruing to the owner from the management skills and experience of the construction manager. The construction manager can provide leadership in the early project phases by working across functional boundaries and actively seeking to minimize coordination and integration problems.

CONCLUSION

The responsibilities of construction management in design can be considerable, and are the result of the need to achieve more efficient, realistic designs which take advantage of the skills of construction professionals. Such knowledge should be provided in the early phases of a project, where the most significant savings can be realized.

In many project design-related activities, such as cost savings, feasibility, and scheduling, the construction manager should play a primary role, whereas in those functions affecting plant design integrity, the con-

struction role must be advisory. In some field management activities, construction managers actually have design-related responsibilities, and their liability exposure can be considerable.

Potential liability is a major consideration in the assumption of any design-related activities, especially in construction management, where the discipline and court precedence are not well-defined. The construction management contract must clearly delineate the construction manager's responsibilities to manage this risk.

There are visible costs to the owner and some minor resistance to using construction expertise in the design phases of a project. However, the benefits outweigh the costs, and obstacles should be overcome as more owners and engineers realize these benefits through experience and other studies now becoming available.

The profession should be aggressive in supporting necessary education in the role of construction in design. The construction manager is more than merely a design advisor; he or she is an integrator of various disciplines, who has a strong role in meeting the project time, schedule, and performance objectives.

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APPENDIX.—REFERENCES

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