

Guidelines for Authorities and Responsibilities in Concrete Design and Construction

PREPARED BY THE ACI COMMITTEE ON RESPONSIBILITY IN CONCRETE CONSTRUCTION

Preface

The ACI Committee on Responsibility in Concrete Construction prepared these guidelines to help ACI technical committees prepare documents. The guidelines will also be useful to those writing contract documents for projects involving concrete and to anyone managing and controlling such projects.

Practices for assigning and accepting responsibility in design and construction vary throughout the world and within the U.S. In many cases, confusion about responsibilities of design and construction team members has led to protracted legal proceedings. To address this problem, the American Society of Civil Engineers (ASCE) prepared the document "Quality in the Constructed Project." These guidelines conform in principle with that work but provide more details pertaining to concrete projects.

One over-riding principle in these guidelines is the simple notion that responsibility and authority must be congruent. The other principle is that every entity should be responsible for its own work. These principles are frequently violated in the construction industry. For example, an engineer may require that certain steps cannot be taken by the constructor without the engineer's approval. But the engineer may not wish to accept responsibility for problems that develop after those steps are approved. This is the case of demanding authority without accepting responsibility. There have also been cases where owners have held engineers responsible for poor quality construction without having given them a contract to monitor the work as it progressed. Safety enforcement agencies and plaintiffs' lawyers also have charged engineers or architects with responsibility for construction accidents. These are cases of responsibility without authority.

PREAMBLE

The Board of Direction, American Concrete Institute, adopted the Guidelines, developed by the ACI Committee on Responsibility in Concrete Construction, in March 1995. These Guidelines have been written in nonmandatory language, but are intended to describe practical ways to handle responsibility and to help ACI technical committees prepare documents. Although it is not possible to cover all responsibility and authority issues in this short document, this document provides the principles that are relevant to situations not specifically addressed. Originally published in the September 1995 issue of *CI*, this printing reflects changes made to the definition of Owner. The entire document was reapproved by the Board of Direction in October of 2004.

A constructor, subcontractor, or materials supplier often wants to alter design features to make construction operations easier or more economical. The design professional should consider requested changes that do not alter the design concept or reduce quality. When these changes involve engineering design, the design professional should be fairly compensated for additional work needed to approve or re-design those aspects affected by requested changes. Construction has now reached a level of complexity that makes design input from constructors and subcontractors desirable and sometimes essential. This input, whether submitted as value engineering proposals, responses to performance requirements, or design alternatives, has a legitimate place in concrete construction.

Shop drawing preparation often entails the use of engineering principles to design or develop many details not shown on the project drawings. But when engineering design is involved and the details have been accepted, there is a shared responsibility. The design professional must always take overall design responsibility for the safety and proper performance of the completed structure; but it can be appropriate to delegate certain aspects of engineering design to specialty engineers working for the constructor or subcontractors. When any of this design work involves engineering (as opposed to simply detailing), it should be done under the control of an engineer who is licensed in the state of the project and who takes responsibility for such work. One state in the U.S. now has formal legal procedures for this process and others are looking at it. Contract documents often require delineation of responsibility regardless of government mandate, and these guidelines provide for this approach.

There are a few areas in concrete design and construction where it is logical for the design professional to "review" a constructor's submittal rather than "approve" it. For example, these guidelines recommend giving the constructor ample control over "means and methods" and total control over job safety. But certain means, methods, and sequences, such as forming flat plate floors, can affect safety or performance of the completed structure. Most constructors prefer design professional input on forming while still retaining control of how and when it is done. Most design professionals want to provide input but do not want to approve the detailed construction methods. In this case, the engineer can review the constructor's forming plans with the expectation that questions or concerns will be resolved prior to commencing work. In this area, the constructor's responsibility (means, methods, sequences) and the design professional's responsibility (completed structure performance) overlap and differences should be settled in the spirit of "partnering."

A similar situation exists with concrete mixture

proportioning. Public works agencies (particularly state highway departments) often prefer to provide prescriptive mixture proportions for their projects. In building design and construction (both public and private), that detail is almost always assigned to the concrete supplier. In such a situation, though, the design professional may still wish to review the mixture proportions to determine if there are questions to be raised or exceptions to be taken. The responsibility for meeting concrete performance requirements remains with the constructor and materials supplier, but review by the design professional may be provided without a formal approval.

Concrete protection during cold or hot weather is another situation in which it may be desirable for the design professional or owner to review the proposed protection methods. The constructor has responsibility for ensuring proper concrete protection under extreme weather conditions. However, the owner or design professional may want to be assured that the constructor has a reasonable plan for protection. These guidelines do not recommend formal review and approval for such a situation, but public works agencies may require such a procedure.

To clarify responsibilities in overlapping areas, one approach is a clear statement in the contract documents which identifies submittals that are for information only and those that require formal approval. Obviously it is not possible to cover all responsibility and authority issues in this short document, but the document provides principles which are relevant to situations not directly mentioned.

INTRODUCTION

Concrete design and construction must comply with all governing building, safety, and technical codes or standards to assure adequate quality, safe working conditions, and structural integrity. Guidelines included here are for cast-in-place concrete, post-tensioned prestressed concrete, precast concrete (including pretensioned prestressed concrete), formwork, shotcrete, and masonry construction. It is important that all general and technical documents relating to concrete design and construction recognize that responsibility and authority are congruent. The following guidelines for authority and responsibility are recommended for concrete and masonry design and construction:

- A.) The Design Professional should have responsibility and authority for all aspects of the design, including joinery and connections. The Design Professional's Contract Documents may specify that design services for portions of the work are to be provided by the Constructor. The Design Professional should review and approve these designs. The Design Professional's Contract and the Contract Documents should clearly state the scope of both design and review responsibilities

as well as the responsibilities of others providing design services. The Design Professional should specify tolerances where appropriate in the Contract Documents as well as any special or unusual requirements that are necessary.

- B.) The Specialty Engineer employed by the constructor should perform design services that are subject to the review and approval of the Design Professional. This review and approval will not relieve the Constructor and his Specialty Engineer of their design responsibility.
- C.) The Constructor should have responsibility and authority for implementing the Contract Documents, which includes furnishing materials, equipment and labor, maintaining specified quality requirements, coordination of trades and Specialty Contractors, and design and construction of formwork. The Constructor should initiate, maintain, and supervise all safety precautions and processes. Contract Documents should also require that the Constructor and Specialty Contractors maintain their own quality control programs. The Constructor is responsible for construction means, methods, techniques, sequences, and procedures unless they have been specified by the Design Professional. Where required in the Contract Documents, the constructor should prepare shop drawings in accordance with plans and specifications.
- D.) The Owner has primary responsibilities on any construction project. The Owner proposes the project, provides adequate funding and needed real estate and rights of way, and sets the project scope, objectives, budget, quality standards, and overall schedule. During project execution, the Owner must develop the project design,

manage and inspect the construction, provide insurance coverage, and provide for site safety, all in conformance with building codes and environmental and other legal requirements. A key ingredient of a successful

project is the Owner's management of the overall finances of the project, making timely decisions and progress payments to all project representatives. To accomplish this, the Owner needs an organized method of

budgeting, forecasting, cost control, project management, and scheduling. Finally, the Owner must be prepared to accept the completed facility. Owners who lack the skill, expertise, or time to perform these duties and responsibilities must engage other parties who are properly licensed, where applicable.

When getting assistance, the Owner may choose from a continuum ranging from delegating all project responsibilities to other parties to active participation in the project management. If the Owner delegates project responsibilities to other parties, the duties of each party must be clearly defined; if the rules are not clear, disputes may arise. The "scope-of-work" responsibilities not assigned by contract remain solely the Owner's. It is in the Owner's best interest to make sure the project team's relationships and lines of communication are established and implemented. Authority and responsibility assignments should maximize each team member's efficiency as well as accountability.

The Owner is encouraged to require that Design Professionals and Constructors maintain their own quality control programs. The Owner should also establish an independent quality assurance program that satisfies governmental requirements and meets the project's contract documents. These programs include design peer review, system mockups, and materials testing and inspection. To maximize quality assurance, it is recommended that the Owner directly engage and pay for these services.

The procedure for final acceptance of the project must be clearly defined in the contract. The Owner must be prepared to adhere to all aspects of the acceptance procedures, including inspection, acceptance, and final payment. The Owner should implement an appropriate operation and maintenance program to maximize in-service performance and useful life.

CAST-IN-PLACE REINFORCED CONCRETE

For cast-in-place concrete construction, the Design Professional should:

- A.) Show on the project drawings member sizes of all structural components including but not limited to beams, slabs, columns, and footings. Show all joints including construction joints required by design.
- B.) Show all reinforcement grades, sizes, spacing, and configuration including requirements for embedment lengths, location and length of lap splices, connection hardware, and information concerning their appropriate use. The Contract Documents should indicate all items that require a design decision or an interpretation of codes and project specifications.
- C.) Specify strength and other requirements of materials, along with testing and inspection requirements.
- D.) Specify general shoring criteria based on design or

governing standards, indicating any special or unusual shoring requirements. Review and approve shoring submissions by the Constructor for their effect on the structure.

- E.) The Design Professional should review and approve placing drawings for reinforcement size and spacing, general bending details, and other information required by the Contract Documents. The Design Professional may review, but is not responsible to review and approve, construction means and methods, bar lengths in schedules, details of fabrication, use of accessories, tolerances, and other items specified in governing codes and standards. Approval of the placing drawings by the Design Professional does not relieve the Constructor of responsibility for correctly determining the requirements of the Contract Documents.
- F.) The Design Professional should review the mixture proportions and submittals concerning materials, procedures, and testing data, but the Constructor remains responsible for compliance with the requirements of the Contract Documents. If approval is required, the Contract Documents should state so specifically.

The Constructor should provide the following:

- G.) Detailed formwork design. It is not necessary for the Design Professional to review formwork designs. This is the sole responsibility of the Constructor.
- H.) A detailed shoring and reshoring program and sequence including minimum required concrete strength before forms are stripped. This should be reviewed and approved by the Design Professional for compliance with the design requirements.
- I.) Detailed placing drawings clearly showing all reinforcing bar sizes, lengths, bends, special considerations, length of embedments, location of lap splices and splice lengths, connection hardware, construction joints, embedded items, and similar information. Placing drawings should be submitted to the Design Professional for review and approval as required by the Contract Documents.
- J.) Concrete mixture proportions. The Constructor is responsible for providing concrete that meets specification requirements. Alternatively, and if stated in the Contract Documents, the Owner's testing laboratory may prepare the concrete mixture proportions. Mixture proportions, materials, special procedures, and testing data should be submitted for review by the Design Professional or approval when required by the Contract Documents.

CAST-IN-PLACE POST-TENSIONED CONCRETE

All items concerning cast-in-place reinforced concrete outlined previously apply to this section.

In addition:

- A.) If no design work is delegated to the Constructor, the Contract Documents prepared by the Design Professional should show, at a minimum, all design loads; the magnitude, location, and profile of effective post-tensioning forces; size and location of nonprestressed reinforcing steel required for flexure and shear; all details and reinforcing required for the mitigation of restraint-to-shortening effects; and all details and reinforcement required to resist localized effects of tendons (bursting forces behind anchorages, horizontal curvature, etc.).
- B.) If the Design Professional delegates any engineering work to the Constructor, the Contract Documents should clearly indicate the parts of the design, as delineated above, which are delegated, and all design criteria necessary to complete the delegated parts of the design.
- C.) If no design work is delegated to the Constructor, the post-tensioning shop drawings should show, at a minimum, the number, location, profile, and required elongation of the tendons and the tendon support system. No nonprestressed reinforcing steel need be shown unless required for clarity (for example, to avoid conflict with the tendons in congested areas) or if some reinforcement is required for the specific tendon system which is in addition to that shown on the Contract Documents. No engineering stamp is required on the post-tensioning shop drawings.
- D.) If design work is delegated to the Constructor, the post-tensioning shop drawings should be prepared under the direction of a Specialty Engineer and should show all tendon placing information described in Item C in the section on "Cast-in-Place Post-Tensioned Concrete," plus all information (nonprestressed reinforcement, joinery details, etc.) required to complete the delegated parts of the design. The post-tensioning shop drawings should bear the stamp of the Specialty Engineer licensed in the state of the project.
- E.) The Design Professional should review and approve the shop drawings, indicating that the criteria and intent of the design have been satisfied. Such review and approval does not relieve the Constructor or the Specialty Engineer of their delegated design responsibility.

PRECAST CONCRETE (INCLUDING PRESTRESSED CONCRETE)

- A.) The Contract Documents prepared by the Design Professional should provide the overall geometry of the structure, member sizes and permissible alternate sizes, typical connection concepts, and information on whether members are prestressed or conventionally reinforced. In addition, the Contract

Documents should also provide the general performance criteria, including loading strength requirements, deflection requirements, temperature considerations, and any boundary condition requirements for proper interfacing with other structural elements designed by the Design Professional. The Contract Documents should clearly define those precast components which should be designed by the Constructor's Specialty Engineer and clearly state who takes the responsibility for elements at interfaces with other parts of the structure designed by the Design Professional, such as pads, bracing frameworks, dowels, and embedded plates.

- B.) The Contract Documents should include details or concepts of supports, anchors, connections, and clearances that are part of the structure designed by the Design Professional with which the precast components will interface.
- C.) The Design Professional should review and approve designs, calculations, and shop drawings submitted for conformance with all design criteria, loading requirements, and design concepts as specified in the Contract Documents. Such review does not relieve the Constructor and Specialty Engineer of their responsibilities for design.
- D.) The Constructor's Specialty Engineer should prepare detailed shop drawings and calculations that are signed and sealed. Such drawings should show all design criteria used in the design, identify the various materials required, and show the magnitude and location of all design loads imposed on the structure. For special conditions, it may be necessary to provide further assurance that the components and connections are adequate for the specified design loads. Shop drawings should include details of supports, anchors, and connections that are part of the precast system and identify how they interface with other parts of the structure not designed by the Constructor.
- E.) The Constructor and the Specialty Engineer should have full responsibility for selecting, designing, and locating lifting hooks, bolts, loops, and all other additional reinforcement or items associated with the methods of handling, storage, shipping, and erecting precast units.

MASONRY CONSTRUCTION

- A.) The Design Professional should specify the strength of masonry materials, including mortar, and methods for testing strength if required. When bond patterns other than running bond are desired, they should be clearly defined in the Contract Documents. Special masonry construction techniques, including grouting, reinforcing, accessories, wetting, cleaning, or corrosion

protection, should be described in the Contract Documents. The Design Professional should also show expansion and contraction joints and connection details in the Contract Documents. All testing and inspection should be specified when desired or required. When working drawings or other submittals are to be sent to the Design Professional for review or approval, the Contract Documents should describe the procedures.

- B.) The Constructor should make all submittals to the Design Professional and is responsible for executing the work to conform to the requirements of the Contract Documents. The Constructor is also responsible for weather protection, job site safety, scaffolding, shoring, and bracing.

SHOTCRETE CONSTRUCTION

- A.) The Design Professional should specify whether the wet process, dry process, or either method is acceptable; specify the strength and other physical requirements of the in-place concrete and specify the test methods to be used to verify compliance. When preconstruction test or evaluation panels are required, the Design Professional should specify in the Contract Documents the make-up, configuration, and orientation for trial shooting and the criteria for evaluation and acceptance of test panels. Shape and thickness tolerances and location of reinforcement should be specified. The Contract Documents should define surface preparation, desired surface finish, tolerances, and the curing requirements.
- B.) The Constructor is responsible for furnishing properly functioning equipment and skilled applicators to perform the work. All construction means, methods, and sequences are the responsibility of the Constructor, including

scaffolding, bracing, weather protection, protection of adjacent work, and curing procedures. Job site safety and worker training and evaluations also are the responsibility of the Constructor.

OTHER RECOMMENDATIONS

- A.) Communication:
 - 1.) Prebid and preconstruction conferences should be held to identify lines of communication and responsibilities and to discuss the contract requirements.
 - 2.) After award of the contract, the Constructor and any Specialty Contractors should meet with the Design Professional to review design requirements and criteria for the shop drawings, samples, or submittals.
 - 3.) A Specialty Contractor should request through contractual channels, from the Design Professional, any written clarifications needed on special conditions not clearly defined by the Contract Documents.
 - 4.) A Specialty Contractor or Specialty Engineer who designs connections or components, or plans special construction procedures, may be authorized to communicate directly with the Design Professional. The Specialty Contractor should coordinate such communication and follow-up in writing through the contractual channels.
 - 5.) The submitter should advise all affected parties when the construction schedule demands a turnaround time for review of submittals of 2 weeks or less.
- B.) Quality Assurance and Quality Control:
 - 1.) Contractual relationships between the parties involved in the project are vitally important to quality and

structural integrity and should follow the procedures outlined in this document.

- 2.) Clearly delineated and efficient office procedures are critical to the administration of design, document control, checking of shop or placing drawings, and processing design changes.
- 3.) The Constructor and Specialty Contractors should provide ongoing quality control to verify that quality conforms with the Contract Documents. The Constructor and Specialty Contractor should not rely on the Owner's quality assurance program.

not be directly under contract to the Constructor.

Specialty Engineer: An engineer licensed in the state of the project who provides engineering design for special aspects of the project. Within this document, the Specialty

Engineer is mentioned in connection with post-tensioning and precast concrete but a Specialty Engineer could be involved in formwork and shoring design or other work under a design-build contract or performance specification.

GLOSSARY

Constructor: An entity that takes overall responsibility for the construction of a project. This entity may be a general contractor, design-builder or a construction manager with financial responsibility for the construction. A construction manager who does not take financial responsibility for the construction is considered here as an agent of the Owner.

Contract Documents: Drawings, specifications, and general conditions describing the project to be constructed.

Design Professional: An architect or engineer, licensed in the state of the project, who prepares the Contract Documents and has overall design responsibility for the project. A prime Design Professional may delegate work to other licensed professionals or Specialty Engineers. A Design Professional may or may not be directly employed or retained by the Owner.

Owner: Public or private organization or an individual who will take title to the project after completion.

Specialty Contractor: A contractor or materials supplier who has responsibility for part of the project. A Specialty Contractor may or may