ENGINEERING
DATA REPORT
NUMBER 50

Placing Drawings — The Detail Drawings for Reinforcing Bars in Site-Cast Reinforced Concrete Construction

A SERVICE OF THE CONCRETE REINFORCING STEEL INSTITUTE

933 N. Plum Grove Rd., Schaumburg, Illinois 60173-4758

Introduction

The terminology regarding the detail drawings for reinforcing bars in site-cast reinforced concrete construction is often misused in contract documents* and is not an accurate description of the detail drawings. The issue of terminology is real. It is not a trivial nor a scholarly matter of semantics. Rather the inappropriate "labeling" of the detail drawings for reinforcing bars can result in:

- Unnecessary added costs to the Reinforcing Bar Fabricator, which are ultimately passed on to the Owner.
- Issues regarding responsibility and ethics.
- Time delay due to drawing submission protocols.

Objective of This Report

The aim of this report is to:

- Define or describe "placing drawings" — the detail drawings for the reinforcing bars in site-cast reinforced concrete construction.
- Dispel the notion that "one size fits all" in the descriptions of the detail drawings for construction materials and products.

What are Placing Drawings?

Placing drawings are working drawings akin to erection or assembly type drawings, instructing the field Ironworker (Placer) where to place and tie the reinforcing bars within the formwork. Placing drawings may also indicate the bar support layout with a placing sequence, thus facilitating the efficient installation of the reinforcing bars.

Placing drawings are prepared by Detailers, trained technicians who are not necessarily graduate engineers, but are extremely proficient in interpreting the structural information shown by the contract documents. At no time does a Detailer make an engineering decision. In fact, in today's litigious society, a Detailer employed by a Reinforcing Bar Fabricator would be foolish to accept this responsibility.

Detailers also prepare lists of the reinforcing bars that are shown on the placing drawings. A bar list is a listing of reinforcing bars making up a bill of materials. The bar list contains the quantities, sizes, lengths, and bending dimensions of the reinforcing bars. These lists serve several purposes. The Fabricator uses a bar list for shearing and bending, tagging, shipping, and invoicing. The Ironworker Foreman and the placing crew use a bar list for checking delivery quantities, sorting bundles of bars in the job-site lay-down area, and hoisting of proper bundles to the placing area on the formwork.

Placing drawings are not used in the fabricating shop, per se. Thus, the generic term "shop" when applied to the detail drawings for reinforcing bars in site-cast concrete construction is extremely inappropriate.

Responsibility Issues

Responsibility for the preparation, review, and approval of placing drawings is established in the ACI detailing standard and in the ASCE quality manual.

ACI 315 Detailing Standard. The USA consensus standard for detailing reinforcing bars for site-cast reinforced concrete construction is promulgated by the American Concrete Institute: "Details and Detailing of Reinforcement (ACI 315-99)".

ACI 315 clearly addresses the responsibilities of the Architect/Engineer regarding placing drawings:

> *"The responsibility of the Architect/Engineer is to furnish a clear statement of design requirements to the Detailer. The Architect/Engineer's project specifications or structural drawings must not merely refer the Detailer to an applicable building code for information to use in preparing the placing drawings. Instead, this information shall be interpreted by the Architect/Engineer and shown in the form of specific design details or notes for the Detailer to follow. Where omissions, ambiguities, or incompatibilities are discovered, additional information, clarifications, or corrections shall be requested by the Detailer and provided by the Architect/Engineer. The Architect/Engineer should require in the project specifications that placing drawings be submitted for approval."*

Regarding the Detailer's responsibility, ACI 315 states:

> *"The responsibility of the Detailer in preparing placing drawings is to carry out all instructions on the Contract Documents."*

ASCE Quality Manual. ASCE's Manual No. 73, *Quality in the Constructed Project*, addresses the role of placing drawings for reinforcing steel in cast-in-place concrete con-

* See the Terminology section for definitions of certain terms used in this report.

struction. Chapter 17 of the manual is titled Construction Contract Documentation and Submittals. Article 17.3.7 states in part:

"…The design professional has authority and responsibility for overall design of the completed structure and for the review and approval of the placing drawings for conformance with the project design concept and the information in the construction contract documents.

The constructor and subcontractors have responsibility for preparing the placing drawings, providing the materials specified, and completing the fabrication and construction process. This work is carried out in accordance with the construction contract documents, approved placing drawings, and accepted industry standards.

In most cases, placing drawings for reinforcing steel in cast-in-place concrete do not need design services and it is not necessary or appropriate for the contract documents to call for certification by a registered professional engineer. For post-tensioned prestressed cast-in-place concrete structures, the design professional may delegate certain design activities to…"

Design Responsibility

Structural Detailing of Reinforcement. Proper structural detailing of reinforcement is critically important to attain the desired level of performance of reinforced concrete structures. Adequate anchorage or embedment lengths and splices of reinforcing bars are crucial — equally as important as connections in structural steel construction.

Since the structural details of reinforcement are critically important, it is unrealistic for the Architect/Engineer to require or expect the Detailer to perform the structural detailing — the Detailer is not qualified to do so.

The ACI 318 Building Code properly assigns certain responsibilities to the Architect/Engineer regarding the structural detailing of anchorage or embedment lengths and splices of reinforcement. In Chapter 1 of the Code, Section 1.2.1 states: The design drawings, details, and [project] specifications must show:

- Anchorage length of reinforcement
- Location and length of lap splices
- Type and location of mechanical and welded splices

This point is further emphasized in Chapter 12 of the Code. Section 12.14.1 states: Splices in reinforcement shall be made only as required or permitted on design drawings, or in [project] specifications, or as authorized by the engineer.

In his presentation at the October 1998 PCI Convention and Exhibition, Norman L. Scott, an eminent Structural Engineer, included comments on the issue of design responsibility. Mr. Scott has been actively involved with the ASCE Committee on the development of Manual 73 and the ACI Board Committee that prepared "ACI Guidelines for Authorities and Responsibilities in Concrete Design and Construction".

Regarding placing drawings, Mr. Scott stated:

"…The reinforcing steel fabricators who supply reinforcing bars for cast-in-place concrete say they never do any design work and, therefore, it is not necessary to sign their submissions, which they prefer to call placing drawings. The ACI responsibility committee looked at this practice very carefully and concluded that they [the reinforcing steel fabricators] are right. There are essentially no reinforcing bar suppliers who do design work; they just do the detailing."

Approval of Placing Drawings

Some project specifications require that reinforcing steel placing drawings be sealed by a licensed Professional Engineer employed by the Fabricator. The application of a licensed Professional Engineer's seal implies that the Engineer was "in responsible charge of", not merely a contributor to, the work. In some states, a contributor may seal a drawing only if the registrant in responsible charge also seals the drawing.

Also some states, in their statutes on professional engineering practice, specifically prohibit the sealing of any drawings except those prepared under the supervision of the "design professional" or "Engineer-of-Record" in responsible charge. One way in which a licensed Professional Engineer employed by the Fabricator could ethically seal the placing drawings would be to, in effect, redesign or re-engineer the structure. This redesign effort by the Fabricator's licensed Professional Engineer would not, however, necessarily relieve the Fabricator's licensed Professional Engineer of violations of applicable state statutes governing engineering practice. Another way would be if the Engineer-of-Record was directly involved in the process of preparing placing drawings — being in responsible charge by supervising the process and reviewing the results.

Since the Fabricator's Detailers make no engineering decisions but only determine the number of bars from preestablished spacings, bar lengths, and bar positioning from instructions provided in the Architect/Engineer's project specifications and structural drawings, there is nothing to be in responsible charge of to seal. All directions of structural importance are provided by the Architect/Engineer.

Occasionally, there are errors in these instructions and opportunities for misinterpretations, as there also can be on the Fabricator's placing drawings. The desire for error-free construction is of importance to all. Requiring the Fabricator to have a licensed Professional Engineer seal the placing drawings, however, does not satisfy this desire.

Aside from possible ethical violations, if a licensed Professional Engineer employed by the Fabricator were to seal the placing drawings, it would be most likely after a review of drawings prepared by others. Since this engineer was not in responsible charge and has little knowledge of the Architect/Engineer's intentions other than what is shown on the structural drawings and project specifications, the placing drawings must still be reviewed and approved by the Architect/Engineer in responsible charge. The result is another layer of engineering expense but certainly not another layer of engineering protection for society. The Architect/-Engineer of record, in responsible charge, must be the one to review and approve reinforcing steel placing drawings.

It is important to recognize the difference between a structural steel Fabricator's service, such as designing structural steel connections, where engineering decisions may be required and a reinforcing steel Fabricator's service preparing reinforcing steel placing drawings where engineering decisions are never required. Even the decision as to whether a structural steel Fabricator's drawings shall be sealed by a licensed Professional Engineer employed by the Fabricator must be made on the basis of whether independent engineering decisions that the Fabricator was in responsible charge of appear on the drawings.

Who Should Approve Placing Drawings? Unequivocally, the final decision-maker — the Architect/Engineer. Only the Architect/Engineer has performed the analyses for all loading effects on the structure and knows the effective area of reinforcing steel required at all points, and thus is the only party that should provide interpretations of Code requirements.

Placing Drawings — Other Aspects

Placing drawings are prepared specifically for each individual structure. They are not produced from a general collection of drawings and sketches. Therefore, the project specifications should allow for an adequate time frame for submission, correction, and approval of the placing drawings.

Exchanging drawings electronically is a way to save time and improve the accuracy of placing drawings. CRSI's *Manual of Standard Practice* describes the electronic exchange of drawings and the responsibility of the Detailer in such a process:

> When both the Architect/Engineer and Detailer have CAD (Computer-Aided Design) capability, the electronic exchange of drawings using, for example, disks or phone lines, is highly recommended. Such exchange of electronic files can further assure that the Architect/Engineer's intentions are conveyed to the Detailer with less need for further interpretation. In turn, the Detailer is able to provide accurate, quality placing drawings. It should be noted that when CAD files are obtained from outside sources, it is the responsibility of the Detailer to remove all information not directly relevant to the creation of placing drawings as well as all references to the outside sources of the files. It is also the responsibility of the Detailer to adhere to the original and revised project drawings and project specifications while detailing the reinforcement for the structure.

Closing Comments

This report has presented the argument:

- The detail drawings for reinforcing bars in site-cast reinforced concrete construction are called placing drawings.
- Since there is no design involved in the preparation of placing drawings, it is unnecessary for a licensed professional engineer to seal placing drawings. Plus, the imposing of such a requirement in the contract documents raises questions of responsibilities and ethics.

As a public service, technical organizations that disseminate model project specifications should adopt the proper terminology, viz., placing drawings for the reinforcing bars in site-cast reinforced concrete construction.

Likewise, architects/engineers and public agencies should adopt the term "placing drawings" in their project specifications. The term "shop" as applied to reinforcing bar placing drawings is not only inappropriate, but obsolete.

Resources

"Partnering for Quality Design in Precast Construction," by Norman L. Scott, *PCI Journal*, Nov.-Dec. 1998, pp. 23-25.

"Quality in the Constructed Project: A Guide for Owners, Designers and Constructors", 2nd Edition, Manual No. 73, 2000, American Society of Civil Engineers, Reston, Virginia.

"Designing and Specifying Rebar Embedments and Splices: Who is Responsible?", by D. P. Gustafson, *ACI Concrete International*, May 1992, pp. 49-50.

"Building Code Requirements for Structural Concrete (ACI 318-02)", American Concrete Institute.

"Details and Detailing of Reinforcement (ACI 315-99)", *ACI Manual of Concrete Practice*, Part 3, 2001.

Manual of Standard Practice, 27th Edition, 2001, CRSI.

"Specifications for Structural Concrete (ACI 301-99)", American Concrete Institute.

"ACI Guidelines for Authorities and Responsibilities in Concrete Design and Construction", *ACI Concrete International*, Sept. 1995, pp. 66-69.

Terminology

The source of the following terms and their definitions is "Specifications for Structural Concrete (ACI 301-99)":

Architect/Engineer or Engineer/Architect — The Architect, Engineer, architectural firm, engineering firm, or architectural and engineering firm, issuing project drawings and project specifications, or administering work under the Contract Documents.

Contract Documents — Documents, including the Project Drawings and Project Specifications, covering the required Work.

Project Drawings — The drawings that, along with Project Specifications, complete the descriptive information for constructing the Work required or referred to in the Contract Documents.

Project Specifications —The written documents that specify requirements for a project in accordance with the service parameters and other specific criteria established by the Owner.

Work — The entire construction or separately identifiable parts thereof that are required to be furnished under the Contract Documents; work is the result of performing services, furnishing labor, and furnishing and incorporating materials and equipment into the construction in accordance with the Contract Documents.

The ACI 315 detailing standard is the source for the following definition of Detailer:

Detailer — Drafter who prepares reinforcing bar placing drawings and bar lists.

Soft Metric Reinforcing Bars

It is important for readers of this document to be aware of current industry practice regarding soft metric reinforcing bars. The term "soft metric" is used in the context of bar sizes and bar size designations. "Soft metric conversion" means describing the nominal dimensions of inch-pound reinforcing bars in terms of metric units, but not physically changing the bar sizes. In 1997, producers of reinforcing bars (the steel mills) began to phase in the production of soft metric bars. Within a few years, the shift to exclusive production of soft metric reinforcing bars was essentially achieved. Virtually all reinforcing bars currently produced and used in the USA are soft metric. The steel mills' initiative of soft metric conversion enables the industry to furnish the same reinforcing bars to inch-pound construction projects as well as to metric construction projects, and eliminates the need for the steel mills and fabricators to maintain a dual inventory. Thus, USA-produced reinforcing bars furnished to any construction project most likely will be soft metric.

Designations of Bar Sizes. The sizes of soft metric reinforcing bars are physically the same as the corresponding sizes of inch-pound bars. Soft metric bar sizes, which are designated #10, #13, #16, and so on, correspond to inch-pound bar sizes #3, #4, #5, and so on. The metric bar designations are simply a re-labeling of the inch-pound bar designations. The following table shows the one-to-one correspondence of the soft metric bar sizes to the inch-pound bar sizes.

Soft Metric Bar Sizes vs. Inch-Pound Bar Sizes

Soft Metric Bar Size Designation	Inch-Pound Size Designation
#10 #13 #16	#3 #4 #5
#19 #22 #25	#6 #7 #8
#29 #32 #36	#9 #10 #11
#43 #57	#14 #18

Minimum Yield Strengths or Grades. Virtually all steel mills in the USA are currently producing reinforcing bars to meet the metric requirements for tensile properties in the ASTM specifications. Minimum yield strengths in metric units are 300, 350, 420 and 520 MPa (megapascals), which are equivalent to 40,000, 50,000, 60,000 and 75,000 psi, respectively. Metric Grade 420 is the counterpart of standard Grade 60.

Bar Marking. Soft metric reinforcing bars are required to be identified with the Producer's mill designation, bar size, type of steel, and minimum yield strength or grade. For example, consider the marking requirements for a #25, Grade 420 metric bar, which is the counterpart of an inch-pound #8, Grade 60 bar. Regarding the bar size and grade, the ASTM specifications require the number "25" to be rolled onto the surface of the metric bar to indicate its size. For identifying or designating the yield strength or grade, the ASTM specifications provide an option. A mill can choose to roll a "4" (the first digit in the grade number) onto the bar, or roll an additional longitudinal rib or grade line to indicate Grade 420.

Chapter 1 in the CRSI *Manual of Standard Practice* includes a detailed presentation of the inch-pound and metric requirements in the ASTM specifications for reinforcing bars. Appendix A in the *Manual* shows the bar marks used by USA producers to identify Grade 420 soft metric bars.

More information about soft metric reinforcing bars is also provided in Engineering Data Report No. 42, "Using Soft Metric Reinforcing Bars in Non-Metric Construction Projects". EDR No. 42 can be found on CRSI's Website at www.crsi.org.

CRSI Website

Readers of this report are also encouraged to visit the CRSI Website for:

- Descriptions of CRSI publications and software, and ordering information
- Institute documents available for downloading
- Technical information on epoxy-coated reinforcing bars
- Technical information on continuously reinforced concrete pavement
- Membership in CRSI and member web links
- General information on the CRSI Foundation
- Information on the CRSI Design Awards competition

CONCRETE REINFORCING STEEL INSTITUTE
933 N. Plum Grove Road, Schaumburg, Illinois 60173-4758
Phone: 847/517-1200 Fax: 847/517-1206
www.crsi.org