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The Guide to Specifying Concrete Performance

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A significant deliverable recently released to support the NRMCA's P2P Initiative is a *Guide to Specifying Concrete Performance – A Phase II Report of Preparation of a Performance-Based Specification for Cast-in-Place Concrete*. The document was developed by the research team of Ken Hover, Cornell University, R. Doug Hooton, University of Toronto and John Bickley, consultant, with funding support from the RMC Research & Education Foundation.

The guide specification covers performance requirements for concrete on the basis of measurable properties using available standard test procedures for design loads, durability and other service conditions. These provisions can be selectively incorporated as appropriate for different concrete structures based on service conditions, severity of environmental exposure and assigned project costs for inspection and testing. It is understood that for most concrete structures, the level of performance testing or mixture pre-qualification recommended may not be necessary. The proposed specification clauses are supported by commentary to provide additional guidance to the design professional. In establishing performance requirements for concrete mixtures, it is recognized that responsibility for expected service life and functionality are not borne by the contractor or concrete supplier. The serviceability conditions and code requirements are recognized to be a design function that should be translated into provisions in contract documents.

The guide specification is organized into three parts. Part I addresses those specification provisions that are based on the concrete materials requirements of ACI 318-08, Building Code for Structural Concrete. It incorporates the new Exposure Class concept

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in ACI 318-08. In some cases performance alternatives and associated criteria are suggested to current prescriptive code provisions – for example, the use of ASTM C1202 testing (resistance to chloride penetration) in lieu of meeting the w/cm requirements of ACI 318. Using performance alternatives to prescriptive code provisions would require the concurrence of the building official. Part II addresses the workability and temperature of fresh concrete in terms that are fully compatible with the requirements of ACI 301-05. Part III offers optional specification requirements that are not currently addressed by either ACI 318 or ACI 301, and would be specified only when applicable to the special needs of a particular project. These optional provisions apply only when specified and no default requirements apply.

This guide specification concentrates on performance and not on means, methods or materials, and while there are multiple requirements herein for submittal of concrete performance records, there are no requirements for a full disclosure of ingredients or mixture proportions. This does not imply, however, that non-standard materials or ingredients are acceptable without prior notification and approval of the engineer of record. However, should concrete as supplied fail to meet one or more performance requirements, the purchaser may need to know the composition of the mixture in order to determine the causes of failure and to evaluate the adequacy of the work.

In many cases the guide specification provides the contractor/producer with one or more options for demonstrating compliance with specification requirements. The option chosen by the contractor/producer, along with the required information that must accompany each option, is to be documented in a pre-construction submittal to the engineer of record.

The guide specification includes performance tests and criteria for laboratory evaluations at a pre-qualification stage, for samples obtained at the jobsite for verification and for in-place tests for referee testing in the case of failing verification tests. In general the specifier will approve the proposed concrete mixture in advance of construction operations (pre-qualification), and in many, but not all cases, specified properties of the pre-qualified mixture will be verified for acceptance at the point of discharge. Pre-qualification permits evaluation of a proposed concrete mixture on the basis of more detailed or time-consuming laboratory-type performance tests that are not generally suitable for jobsite verification.

The owner of the structure anticipates that the performance defined in the specification is achieved in the structure. An important aspect of testing the properties of concrete from samples obtained from the structure is the change of control of the product from the concrete supplier to the concrete contractor and the appropriate assignment of responsibility if specification requirements are not met. It is anticipated that as performance specifications evolve, there will be a need for increased coordination and partnering between these two parties to ensure that specified requirements are achieved. In this guide specification, most tests and criteria for properties of concrete in the structure are deferred to referee evaluations when there is non-compliance with samples obtained at the point of discharge.

Significant effort was expended by the research team and the P2P Steering Committee in arriving at consensus recommendations published in this document. Compromises were necessary on testing in-place concrete and the types of tests conducted on samples obtained at the jobsite. Another concern was the reliability of jobsite sampling handling and care, especially for some sensitive durability tests.

ACI has formed an Innovative Task Group (ITG) that is developing a report in a 2-year time frame on performance requirements for concrete materials. The ITG is using this guide specification as a basis for its report. It is anticipated that the ITG report will provide specific recommendations for revisions to current ACI standards. NRMCA is also establishing a focus group of engineers and contractors to discuss opportunities and barriers to implementing this guide specification in actual projects.

The guide specification is available at www.nrmca.org/p2p. Also available on the Website is a document titled: *Preparation of a Performance-based Specification for Cast-in-Place Concrete – Phase I*, by Bickley., J.A., Hooton, R.D., and Hover, K.C., published in January, 2006. This report contains more detailed discussions of the advantages and disadvantages, test methods, the international state of the practice, and risks and responsibilities associated with performance specifications. ■