Construction Specification For Concrete Work On Ordinary Buildings

Proposed American Concrete Institute Specification No. 502
(To be Used on Buildings Requiring Considerable Concrete)

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Committee 502—Mixing and Placing Concrete on Buildings

Editor's Foreword

THIS *is the first of a contemplated new series of specifications to be prepared and issued under the auspices of the American Concrete Institute. Others are in progress, including Specification No. 503 for Fabricating and Setting Reinforcing Steel, a companion document to the one here presented. It is hoped —expected that Institute members will be served not merely in their use but in that discussion by which they may be perfected for use. * * * The new committee plan of the Institute, in which a single member prepares the report and others of experience criticise it in advance of publication, has been applied to the production of the specification which comprises the report of Committee 502, whose work is in the new Department of Specifications.*

The Author of Proposed Specification No. 502 is exceptionally qualified for this work. He brings to it a diverse experience with concrete—research under Professor Talbot at Illinois; chief engineer of one of the larger construction companies for many years and independent practice as an architectural engineer in the special field covered by this specification for the last fifteen years, in which many notable structures have been designed and constructed under his supervision—and many smaller ones as well. He is the author

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of "Design and Cost Data for the 1928 Joint Standard Building Code," a notable 1928 paper before the Institute (Vol. 24, p. 537) which with Building Regulations for Reinforced Concrete, tentatively adopted by the Institute the same year, comprise the "Handbook of Reinforced Concrete Building Design," and of many other published bulletins, books and articles on concrete, including his 1927 Institute paper: "Notes on Concrete—Wacker Drive, Chicago" which made him a Wason Medalist for that year.

Critic members of the committee, A. S. Douglass, A. B. MacMillan, J. Thumley, W. F. Way brought to their task a varied and thoroughgoing experience in the work covered by such a specification.

The specification has the approval in general of all four critics and in detail with exceptions noted in discussion by Messrs. Douglass and MacMillan, following the report in these pages.

And for all the labor which goes to make such a document, and for all the well considered experience from which it is drawn—no specification is final except as made an effective part of each building contract. A composite of the accretions of experience, it will continue to grow from the experience of others yet to be heard. Thus, the Institute's work is effective as such a specification draws upon the experience of all. Even when and if acceptable and adopted as an Institute standard, it becomes but a temporary "last word"—a new point of departure for still better practice than it implies. To attribute to standards any undue degree of finality is an obstacle to the purpose of the Institute. No small part of the good of a specification is in the rub of comparative judgment and experience through which it is adopted. It is with this thought that the Program Committee has placed the report of Committee 502 on the 1930 convention program and invites discussion.—EDITOR.

TO THE USER

THIS specification is intended for the use of Architects and Engineers, to be incorporated as a whole in the specifications for particular structures by reference at the proper place in the typewritten pages and to become a part of the contract in the usual manner. It applies to ordinary commercial or industrial buildings or to other buildings in which ordinary concrete surfaces, as they are produced by reasonably good formwork and concrete control are acceptable. For fine architectural surfaces it should not be used. This specification also incorporates (unless stricken out by the user) Specification No. 503* for Fabricating and Setting Reinforcing Steel in this type of building.

In the preparation of this specification, the author has had the active criticism and cooperation of the critic members of the committee: A. S. Douglass, construction engineer, Detroit Edison Co.; A. B. MacMillan, chief engineer, Aberthaw Co., Boston; J. Thumley, superintendent, Graham, Anderson, Probst & White, architects and engineers, Chicago, and W. F. Way, Henry & McFee Contracting Co., contractors and engineers, Seattle.

The following wording is suggested to be used in the Architect's and Engineer's typewritten specification for individual building:

Specification for Concrete Work
Name and Location of the Building
Name and Address of Owner
Name and Address of Architect or Engineer

All plain and reinforced concrete work on this structure shall be done in strict accordance with Specifications Nos. 502 and 503 of the American Concrete Institute, which are hereby made a part of these specifications and which will be made a part of the contract for this work. All the provisions of these two specifications shall be in full force and effect except as expressly modified or supplemented in the following special instructions for this structure.

(Here incorporate any necessary clauses arising from unusual conditions surrounding the work to be done, as for example: quicksand or unusual water conditions; protection of existing construction; materials purchased or furnished by the Owner direct; early strength concrete; unusual chemical exposures to be safeguarded; maintenance of manufacturing operations during construction; concrete piles, caissons or tunnels; very deep basements; underpinning work; special grading or maximum size of aggregates with revised fineness modulus; admixtures; etc.; etc.)

*In Preparation by Committee 503—Fabricating and Setting Reinforcing Steel. William F. Zabriskie, Author-Chairman.

Wherever the words "Architect or Engineer" are used they shall be construed to mean the Architect Engineer (Strike out one) only or his duly accredited representative on the work.

1. GENERAL CONDITIONS OF THE CONTRACT

This Contractor shall acquaint himself fully with the General Conditions of the Contract for this work. He shall be bound by all requirements of these general conditions insofar as they are applicable to his part of the work in the opinion of the Architect or Engineer. These General Conditions shall be made a part of the contract for the concrete work covered by this specification.

2. SCOPE OF THE CONCRETE WORK.

This Contractor shall provide all necessary labor and material and install complete, ready for convenient use, all portions of the structure specifically mentioned in these specifications and/or shown on the architectural or engineering plans or details of the structure, and also all usual necessary and essential portions of a structure of this type that would commonly be made of plain or reinforced concrete, whether or not they are definitely shown on the plans or listed in the specifications. In general the work of this Contractor shall include: concrete foundations; concrete floors on the ground, including fine grading and filling therefor; concrete retaining walls at building lines and area ways; concrete columns, roofs and floors; concrete walls; concrete or terrazzo floor or stair finish; any cutting, shoring, sheeting, hand excavation, backfilling or underpinning necessary to install concrete work properly; concrete sidewalks, paving and parking strips; installation of masonry ties or other inserts; concrete stairways; concrete penthouses or tank supports; formwork for all concrete work requiring same; and so forth. This contractor shall also furnish and place all necessary reinforcing material, properly bent and marked, together with complete accessories to hold securely all reinforcement in its designed position during construction.

3. CONDITIONS AT SITE OF WORK.

This Contractor shall visit the site of the work and make himself thoroughly familiar with all conditions affecting the conduct of his work, the location and arrangement of his plant, the storage of materials, and so forth. He shall make any necessary observa-

tions as to soil conditions, ground water level, sewers or public utilities, traffic requirements and so forth. No additional allowance of time or money shall be asked or granted because of this Contractor's lack of knowledge of conditions prevailing at the site at the time of estimating or which may be readily foreseen to exist at the time that the work is undertaken.

4. PRELIMINARY PREPARATIONS.

Promptly upon the receipt of contract for this work this Contractor shall decide upon the materials to be used in the work, furnish adequate samples of them to the Architect or Engineer and shall cause to be made such tests as are herein specified (Articles 17 and 18) for the determination of the mix. He shall also make all necessary arrangements for tools and equipment and for the installation of his mixing plant and conveying equipment, except as he may arrange to secure his concrete from a central mixing plant approved by the Architect or Engineer. No hand mixed concrete shall be used on account of the failure of this Contractor to make adequate preparations, but concrete needed before the job plant is ready, at times when it is disabled or after it has been dismantled, shall be procured from an approved central mixing plant.

5. CEMENT.

Portland cement, meeting all requirements of the standard specifications of the American Society for Testing Materials (serial designation: C9-26) shall be used for all concrete work.

Cement shall be delivered in cloth or paper sacks plainly marked with the name of the manufacturer and shall be stored for at least seven days in sealed warehouse after test samples are taken. It shall be so stored and handled at all times as to be protected from moisture from the air or from the ground or from any other source. It shall be so stored as to be readily inspected and as to remain free of any foreign material. All the cement in any container, in which part of the cement has become caked or has otherwise deteriorated, shall be entirely removed from the work.

6. FINE AGGREGATE.

Fine aggregate for this work shall consist of well graded natural or artificial sand taken from sources that have furnished satisfac-

tory material for previous concrete work for several years, or if from a new source, shall be thoroughly tested for soundness and permanence. It shall have a fineness modulus of not less than 2.75. It shall not contain in excess of two per cent (by weight) of dust passing the 100 sieve when thoroughly dried. It shall be free from organic matter and dirt and shall be so stored and handled at all times as to remain free of all foreign material and separate from other aggregates until placed in the mixer.

7. COARSE AGGREGATE.

Coarse aggregate for this work shall consist of washed gravel, crushed rock, or similar inert materials, taken from sources that have furnished satisfactory material for previous concrete work for several years, or if from a new source shall be thoroughly tested for soundness and permanence. It shall have a fineness modulus not less than 5.5. It shall be well graded from fine to coarse and not more than five per cent (by weight) of the particles shall be retained on the one-inch sieve.* It shall be free from organic matter and dirt. It shall not contain in excess of two per cent (by weight) of dust passing the 100 sieve, nor in excess of three per cent (by weight) of soft, friable, thin, flaky, elongated or laminated particles.

Coarse aggregate shall be so stored and handled as to remain clean and well graded at all times and shall be kept separate from other aggregate until placed in the mixer.

8. WATER.

Water used in the concrete for this work shall be taken from a source which has proven satisfactory on similar work. Surface water shall not be used nor water subject to pollution by industrial waste, except after tests satisfactory to the Architect or Engineer. Where city water is used the same shall be paid for by this Contractor. (See also article 25 of this specification).

9. CONSTANT SOURCE OF SUPPLY.

Having determined upon the source and kind of cement and aggregates to the satisfaction of the Architect or Engineer, this Contractor shall secure his entire supply of each material from the same source so as to maintain the same quality and grading

*(Larger or smaller maximum size may be desirable for portions of the structure or for particular jobs.) Consult typewritten specifications for any change in grading of coarse aggregate.

throughout the work. Should it become necessary to change the source or characteristics of the materials used this shall only be done after additional proportioning tests have been completed for the new materials and subject to such safeguards as the Architect or Engineer may impose for the maintenance of the quality of the concrete in all respects.

10. ADMIXTURES AND SPECIAL CEMENTS.

Nothing shall be added to the essential ingredients of concrete (portland cement, fine and coarse aggregate, and water) without the approval of the Architect or Engineer in writing and then only such materials shall be added as have been thoroughly tested by reputable independent investigators so as to demonstrate their effect on the strength, elastic properties, permeability and permanence of concrete produced from materials such as are being used on this work.

No special cement shall be used in place of standard portland cement except upon the same basis of adequate test and known effect upon all vital properties of the resulting concrete.

Whenever such admixtures or special cements are approved for use on this work in this manner they shall be used in accordance with the manufacturer's instructions and in conformity with their use in the tests on which their acceptance is based.

11. REINFORCING STEEL AND INSERTS.

All reinforcing steel for this work shall be furnished and placed by this Contractor and shall be of the quality specified, and shall be fabricated and placed as required in Specification No. 503 of the American Concrete Institute.* All reinforcement shall be supported adequately in its designed location as specified therein. American Concrete Institute Specification No. 503 is hereby made a part of this specification and will become a part of the contract for this work when awarded.

All portions of the concrete work shall be provided with reinforcement (unless resting directly on the ground). Any gaps in the reinforcement as shown on plans shall be suitably filled, using not less than $\frac{3}{8}$ ∅ bars at six inches on centers in any case.

*In preparation.

12. FORMWORK.

Forms for the work may be made of wood, steel or other material which has been satisfactorily used on similar work for this purpose. All forms shall be mortar tight and sufficiently rigid to prevent sagging between supports. Surfaces of metal forms shall be free of marked irregularities, dents or sags. Knot-holes or broken places in wood forms shall be covered with metal patches. All formwork shall be so designed (cleanout openings at base of columns, at bottoms of deep girders, etc.) as to permit of ready cleaning after the reinforcement has been placed. For spans in the structure in excess of twenty feet the bottom of beams or girders shall be cambered allowing one-twenty-fourth of an inch rise per foot of span.

Wooden formwork shall be kept continually moist after being erected, so as to prevent the opening up of cracks in which dirt may lodge. Parafin oil shall be applied to forms immediately before the reinforcement is placed but in no case shall the oil be permitted to coat the reinforcement. Concrete shall be placed as soon as possible after the reinforcement has been placed and inspected, so as to prevent the collection of dust and dirt on the oiled formwork.

The design of the formwork shall include all necessary shores built in place in advance of concreting in cases where portions of the forms are to be wrecked before the concrete on them is ready to support itself. These shores shall not be disturbed in the wrecking of the adjacent formwork. No re-shoring will be permitted.

An experienced workman shall be employed at all times during the placing of concrete to watch the formwork and its supports and to strengthen any portions that may show signs of sagging, displacement or failure.

13. REMOVING FORMWORK.

This Contractor shall be solely responsible for the safety of the construction during and after form removal, and no act of the Architect or Engineer or of his representatives on the work shall relieve this Contractor of such responsibility. Subject to this limitation, forms for columns may be removed after one day, forms for slabs or other members whose span does not exceed

five feet nor eight times their depth and only for members which carry only their own weight or in which all superimposed loads are adequately supported by built-in shores, may be removed after three days. Other forms may be removed after seven days. The time referred to in each case is to be measured in days of good curing temperatures of not less than 60° F. (twenty-four hour average). At lower temperatures a longer period shall elapse sufficient to produce the same strength of concrete.

14. PATCH FORMWORK.

Forms for patches (where temporary openings have been left for any reason) shall be rigidly supported, being posted from the floor below or suspended by rods or bolts and not hung by twisted wires or other means that will permit displacement of the patch formwork and unsightly surfaces.

15. CONCRETE MIXING PLANT.

Concrete for this work may be mixed on the job or at an approved central mixing plant. In either case the equipment shall be in first class working order so as to eliminate breakdowns and shall be replaced if necessary to insure satisfactory and continuous performance. A rotary batch mixer shall be used, of at least one-half cubic yard capacity and this capacity shall be increased if necessary so that the yardage of concrete to be placed at any one level above the foundations will be produced in not to exceed three working days, with a maximum requirement of two cubic yard mixers on very large jobs.

16. MEASUREMENT OF THE BATCH.

All materials, including water, shall be accurately measured by weight or volume for each batch of concrete. When wheelbarrows are used, the accuracy of measurement shall be maintained by striking off each load level full or by charging the wheelbarrow with measuring boxes that are struck off. Other measuring devices shall be calibrated and checked at frequent intervals. When additional water is used on account of weather (as, for example, on account of hot drying wind on a long haul in carts) it shall be accurately measured to produce the desired slump at the point of deposit of the concrete, and not added by guess or by operator's judgment.

The quantities of material for each batch for each class of concrete shall be computed from the mix as stated on the drawings (all concrete not otherwise shown or called for to be mixed with seven and one-half gallons of water per sack of cement) or determined by trial batches and preliminary tests as provided under articles 17 and 18 of this specification.

The quantity of water as finally determined for each batch shall include the free moisture on the surface of the aggregates. Tests shall be made as necessary to determine the amount of such surface moisture present in the aggregate. The maintenance of a uniform slump by this Contractor shall be considered a sufficient control of moisture variation and tests may be waived if such uniformity is secured on the job.

17. TRIAL BATCHES AND PRELIMINARY TESTS.

Class A concrete for this work shall be designed to produce a strength at 28 days in standard laboratory test cylinders of not less than 2000 lb. per sq. in.

Class B concrete—not less than 2500 lb. per sq. in.
Class C concrete—not less than 3000 lb. per sq. in.
Class D concrete—not less than 3750 lb. per sq. in.
Class E concrete—not less than 5000 lb. per sq. in.

When the materials to be used on this work have been approved by the Architect or Engineer this Contractor shall cause to be made, by an approved testing agency, a series of preliminary laboratory tests in strict accordance with the Standard Method of Making Compression Test of Concrete of the American Society for Testing Materials (serial designation C 39-27). These tests shall cover a water-cement ratio range beginning with eight gallons of water per sack of cement and including seven and six gallons per sack for Class A concrete; seven, six and five gallons per sack for Class B or Class C concrete; and seven, six, five and four gallons per sack for Class D or Class E concrete. These preliminary tests shall include at least [redacted] cylinders for each water-cement ratio used, three to be tested at 7 days and three at 28 days. The concrete for these cylinders shall be mixed to a consistency (and the slump recorded) suitable for placing concrete in this building. From the results of these tests (which may be judged from 7-day tests subject to checking, and to changing, if