ACI 306.1-90
(Reapproved 2002)

Standard Specification for Cold Weather Concreting

An ACI Standard

Reported by ACI Committee 306

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Advancing concrete knowledge

Standard Specification for Cold Weather Concreting

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This Standard Specification gives requirements for cold weather concreting. It includes cold weather requirements for preparations prior to placement of concrete, and protection of concrete.

Keywords: accelerating admixtures; cold weather; compressive strength; construction; curing; formwork; freezing; heating; insulation; maturity; protection; temperature.

FOREWORD

F1. This foreword is included for explanatory purposes only; it does not form a part of the Standard Specification ACI 306.1.

F2. Standard Specifications ACI 306.1 is a Reference Standard which the Architect/Engineer may cite in the Project Specifications for any building project, together with supplementary requirements for the specific project.

F3. Each technical section of Standard Specification ACI 306.1 is written in the Three-Part Section Format of the Construction Specifications Institute, as adapted by ACI and modified to ACI requirements. The language is generally imperative and terse.

F4. Checklists do not form a part of Standard Specification ACI 306.1. Checklists are to assist the Architect/Engineer in properly choosing and specifying any necessary requirements for the Project Specifications.

PREFACE TO SPECIFICATION CHECKLIST

P1. Standard Specification ACI 306.1 is intended to be used by reference or incorporation in its entirety in the Project Specifications. Individual sections, articles, or paragraphs shall not be copied into the Project Specifications, since taking them out of context may change their meaning.

P2. If sections or parts of Standard Specification ACI 306.1 are edited into project specifications or any other document, they shall not be referred to as ACI Standards, since the Standard Specification has been altered.

P3. Building codes set minimum requirements necessary to protect the public. This Standard Specification may stipulate requirements more restrictive than the minimum. Adjustments to the needs of a particular project shall be made by the Architect/Engineer by reviewing each of the items in the Specification Checklist and then including the Architect/Engineer's decision on each item as a mandatory requirement in the Project Specifications.

P4. These mandatory requirements designate the specific qualities, procedures, materials, and performance criteria for which alternatives are permitted or for which provisions were not made in the Standard Specification. Exceptions to the Standard Specification shall be made in the Project Specifications, if required.

P5. A statement such as the following will serve to make Standard Specification ACI 306.1 a part of the Project Specifications.

> Work on _____ shall conform to all requirements of ACI 306.1, Standard Specification for Cold Weather Concreting, published by the American Concrete Institute, Detroit, Michigan, except as modified by the requirements of these Contract Documents.

P6. The Standard Specification Checklist identifies Architect/Engineer choices and alternatives. The checklist identifies the sections, parts, and articles of the Standard Specification and the action required by the Architect/Engineer.

ACI 306.1-90 supersedes ACI 306.1-87. Revised by the Expedited Standardization Procedure, effective July 1, 1990. In 1990, the format was revised. The Forword, Preface, and Specification Checklist were revised. Reference Standards were updated and the sections on Materials and Execution were rewritten and renumbered.

MANDATORY REQUIREMENTS CHECKLIST

Section/Part/Article of ACI 306.1	Notes to Architect/Engineer
1.4	Review applicability of the cited references and take exception if required.
3.1	If the temperature of massive embedments, such as heavy steel guide rails or channels and steel grate frames or ducts, is lower than 32 F, concrete cast around them will be damaged by freezing. Identify in the Contract Documents massive embedments which must be at a temperature above freezing prior to placement of concrete. A frozen subgrade can lead to freezing of newly-placed concrete or foundation settlement upon subsequent thawing of the subgrade. Specify in the Contract Documents the depth to which frozen subgrade should be thawed prior to placement of concrete. Specify procedure to verify that subgrade has been thawed to specified depth.
3.2.2	Specify the frequency for recording the temperature but do not use a frequency lower than twice per 24-hour period.
3.4.5	Indicate in the Contract Documents the concrete strength required for each structural member before form removal or continued construction, or both.

OPTIONAL REQUIREMENTS CHECKLIST

Section/Part/Article of ACI 306.1	Notes to Architect/Engineer
1.5.1	Indicate in the Contract Documents whether submittal, review, and acceptance of procedure is required. Designate degree of detail required in any submittal procedure.
3.2.2	Specify the minimum protection temperature if different than Column 2 of Table 3.2.1.
3.3	Strength gain may not continue after removal of the protection because of rapid drying in regions where there are periods of cold, dry, windy weather. Therefore, under these conditions, consideration should be given to extending the protection period in order to facilitate moist curing.
3.4.4	• Any changes in the concrete mix proportions for reducing the duration of the protection period to prevent early freezing should be submitted for review or acceptance. • For certain structures, the protection period may be reduced if, after 24 hours of protection, the compressive strength of the in-place concrete is at least 500 psi. The requirements for these structures are that they do not require early strengths, will undergo little or no freezing and thawing during construction and in service, and have not been exposed to an external supply of moisture during the protection period. • The minimum protection temperature specified in Table 3.2.1 may be reduced, provided that the protection period is extended until the compressive strength of the in-place concrete is at least 500 psi. • Note that a compressive strength of 500 psi is only adequate to protect the concrete against damage from one cycle of freezing and thawing. • The specified minimum protection periods are based on the assumption that additional curing will be specified and provided, as needed, prior to putting the structure into service. Longer protection periods may be specified to assure that desired properties are developed prior to removal of protection.

SUBMITTALS CHECKLIST

Section/Part/Article of ACI 306.1	Notes to Architect/Engineer
1.5	If required, indicate to whom submittals will be sent.
1.5.1	Minimum procedures for placement, curing, and protection of the concrete may follow the recommendations in ACI 306R, "Cold Weather Concreting." The details should include, but not be limited to, the following: • Procedures for protecting the subgrade from frost and the accumulation of ice or snow on reinforcement or forms prior to placement. • Methods for temperature protection during placement. • Types of covering, insulation, housing, or heating to be provided. • Curing methods to be used during and following the protection period. • Use of strength accelerating admixtures. • Methods for verification of in-place strength. • Procedures for measuring and recording concrete temperatures. • Procedures for preventing drying during dry, windy conditions. Require detailed procedures for those items of concern for the Work.

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SECTION 1—GENERAL

1.1—Scope

1.1.1 This Standard Specification covers requirements for cold weather concreting and protection of concrete from freezing during the specified protection period.

1.1.2 The provision of this Standard Specification shall govern unless otherwise specified in the Contract Documents.

1.2—Definitions

These definitions are to assist in interpreting the provisions of this Specification.

accepted—accepted by or acceptable to the Architect/Engineer.

Architect/Engineer—the architect, engineer, architectural firm, engineering firm, or architectural and engineering firm issuing Project Drawings and Specifications, or administering the Work under the Contract Documents.

cold weather—a period when for more than three successive days the average daily outdoor temperature drops below 40 F. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. When temperatures above 50 F occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.

cold weather concreting—operations concerning the placing, finishing, curing, and protection of concrete during cold weather.

Contractor—the person, firm, or corporation with whom the Owner enters into an agreement for construction of the Work.

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

day—a time period of 24 consecutive hours.

Owner—the corporation, association, partnership, individual, or public body or authority with whom the Contractor enters into an agreement and for whom the Work is provided.

Project Drawings—the drawings which, along with the 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.

protection period—the required time during which the concrete is maintained at or above a specific temperature in order to prevent freezing of the concrete or to ensure the necessary strength development for structural safety.

reference standards—standards of a technical society, organization, or association, including the codes of local or state authorities, which are referenced in the Contract Documents.

required—required by this Specification or the Contract Documents.

submitted—submitted to the Architect/Engineer for review.

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, all as required by the Contract Documents.

1.3—Reference organizations

American Concrete Institute
38800 Country Club Dr.
Farmington Hills, MI 48331

ASTM
1000 Barr Harbor Dr.
West Conshohocken, PA 19428-2959

1.4—Reference standards

1.4.1 *ACI Standards*

301-89 Specifications for Structural Concrete for Buildings

1.4.2 *ASTM Standards*

C 31-88 Standard Method of Making and Curing Concrete Test Specimens in the Field
C 150-86 Standard Specification for Portland Cement
C 494-86 Standard Specification for Chemical Admixtures for Concrete
C 803-82 Standard Test Method for Penetration Resistance of Hardened Concrete
C 873-85 Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
C 900-87 Standard Test Method for Pullout Strength of Hardened Concrete

1.5—Submittal of procedures

1.5.1 *Detailed procedures*—If required, submit detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather. In the submittal, include procedures to be implemented upon abrupt changes in weather conditions or equipment failures. Do not begin cold weather concreting until these procedures have been reviewed and accepted.

SECTION 2—MATERIALS

2.1—Scheduling protection materials

All materials and equipment required for protection shall be available at the project site before cold weather concreting.