

# **Guide to Cold Weather Concreting**

Reported by ACI Committee 306



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## Guide to Cold Weather Concreting

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# Guide to Cold Weather Concreting

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*The objectives of cold weather concreting practices are to prevent damage to concrete due to freezing at early ages, ensure that the concrete develops the required strength for safe removal of forms, maintain curing conditions that foster normal strength development, limit rapid temperature changes, and provide protection consistent with the intended serviceability of the structure.*

*Concrete placed during cold weather will develop sufficient strength and durability to satisfy intended service requirements when it is properly produced, placed, and protected. This guide provides information for the contractor to select the best methods to satisfy the minimum cold weather concreting requirements.*

*This guide discusses: concrete temperature during mixing and placing, temperature loss during delivery, preparation for cold weather concreting, protection requirements for concrete that does not require construction supports, estimating strength development, methods of protection, curing requirements, and admixtures for accelerating setting and strength gain including antifreeze admixtures.*

*The materials, processes, quality control measures, and inspections described in this document should be tested, monitored, or performed as applicable only by individuals holding the appropriate ACI Certifications or equivalent.*

**Keywords:** accelerating admixtures; antifreeze admixtures; cold weather concreting; concrete temperature; curing; enclosures; form removal; freezing and thawing; heaters; heating aggregates; insulating materials; maturity testing; protection; strength development.

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Reference to this document shall not be made in contract documents. If items found in this document are desired by the Architect/Engineer to be a part of the contract documents, they shall be restated in mandatory language for incorporation by the Architect/Engineer.

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**CHAPTER 1—INTRODUCTION**

Cold weather exists when the air temperature has fallen to, or is expected to fall below 40°F (4°C) during the protection period. The protection period is defined as the time required to prevent concrete from being affected by exposure to cold weather. Concrete placed during cold weather will develop sufficient strength and durability to satisfy the intended service requirements when it is properly produced, placed, and protected. The necessary degree of protection increases as the ambient temperature decreases.

If requirements for cold weather concreting are needed in specification form, reference ACI 306.1. If necessary, add appropriate modifications to the contract documents after consulting the specification checklist.

This guide provides the necessary information for the contractor to select the best methods to satisfy the minimum cold weather concreting requirements.

**CHAPTER 2—NOTATION AND DEFINITIONS****2.1—Notation**

$M$	=	maturity factor, degree-hour
$T$	=	temperature of concrete, °F (°C)
$T_a$	=	temperature of coarse aggregate, °F (°C)
$T_c$	=	temperature of cement, °F (°C)
$T_d$	=	temperature drop to be expected during a 1-hour delivery time, °F (°C). (This value should be added to $t_r$ to determine the required temperature of concrete at the plant.)
$T_o$	=	datum temperature, °F (°C)
$T_s$	=	temperature of fine aggregate, °F (°C)
$T_w$	=	temperature of added mixing water, °F (°C)
$t_a$	=	ambient air temperature, °F (°C)
$t_r$	=	concrete temperature required at the job, °F (°C)
$W_a$	=	saturated surface-dry weight of coarse aggregate, lb (kg)
$W_c$	=	weight of cement lb (kg)
$W_s$	=	saturated surface-dry weight of fine aggregate, lb (kg)
$W_w$	=	weight of mixing water, lb (kg)
$W_{wa}$	=	weight of free water on coarse aggregate, lb (kg)
$W_{ws}$	=	weight of free water on fine aggregate, lb (kg)
$w/cm$	=	water-cementitious material ratio
$\Delta t$	=	duration of curing period at temperature $T$ , degree-hour

**2.2—Definitions**

ACI provides a comprehensive list of definitions through an online resource, “ACI Concrete Terminology,” <http://terminology.concrete.org>. Definitions provided herein complement that resource.

**admixture**—a material other than water, aggregates, cementitious materials, and fiber reinforcement, used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during its mixing.

**backshores**—shores placed snugly under a concrete slab or structural member after the original formwork and shores have been removed from a small area without allowing the