

PLACING & PROTECTING CONCRETE DURING Cold Weather



Concrete work takes place year-round in Pennsylvania, however placing concrete in cold weather brings some additional responsibilities. Concrete placed during cold weather will only develop sufficient strength and durability if it is properly placed and protected.

To accomplish this, we need to:

- Provide the proper temperature and moisture environment for concrete to gain the strength required for service and durability.
- Protect it from the elements while it gains the strength needed to protect itself.

ACI 306R-16 provides detailed guidance to a successful cold weather placement. This document, and the ACI building code specifications, are included in the building code requirements of Pennsylvania. ACI 306R defines cold weather to exist when the air temperature has fallen to, or is expected to fall, below 40° F during the protection period.

The key to successful cold weather placement is what happens in the field, however, there are a few ways that your concrete producer can help you achieve this. Concrete producers are able to heat the materials and provide initial concrete temperatures that promote normal set times and strength gain. Producers can also add set accelerating admixtures that will overcome some of the reduction in set time due to lower temperatures.

Two values determined from ACI 306R provide the keys to properly managing cold weather concrete placements.

First, the minimum concrete temperature for concrete as mixed and placed, is shown in Table 5.1.

Second is the duration of time which the concrete must be maintained at the said temperatures from Table 7.1.

Recent research has shown that concrete should not be exposed to freeze and thawing cycles until it has achieved a compressive strength of 4000 psi.

TABLE 5.1. RECOMMENDED CONCRETE TEMPERATURES*

Line	Air Temperature (°F)	Section Size, Minimum Dimension (in.)	
		<12	12-36
Minimum Concrete Temperature, as Placed and Maintained			
1	—	55	50
Minimum Concrete Temperature, as Mixed			
2	Above 30	60	55
3	0 to 30	65	60
4	Below 0	70	65

* This is a compressed and simplified version of Table 5.1 in ACI 306R-10.
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TABLE 7.1. LENGTH OF PROTECTION PERIOD DURING COLD WEATHER

Line	Service Condition	Protection Period (days) at Minimum Temperature (Line 1, Table 5.1)	
		Normal-Set Concrete	Accelerated-Set Concrete
1	No load, not exposed	2	1
2	No load, exposed	3	2
3	Partial load, exposed	6	4
4	Full load	see Chapter 8	

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COVER, HEAT and ENCLOSE

Insulating blankets, jobsite heating units, and enclosures are the proven ways to provide the needed protection during cold weather. ACI 306R provides you with details, such as the number of insulating blankets needed, and additional requirements for your specific job site conditions. Additional practical guidance can be found from NRMCA's CIP 27 "Cold Weather Concreting" which can be at: <https://www.nrmca.org/aboutconcrete/cips/27p.pdf>.

During cold weather test cylinders should be stored in heated and controlled curing boxes to ensure that they are cured at 60° F to 80° F for the first 24 to 48 hours. A minimum/maximum thermometer should be placed in the curing box to provide a temperature record. **As detailed in paragraph 8.2 of ACI 306R, field cured cylinders should not be used to determine in place strength of concrete during cold weather.**



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References:

- Cold Weather Concreting, ACI 306R, American Concrete Institute, Farmington Hills, MI.
- ASTM C94 Standard Specification for Ready Mixed Concrete, ASTM, West Conshohocken, PA.
- ASTM C31, Making and Curing Concrete Test Specimens in the Field, ASTM, West Conshohocken, PA.
- NRMCA CIP 27 – Cold Weather Concreting, NRMCA, Silver Spring, MD.



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