



*BUILDING DIVISION*

## Cold Weather Concrete Guidelines

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This procedure may be used as the basis for the acceptance or rejection of any concrete foundation placed during periods of cold weather. **Building Inspector approval to place concrete during cold weather conditions does not relieve the contractor/builder of responsibility to protect uncured concrete in accordance with recognized standards.** Any approval to place concrete during periods of cold weather as defined below should be considered as “at risk.”

Low temperatures during the placement and curing of concrete and masonry work can affect the ultimate strength and durability of concrete both temporarily and permanently. Concrete cures slower in cold temperatures and develops ultimate strengths over longer periods of time. Exposure of fresh concrete to temperatures significantly below freezing may actually stop the curing (hydration) process.

Both the International Residential Code (IRC) and the International Building Code (IBC) reference American Concrete Institute (ACI) 318 as the standard to follow for cold weather concreting. It is the intent of this guideline to closely follow specific Code requirements and the ACI Committee 306, Standard Specification for Cold Weather Concreting.

It is required that the Responsible Design Professional specifies the method(s) of concrete placement and protection to be utilized on any site during cold weather.

### **Cold Weather Defined**

The provisions that follow apply to “cold weather,” which is defined as a period of time when, for more than three (3) consecutive days, the following conditions exist: 1) the average daily air temperature is less than 40°F and: 2) the air temperature is not greater than 50°F for more than one-half of any 24-hr period. (The average daily air temperature is the average of the highest and the lowest temperatures occurring during the period from midnight to midnight.)

### **Protection During Cold Weather**

In “cold weather” conditions it is important to protect the concrete from freezing and to maintain curing conditions to ensure sufficient strength and durability to satisfy intended service requirements. When “cold weather” conditions exist, concrete temperatures must be maintained at 50°F for at least two (2) days if using high-early-strength or approved accelerated concrete. Three (3) days of 50°F concrete temperature is required if regular concrete is used. Depending on the adequacy of thermal protection provided, this protection period may need to be extended. The building code requires a 2500-psi minimum compressive concrete strength for footings and 3000-psi minimum for foundation walls. The code also requires the concrete to be air-entrained during cold weather concreting. The total air content (percent by volume of concrete) shall not be less than 5% or greater than 7%. Non-chloride admixtures are strongly recommended. The maximum slump without Superplasticizer is 5.0” and with Superplasticizer is 8.0”.

### **Inspection Practices**

1. Inspectors shall approve only the foundation elements that are proposing to place concrete that same day. Projects, which are demonstrated that protection of all exposed earth, steel, and forms will be maintained, may also be approved. This will normally require supplemental heat capability.

2. The inspectors will verify the sub-grade is not frozen and whether freeze protection components are on site at the time of inspection. The minimum time period for which the concrete must be protected against freezing is as follows:
  - When placing regular concrete during “cold weather” conditions, the 50°F concrete temperature shall be maintained at least three (3) days.
  - When placing high-early-strength concrete or concrete with approved accelerators the 50°F concrete temperature shall be maintained for two (2) days.
  - Depending on the performance of thermal protection provided, this protection period may need to be extended.
  
3. Footings may be permitted to be unprotected for a maximum time period of twelve (12) hours to allow foundation walls to be formed and the placement of concrete. This condition is permitted only after the footing concrete has reached a minimum of 500-psi compressive strength (usually about two (2) days after placement for most concrete maintained at 50°F). The foundation wall concrete can be placed using one of the approved mixes with the footings and wall totally covered again and cured as discussed.

If the inspector determines that the concrete has not been adequately protected as evidenced by ice crystals in the concrete and/or crystal patterns on the concrete surface, the inspector shall require that this concrete be tested in order to ensure that required strength has been developed.

### **Methods of Protection**

Methods of protection noted below are acceptable for temperatures 20°F to 40°F:

- Insulated blankets – double R-5.1 blankets
- Insulation forms – insulation value equal to the blanket requirements.

Method of protection for temperatures below 20°F:

- Heated weather-resistive enclosures enveloping the footing and/or walls. The heat provided should maintain a minimum, concrete temperature of 50°F degrees until the concrete attains strengths of 500 psi (usually two (2) days) and double R-5.1 blankets.
- The heated enclosure-heating source shall be vented to the exterior. If propane, kerosene, or petroleum products fuel the heater, the fumes can cause damage to the fresh concrete and cause premature carbonation. The exposed area will experience a dusting of the surface which will reduce its' strength and durability.
- At the end of the protection period, concrete should be cooled gradually to reduce crack-inducing differential strains between the interior and exterior of the structure.

For further information, see Chapters 4 and 5 of ACI 318, ACI 306.1-90, and referenced ASTM Standards.