

Protecting Concrete 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 days if the using high-early-strength or approved accelerated concrete. Three days of 50°F concrete temperature are required if regular concrete is used.

Depending on the adequacy of thermal protection provided this protection previous may need to be extended. The building code requires a 2,500 psi minimum compressive concrete strength for footings and 3,000 psi minimum for foundation walls. The code also requires the concrete to be air entrained during cold weather concrete. 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 for which concrete shall be placed that same day. Projects for which it is 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 that weather 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:
 - a. When placing regular concrete during cold weather conditions the 50°F concrete temperature shall be maintained at least 3 days.
 - b. When placing high early-strength concrete or concrete with approved accelerators the 50°F concrete temperature shall be maintained for 2 days.
 - c. Depending on the performance of the 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 hours to allow foundation walls to be formed and for 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 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 detailed.

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

Methods of protection

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

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

The methods 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 until the concrete attains strengths of 500 psi usually two days and double R-5.1 blankets.
- The heated enclosure heating source shall be vented to the exterior. If the heater is fueled by propane kerosene or petroleum products 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.