-Definition of Cold Weather (1.1)
As per ACI-306R report, cold weather is defined as: a period for more than 3 consecutive days the average daily air temperature is less than 40°F, and the air temperature is not greater than 50°F for more than half (12hrs.) of any of the 3 days. “The average daily air temperature is the average of the highest and the lowest temperatures occurring during the period from midnight to midnight.”

-Objectives (1.3)
The objectives for cold weather concreting are:
- prevent damage to concrete from early stage freezing. As concrete gains maturity the mixing water combines with the cement during hydration decreasing the degree of saturation below the critical level. The critical level is the degree of saturation where a single cycle of freezing could cause damage to the concrete.
- assure that the concrete develops essential strength for safe removal of forms and safe loading of the structure during construction and after.
- limit rapid changes of temperature before the concrete has obtained sufficient strength to withstand induced thermal stresses.
- provide protection that warrant normal strength development and the intended serviceability of the structure.

“Short-term construction economy should not be obtained at the expense of long-term durability.”

-Principles (1.4)
Concrete that has attained a compressive strength of at least 500-psi will not be damaged by exposure to a single freezing cycle. Concrete that is protected will obtain its potential strength despite subsequent exposure to cold weather. Except within heated enclosures little or no external supply of moisture is required. Calcium chloride should not be used to accelerate setting because of increased chances of corrosion to re-enforcing metal.

-Economy (1.5)
The owner must decide whether the extra costs in cold weather concreting are more profitable or cost effective than waiting for milder weather. Neglect of protection against freezing in the early stages can cause immediate destruction or weakening of the concrete.

-Planning (2.1)
Plans to prevent early freezing of fresh concrete and maintaining temperatures above the recommended minimums should be made well before freezing temperatures are expected to occur. The necessary equipment and materials should be at the work site before cold weather is likely to occur, not after the fresh concrete begins to approach the freezing point.

-Preparation before concreting (4.1, 4.3, 4.4)
Preparation for concreting primarily consists of insuring that all surfaces that will be in contact with the freshly poured concrete are at temperatures that will not cause freezing or prolonged setting. All snow, ice and frost must be removed prior to placement of the concrete. Concrete will not be placed on frozen subgrade. The subgrade can be thawed, sometimes, by covering it with insulating material for a few days prior to concrete placement.

-Protection to prevent early-age freezing (5.1)
Prevention of early-age freezing must be provided immediately after concrete placement. Arrangements for covering, housing or heating of newly placed concrete should be made before placement. Protective materials must be on-site ready for installation to prevent corners and edges from freezing. In cold weather, the temperature of newly placed concrete should be kept close to the values given in Table 3.1 and the corners and edges are more vulnerable to freezing and are more difficult to maintain at the optimal temperature.

-Length of protection period (5.3)
The length of the required protection period depends on the type and amount of cement used and whether an accelerator is used. The length of protection may be reduced by: (1) using Type III cement; (2) using an accelerating admixture (non-chloride); or (3) using 100 lb/ yd³ of cement in excess of the design cement content. Table 3.1 gives the minimum length of protection, in days at the temperatures given in Line 1 of Table 3.1.
The heat of hydration is mostly generated during the first 3 days. The heat may be retained on unformed surfaces using insulating blankets and by using insulated forms. The insulation must be kept in close contact with the concrete or the form surface. Suitable protection from wind, moisture and heat loss are required. Corners and edges are particularly vulnerable, therefore the thickness of the insulation should be about three times the thickness used for walls or slabs. Commonly used insulating materials follow, definitions are listed in Chapter 7 ACI-306R:

- Polystyrene foam sheets
- Urethane foam
- Foamed vinyl blankets
- Mineral wool or cellulose fibers
- Straw
- Blanket or batt insulation

The heat of hydration will gradually decrease with age. It may be necessary to use enclosures and heating units to maintain the required temperature for the required protection period. Enclosures conserve heat, keep out cold air, and if secured properly block the wind. They can be made with any suitable material such as wood, canvas or plastic sheet. Enclosures must capable of withstanding wind and snow loads and be reasonably air tight. Sufficient space between the concrete and the enclosure to allow circulation of warmed air. If combustion heaters are used, venting is required to prevent reactions between exhaust gasses and exposed concrete surfaces that will result in a weak concrete surface. Also, heaters and vents should be placed so as not to cause overheating or drying of concrete. The operation of combustion heaters should be supervised continuously and fire fighting equipment should be available at the job site at all times.

**Warning, exhaust gasses poses a serious health threat in an enclosed structure. Never enter without properly venting before hand.**

**NOTE:**
This fact sheet does not include all information set forth in the ACI-306. Consult the latest edition for further details. A complete catalog of all ACI publications is available from:

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