

# WARREN COUNTY BUILDING INSPECTION COUNTY ADMINISTRATION BUILDING

406 Justice Drive, Room 167, Lebanon Ohio 45036

## COLD WEATHER CONCRETING

### 1. INTRODUCTION

#### **Warren County Policy:**

1. Concrete may be placed if air temperature is 25° F and rising
2. Protection on site at time of inspection
3. Cover for 3 days

#### **OBC 1905.15 Cold weather requirements:**

Concrete that is to be placed during freezing or near freezing weather shall comply with the following:

1. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather.
2. Concrete materials and reinforcement, forms, fillers and ground with which concrete is to come in contact shall be free from frost.
3. Frozen materials or materials containing ice shall not be used.

#### **ACI Cold Weather:**

1. Cold weather is defined as a period when, for more than 3 consecutive days, the temperature is less than 40° F
2. and the air temperature is not greater than 50° F for more than one-half of any 24 hour period

#### **General comments:**

- Cincinnati has 107 days per year with below freezing temperatures, 80% of these days are ACI "Cold Weather"
- Cold weather concreting problems:
  - Frozen subgrades/forms
  - Extended setting times
  - Slower strength gain
- Cold weather practices should:
  - Prevent freezing at early ages
  - Protect until it reaches necessary strength
  - Allow concrete to cool gradually when protection is removed so that rapid temperature drop doesn't cause the concrete to crack.

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### Protection:

1. When cold weather is expected thorough and careful planning is needed:
  - Pre-pour conference to agree on methods
  - Concrete mix suitable for cold weather
    - Four inch slump
    - Air Entrainment (Air entrained concrete should be used even if concrete won't be exposed to the weather after the structure has been completed)
    - Higher cement content
    - High early strength cement
    - Accelerator (do not use Calcium Chloride if reinforcement is present)
    - If concrete contains fly ash extend protection period
  - Determine type of protection required (The specific protection required depends on; ambient temperatures, the geometry of the structure, and the mixture proportions)
  - Equipment should be on the job site
  - How frozen subgrade will be thawed (never place concrete on frozen subgrade, if thawed recompact)
  - All surfaces to be in contact with concrete are not frozen (All surfaces that will be in contact with newly placed concrete must be free of frost, ice, and snow and should be at temperatures that cannot cause the early freezing or seriously prolong setting time.)
  - Do not allow concrete to dry out
  - Maintain concrete above 50° F for 3 to 7 days
  - Maintain above 40° F for at least an additional 4 days
  - Curing and temperature protection should be continuous and uninterrupted
  - Edges and corners require extra protection
  - How concrete strengths will be determined for stripping forms and loading concrete (When structures will be fully loaded soon after placing in cold weather, the concrete should be protected until the required strength is obtained)
2. Some commonly used insulating materials include polystyrene form sheets, urethane foam, foamed vinyl blankets, mineral wool, or cellulose fibers, straw, and commercial blanket or batt insulation
3. If wind velocities are greater than 15mph, increase insulation thickness
4. Provide triple thickness of insulation at corners and edges
5. Place insulation on slabs immediately after concrete has set sufficiently so that the concrete surface isn't marred
6. Insulation must be kept in close contact with the concrete or the form surface.
7. When enclosures are heated with forced hot air heaters, provide a fresh air intake to reduce carbon dioxide and carbon monoxide levels
8. Wrap protruding rebar with insulation to avoid heat drain from the warm concrete
9. Maintain concrete at not less than 50° to 55° F, protect 3 days for footings and 5 days for flatwork

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### Curing:

1. Ice doesn't form in concrete until the concrete temperature drops to 27° F or lower. If admixtures are present, the freezing temperature may be as low as 20° F.
2. When the mix water in fresh concrete freezes it increases in volume 9% and creates an overall volume expansion of the concrete. This expansion causes more void space, making the concrete weaker and more porous even when thawing and further hydration occurs
3. If concrete freezes at an early age results will be; strength loss, increased permeability, and reduced resistance to weathering
4. Water curing should not be used since it increases the likelihood of concrete freezing in critically saturated condition when protection is removed
5. To prevent damage caused by early freezing, cure concrete long enough to partially empty water-filled void spaces. This internal drying leaves room for the expansion that occurs when water converts to ice. For most concrete, water content in the void spaces is sufficiently reduced when the concrete reaches 500 psi compressive strength and no additional curing water has been supplied
6. At 50° F, most well proportioned air entrained concretes will reach 500 psi during the second day of curing and will be adequately protected from damage caused by a single cycle of freezing. A 1-day curing time is permitted if a Type III cement, an accelerator, or an additional 100 pounds of cement per cubic yard is added
7. If the concrete will be exposed to multiple freeze thaw cycles while saturated it is recommended that protection continues until 3500 psi is achieved
8. Increase set time up to one third for each 10° F decrease in air temperature