CITY OF POST FALLS
BUILDING DIVISION

Cold Weather Concrete Guidelines

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Standard Operating Procedures

Supersedes all previous SOPs related to this subject unless otherwise stated herein.

SOP # 2023-1 Effective Date: Immediately

Subject: Cold Weather Concrete Requirements

Purpose: To provide requirements for the placement of concrete during cold weather conditions.

Procedure:

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 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 when the average daily air temperature is less than 40°F (4°C) during the protection 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 period is defined as the time recommended to prevent concrete from being adversely affected by exposure to cold weather during construction.

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 days if using high-early-strength or approved accelerated concrete. Three 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% (IRC Table 402.2). 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. They will also be checking the maintenance of the protection for two days following the inspections. The minimum time period for which the concrete must be protected against freezing is as follows:

    - When placing conventional concrete during cold weather conditions, the concrete shall be protected from freezing for at least 72 hours (three days).
    - When placing concrete utilizing approved accelerators, Type III Portland Cement, or where the cement ratio is increased 100 lbs. per cubic yard; the concrete shall be protected from freezing for at least 48 hours (two days).
    - Depending on the performance of thermal protection provided, this protection period may need to be extended.
    - At the inspector’s discretion, concrete drivers batch tickets may be reviewed for the purpose of determining the time the concrete truck left the plant, strength of the concrete, percent of air entrainment or any special additives in the concrete mix.

3. Footings may be permitted to be unprotected for a maximum time period of twelve hours to allow foundation walls to be formed and the placement of concrete. This condition is permitted only after a minimum of 48 hours of protection. 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, or show evidenced of 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.

1. **Selection of insulation when supplementary heat is not used.**

   a. **Insulating Blankets** – The table below lists the R-Value protection requirements based on wall thickness and lowest temperature.

Modified table 9.3b ACI 306R-16

Wall Thickness	Cement Content = 400lb/yd (4.26 sack)			
	R-2	R-4	R-6	R-8
6	44	38	32	26
8	41	33	25	17
10	39	29	19	10
12	37	24	12	10
18	30	12	10	10
24	25	10	10	10

Wall Thickness	Cement Content = 500lb/yd (5.32 sack)			
	R-2	R-4	R-6	R-8
6	43	35	28	20
8	40	29	20	10
10	37	24	12	10
12	34	18	10	10
18	25	10	10	10
24	18	10	10	10

Wall Thickness	Cement Content = 600lb/yd (6.38 sack)			
	R-2	R-4	R-6	R-8
6	41	32	**23**	**14**
8	37	25	**13**	**10**
10	34	19	10	10
12	31	12	10	10
18	21	10	10	10
24	11	10	10	10

* Heaters will be required for temperatures not covered by the above tables
* *Temperature date based on National Oceanic and Atmospheric Administration (NOAA)

- Example 1: The proposed project is a 6” foundation wall containing a design mix of 5 ½ sack (517lb/yd cement content). The lowest projected temperature is 22°F. Using the 500lb design from table 9.3b, the foundation must be protected with a minimum of R-8 insulation.
- Example 2: The proposed project is an 8” x 16” footing containing a design mix of 5 sack (470lb/yd cement content). The lowest projected temperature for 3 days is 25F. Using the 400lb/yd design from table 9.3b, R-6 insulation is acceptable.
- Example 3: The proposed project is to install an 8” foundation wall containing a design mix of 5 sack (470lb/yd cement content). The lowest projected temperature for 3 days is 15°F. Using the 400lb/yd design from table 9.3b, the foundation must be protected with a heated enclosure.

2. **Heated, weather-resistive enclosures enveloping the footing and/or walls by use of direct fired, indirect fired, and hydronic heat.**

    - The heat provided should maintain a minimum, concrete temperature of 50°F degrees until the concrete attains strengths of 500 psi (Usually two days).
    - Heaters and ducts must be positioned such that hot air does not cause areas of overheating or drying of the concrete surface. Concrete surfaces must not be exposed to air temperatures at more than 20ºF above the minimum placement temperatures given in line 1 of Table 5.1.

Table 5.1—Recommended concrete temperatures

		Section size, minimum dimension			
		< 12 in. (300 mm)	12 to 36 in. (300 to 900 mm)	36 to 72 in. (900 to 1800 mm)	> 72 in. (1800 mm)
Line	**Air temperature**	**Minimum concrete temperature as placed and maintained**			
1	—	55°F (13°C)	50°F (10°C)	45°F (7°C)	40°F (5°C)
		Minimum concrete temperature as mixed for indicated air temperature*			
2	Above 30°F (–1°C)	60°F (16°C)	55°F (13°C)	50°F (10°C)	45°F (7°C)
3	0 to 30°F (–18 to –1°C)	65°F (18°C)	60°F (16°C)	55°F (13°C)	50°F (10°C)
4	Below 0°F (–18°C)	70°F (21°C)	65°F (18°C)	60°F (16°C)	55°F (13°C)
5	—	**Maximum allowable gradual temperature drop in first 24 hours after end of protection**			
		50°F (28°C)	40° (22°C)	30°F (17°C)	20°F (11°C)

*For colder weather, a greater margin in temperature is provided between concrete as mixed and required minimum temperature of fresh concrete in place.

Note 1: For Line 1, maximum placement temperature is minimum temperature in the table plus 20°F (11°C).

Note 2: For Lines 2-4, maximum temperature is minimum temperature in the table plus 15°F (9°C).

- Direct fired heaters fueled by propane, kerosene, or petroleum products, are not suitable for cold weather application unless the concrete is protected from the gasses. Large amounts of carbon dioxide (CO2) created by the heater can cause damage to the surface of freshly placed concrete. This can create a chalky surface that continues to dusk for the life of the concrete. Direct fire heated enclosures shall be vented to the exterior.
- 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 306R-16, and referenced ASTM Standards.

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Justin Miller, Building Official
Building Division