**POLICY MEMORANDUM**

Eagle County Building Division 6.30.2023

TO: CONTRACTORS

SUBJECT: REQUIREMENTS FOR COLD WEATHER CONCRETING

* PURPOSE

  * This policy memorandum outlines the minimum requirements for cold weather concreting. Cold weather is defined as whenever the average ambient air temperature during day or night drops below
    40 ℉

    COLD WEATHER CONCRETING PLAN

  * The contractor shall submit a cold weather concreting plan to the Building Department for approval. Cold weather concreting operations are not
    allowed to proceed until the contractor's cold weather concreting plan has been approved by the Eagle County Building Official

  * The contractor's plan shall comply with this memorandum and shall address, as a minimum, the following:

    * Concrete Mix Manufacturing
    * Concrete Mix Temperature Monitoring
    * Base Preparation
    * Concrete Curing and Protection
    * In Place Concrete Temperature Monitoring
    * Strength Test Specimens

* MINIMUM REQUIREMENTS

  * Concrete Mix Manufacturing

    * The contractor must make the necessary adjustments so that the concrete temperature is maintained from 50 ℉ to 90 ℉ for placement. Acceptable methods include:

        * Heating the mixing water Note: If the mixing water is to be heated to a temperature above 100 ℉, the contractor must include a mixing sequence plan to indicate the order that each component of the mix is to be charged into the mixer.

        * Heating the aggregates Note: The exact method of heating the aggregates shall be included as part of the cold weather concreting plan. Aggregates must be free of ice and frozen lumps. To avoid the possibility of a quick or flash set of the concrete, when either the water or aggregates are heated to above 100 ℉, they should be combined in the mixer first before the cement is added.

* Concrete Mix Temperature

    * The contractor shall monitor the mix temperature at the plant and prior to placement in the forms. Mix that does not meet the temperature requirement of 50 ℉ to 90 ℉ shall be rejected for use on the project.

* Base Preparation

    * Paving or placing concrete on a frozen base, subbase, or subgrade is prohibited.

    * The base, subbase, or subgrade on which the concrete is to be placed shall be thawed and heated to at least 40 ℉. The method by which the base subbase or subgrade is to be heated shall be indicated in the contractor's cold weather concreting plan. Insulating blankets or heated enclosures may be required.

    ❖ Concrete Protection and Curing

    The contractor shall protect the concrete in such a manner as to maintain a concrete temperature of at

least 50 ℉ for 7 days.

* The method of concrete protection shall be by use of an insulating layer or heated enclosure around the concrete. The method of protection shall be indicated in the contractor's cold weather concreting plan. When insulating layers are to be used, the thermal resistance to heat transfer (R Value in *hr*ft$^2$/BTU) of the insulation material selected, shall be appropriate for the thickness being constructed and shall be indicated in the cold weather concreting plan.

* Appendix A shows a chart and table taken from the American Concrete Institute specification, ACI 306 R Cold Weather Concreting, which may be used by the contractor in selecting the proper insulation (R Value) and insulating material which may be used.

* In-Place Concrete Temperature Monitoring

  * Once the concrete is in place, the protection method used, must ensure that the concrete temperature does not fall below 50 ℉ for the time period specified in Section (D. 1.) of this Policy Memorandum (7 days).

  * The concrete temperature on the surface and below the surface must be monitored and recorded by the contractor for the duration of the protection period in Section (D. 1.).

  * After the concrete has hardened, surface temperature can be checked with special surface thermometers or with an ordinary thermometer that is kept covered with insulating blankets. The high and low values for each 24-hour period of protection must be measured and recorded.

  * One acceptable method of checking temperature below the concrete surface is given in the Portland Cement Association (PCA) book entitled "Design and Control of Concrete Mixtures" latest edition. The method is indicated below and it should be noted that the thermometer should be capable of recording

high and low values for a given 24-hour period.

* The exact method for surface and subsurface concrete temperature monitoring shall be indicated in the contractor's cold weather concreting plan. The maximum permissible difference between the interior and surface temperature is 35 °F. Adjustments in protection method shall be implemented if the maximum permissible difference is exceeded.

Strength specimen handling

* The Contractor is responsible for making, transporting, and curing all samples (beams or cylinders)
* The Contractor is required to load the testing machine and dispose of the broken pieces.
* Onsite, indoor curing facilities, meeting the requirements of ASTM C-31, shall be required for cold weather concreting operations.

* Sampling for strength specimens shall be according to the Contract Special Provisions. Sampled concrete shall be transported to the indoor curing facilities for the casting of strength specimens.

* The exact location and description of the curing facilities shall be indicated in the contractor's cold weather concreting plan.

* The method of transporting concrete sampled from the grade to the curing facilities for casting shall be indicated in the contractor's cold weather concreting plan.

# APPENDIX A

**Minimum exposure temperatures for concrete flatwork placed on the ground for concrete placed & surface temperature maintained at 50 F (10 C) for 3 days on ground at 35 F (2 C)**

| Slab thickness, in. (m) | Minimum ambient air temperature, deg F (deg C) allowable when insulation having these values of thermal resistance **R**, hr-ft$^2$-F/Btu (m$^2$-K/W), is used | | | |
|---|---|---|---|---|
| | **R** = 2 (0.35) | **R** = 4 (0.70) | **R** = 6 (1.06) | **R** = 8 (1.41) |
| Cement content = 300 lb/yd2 (178 kg/m2) | | | | |
| 4 (0.10) | * | * | * | * |
| 8 (0.20) | * | * | * | * |
| 12 (0.31) | * | * | * | * |
| 18 (0.46) | 42 (6) | 38 (3) | 32 (0) | 26 (-3) |
| 24 (0.61) | 37 (3) | 25 (-4) | 11 (-12) | -3 (-19) |
| 30 (0.76) | 31 (-1) | 15 (-9) | -1 (-18) | -17 (-27) |
| 36 (0.91) | 31 (-1) | 12 (-11) | -5 (-21) | -22 (-30) |
| Cement content = 400 lb/yd2 (237 kg/m2) | | | | |
| 4 (0.10) | * | * | * | * |
| 8 (0.20) | * | * | * | * |
| 12 (0.31) | 46 (8) | 44 (7) | 42 (6) | 40 (4) |
| 18 (0.46) | 36 (2) | 22 (-6) | 8 (-13) | -6 (-21) |
| 24 (0.61) | 28 (-2) | 9 (-13) | -10 (-23) | -29 (-34) |
| 30 (0.76) | 21 (-6) | 0 (-18) | -21 (-29) | -42 (-41) |
| 36 (0.91) | 21 (-6) | -4 (-20) | -29 (-34) | -50 (-46) |
| Cement content = 500 lb/yd2 (296 kg/m2) | | | | |
| 4 (0.10) | * | * | * | * |
| 8 (0.20) | * | * | * | * |
| 12 (0.31) | 42 (6) | 36 (2) | 30 (-1) | 24 (-4) |
| 18 (0.46) | 30 (-1) | 12 (-11) | -6 (-21) | -22 (-30) |
| 24 (0.61) | 21 (-6) | -5 (-21) | -31 (-35) | -50 (-46) |
| 30 (0.76) | 16 (-9) | -10 (-23) | -42 (-41) | -74 (-59) |
| 36 (0.91) | 16 (-9) | -18 (-28) | -50 (-46) | # |
| Cement content = 600 lb/yd2 (356 kg/m2) | | | | |
| 4 (0.10) | * | * | * | * |
| 8 (0.20) | * | * | * | * |
| 12 (0.31) | 38 (3) | 26 (-3) | 14 (-10) | 2 (-17) |
| 18 (0.46) | 24 (-4) | 0 (-18 ) | -24 (-31) | -48 (-44) |
| 24 (0.61) | 14 (-10) | -16 (-27) | -46 (-43) | -82 (-63) |
| 30 (0.76) | 10 (-12) | -20 (-29) | -62 (-52) | # |
| 36 (0.91) | 7 (-14) | -30 (-34) | # | # |

* > 50 F (10 C): additional heat required # << -60 F (-51 C)

**Minimum exposure temperatures for concrete flatwork placed on the ground for concrete placed & surface temperature maintained at 50 F (10 C) for 7 days on ground at 35 F (2 C)**

| Slab thickness, in. (m) | Minimum ambient air temperature, deg F (deg C) allowable when insulation having these values of thermal resistance **R**, hr-ft$^2$-F/Btu (m$^2$-K/W), is used | | | |
|---|---|---|---|---|
| | **R** = 2 (0.35) | **R** = 4 (0.70) | **R** = 6 (1.06) | **R** = 8 (1.41) |
| Cement content = 300 lb/yd2 (178 kg/m2) | | | | |
| 4 (0.10) | * | * | * | * |
| 8 (0.20) | * | * | * | * |
| 12 (0.31) | * | * | * | * |
| 18 (0.46) | 46 (8) | 42 (6) | 36 (2) | 30 (-1) |
| 24 (0.61) | 40 (4) | 31 (-1) | 22 (-6) | 11 (-12) |
| 30 (0.76) | 35 (2) | 22 (-6) | 7 (-14) | -8 (-22) |
| 36 (0.91) | 31 (-1) | 13 (-11) | -5 (-21) | -23 (-31) |
| Cement content = 400 lb/yd2 (237 kg/m2) | | | | |
| 4 (0.10) | * | * | * | * |
| 8 (0.20) | * | * | * | * |
| 12 (0.31) | * | * | * | * |
| 18 (0.46) | 41 (5) | 32 (0) | 22 (-6) | 12 (-11) |
| 24 (0.61) | 35 (2) | 19 (-7) | -1 (-17) | -15 (-26) |
| 30 (0.76) | 28 (-2) | 8 (-13) | -14 (-26) | -36 (-38) |
| 36 (0.91) | 23 (-5) | -4 (-20) | -29 (-34) | -54 (-48) |
| Cement content = 500 lb/yd2 (296 kg/m2) | | | | |
| 4 (0.10) | * | * | * | * |
| 8 (0.20) | * | * | * | * |
| 12 (0.31) | 48 (9) | 44 (7) | 40 (4) | 36 (2) |
| 18 (0.46) | 36 (2) | 22 (-6) | 8 (-13) | -6 (-21) |
| 24 (0.61) | 28 (-2) | 6 (-14) | -16 (-27) | -38 (-39) |
| 30 (0.76) | 22 (-6) | -7 (-22) | -36 (-38) | -64 (-53) |
| 36 (0.91) | 16 (-9) | -18 (-28) | -50 (-46) | # |
| Cement content = 600 lb/yd2 (356 kg/m2) | | | | |
| 4 (0.10) | * | * | * | * |
| 8 (0.20) | * | * | * | * |
| 12 (0.31) | 44 (7) | 38 (3) | 32 (0) | 26 (-3) |
| 18 (0.46) | 31 (-1) | 14 (-10) | -5 (-21) | -24 (-31) |
| 24 (0.61) | 22 (-6) | -5 (-21) | -32 (-36) | -61 (-52) |
| 30 (0.76) | 14 (-10) | -19 (-28) | -67 (-55) | # |
| 36 (0.91) | 7 (-14) | -30 (-34) | # | # |

* > 50 F (10 C): additional heat required # < -60 F (-51 C)

# Thermal Resistance of Various Insulating Materials

| Insulating Material | Thermal resistance "R" for these thicknesses of material* | |
|---|---|---|
| | 1 in., hr·ft3·F / Btu | 10 mm, m3·K / W |
| Boards and slabs | | |
| Expanded polyurethane (R-11 exp.)<br>Expanded polystyrene extruded (R-11 exp.)<br>Expanded polystyrene extruded, plain<br>Glass fiber, organic bonded<br>Expanded polystyrene, molded beads Mineral fiber with resin binder<br>Mineral fiber board, wet felted Sheathing, regular density<br>Cellular glass<br>Laminated paperboard<br>Particle board (low density)<br>Plywood | 6.25 | 0.438 |
| | 5 | 0.347 |
| | 4 | 0.277 |
| | 4 | 0.277 |
| | 3.57 | 0.247 |
| | 3.45 | 0.239 |
| | 2.94 | 0.204 |
| | 2.63 | 0.182 |
| | 2.63 | 0.182 |
| | 2 | 0.139 |
| | 1.85 | 0.128 |
| | 1.25 | 0.087 |
| Blanket | | |
| Mineral fiber, fibrous form processed from rock, slag, or glass | 3.23 | 0.224 |
| Loose fill | | |
| Wood fiber, soft woods | 3.33 | 0.231 |
| Mineral fiber (rock, slag, or glass) | 2.5 | 0.173 |

| | | |
|---|---|---|
| Perlite (expanded) | 2.7 | 0.187 |
| Vermiculite (exfoliated) | 2.2 | 0.152 |
| Sawdust or shavings | 2.22 | 0.154 |

*Values from ASHRAE Handbook of Fundamentals, 1977, American Society of Heating, Refrigerating, and Air- Conditioning Engineers, New York.