

## USE OF MORTARS AND GROUTS IN COLD WEATHER CONSTRUCTION

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Cold weather conditions can have adverse affects on the construction industry in general, therefore, preparations should be taken to combat these conditions. It is recommended to comply with cold weather requirements of applicable building codes. Industry practice states that normal temperatures are those between 40° and 100°F (4.4 °C and 37.8 ° C). Cold temperatures then occur when ambient temperatures drop below 40°F (4.4 °C) during construction. Cold weather can affect masonry, mortars and grouts during construction and if not constructed correctly can affect future performance of the masonry system. Successful construction considers cold weather effects of masonry during the planning, scheduling and set up of masonry work and protection of finished projects.

Cold weather can affect the setting time of mortars and grouts. If weather gets below 40°F within 24 hours for mortars and 24 to 48 hours for grouts, hydration of cements will stop. Incomplete hydrations before mortar and grouts dry compromises cured strength. The reduced rate of hydration can slow construction since mortar can squeeze out of the joints because the mortar cannot support the weight of the masonry above. If free water within the mortar freezes, it will cause internal cracking. Free water in mortar expands which can result in internal damage. This results in weak mortar with high water penetration. High water content is necessary for grouts to flow well, but it also increases the amount of volumetric expansion which occurs upon freezing. This can lead to system failures.



Cold weather can lead to frozen mortar and grouts, efflorescence, and flashing failures. Freezing water expands 9% in volume and this creates a network of micro cracks that can destroy the structure of the mortar. Frozen mortar can lift a section of masonry

resulting in additional damage due to movement. It can cause cracking and spalling within the cores of the units. Efflorescence can also occur when water is held within the masonry unit. Wet walls allow soluble compounds in the mortar to dissolve and migrate to the surface. Cold weather can create adhesion problems with flashing systems. Flashing failures can occur from cold weather when the rubberized asphalt flashing never bonds to the metal drip edge. Laps don't bond and the flashing doesn't bond to the backup.

Proactive measures should be taken to avoid problems occurring from cold weather. Building partial or full enclosures, heating materials, material selection and admixtures are a few ways to combat cold weather conditions. Masonry units should be at a temperature of at least 40°F (4.4°C) prior to laying.



Mortar mixed from cold materials have different properties from mortar mixed with normal tempered materials. Mortar mixed at cold weather conditions have lower water content, increased, air content, and reduced early strength compared to mortar mixed at normal temperatures. Mixing water must be heated to produce mortar that is between 40°F (4.4°C) and 120°F (48.9°C) at the time of mixing. Mixing water can be heated with an electric rod placed in a drum of water. The rod heats the water over several hours. Ideal mortar temperatures are between 60°F (15.6°C) and 80°F (26.7°C). Do not heat mortar above 120°F (48.9°C) because this may lead to lower compressive strength and reduced bond strength. In cold weather mortar should be mixed in small amounts so it can be used before it's temperature cools. Avoid mortar freezing during construction at all cases and protect mortar in newly completed masonry from freezing.

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Grout should also be mixed from heated materials, if the materials temperature is below 32°F (0°C). This will prevent damage from freezing effects. Grout mix and water should be heated to produce a grout mix temperature between 70°F (21.1°C) and 120°F (48.9°C) at the time of mixing. Do not heat the grout mix and water above 140°F (60.0°C) and keep the grout temperature above 70°F (21.1°C) when it is placed. Grout should also be heated and protected and should be placed within 1½ hours of mixing. Due to the hydration process of cement which continues for an extended period, heating and protecting is required to ensure that masonry surfaces under construction do not extract excessive heat from mortar and grout. Masonry under construction that will receive grout should be heated to a minimum temperature of 40°F (4.4°C) when the ambient temperature reaches 25°F (-3.9°C) or below. If ambient temperatures fall to 20°F (-6.7°C) or below, the masonry under construction needs to be enclosed and air temperature inside the enclosure should be above 32°F (0°C) at all times.



Covering masonry materials with tarps or poly sheets to keep materials dry and free of ice and snow is recommended. Newly constructed masonry must be protected to maintain enough heat for the cement hydration process to fully take place. When the mean daily temperature is below 40°F (4.4°C), protective measures are required, starting with covering newly constructed masonry with a weather-resistant membrane for 24 hours after completion. Large tents, temporary wood structures with plastic covering, and shelters constructed of prefabricated panels covered with plastic are some examples of enclosures. Some partial enclosures are made from scaffolds that can be moved from floor to floor when necessary. Commercial electric blankets can also be used to cover walls and provide heat during the curing stages. Forced or torpedo heaters can be

used to heat enclosures. Space heaters also work to heat enclosures. Circulation of warm air on both sides of the masonry wall is required.

In the event that covering is displaced and snow or ice covers the masonry wall, the top course must be thawed with steam or a portable blowtorch. The heat should be sustained until the masonry is thoroughly dry.

Accelerators may also be used to speed up the setting time of the mortar and grout. This will increase the rate of the hydration process the cement goes through. Accelerators increase the rate of early strength gain. Accelerators should not be the only remedy for cold weather conditions.



Mortars or grouts that contain accelerators must still be protected from freezing as cement hydration completely stops below 40°F (4.4°C).

Use of Akona Concrete/Masonry Set Accelerator (ASTM C494 Non-Chloride Accelerator) is recommended because it will not cause corrosion to metals used in masonry reinforcement, ties or anchors ([www.akonallc.com](http://www.akonallc.com)).

### References

- All-Weather Concrete Masonry Construction, NCMA TEK 3-1C, National Concrete Masonry Association, Herndon, Virginia, 2002.
- Cold and Hot Weather Construction, BIA Technical Notes 1, Brick Industry Association, Reston, Virginia, June 2006.
- Cold Weather Masonry Construction, Portland Cement Association, Skokie, Illinois, 2008.
- Concrete Masonry Handbook for Architects, Engineers and Builders, Portland Cement Association, Skokie, Illinois, 1991.

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| RECOMMENDATIONS FOR MASONRY CONSTRUCTION IN COLD WEATHER |                                       |   |   |   |
|--|---------------------------------------|---|---|---|
| Type   | Temperature                           | Preparation Requirements<br>(Prior to Work)   | Construction Requirements<br>(Work in Progress)   | Protection Requirements<br>(After Masonry is Place)   |
| Normal Weather   | 100°F to 40°F<br>(37.8 °C to 4.4 °C)  | Normal Procedures   | Normal Procedures   | Normal Procedures   |
| Cold Weather   | 40°F to 32°F<br>(4.4 °C to 0 °C)      | <ul style="list-style-type: none"> <li>• Don't lay masonry units that have a temp below 20°F (-6.7°C) or contains frozen moisture, ice, or snow on their surface.</li> <li>• Remove all ice &amp; snow from the top surface of existing foundations &amp; masonry to receive new construction. Heat these surfaces to above freezing, using damage free methods.</li> </ul> | <ul style="list-style-type: none"> <li>• Heat mixing water to product mortar between 40°F (4.4°C) and 120°F (48.9°C).</li> <li>• Do not heat water or aggregates used in mortar or grout above 140°F (60°C)</li> <li>• Heat grout materials when their temperature is below 32° F (0°C)</li> </ul>  | Completely cover newly constructed masonry with a weather-resistive membrane for 24 hours after construction.   |
|  | 32°F to 25°F<br>(0 °C to -3.9 °C)     | Comply with cold weather requirements stated above.   | <ul style="list-style-type: none"> <li>• Comply with cold weather requirements stated above.</li> <li>• Maintain mortar temperature above freezing until used in masonry.</li> <li>• Heat grout materials so grout is at a temp. between 70°F (21.1°C) &amp; 120°F (48.9°C) during mixing and placed at a temperature above 70° (21.1° C).</li> </ul> | Comply with cold weather requirements stated above.   |
|  | 25°F to 20°F<br>(3-3.9 °C to -6.7 °C) | Comply with cold weather requirements stated above.   | <ul style="list-style-type: none"> <li>• Comply with cold weather requirements stated above.</li> <li>• Heat masonry surfaces under construction to 40°F (4.4°C) and use wind breaks or enclosures when the wind velocity exceeds 15 mph (24 km/h)</li> <li>• Heat masonry to a minimum of 40°F (4.4°C) prior to grouting.</li> </ul>                 | Completely cover newly constructed masonry with a weather-resistive insulating blankets or equal protection for 24 hours after completion of work. Extend time period to 48 hours for grouted masonry.  |
|  | 20°F to Below<br>(-6.7 °C to Below)   | Comply with cold weather requirements stated above.   | <ul style="list-style-type: none"> <li>• Comply with cold weather requirements stated above.</li> <li>• Provide enclosure and heat to maintain air temperatures above 32°F (0°C) within the enclosure.</li> </ul>   | Maintain newly constructed masonry temperature above 32°F (0°C) for at least 24 hours after being completed by using heated enclosures, electric heating blankets, infrared lamps, or other acceptable methods. Extend time period to 48 hours for grouted masonry. |

\*Mean daily temperature is determined by adding the maximum temperature for each day to the minimum temperature for the same day and dividing by two.

\*Ambient temperature is the outdoor temperature at the time considered