

USE OF MORTAR AND GROUT IN COLD WEATHER CONSTRUCTION

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Cold weather conditions can have adverse affects on the construction industry in general and 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°F-100°F (4.4°C-37.8°C). Cold weather then occurs when ambient temperatures drop below 40°F (4.4°C) during construction. Cold weather can affect masonry, mortar, and grout during construction and can affect future performance of the masonry system if not constructed correctly. Successful construction must include cold weather considerations during the planning, scheduling, and preparation of masonry work as well as protection of finished projects.

Cold weather can **slow construction** by affecting the set time and strength development of mortar and grout. If weather gets below 40°F (4.4°C) within 24 hours for mortar and 24-48 hours for grout hydration of cement will stop until temperatures become warm enough for hydration to continue.

- ⇒ Incomplete hydration before mortars and grouts dry out will compromise the cured strength.
- ⇒ The reduced rate of hydration can cause the mortar to fail to support the masonry above and cause mortar to squeeze out of the joints.



System failures caused by cold weather include loss of strength and performance, efflorescence, and flashing failures.

- ⇒ Frozen mortar can lift a section of masonry resulting in additional damage due to movement. Frozen grout can also cause cracking and spalling within the cores of the units.
- ⇒ If water within the mortar freezes it will expand resulting in internal cracking and permanent damage to the mortar bed. This results in weak

mortar with a high potential for water penetration.

- ⇒ Efflorescence can also occur when water is held within the masonry unit. Wet walls allow soluble alkalis in the masonry, mortar, and grout 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. Choosing the correct materials, heating materials, building partial or full enclosures, and using admixtures are a few ways to combat cold weather conditions.

- ⇒ Accelerators may be used to speed up the setting time of the mortar and grout. This will increase the rate of the cement hydration process. Accelerators also increase the rate of early strength gain. Accelerators should not be the only remedy for cold weather conditions. Accelerators should not be considered anti-freeze. Mortars or grouts that contain accelerators must still be protected from freezing. Use of an ASTM C494 compliant non-chloride accelerator such as ProSpec Set Accelerator is recommended as it will not cause or contribute to corrosion of metals used in masonry anchors, ties, or reinforcement.
- ⇒ Masonry units should be temperature conditioned to at least 40°F (4.4°C) prior to installation.
- ⇒ Mortar mixed with cold materials have different properties from mortar mixed at normal temperatures. Mortar mixed in cold weather conditions has lower water content, increased air content, and reduced early strength

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compared to mortar mixed at normal temperatures. Mixing water must be heated to produce mortar that is between 40°F-120°F (4.4°C-48.9°C) at the time of mixing. Ideal mortar temperatures are between 60°F-80°F (15.6°C-26.7°C). Do not heat mortar above 120°F (48.9°C) as 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 cools below 60°F (15.5°C). Protect mortar from freezing until fully cured.
- ⇒ When grouting the masonry wall assembly should be temperature conditioned. This will prevent damage from freezing effects. The masonry wall receiving 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.
- ⇒ Grout mix and water should be heated to produce a grout mix temperature between 70°F-120°F (21.1°C-48.9°C) at the time of mixing. Do not heat the grout mix and water above 120°F (48.9°C). Keep the grout temperature above 70°F (21.1°C) while being placed. Grout should be heated, protected, and placed within 1½ hours of mixing.



In cold weather the cement hydration process continues for an extended time period. Heating and protection are required to ensure that masonry surfaces under construction do not extract excessive heat from the mortar and grout. When the mean daily temperature is below 40°F (4.4°C), protective measures are required.

- ⇒ Examples of enclosures include large tents, temporary wood structures with plastic covering, and shelters constructed of prefabricated panels covered with plastic. Some partial enclosures are made from scaffolds that can be moved from floor to floor when necessary.
- ⇒ Forced air or torpedo heaters can be used to heat enclosures. Circulation of warm air on both sides of the masonry wall is required.
- ⇒ Finished masonry construction must be protected to maintain enough heat for the cement hydration process to fully take place. Cover completed wall area including top of wall with weather-resistive protection for 24 hours. Masonry may be covered with tarps or poly sheets to keep materials dry and free of ice and snow. Commercial electric blankets can also be used to cover walls and provide heat during the curing stages. Newly constructed masonry must be protected to maintain enough heat for the cement hydration process to fully take place.
- ⇒ In the event that covering is displaced and snow or ice covers the masonry wall, the top course must be fully thawed. The heat should be sustained until the masonry is thoroughly dry.

For product information visit www.tccmaterials.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.
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RECOMMENDATIONS FOR MASONRY CONSTRUCTION IN COLD WEATHER				
Type	Temperature	Preparation Requirements (Prior to Work)	Construction Requirements (Work in Progress)	Protection Requirements (After Masonry is Place)
Normal Weather	100°F to 40°F (37.8°C to 4.4°C)	Normal Procedures	Normal Procedures	Normal Procedures
Cold Weather	40°F to 32°F (4.4°C to 0°C)	<ul style="list-style-type: none"> 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. Remove all ice & snow from the top surface of existing foundations & masonry to receive new construction. Heat these surfaces to above freezing, using damage free methods. 	<ul style="list-style-type: none"> Heat mixing water to product mortar between 40°F (4.4°C) and 120°F (48.9°C). Do not heat water or aggregates used in mortar or grout above 140°F (60°C) Heat grout materials when their temperature is below 32°F (0°C) Consider the use of ProSpec Concrete/Masonry Set Accelerator 	Completely cover newly constructed masonry with a weather-resistive membrane for 24 hours after construction.
	32°F to 25°F (0°C to -3.9°C)	Comply with cold weather requirements stated above.	<ul style="list-style-type: none"> Comply with cold weather requirements stated above. Maintain mortar temperature above freezing until used in masonry. Heat grout materials so grout is at a temp. between 70°F-120°F (21.1°C-48.9°C) during mixing and placed at a temperature above 70°F (21.1°C). 	Comply with cold weather requirements stated above.
	25°F to 20°F (3.9°C to -6.7°C)	Comply with cold weather requirements stated above.	<ul style="list-style-type: none"> Comply with cold weather requirements stated above. 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) Heat masonry to a minimum of 40°F (4.4°C) prior to grouting. 	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 and below (-6.7°C and below)	Comply with cold weather requirements stated above.	<ul style="list-style-type: none"> Comply with cold weather requirements stated above. Provide enclosure and heat to maintain air temperatures above 32°F (0°C) within the enclosure. 	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