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Placing Concrete in Cold Weather

The performance of many building and remodeling materials is rooted in basic chemistry and physics. Concrete seems like a simple product… but in reality it's a highly sophisticated chemical compound. Due to its sophistication, care must be taken in its application to ensure proper curing and strength.

Concrete mixing is like a typical powdered mix, add water, stir it and before long you have a semi-solid compound.

There is a difference, however, between concrete and other powders. With concrete, cold temperatures slow the transition to a solid. In the case of concrete, cold temperatures can be disastrous.

Concrete is a strong material because of its chemistry. When you mix water with the cement powder, you start an irreversible chemical reaction. Tiny crystals begin to grow. These crystals attach to one another and the sand and gravel in the mixture. When everything goes right, you've created a compound hard as rock.

Let's take a step back and talk about crystals in concrete. When water freezes it also turns into ice crystals. This transition would normally be no problem, but as the ice forms the volume of the water grows by nine percent. (That's why ice cubes end up larger than the volume of water that produced them.) The ice tends to push or break things that get in its way.

In the case of freshly poured concrete, ice can destroy your slab. Depending on the outside temperature, it can be a race against time. Most concrete chemists and engineers agree that if the concrete can attain a minimum strength of 500 pounds per square inch (PSI), it can resist ice damage.

The chemical reaction of concrete formation creates heat. This heat can be trapped by the use of insulating blankets. But if it's cold enough, insulating blankets won't keep the temperature at an optimum level for maximum curing efficiency. Insulating blankets alone will not keep concrete at a temperature between 65 - 85°F, the optimum temperature range for proper concrete curing.

To ensure the concrete maintains the optimum temperature range, use heated concrete curing blankets. Heated concrete curing blankets not only insulate the concrete, holding in heat, it produces additional heat to keep the concrete within the desired temperature range.

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General suggestions for obtaining Durable Concrete in Cold Climates

- **Maintain a Low Water to Cement Ratio**

The cement in concrete is the glue that holds everything together. The more water you add when you mix, the weaker the concrete will be for a given amount of cement. While adding water to concrete makes it easier to pour, it can also weaken the concrete.

- **Use No More than a Four Inch Slump**

Slump refers to the stiffness of the mix. The lower the number the stiffer concrete is. Concrete can actually be mixed and poured with a one or two inch slump. Highway median crash barriers are frequently poured with a 1 or 2 inch slump. The resulting concrete is stiff enough to stand three to four feet tall within moments after pouring. It also becomes extremely strong once it's cured. Have you seen highway median work where the crash barrier is done with a forming machine? The concrete is so stiff that it can stand four feet tall moments after it is poured - yet it attains a high strength once cured and dried.

- **Use a Six Bag or 4,000 PSI Mix**

You must have enough cement in each cubic yard to make sure it is strong. For concrete exposed to freezing temperatures you'll need a minimum of 6 bags (564 lbs) of cement per cubic yard, or mixture strength of 4,000 pounds per square inch.

- **Use Air-Entrained Concrete**

Special chemicals can be added to concrete as it is mixed. These chemicals create micro-air bubbles within concrete. The air spaces become shock absorbers as water freezes within concrete. Make sure you use air-entrained concrete in cold temperatures.

- **Create the Right Slope**

Concrete slabs need to have good drainage. Slabs need a minimum slope of 1/4" per linear foot to shed water. If water pools on the surface and freezes, the concrete can be damaged.

- **Provide Adequate Curing Conditions**

If the temperature is too cold, the concrete may not have reached a minimum strength of 500 psi soon enough to resist the effects of freezing temperatures. If your concrete isn't protected with **heated concrete curing blankets** after its poured, it may cool too rapidly, slowing the chemical reaction. Use heated concrete curing blankets to maintain the optimal curing temperature of between 65 - 85°F.

- **Don't Use Silicone Sealers**

If you feel the need to seal your concrete, don't use silicone sealers. Silicon sealers form a film. Use a breathable sealant or water repellent containing silanes or siloxanes.

Conventional Insulated Concrete Blankets versus Electric Concrete Curing Blankets

If you read almost any guide, you'll see a sentence similar to, "If temperatures are below 40°F, use **insulated concrete blankets** or straw to keep your freshly-poured concrete from freezing."

That sounds good, but simply keeping the concrete from freezing isn't enough.

The chemical reaction of concrete formation does create heat. This heat can be trapped (to some degree) with the use of **insulating blankets** or straw. But if it's cold enough outside, **insulating concrete blankets** won't keep the temperature at an ideal level for maximum curing efficiency. No insulating blanket will keep concrete at a temperature between 65 - 85°F. Contact Power Plant Supply Co; for *heated* concrete curing blankets. mailto:sales@powerplantsupplyco.com

The colder the temperature the concrete is exposed to, the longer it will take to set and the longer it will take to reach its proper strength. For example, concrete maintained at 70°F will set in approximately 6 hours; concrete maintained at 40°F will take 14 hours to set. Concrete maintained at 70°F will reach a compressive strength rating of 2,700 psi in three days; concrete maintained at 40°F will only reach a strength rating of 1,200 psi in three days. That strength difference makes a huge difference in whether your construction project can proceed - if the concrete takes too long to set, cure, and reach proper compressive strength rating, your project can be significantly delayed.

The difference in conventional insulating concrete blankets and heated concrete curing blankets is significant.

Heated concrete curing blankets can be used for ground thawing before placing concrete. Once the concrete is placed, heated concrete curing blankets maintain the concrete at the temperature you need. In effect, heated **curing blankets** allow you to cure the concrete as if it's a spring day, even if you're working in an extremely cold climate zone. By using heated concrete curing blankets for ground thawing, and using heated concrete curing blankets to maintain an ideal concrete temperature, you virtually eliminate costly weather delays, ensuring the project proceeds on schedule - and that your concrete will be long-lasting and durable.

To define cold weather with respect to concrete: any time you have 3 consecutive days where the average daily temperature is less than 40°F or if the temperature is lower than 50°F for less than half of any of the 3 days, concrete thinks it's cold. Cold weather can have a detrimental effect on concrete curing for several reasons.

Concrete transforms from a liquid to a solid material through a chemical reaction. The speed of the reaction depends upon the temperature of the concrete. When the weather is warm, the reaction proceeds quickly. When it's cold and the ground hasn't been thawed, the reaction slows down. That's the problem: the concrete needs to harden as rapidly as possible to resist pressures caused by water freezing within the concrete.

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Poor finishing techniques can also doom your slabs. Freshly poured concrete often bleeds. The water in the mix floats to the top, since it's the lightest ingredient. Floating or toweling this water into the concrete weakens the top layer. Toweling the concrete too early can seal this bleed water just below the surface as well. If your slab is then exposed to freezing temperatures several days later, this water can freeze and fracture the top layer. Using a concrete curing blanket can eliminate the potential of freezing.

Concrete can be successfully poured in cold weather.

Several precautions need to be taken:

- Never pour concrete on frozen ground, snow, or ice. Use heated concrete curing blankets for ground thawing ahead of time.
- Be sure to order air-entrained concrete. Request a heated mix or order 100 lbs of extra cement for each cubic yard of concrete. This extra cement helps develop early strength.
- Be sure the concrete is ordered with a low slump (drier mix). This minimizes bleed water.
- After the final finish is completed, cover the concrete with a heated insulated concrete curing blankets. Powerblanket concrete curing blankets will prevent freezing and keep the concrete at optimal curing temperature.
- After about 3 days, remove the curing blankets to allow the concrete to air dry.

Contact Power Plant Supply Co to order heated concrete curing blankets for your project