ICE AGE: DESIGNING FOR COLD STORAGE FACILITIES

One of the most unique challenges in designing buildings for the Food & Beverage Industry is to provide facilities with low temperature requirements, such as a -20°F freezer. Most people have not experienced temperatures that low. Food, pharmaceutical, and other products sometimes need to be stored at low temperatures to maintain their integrity. Proper building design and construction is critical to keep the next "ice age" from coming within the cold storage facility!

Cold storage spaces have their own unique environmental climates and need to be properly separated from the surrounding spaces; otherwise, condensation, snowing and ice conditions will occur – the referenced "ice age." Proper insulation and vapor barrier design and construction are essential to minimize the risk of a building envelope failure, which can lead to loss of temperature control, ice on floors, and water on products.

With low temperature building design, there is a "warm" side and a "cold" side. The greater the temperature difference between the two sides, the greater the risk of moisture infiltration through water vapor transmission. Because of this, it is critically important to maintain the continuity of the envelope.

Warm air is actually a gas blend that holds moisture. If moisture seeps through the walls around a low-temperature area, this gas will condense on the cold side, forming water and eventually turning to ice and snow.

Nutec was recently hired to visit the site of a freezer/cooler storage facility that was exhibiting these exact challenges. Unfortunately, there was visible evidence of vapor barrier issues – they were either missing altogether or not continuous in the wall assembly, resulting in snow and ice forming at the insulated metal panel joints.

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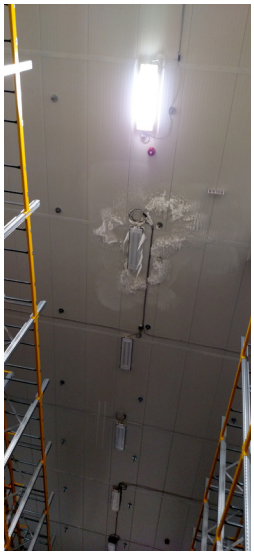


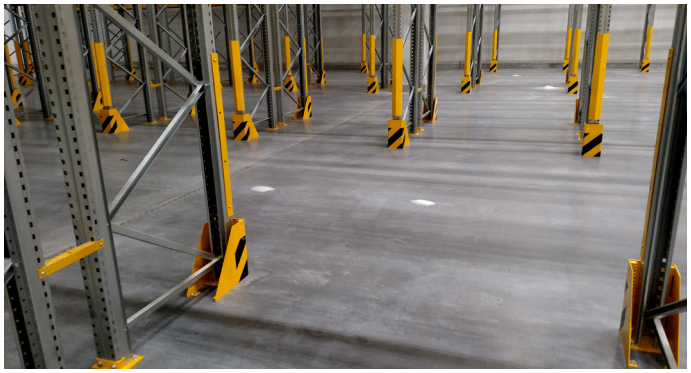
Another pitfall occurs when companies in need of freezer space attempt to convert an existing cooler to freezer use – often with varied results. Is it cost effective to convert a cooler to a freezer? Like most things in life, the answer is … it depends.

Coolers and freezers do share a general concept – keeping spaces cooler than ambient room temperature. In practice, they are very different. The requirements for freezers and coolers will vary depending upon the temperature needs of each space. Although the vapor barriers for freezers and coolers are essentially the same, wall and roof insulation thicknesses, floor insulation, and floor warming requirements will vary widely. Coolers are also designed to keep temperatures above +34°F, so moisture within the space will not condense and freeze.

Coolers do not typically have floor insulation under the entire slab. More common is the presence of perimeter insulation to reduce thermal bridging. Floor warming systems are not required in cooler spaces because of the higher temperatures; however, for freezer areas, floor warming is a must.

Soil contains moisture, so it is critical that freezer floors be separated from the soil. If this doesn't occur, over time the temperature of the freezer will transmit through the floor slab, and eventually the soil will be at the same temperature of the freezer. Once this happens, soil will freeze and expand, create an ice lens, and result in heaved floor slabs as well as building foundation and column issues. These conditions can be mitigated by installing an insulated floor slab along with floor warming. This floor warming system will heat the soil and prevent it from freezing.

Vapor barriers serve an important role in both coolers and freezers. These vapor barriers need to be continuous and be installed on the warm side of the space in order to keep the moisture vapor temperature from dropping too low. If moisture vapor does penetrate the cold storage space, it behaves differently. Within coolers, this moisture will condense and form water. In freezers, however, the moisture will turn to ice or snow.



The most critical design elements for freezers are:

+ Floor warming is present to ensure that the soil under the slab and foundations remains above 32°F. Techniques to prevent soil from freezing include vent tubes, electric warming, or heated glycol in tubing beneath the floor insulation.
+ Floor insulation is placed between the floor warming system and the building floor slab. The insulation thickness is dependent upon the freezer temperature. For instance, at -10°F, a minimum of six inches of insulation is recommended.
+ Building columns that extend through the slab have a thermal break that is equivalent to the floor insulation.
+ A vapor barrier should be present in any facility, but this is absolutely critical for freezer storage facilities. If the vapor barrier is not installed properly or does not have a complete seal, moisture vapor will penetrate into the building, and over time ice will begin forming and expanding.
+ The building location's annual outside temperatures plays a role in determining insulation thickness, both for walls and roofs. Room temperature is another driver of insulation thickness. For instance, a -10°F freezer in a certain geographic region may require as much as six inches of wall panel insulation and eight to nine inches of roofing insulation.
+ Wall and roof penetrations through vapor barriers must be completely sealed and properly insulated to minimize the risk of condensation and moisture vapor infiltration. This is particularly challenging at personnel and forklift doors within freezer walls, and at duct penetrations in roofs.

Have you faced any challenges with moisture penetration in your freezer spaces? Looking for best practices to fend off the next "Ice Age"?

Contact David S. Miller, RA (dmiller@nutecgroup.com) or 717-434-1577 to learn more and discuss your project.