Insulating Metal Buildings

by William A. Lotz

The view of Mt. Washington to the south was awe-inspiring, but inside the roller-skating rink, things were a mess. This particular building in New Hampshire was a corrugated-steel, Quonset-hut-type structure that had been sprayed with a $1^5/_8$-inch-thick layer of cellulose adhesive insulation.

I was called in to assess the damage and prescribe a cure, and when I arrived on the site in February, most of the insulation was scattered about the hardwood floor. The "chopped newspaper" insulation was saturated with condensation, and it dropped all around me with a splash.

The contractor claimed that the problem was caused by oil on the steel. (The contractor's insurance company didn't buy that explanation, either; it paid a large claim to the owner of the skating rink.)

The building had been insulated twice, and both times the insulation fell down.

The Dew-Point Factor

A substantial portion of the building's exterior was covered with snow. The dew point inside the building was a fairly dry 35 degrees Fahrenheit. (In most parts of Maine, Vermont and New Hampshire, there are 3,000 to 4,000 hours a year when the outdoor temperature will be 35 degrees or below.)

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In a metal building, the temperature of the steel under the insulation will be essentially the same as that of the outdoor air. This means that for 3,000 to 4,000 hours a year, condensation will be collecting in the insulation of this skating rink.

As with most sprayed fiber insulations, cellulose insulation is impossible to apply with a vapor barrier. The manufacturers claim it operates under the "blotter principle," which means it absorbs water until the weather changes, and then it dries out. While this may work in Memphis, however, it does not work in cold climates.

A simple calculation shows that in cold weather, a single square foot of cellulose insulation will accumulate almost 2½ pounds of condensation within one month. The adhesive holding the granules of cellulose together (and to the steel) is not strong enough to hold the insulation to the steel under these circumstances.

Sprayed fiber insulation cannot possibly be successful in a metal building in a cold climate (one with more than 4,000 degree-days). As I have said for years, *any insulation system is only as good as its vapor-barrier system.*

The same type of cellulose adhesive insulation works reasonably well in a concrete-block building, whereas if that same building were made of plywood, the insulation could fall off. The difference is due to the dew-point temperature; plywood or steel will be colder than concrete block.

So what exactly is the proper way to insulate a metal building? The answers are *not* inexpensive, unfortunately. Whatever method is used, metal buildings simply cost more to insulate than wood-framed buildings.

The McQuarrie System

This system consists of a series of wires attached to studs, with polystyrene foam boards also nailed to the studs. Painted galvanized-steel panels are used as an interior finish.

An offshoot of this method (and one that would bring plenty of money) would be a prefab, steel-panel system.

Urethane Spray Foam

This method requires an experienced contractor and steel that is clean and free of oil. The urethane foam must be Class A fire resistant. The foam is sprayed on the *exterior* of the building, and it, in turn, is sprayed with a compatible roof coating for weather resistance.

Single passes of the foam spray should not be more than one inch thick, which means that multiple passes are required in our climate, and the foam density should be three pounds per cubic foot. The foam cannot be sprayed when the temperature is below 60 degrees or when rain is pending. The waterproof coating should be applied in two layers that are 15 mils thick each.

Classic Metal Insulation

The generic "Butler" building traditionally is insulated with wide (usually 48-inch) rolls of commercial fiberglass with a facing tested by United Laboratories. These facings include four-mil-thick vinyl, foil-scrim-kraft (FSK) and vinyl-reinforced foil (VRF).

The vinyl is not an adequate vapor barrier for cold climates, as it is rated at only one perm. The other products are only as good as the joint sealing, which generally provides 0.02 perms.

Proprietary Systems

Many companies, including Owens-Corning and Manville, have special systems based upon a device, such as a clip or extrusion system, to hold in place a combination of fiberglass batts and 4'x4' acoustical-type panels with vapor-barrier facings. These systems should be installed only by experienced contractors. They aren't cheap, but they provide a reasonably attractive interior finish as a part of the system.

Other Considerations

Another aspect of metal construction that should be considered in New England and areas with a similar climate is the conductivity of the metal structure itself.

Whenever the steel penetrates the entire insulation system (such as in a metal-stud system), two problems result. First, the insulation system is seriously compromised, and substantial heat loss occurs. Second, due to the cold spots on the steel, condensation and dust "ghost marks" result on the inside of the structure. There must be *some* insulation on either the outside or the inside of all steel structural components.

When all else fails, use common sense —but don't ask me where to buy it! ■

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