CRCA CANADIAN ROOFING CONTRACTORS ASSOCIATION

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Effect Of Increased Thermal Resistance On Conventional Roofing Systems

The need to reduce operating costs and conserve energy is compelling owners and designers to reassess their traditional approach towards roof design with regards to the thermal performance of the system. Such studies invariably justify the use of additional thermal resistance on roofs, meaning thicker and/or more efficient insulations. This in turn is creating some concern amongst roofing contractors who fear that lower membrane temperatures resulting from increased thermal resistance of the roofing could induce higher stresses in the membrane increasing thermal shrinkage and splitting failures. Roofing contractors also question the effect that the additional insulation might have on roofs partially covered with snow resulting from a possible greater temperature difference between snow-covered and bare areas of membrane.

Our steady state calculations (a computer simulation would have given more accurate results) show that increasing the insulation on roofs does not appreciably increase the severity of exposure of the roof membrane unless one considers the uninsulated deck condition, a condition which is not very common in our country.

To arrive at this conclusion a specific roof construction was studied. Roof insulation thicknesses (R4 per inch) ranging from 0 to 4 in. and two outside temperatures and wind conditions were assumed; -18°C with a 15 mph wind and -43°C with no wind.

The membrane temperatures were calculated assuming two conditions: a bare roof and one resistance; however, as the mean temperature drops, so does the temperature difference across the membrane.

The indications are therefore, that increasing the amount of insulation should not be detrimental to the performance of the membrane and that certain effects may even be beneficial.

The added thickness of insulation, however, means that the membrane and the structural deck are spaced further apart. The physical properties of the insulation and of the adhesives take on added significance therefore, since thermal stresses should be transferred from the membrane to the deck in well designed and well built roofs. These stresses must be considered by the designer and roofing contractor in selecting the insulation, the adhesive, the felts and the installation techniques. Proper adhesion of all components between the membrane and the deck should be ensured. The insulation should have adequate shear and tensile strength. All layers of insulation should be firmly bonded together when more than one layer is used.

NOTE: Those who are interested in the complete calculations may obtain them by writing CRCA.

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Table 1

Insulation Thickness "t" in.	Mean Membrane Temp. °C		Difference Due to Snow °C	Surface Temp. °C		Temp. Difference Across Membrane °C		Heat Loss From Interior Btu/hr-ft^2	Heat for Melting Btu/hr-ft^2
	No Snow	1 ft Snow		No Snow	1 ft Snow	No Snow	1 ft Snow		
Conditions for a -18 °C Outside Temperature									
0	-9.0	2.75	11.75	-13.5	0	9	5.5	30.2	27
1	-15.5	0.75	16.25	-16.8	0	2.3	1.3	7.0	3.8
2	-16.5	0.50	17.0	-17.3	0	1.3	0.7	4.0	0.8
4	-17.0	-3.50	13.5	-17.6	-3.6	0.7	0.4	2.2	None
Conditions for a -43°C Outside Temperature									
0	-16.5	2.75	19.25	-7.5	0	11.0	5.5	30.2	23
1	-35.0	0	35.0	-33	0	3.5	1.25	7	None
2	-38.0	-8.5	29.5	-38	-8.5	2.0	1.0	4.0	None
4	-40.0	-18.5	21.5	-41	-18.5	1.0	0.75	2.2	None

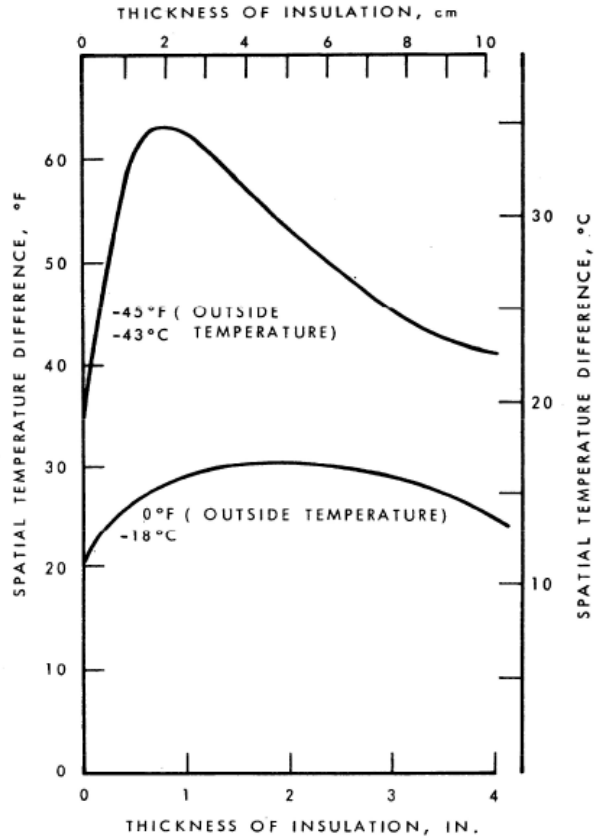

Figure 1: Relationship between thickness of insulation and temperature difference of membrane when covered with snow.