DEBUNKING COOL ROOF CONDENSATION MYTHS

THIRD-PARTY STUDY OF FIVE PVC ROOFS

Sarnafil BUILDING TRUST Sika

Introduction

Some individuals in the roofing industry have expressed concern that white, highly reflective "cool roofs" can cause condensation within a roof system. The concept around this issue is that all roofs without a vapor retarder accumulate moisture to some degree due to vapor drive and air movement from interior to exterior. A roof will undergo cyclic wetting (winter) and drying (summer). Some claim that black roofs, which get hotter than white roofs, will allow for a more complete drying cycle. They allege white, reflective cool roofs may not thoroughly dry during the cycle, resulting in an accumulation of moisture and potential degradation of the roof system over time. This reasoning ignores decades of excellent performance of PVC cool roofs in all climate zones and system configurations

Surveys[1,2] of older cool roofs on insulated steel decks have been conducted and have disproved that condensation in cool roofs are an issue in conventional roof systems of this type.

Wood deck construction, in which the roof is typically insulated from the underside with only a cover board between the deck and membrane, is viewed as being more susceptible to condensation. Interior moisture may make its way through the insulation to the cool (in winter) underside of the deck and membrane, then condensate. Some allege that cool roofs may not thoroughly dry during the summer in such constructions. In September of 2017, a moisture survey of five PVC roof membranes installed on wood decks that were insulated from below was conducted in California by third-party consultant Pacific Building Consultants, Inc. The purpose of the survey was to determine if condensation moisture was present and whether condensation had accumulated in the assemblies and had deteriorated the roof systems. All five roof assemblies consisted of, from top to bottom, a mechanically attached PVC roof membrane, gypsum cover board, and plywood deck, below deck insulation, and were 9 – 17 years old.

The survey disproved the generalizations and allegations that cool roofs are inherently more prone to condensation and moisture accumulation than other types of roofing materials.

The following five roofs were surveyed between September 19-28, 2017:

Building Name	Location	Install Completion Date (PVC age at time of survey)	Application Type
1. Latter Day Saints Church	Sacramento, California	11/15/2003 (14 years)	Tear-off
2. California Highway Patrol	Rohnert Park, California	5/21/2004 (13 years)	Tear-off
3. Golden Valley High School	Santa Clarita, California	5/31/2006 (11 years)	New Construction
4. Jet Propulsion Lab (Building 103)	Pasadena, California	6/30/2000	Tear-off

[1] "Study Targets Cool Roofs: Assessing The Performance of Cool Roofs in Northern Climates", Fenner, M., DiPietro, M., Graveline, S., Roofing Contractor, October, 2014

[2] "Case Study: Cool Roofs in Use in Northern Climates", Fenner, M., DiPietro, M., Graveline, S., Architectural Roofing and Waterproofing"

		(17 years)	
5. San Diego Community College	San Diego, California	6/2/2008 (9 years)	Tear-off

Survey Method

- The moisture surveys were conducted in general compliance with ASTM D7954 "Moisture Surveying of Roofing and Waterproofing Systems Using Non-Destructive Electrical Impedance Scanners," Technique A (continuous scanning).
- It was judged that estimates of water content obtained by an electrical pin-type resistance meter (i.e., Delmhorst BD-2100) were acceptable for use within the scope of this study. Nevertheless, before the electrical resistance meter was used at each site, it was subjected to the manufacturer recommended calibration self-check. And, if successful, the meter was set to the appropriate scale (i.e., scale 1 for wood, scale 3 for gypsum) and readings obtained.
- Impedance meter readings were continuously monitored as the equipment was rolled in swaths about 3-feet on center (~70% to 80% coverage). Locations where impedance readings changed abruptly were noted and, if merited, marked on the roof surface.

"Wet/Dry" Criteria – Wood and gypsum materials uncovered at test cuts were judged "wet" if the pin-type electrical moisture readings exceeded the following values.

1. Glass-Fiber Faced Gypsum Sheathing, Wet >2% water content – This criterion is based on interpretation of data compiled from several sources (e.g., 2014 RCI Interface, "Reducing the risk of moisture problems from concrete roof decks", Doelp and Moser, Simpson Gumpertz and Heger).
2. Wood, Wet >20% water content – This criterion is based on recommendations in the 2009 ASHRAE Handbook of Fundamentals (e.g., page 25.15) and The Wood Handbook (e.g., Chapter 14).

Figure 1 – Summary Observations, Moisture Surveys and Test Cuts

Site	Ceiling Tile "Stained"	Moisture Survey "Wet" Plywood	Roof Fasteners "Stains/Rust"	Wood Deck "Stains/Rust"
1. Latter Day Saints Church	Yes (3)	Yes (1)	Yes (1)	Yes (1), Yes (2)
2. California Highway Patrol	No	No	No	Yes (2)
3. Golden Valley High School	Yes (3)	No	No	No
4. Jet Propulsion Lab (Building 103)	Yes (3)	No	No	Yes (2)
5. San Diego Community College	Yes (3)	No	No	Yes (2)

1 – Limited to location of confirmed rainwater leak due to improperly heat-welded lap.

2 – Wood stained dark around nails and nail heads moderately corroded.
Not clear if stains/corrosion occurred before and/or after installation of PVC Roof.
3 – Unclear when the staining had occurred

Figure 2 – Summary of Plywood Deck Water Contents (avg. of 4 or more meter readings)					
Site	**TC A**	**TC B**	**TC C**	**TC D**	**Remarks**
1. Latter Day Saints Church	7.8%	6.0%	34.0%	7.2%	34% reading at leak due to improperly heat welded lap
2. California Highway Patrol	8.6%	8.3%			TC A at insulation cricket
3. Golden Valley High School	8.6%				
4. Jet Propulsion Lab (Building 103)	7.3%	-			TC B at wood plank deck
5. San Diego Community College	8.0%	-	7.7%		TC B probes only into gypsum board

OBSERVATIONS SUMMARY

On all of the roofs, test cuts indicated no evidence of moisture anywhere in the system or corrosion of roof fasteners and plates. No staining or deterioration of the gypsum cover boards or membranes was observed. In all re-roof cases, there was only mild to moderate corrosion on the plywood deck nail heads (untreated mild steel). Based on the age of the roofs, and the fact that in all instances where minor nail head corrosion was observed, the current roof assembly was at least the second roof on the facility (i.e. each had been re-roofed at least once), it may have taken place prior to the installation of the current membrane. No corrosion was observed on the deck nail heads in the only facility with its original roof.

Both surveys of wood and steel decks referenced confirm what the Department of Energy has noted in reference to the potential for condensation in cold climates[3]:

"… while this issue has been observed in both cool and dark roofs in cold climates, the authors are not aware of any data that clearly demonstrates a higher occurrence in cool roofs."

A copy of the full report is available by contacting your local Sika Corp. – Roofing Sales Representative.

[3] Urban, B., Roth Ph.D., K., U.S. Department of Energy, Building Technologies Program: Guidelines for Selecting Cool Roofs, July 2010, V. 1.2