WSRCA
TECHNICAL BULLETIN
No.2023-2

Cool Roof Effects on Sheathing & Framing

Spring 2023

WESTERN STATES
ROOFING CONTRACTORS ASSOCIATION

WESTERN STATES
ROOFING CONTRACTORS ASSOCIATION

TECHNICAL BULLETIN NO. 2023-02

Case Study - Cool Roof Effects on Sheathing and Framing

To: WSRCA Contractor Members Spring 2023

From: WSRCA Low-Slope Roofing Committee

Over the last several years, the low slope and industry WSRCA committees issued technical bulletins on sheathing performance[1] and cool roof[2] effects on roof sheathing and framing, relative humidity, and condensation potential.[3] This bulletin shows how cool roof effects led to deteriorated sheathing and framing and extensive repairs on a project in Portland, Oregon.

The project is a 5-year-old wood-framed, one-story residential structure with tapered wood rafters placed over a level wood sheathing diagram. There were no reports of interior leaks but there a sponginess when maintenance staff walked on the roof. The as-built roof assembly consisted of the following (from the interior to the exterior):

- Continuous, closed-cell spray foam in a 4 to 6" thick application in the ceiling space below the wood sheathing diaphragm.
- Wood sheathing over tapered rafters creating closed cavities. These cavities were not filled with insulation, and it was unvented. The uppermost wood sheathing substrate consisted primarily of OSB, but some locations, were covered with pressure-treated plywood.
- A fire barrier sheet and a grey, single-ply thermoplastic roof membrane.

The photographs below show the as-built conditions and the extensive damage that was revealed when the roof covering was removed.

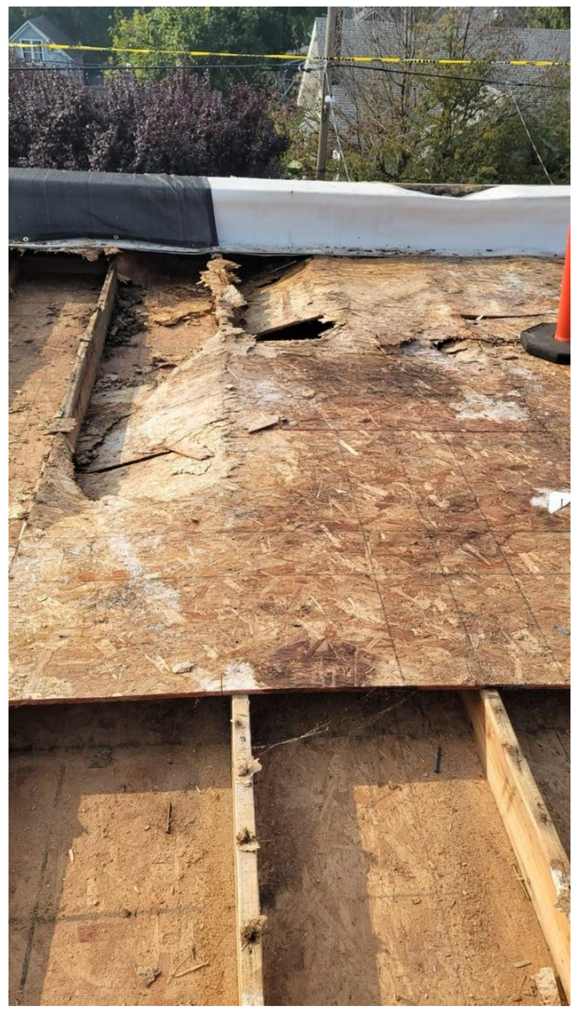
---

[1] Roof Wood Sheathing Susceptibility to Moisture - WSRCA Technical Bulletin No. 2020 IS-II 1stEd.

[2] Cool Roofs are roofs covered with highly reflective and low thermal emittance roof membranes.

[3] Design Considerations Related to White and Light-Colored Membrane Low-slope Roofs - WSRCA Technical Bulletins No. 2020 LS-II 1stEd

Within five years, the underlying OSB sheathing had deteriorated. Apparently, the closed cell spray foam insulation either did not bond to the adjacent rafters and/or was not installed continuously to create a functioning vapor barrier. Possibly there was excessive moisture when the roof was installed and closed in the cavity. The absence of a functioning vapor barrier and venting allowed interior moisture-laden air to reach the unfilled cavities and create high relative humidity. Condensation occurred on cold days and nights, and even during relatively warmer nights, due to radiative cooling of the roof membrane. We also noticed that sections covered with plywood were intact and not as deteriorated as the OSB sheathing, despite being wet from condensation. The attached photographs illustrate how the combination of wet sheathing and highly reflective roof membranes can adversely affect the performance of the sheathing and wood framing.



The repair for this roof required extensive framing and sheathing replacement and a new roof system above the plywood diaphragm that included a vapor retarder, 2 staggered layers of 2" polyisocyanurate insulation, a tapered polyisocyanurate insulation to provide a 1/4" per ft slope, ½" high density polyisocyanurate cover board, and mechanically fastened thermoplastic single ply membrane. This roof assembly will achieve an r-27 average r-value and prevents interior moisture-laden air from reaching the dew point temperature and causing condensation.

Lessons learned include.

- Highly reflective and emitting single-ply roofs do not retain heat. Therefore, if no above-deck insulation exists, the exterior temperature changes will impact the underlying sheathing, creating the possibility of a high relative humidity and condensation risk.
- One potential remedy is to provide a sufficiently thick layer of continuous insulation under the roof membrane so that the sheathing will stay closer to the interior temperature[4]. This approach was how the roof was repaired.
- Another possible remedy is providing adequate venting of the cavity[5]
- Provide an interior vapor retarder or a vapor barrier, if needed, to stop moisture from reaching the sheathing level. [6]
- Ensure the sheathing is at the recommended moisture content when the building is enclosed.
  - Maximum 16% (preferably 14%) for OSB
  - Maximum 18% for plywood
- Understand the limitations of OSB sheathing and only use it in environments that stay below 80% relative humidity with no potential for interior condensation.

Ultimately, designers are responsible for providing the appropriate roofing design to limit interior relative humidity and prevent condensation on the sheathing. However, understanding moisture vapor transport in roofing systems and how design features can mitigate or create problems is important to the entire roofing community. While it is not the roofing contractor's responsibility to perform the roof design, a roofer's awareness of these basic concepts and how they occur may help prevent future problems. Providing the roofing contractor some information so they understand that in some locations (based on climatic zones) and building types, there may be the need for above-deck insulation and possibly venting and an air and vapor barrier when a cool roof is specified.

Sincerely

WSRCA Low Slope Roof Committee

REFERENCES

Roof Wood Sheathing Susceptibility to Moisture - WSRCA Technical Bulletin No. 2020 IS-II 1stEd.

Design Considerations Related to White and Light-Colored Membrane Low-slope Roofs - WSRCA Technical Bulletins No. 2020 LS-II 1stEd

---

[4] Computer modeling using WUFI will provide the designer the recommended insulation thickness.
[5] Computer modeling using WUFI will confirm the viability of this approach.
[6] Computer modeling using WUFI will determine if a vapor barrier or air barrier is needed.

LEGAL DISCLAIMER