Extending Wood Crosstie Life:

Weathering Experiment Results

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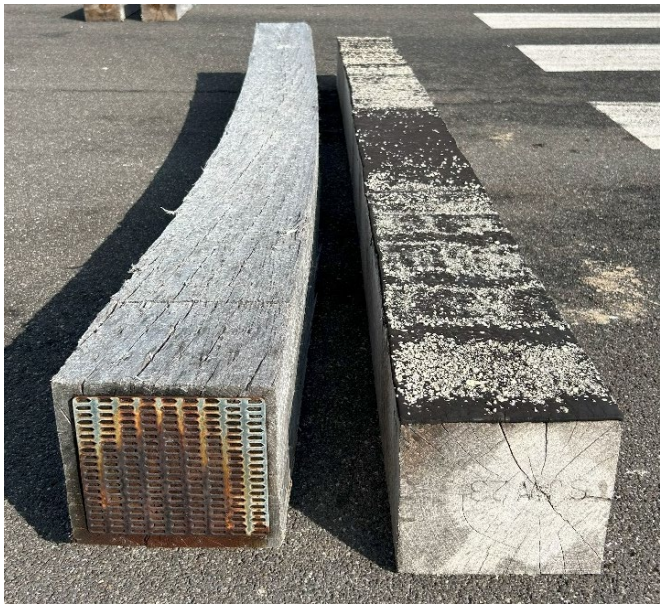
Extending the service life of wood ties is a critical goal for railroads facing high replacement costs and operational challenges. One logical approach is to shield ties from the elements—essentially putting a "roof" on them to reduce weathering. This report examines the performance of Tietan™, an asphalt-based coating engineered and polymer-modified to protect wood ties and mitigate deterioration caused by moisture and ultraviolet exposure.

Accelerated Weathering Experiment

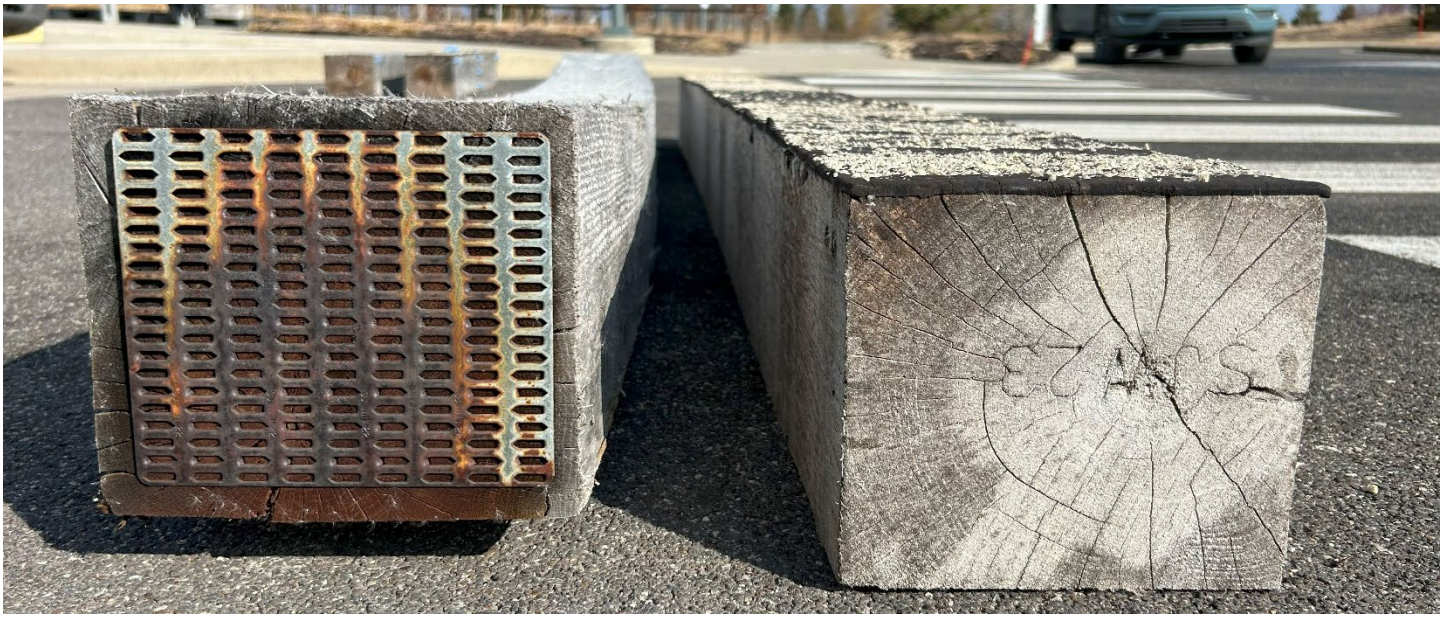
A team from Heritage Research Group conducted an experiment, starting with new, identically matched, incised red oak wood ties. To encourage rapid weathering, the seasoned ties were *not* preserved with a typical chemical treatment such as Creosote or CuNap, but borate-treated and dry-stacked. Half were coated with Tietan™, an engineered asphalt coating, and the others were not. The ties were left side-by-side on an outdoor pallet. After 20 months of exposure to precipitation and ultraviolet (UV) rays, the uncoated ties warped, with a notable increase in surface opening size as well as check and split presence. In contrast, the Tietan-coated ties maintained a uniform structure with minimal weathering. Any pending cracks on the top surface were sealed by the asphalt. No further checks or splits were visible.

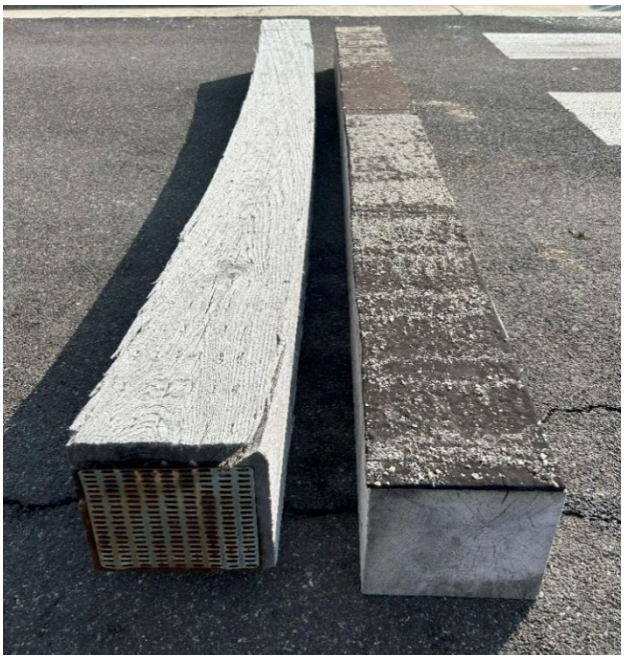
Full-length Tie Specimen

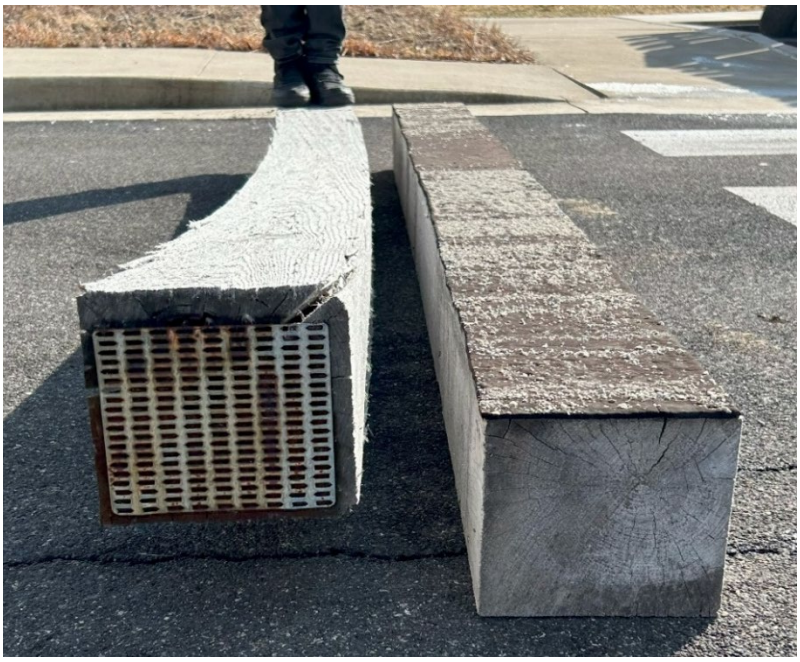
- *Uncoated Tie left Vs. Tietan Coated Tie right*
- *Left outside for 1 year and 8 months at the time of images*
- *Tietan Coating: A highly polymer-modified, weather-resistant asphalt coating applied to the top surface of the tie. Designed to protect and extend the life cycle of wood ties. Aggregate is added to ensure worker footing and safety.*



Uncoated Tie left vs. Tietan-coated Tie right



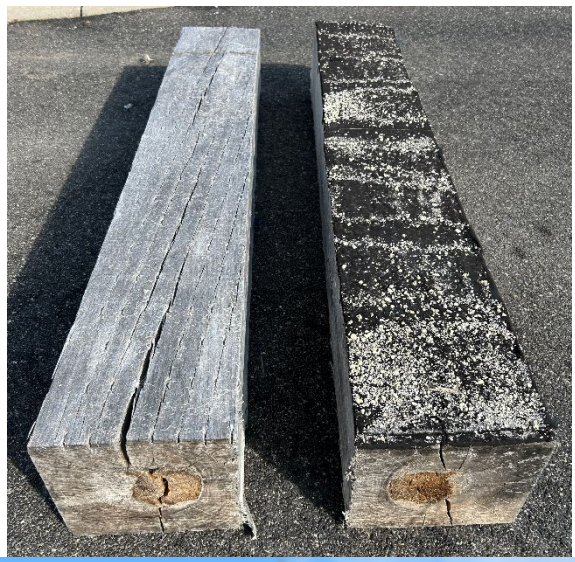




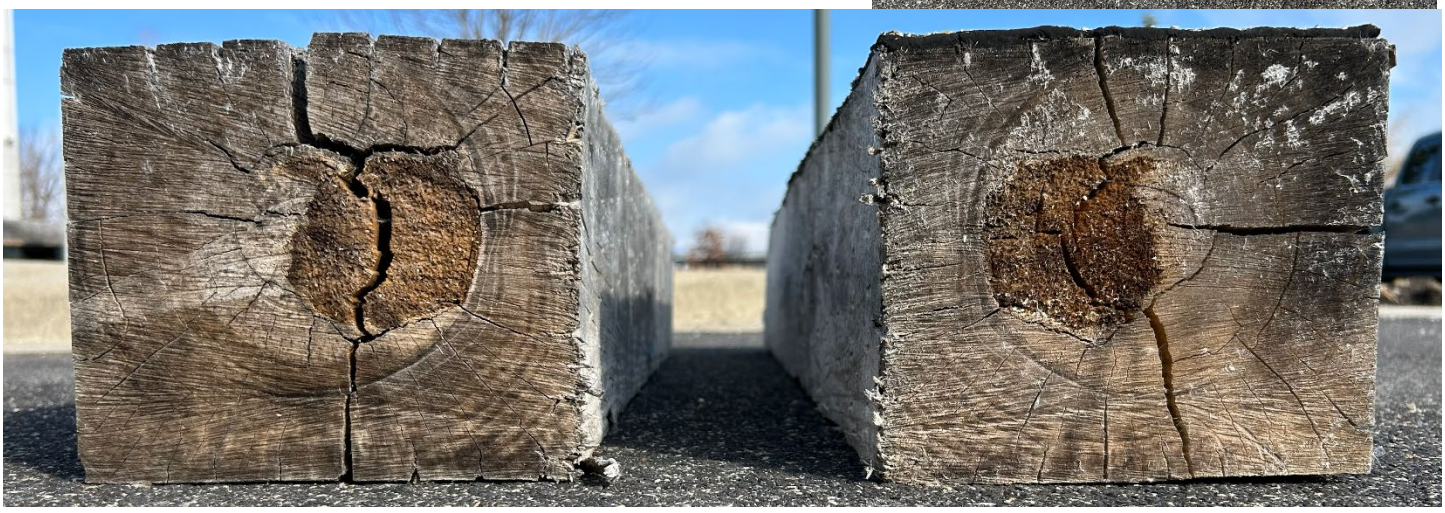
The uncoated tie (left) has warped into a banana curve. The extent of the warping is evident by holding down the far end of the uncoated tie. It bends 3-4 inches off the ground.

Original Wood Tie Cut in Half, One Half Coated

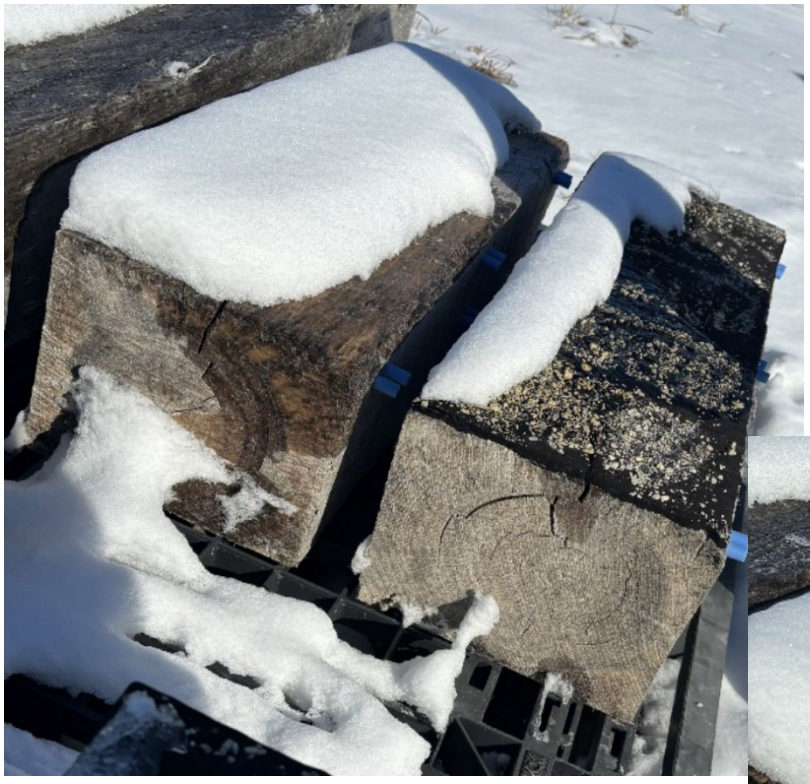
These two ends were once connected before the original, untreated tie was cut in half. The checks in the uncoated tie have expanded into a wide split due to UV and water damage. The coated tie remained sealed from the top, protecting the wood from top-down exposure to weather.



Uncoated Tie left Vs. Tietan Coated Tie right



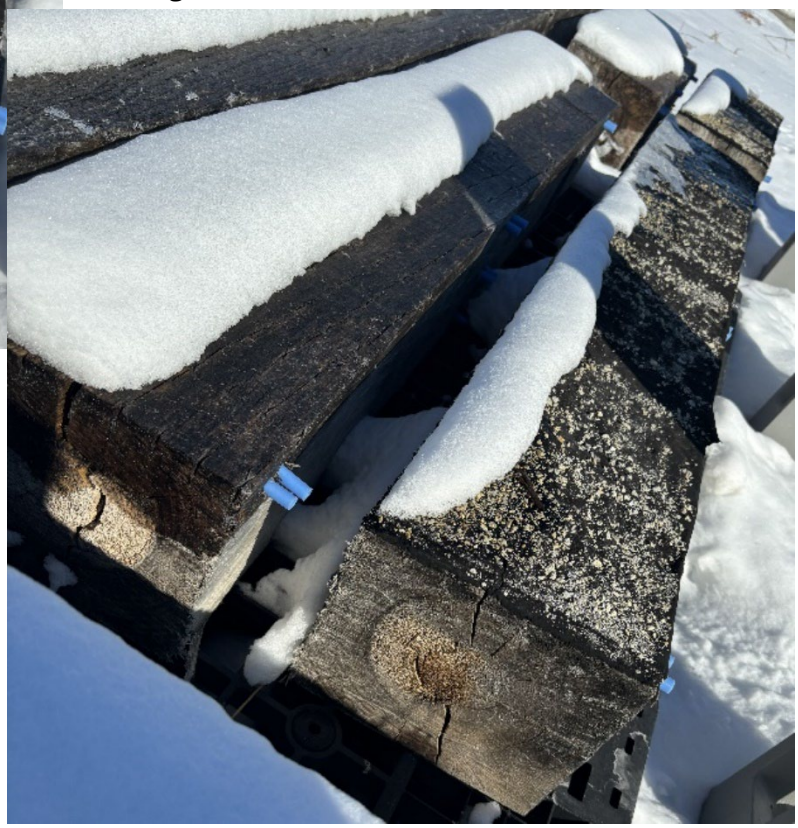
Ties Exposed to Snow



¼ Length Ties: Uncoated vs. Tietan Coated

Look at the ends of these two sets of uncoated and coated ties. In the uncoated specimens, the snow melt has deeply saturated the wood, compared to the dry wood of the Tietan ties.

½ Length Ties: Uncoated vs. Tietan Coated



Asphalt Coating for Tie Protection

The results of outdoor weathering emphasize how a Tietan protective coating can make a significant difference in the aging of the wood. While chemical preservatives are necessary for wood tie longevity, ties are still deteriorating at an unsustainable rate.

Tietan serves as a supplemental roof for chemically-treated ties, similar to how asphalt shingles protect a house. By coating ties with a flexible waterproof shield, pending cracks, checks and splits are sealed, preventing water from working its way past the chemical preservative into the heart of the wood. The asphalt coating also protects the preservatives from degradation by the wear and tear of the elements so they can do their job for longer.

The Cause of Tie Deterioration

Outdoor weathering shows that untreated ties can deteriorate rapidly. Water and UV radiation each threaten wood's mechanical integrity, and their combined effect with temperature accelerates dimensional changes and ultimately cracking. This observation is supported by published research:

- "*UV weathering causes surface degradation of wood. Additionally, the wetting and drying of wood through precipitation, diurnal and seasonal changes in relative humidity, abrasion by air particulates, temperature changes, atmospheric pollution, oxygen, and human activities, all contribute to the degradation of wood surfaces.*"

  -BioResources, NC State University[7]

- "*It is the absorption of solar UV radiation by lignin in wood that initiates the degradation and discoloration often accompanied by surface cracking.*"

  - Photochemical Photobiological Science[1]

The Impact of UV Radiation on Wood Surfaces

UV radiation is shown to initiate the degradation of wood materials by breaking down wood's primary chemical components—lignin, cellulose, hemicellulose and extractives—through photooxidative reactions. Lignin, a major component of wood cell walls, is a strong absorber of UV light. Routine absorption of solar UV radiation leads to the loss of both aesthetic and mechanical properties (Polymers Journal[3]).

The weathering process is a "*complex combination of chemical and mechanical factors*". For a detailed understanding of wood photodegradation, explore this published study: Structural changes in wood under artificial UV light irradiation[7]. This process contributes to discoloration, surface cracking and structural weakening, ultimately reducing wood's durability and service life (Photochemical Photobiological Science[1]).

Anecdotal evidence has shown that wood ties in tunnels perform significantly better than their counterparts exposed to sun and rain.

Understanding How Moisture Affects Wood Ties

Wood holds moisture in two ways: As *free water* in the cell cavities - the lumina - and as *bound water* held chemically inside the cell walls. The *fiber saturation point* (FSP) describes the level of moisture at which the cell walls are completely saturated by bound water, but there is no excess free water in the lumina. Think of a sponge that has been completely wrung out but still feels damp. The average FSP is typically 25-30% for most tree species. Dimensional changes in wood occur as the bound water is removed.

Essentially, the ebb and flow of bound water is what causes the natural contraction and expansion of wood (NWFA Technical Standards & Publication Committee[4]).

Wood is hygroscopic, meaning it naturally absorbs and releases moisture from the surrounding environment to reach equilibrium. However, with excess water above the FSP from rainfall and snow melt, moisture can open up a vulnerability to fungal attack. Wood decay is due to fungal spore growth in wood tissue under specific temperatures and moisture contents. Research shows that fungal spores do not easily germinate in wood when the moisture content is below the FSP of 25-30%. Wood can be considered immune to fungus when the moisture content is below 20% (National Research Council Canada[2]). Therefore, by eliminating excess free water from entering the cracks, checks and splits in wood, ties have a much better chance of avoiding oversaturation and decay.

Decay exponentially impacts tie strength. As studies show, "*Wood decay weight loss as little as 2% may be undetectable visually but can result in as much as 30- 50% strength loss*" (UTIA Institute of Agriculture[6]).

Moisture Content Fluctuation Study

The uptake of water into the wood fibers, coupled with the release (drying) of excess water, generates significant stress within the wood structure. The resultant strain is seen in cracks, splits, and checks in the wood.

A 2025 study demonstrates the ability of the Tietan coating to reduce levels of water uptake and release by 34% on average (RIS[5]). By offering the tie a more stable moisture content, stress and strain on the wood fibers can be minimized, reducing the development of cracks, splits and checks.

How the Asphalt Coating Works

Tietan eliminates the threat of UV and water damage from the top surface of the tie. For crossties, it is applied hot and seeps into existing openings in the wood prior to cooling, forming a durable and flexible membrane that will bond with solvent-based treatments like Creosote, Cu-Nap and DCOI. The hot asphalt is immediately covered with aggregate for slip resistance. Alternatively, it can be applied in a pre-formed pad, acting as a roof for the tie. Over time, the engineered asphalt flexes with the natural expansion and contraction of wood, ensuring a protective layer to extend the service life of wood ties.

Want to learn more about this solution to premature tie deterioration?

Visit Tietan.com or reach out to Erin Meehan at emeehan@tietan.com or Buddy Clark at buclark@tietan.com

Tietan is developed in the labs of the Heritage Research Group, and owned and distributed exclusively through Railway Innovative Solutions, LLC, a company of The Heritage Group.

Resources

1. Andrady, A.L., et al. (2023). *Effects of UV radiation on natural and synthetic materials*. **Photochemical & Photobiological Sciences**.
2. Baker, M.C.(1969). *Canadian Building Digest No. 111 – Decay of Wood*. **National Research Council Canada**.
3. Gržan, T., et al. (2023). *UV Irradiation of Wood Surface: Bonding Properties*. **Polymers**, 15(11), 2552.
4. National Wood Flooring Association (NWFA). (2017). *Moisture and Wood. Technical Publication No. A100, 2nd Edition*. **NWFA Technical Standards & Publication Committee**
5. Railway Innovative Solutions, LLC (RIS). (2025, July 29). *An Examination of Wood Tie Failure: And the Protective Capabilities of an Asphalt Coating*. **Tietan**.
6. Taylor, A., et al. UT Extension, Institute of Agriculture, The University of Tennessee. (2023). *Best Practices for Handling Crossties -PB1833*. **UTIA Institute of Agriculture.**
7. Teacă, C.-A., Roşu, D., Bodîrlău, R., and Roşu, L. (2013). *Structural changes in wood under artificial UV light irradiation determined by FTIR spectroscopy and color measurements* - A brief review, BioRes. 8(1), 1478-1507.**BioResources, North Carolina State University**.