



Tropical hardwoods are increasingly popular for exterior applications due to their highly attractive appearances, exceptional durability, and certifiable sustainability. Shown here is batu hardwood creating a sign band facade area that is held in place with resilient rain-screen clips and finished with polymerized tung oil in black walnut.

# Technology and Trends in Sustainable Tropical Hardwoods

New products for fastening and finishing systems ensure ease of installation, low maintenance, and beauty

Sponsored by Nova USA Wood Products LLC

By Peter J. Arsenault, FAIA, NCARB, LEED AP, and Stephen A. Getsiv

**T**here is no substitute for the natural beauty of newly installed tropical hardwood; but keeping it looking great and achieving the desired performance over time requires careful attention to detail. Choosing the best hardwood species and specifying the appropriate fastening and finishing systems will ensure an aesthetically pleasing, low-maintenance and successful design in terms of installation, performance, and appearance.

Anyone with experience in working with wood quickly discovers the diversity between the individual species. Each one has unique properties which determine the suitability for different uses. There are many great choices when it comes to selecting a species of wood for decking, siding, trim, and finish work. Hardwoods harvested from tropical locations around the world have become a popular choice

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### Learning Objectives

After reading this article, you should be able to:

1. Identify the characteristics of sustainable tropical hardwood options related to appearance, durability, and other performance issues.
2. Investigate the different tropical hardwood options available from different locations around the world.
3. Recognize the different sustainability certifications that are applicable to the selection of tropical hardwood.
4. Specify sustainable tropical hardwood, including the means for installation and finishing based on best practices.

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because they provide very desirable traits related to appearance and natural durability, especially for exterior use on buildings. However, architects looking to use tropical hardwoods in buildings often receive conflicting and contradictory information regarding characteristics, sustainability, and even legality of different tropical wood species. Once a suitable species is determined, questions will certainly arise on the best practices for installation and finishing.

Overall, this course will provide the key information needed to specify the species, installation, and finishing of tropical hardwoods to get the best results possible in conventional or green and sustainable buildings. The course will introduce the latest technologies in both fastening and finishing systems, as well as present a wide variety of product options available in common species of tropical hardwoods. Lastly, the course will review some of the international programs that are used to successfully determine sustainability.

#### NATURAL BEAUTY AND DURABILITY: THE AMAZING DIVERSITY OF TROPICAL HARDWOODS

Naturally durable tropical hardwoods have exceptional strength, hardness, and beauty. There is no comparison in terms of performance and quality of wood fiber. Producing long length and relatively defect-free lumber, tropical hardwood trees grow tall and straight in the most lush and verdant climates on the planet. Imported primarily from South America and



**Stunningly beautiful and incredibly hard, guajuvira is also known as Brazilian hickory. This species of tropical hardwood is typically used for interior flooring.**

Southeastern Asia, these naturally durable tropical hardwoods have grown in popularity over the past few decades.

The tropical hardwood market today includes a wide variety of incredible woods. Ipe may be the most well-known, but there are plenty of other sound choices when it comes to rot-resistant, durable tropical hardwoods. From South America, cumaru, garapa, masaranduba, tigerwood, and even purpleheart have been used in exterior applications. From Southeast Asia, merbau, yellow balau, and red balau, or batu, are all rot-resistant choices. In fact, our tropical rain forests have hundreds of commercially marketable species that are uniquely beautiful as well as naturally durable.

All of these woods can be used successfully in exterior applications. The key is to understand the potential issues and design accordingly.

Tropical hardwoods first started showing up on outdoor decks, where they provided a significant upgrade in appearance and longevity when compared to other wood species and composites, including softwood materials that were finished or treated with preservatives. These hardwoods soon caught on for use as exterior siding and rainscreen cladding. Additionally, these durable hardwoods started to be used for wood trim, soffits, and exterior wall panels instead of other more costly materials. Tropical hardwoods are also being fabricated into outdoor furniture and structural timber framing due to their pleasant appearance, durability, and longevity in outdoor environments.

Tropical hardwoods have similarly been used for many years as interior flooring. It makes perfect sense that some of the most beautiful and hardest woods in the world are sought-after for interior flooring.

#### CRITICAL SUCCESS FACTORS IN DESIGNING WITH TROPICAL HARDWOODS

Successful designs with tropical hardwoods require paying close attention to the installation and finishing details as well as a complete understanding of the particular species of hardwoods that are specified in the project. The most common mode of failure is not designing to accommodate the natural expansion and contraction of wood due to moisture exposure and varying humidity levels. This situation is easily avoidable by specifying the proper fastening system, ventilation, and even finishing—which helps prevent moisture from penetrating the wood unevenly.

The latest technology in hardwood installations is the use of resilient fastening systems. Recognizing that in exterior conditions wood will continue to shrink and swell with humidity changes over the seasons, at least one company has produced an attachment system that accommodates this natural movement. These resilient clip systems also help make installation faster and easier.

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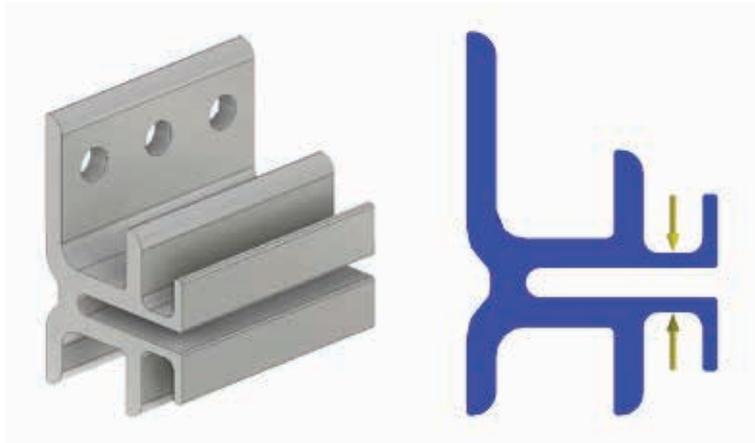
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Naturally durable tropical hardwood is an ideal choice for decks and outdoor living spaces because of its strength and ability to hold up against the weather. (Supplier: POCO Building Supplies, Contractor: Houston Landscapes)



Nova is a direct importer of premium-quality hardwood products with distribution throughout North America. Specializing in flooring, decking, siding, rough lumber, and industrial products, Nova thrives on creating real wood solutions that include the finest in architectural-grade wood products, innovative fastening systems for siding and decking, and ExoShield premium exterior wood stain. [www.novausawood.com](http://www.novausawood.com)



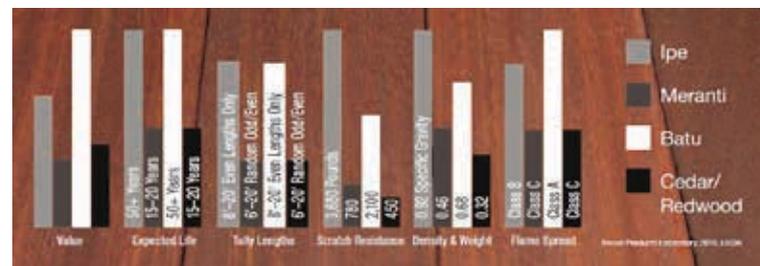
**Resilient clip systems for attaching rainscreen siding accommodate the natural movement of wood as it shrinks and swells with changes in moisture content.**

Another common complaint is just how quickly a beautiful hardwood installation begins to weather. Low-quality linseed oil finishes offer next to nothing to protect the material and do little to help keep the wood looking beautiful. Significant color degradation can be seen in as little as three months after installation. Finishing systems have improved massively over the past few years to include nanotechnology water-based products, synthetic oils, and tung oil products. Featuring ultraviolet (UV) rays protection and color retention, these new finishing products have been shown to keep projects looking fresh for notably longer.

## Selection Criteria and Issues

You don't need to have years of experience or a forestry degree to select and specify tropical hardwoods. However, some basic knowledge is helpful to avoid confusion. Let's delve into more detailed information regarding specific characteristics and species of tropical hardwood.

**Durability:** The degree of durability can and does vary between different tropical hardwoods. Some are very durable and rot resistant, while others, even though they may be dark in color and heavy, are not rot resistant at all. One of the most popular hardwoods used for exterior decking during the 1990s and 2000s, primarily in the Northeast United States, was cambara (*Erisma uncinatum*). These decks tended to rot and decay within only 10 to 15 years, similar to a tight-knot cedar or redwood deck. Red meranti, another very popular species used primarily in the Northeast and Mid-Atlantic regions of the United States, is actually a mix of individual species within the shorea genus—and many of these species are not durable at all. Therefore, it is absolutely critical to specify, preferably by the complete scientific name, a durable species of tropical hardwood. Checking the supplier's warranty against rot and decay is a prudent measure as well.



**Know your options when specifying hardwoods. It is very important to compare durability, hardness, and strength, as well as fire ratings and length availability.**

**Appearance:** Like all hardwoods and softwoods, the natural color in tropical hardwoods can vary significantly within a single species of wood. Ipe, for example, has a wide range of colors, from dark brown to olive green to deep red. When left unfinished in exterior conditions, all of these tropical hardwoods eventually become gray or silver.

**Texture:** The texture of some tropical hardwood species can become rough over time. This change in texture is referred to as raised grain and is common in some woods, such as cumaru. This is an especially important consideration for exterior decking, particularly if there will be people walking barefoot on the deck. Frequent pressure washing will exacerbate the problem, which can generally be mitigated by sanding after pressure washing.

**Tannin bleed:** In a few particular species, tannin bleed can be a major issue. With merbau, for example, tannin bleed is dark blood red—clearly not a good choice for your clients that like to dress in whites. A typical second-story deck open to the ground below will stain everything underneath the structure.

**Stability and movement:** When timber is initially cut, it is called unseasoned or “green” wood, meaning it has not undergone any drying treatment and contains a high moisture content (MC). Once the cut wood dries below its fiber saturation point, it begins to shrink as its MC decreases. There is a direct linear relationship between shrinkage and MC below fiber saturation. Conversely, when dry wood is exposed to rain or humidity, it will absorb moisture, and the wood will swell.

The vast majority of customer complaints are the result of wood products either taking on moisture and swelling or losing moisture and shrinking. The boards on decks built too close to the ground, without adequate spacing edge to edge or adequate ventilation on the underside of the deck, will likely cup, buckle, and warp. Most hidden fastener systems for decking do not allow for swelling of boards after installation.

Some tropical hardwoods, like massaranduba, are known for their high movement with changes in the MC, while others move much less. This is important when attaching wood to a structure since hardwood movement based on moisture changes has been measured to exert upward of 10,000 pounds per square inch of pressures. That amount of pressure has been known to push decking off its supports or even bend and shear some fasteners.

Since wood is dimensionally stable with changes in temperature, swelling and shrinkage in tropical hardwoods is therefore a direct result of changes in moisture content in the wood. Hence, all installations must have adequate spacing, fasteners that accommodate that movement, and adequate ventilation.

**Checking, warping, and cupping:** All tropical hardwood species will exhibit some degree of checking, cupping, and warping when allowed to fluctuate from very dry to very moist conditions. The best way to minimize this movement is to slow the flow of moisture into and out of the boards, which requires waxing end cuts and coating all sides with a high-quality finish.

**Common names vs. scientific names:** Understand that even though tropical hardwoods may have the same common name, they can be vastly different. Tropical hardwoods are called by many different names. Some common names like mahogany or meranti are used as a broad reference to include hundreds of different species of wood. Therefore, it is important to identify wood by the genus and species. Doing so will ensure the wood specified will have the desired characteristics.

## **CHOOSING TROPICAL HARDWOOD SPECIES**

Recognizing the above criteria, we will now look at two of the most common species of tropical hardwoods that exhibit exceptional characteristics and very minimal undesirable qualities.

### **Ipé from South America**

This is perhaps the best-known and most publicized tropical hardwood. Ipé (pronounced ee-pay) is a very dense, non-buoyant wood with excellent durability. Dense wood is appealing because density is associated with strength and hardness. Another great quality is that it can survive for 50-plus years with very little maintenance when compared to other hardwoods. Ipé has a high tannin content, allowing it to remain very rot resistant and maintain an attractive appearance. It's also great for decks exposed to direct sunlight because wood conducts heat slower than PVC decking, meaning that it remains cool to the touch for longer.

### **Is Ipé Sustainable?**

Ipé clearly sounds like a great choice, but it also appears that it has become a victim of its own success. The difficulty of cutting and milling this very hard wood combined with high demand means that it comes with a comparatively high price. That high demand has also led to some concerns with

sustainability due to over-harvesting. Increased harvesting has been high enough in recent years that there is speculation that it may soon be listed as a threatened species by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). This is an international agreement between governments whose aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. This pending designation has caused inconsistent availability and very high market prices. Going forward, ipé may not be a sustainable or cost-effective viable option.

### **Batu as an Alternative Tropical Hardwood to Ipe**

Based on the discussion above, there has been a trend to use other tropical species that are more available, more sustainable, and still very appropriately suited for use as decking, siding, and other exterior applications. One of these alternative species is a tropical hardwood referred to as batu, which is emerging as a preferred and highly available choice. The name batu is the generic or local name given to red balau, which is in the Dipterocarpaceae family, the *Shorea* genus, and the guiso species.



**Batu/red balau is an attractive tropical hardwood that is available in a wide variety of sizes and shapes.**

Batu has sometimes been grouped in with “mahogany decking.” This designation is based more on its red coloring and straight grain than its natural strength and durability. For example, red meranti is a group of species, sometimes called Philippine mahogany, which is naturally found in Southeastern Asia, specifically in Malaysia, Indonesia, and the Philippines. The heartwood of meranti trees is considered only moderately durable, and it can have a much wider range of coloration than batu. Similarly, cambara is another medium-density wood sourced from South and Central America. The heartwood is typically a uniformly dull pink, pinkish brown, or golden brown. It is important to note that neither meranti nor cambara are derived from the same family of trees as genuine mahogany. Genuine mahogany (*Swietenia macrophylla*) is not readily available in typical decking or siding boards and is prohibitively expensive for exterior applications. Plantation

mahogany, primarily grown in the island of Fiji or Honduras, is more available but lacks the strength and stability of natural forest-grown genuine mahogany. The generic grouping of batu as a mahogany has caused confusion since batu is the only durable species in this group.

The key point here is to do the research and be sure to specify a truly durable species of wood. Avoid meranti, Philippine mahogany, cambara, and plantation mahogany, and in all cases, check the supplier's warranty against rot and decay. In this light, genuine batu is often selected as the preferable choice.

### **Batu Traits**

Batu is currently imported into the United States by at least a half dozen different importers from forests in Indonesia and Malaysia. Most people compare it to ipé and point out several shared characteristics. Batu shares a high density and hardness but is easier to work with than ipé. It will also last 50 years or more but is a lighter-weight and more color-consistent product. It is readily available in a wide variety of sizes and is cost effective, typically being quoted at 30 percent less.

While the price alone can make batu more appealing than ipé, it also has some other desirable qualities that set it apart. Consistent color and grain are probably the most notable from a design standpoint. Its natural, reddish-brown tone can be preserved or allowed to weather to lighter tones that are all very visually appealing. In terms of durability, it is rated in the highest durability class of hardwoods with very good scratch resistance. It also achieves a Class A fire rating—the highest tested rating for tropical hardwoods. In order to address stability from moisture movement, batu is commonly kiln dried whenever it is used for a wood construction product.

Because batu is typically kiln dried and somewhat less stable than ipé, it cannot be used as a direct replacement for ipé in close-to-ground or close-to-water decking applications. A minimum of 36-inch clearance is recommended by most suppliers for 1x6 and 5/4x6 nominal boards, and 16 inches of clearance is required for 1x4 and 5/4x4 boards.

Another notable difference of batu is that it doesn't have the same sustainability concerns of ipé. It is readily available from forests that are sustainably harvested with full chain-of-custody documentation. Note that species identification is important here since there are literally hundreds of species of wood under the Shorea genus, many of which are critically endangered. Hence, verifying that the wood is only sustainably harvested and legally verified as batu (red balau) is significant.

## **INSTALLING TROPICAL HARDWOOD**

Once tropical hardwoods are selected, certified as sustainable, and delivered to the construction site, they need to be installed in a manner suitable to the material. Since most of them are denser and stronger, the installation tools and techniques used need to match the characteristics of the wood. Some recommended best practices are listed as follows.

### **Storage and Handling**

For best results, tropical hardwood should be specified to be kept out of direct sunlight and not exposed to weather before installation. Once it is delivered to the job site, the material should be kept off of the ground by placing a few pieces of lumber underneath the stack. Cover the material with a tarp to protect from sun damage and rain. Note that air-dried hardwood must be allowed to acclimate to the ambient humidity and moisture content on the job site prior to installation. By contrast, kiln-dried hardwood can be installed after a few days of acclimation.

## **Deck Installations**

One of the very common uses for tropical hardwoods is for outdoor decks. Generally, in coordination with applicable codes, 1x4 and 1x6 decking are commonly installed when joists are spaced at 16 inches on center. When joists are spaced 24 inches on center, 5/4x4 or 5/4x6 decking can be installed. If installing the decking on an angle, joist spacing should be 12 inches on center for best results. The spacing between the deck boards will depend on whether kiln- or air-dried wood products are being used. For kiln-dried decking, spacing between boards should be at least 3/16 inch for 4-inch decking and 1/4 inch for 6-inch decking. For air-dried decking, the wood must acclimate on the job site until the material is approximately 18 percent moisture content first. Then the spacing can be set between boards at 3/32 inch for 4-inch decking and 1/8 inch for 6-inch decking. This space between boards will allow for air circulation, room for expansion, and provide for the proper spacing as boards become fully seasoned.

In regards to ventilation under the deck (i.e., ground side), the deck surface should be at least 16 inches above the ground (or a roof deck if installed there) when using 1x4 or 5/4x4 decking material. When using 1x6 or 5/4x6, the deck should be constructed a minimum of 36 inches off the ground. These heights are recommended because there must be adequate air circulation underneath the deck in order to prevent cupping and warping of boards. In locations that are closer than 16 inches to the ground or a deck below, only 1x4 or 5/4x4 boards are recommended. Further, the spacing of the boards should be increased by at least 1/16 inch up to 1/4 inch total between boards. Additional clearance is recommended in locations that are over wet areas or water. In close-to-ground applications, 60 inches or less above the ground, a vapor barrier is necessary to prevent moisture from absorbing into the underside of the decking boards.

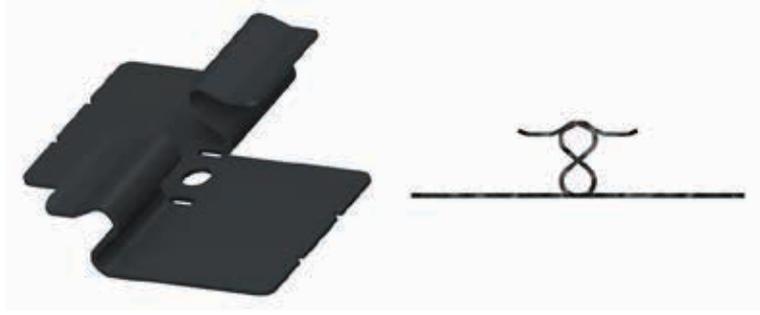
## **Exposed Decking Fasteners**

Several different options are available for fasteners and for fastening techniques. It is recommended that stainless steel screws are used, installed through the face of every board with two screws per joist. Pre-drilling is always required on the ends of the boards and may be needed and preferred in between. A countersink drill bit with a positive stop should be used to ensure that all screw heads end up at a consistent depth. The fasteners can be pre-lubricated for easiest penetration and assembly. Note that self-tapping stainless steel screws are available but may still require pre-drilling. The use of non-stainless fasteners is not recommended because they will cause discoloration near the fastener. In particular, do not use carbon-steel screws. Stainless-steel screws will bend somewhat, allowing the wood to move with changes in moisture content as opposed to carbon-steel fasteners, which can snap due to stress from swelling and shrinkage. Several manufacturers sell a system for countersinking the screws and then plugging the hole with the same species of hardwood; this creates a nearly invisible fastening system.

## **Hidden Decking Fasteners**

The only hidden decking fastener systems recommended for tropical hardwood use are those that allow for the natural expansion and contraction of the wood as it takes on seasonal moisture. When the proper hidden fasteners or clips are used, no face drilling or attachment is needed, which allows for a cleaner finished appearance and avoids undue stress from movement being transferred to the screws and substrate or framing. Deck clips made of metal and not plastic that specifically provide some resiliency (i.e., allow for movement and bounce back) are the only ones for which some wood product

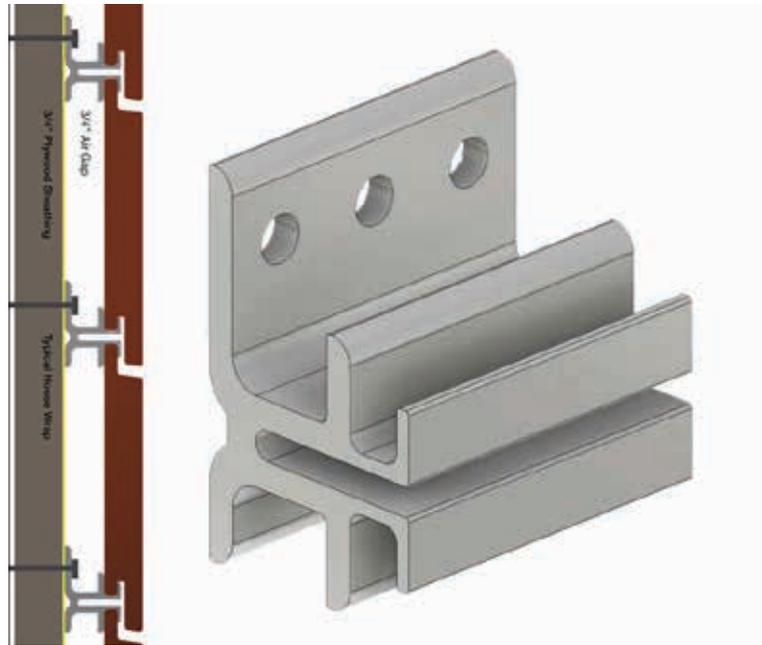
suppliers will recommend and provide a warranty. At least one supplier has developed its own superior clip that is made from heat-treated stainless steel and has the built-in resiliency as part of the design. Other hidden fasteners, or any other mechanical fastening systems, including those that fasten from the underside or edges of the boards, do not perform as well. Despite manufacturers' claims, it has been determined that these types of products do not provide adequate anchoring of hardwood deck boards to the substructure. They also don't always allow for the proper spacing and movement.



**Hidden fasteners that provide enough resiliency to move with the natural expansion and contraction of wood based on moisture content are the only type of fastener recommended by some suppliers for tropical hardwood decks.**

### **Siding Installations**

Tropical hardwood is available in traditional siding profiles as well as profiles suitable for rainscreen siding applications. For rainscreen installations, siding is commonly run horizontally using 1-by-6 siding boards. To function properly, a gap of approximately  $\frac{3}{4}$  inch is needed between the siding and the sheathing, which is typically covered with an air barrier and a water-resistive barrier. To create that gap and hold the siding in position, a metal clip is the recommended best practice. Other methods, such as furring strips or channels, don't have the same durability or capability to accommodate the tropical hardwood material.



**Rainscreen siding clips that are non-penetrating, specifically designed for tropical hardwood, and allow for movement are highly recommended.**

The issues of mounting rainscreen siding properly are much the same as installing decking properly: allowing for the natural movement of the wood due to expansion and contraction from moisture content changes. As such, the clips that are used to hold the siding in place should be non-penetrating and provide the same resilient qualities as the deck clips discussed already. The best ones are made from marine-grade extruded aluminum and attached using exterior grade screws. Regardless of the siding installation technique, it is clearly worthwhile to use high-quality fastening products that won't stain or deteriorate so they last at least as long as the tropical hardwood itself.

#### **FINISHING TROPICAL HARDWOOD**

The final step for any wood-based installation is the finishing. As with most other species, there are choices and recommendations for how this is best done for tropical hardwoods. This starts with some general recommendations about proper job-site storage, as noted earlier, so that the wood has the chance to acclimatize before being finished. If the wood is kiln dried, it should be ready to receive finish quickly. If it is air dried, proper seasoning will be needed to under 15 percent moisture content in order to accept a finish. (This typically only applies to ipé since virtually all other tropical hardwoods are sold as kiln-dried.)



**Finishing tropical hardwoods with a high-quality tung oil blend has been tested and found to provide the best results for preserving the character and visual appeal of the wood. This tigerwood outdoor dining table, fully exposed to the weather year around on a south-facing deck in Portland, was finished 22 months before this picture was taken and has had only two light maintenance coats since then.**

Part of the reason that tropical hardwoods are used on exteriors is their natural appeal in their color and grain texture of the wood. In many cases, that means that there is a desire to leave the wood unfinished. The hardwood itself will hold up just fine without finishing, but its appearance will change. The ultraviolet (UV) rays of the sun will lighten the color over time, generally turning the wood to a light shade of grey or silver. Further, weathering and usage, particularly on horizontal deck surfaces, may cause other unwanted conditions such as raised or rough grain and/or surface checking. Therefore, it is recommended that at least one coat of a penetrating oil is applied to tropical hardwoods to provide some protection to the wood and help preserve its initial unfinished appearance. Installing the hardwoods without any such finish coat may cause refinishing issues in the future if the original color is desired. In particular, it will likely require deep pressure washing or sanding of the entire surface.

Conversely, some people assume that they can use a semitransparent or solid body stain on tropical hardwoods the same way they do on softwood lumber. While those stains may be composed with a penetrating oil, they also permanently change the color and appearance of the wood. This is assuming that they actually penetrate the wood and don't end up forming a surface layer or film, which will most certainly flake after prolonged exposure. As such, they essentially negate the aesthetic reasons to use tropical hardwood in the first place. There are much less expensive woods that can be used if a solid stain color is desired. Hence, semitransparent and solid body stains are virtually never used on tropical hardwoods.

The best practice for finishing tropical hardwoods is to use a high-quality penetrating oil. However, not all oils are alike. Linseed oil (vegetable oil) finishes are popular because of their low cost. However, they do not perform well, and weathering can generally be observed within just a few months of exposure. Performance is not consistent due to variations in the levels of UV blockers and polymerization of the oil itself. Long-term maintenance issues are common with linseed oil finishes. Most importantly, each refinishing will require a deep pressure washing or sanding in order to remove the graying or weathering that has occurred.

A preferred alternative to linseed oil is tung oil, which is a natural, sustainable oil made from the nuts of the tung tree, known to grow mainly in China. It has natural qualities that allow it to penetrate deep into the wood and harden as it dries to help prevent checking and cracking of the wood. Nonetheless, it remains flexible enough to move with wood as it naturally expands and contracts. It also provides a good degree of water resistance for the wood and, as such, should be applied on all sides of each board. (An alternative for non-exposed sides of decks and siding is to use a wood wax on those back sides of the wood.)

Recognizing the value of tung oil, at least one manufacturer has developed a high-quality, low-VOC, marine-grade finish that starts with pure tung oil and adds some important enhancements. Premium-quality transparent iron-oxide pigments are used to not only help preserve the natural color and grain of the wood but also provide excellent UV protection. High-quality UV blockers, similar to use in automotive finishes, are also added to the mix in order to maximally protect the wood from color fade. A fungicide is added to help prevent fungi or mold from ever growing on the wood. This type of finish is competitively priced on a square-foot basis since it covers about twice as much as other lower-quality wood finishes, approximately 600–800 square feet per gallon. It is designed to be applied in one coat and has been shown to last longer than other transparent finishes. When it is time to refresh the finish, no sanding or pressure washing is needed, just a general cleaning of the surface to remove any dirt, dust, pollen, etc. Of course, the manufacturer's instructions should be followed in all cases.



Tung-oil-based finishes specifically designed for premium-quality protection of tropical hardwoods are recommended to enhance color, provide UV protection, and fight fungus and mildew. Tung oil by itself will develop stain and mildew; the key is to use a polymerized tung oil finish with all the right additives for long-term protection.

## EXTERIOR HARDWOOD FINISHES

The two most common wood stains are film-forming and penetrating oil finishes. Although the finishes may look similar at first on wood, they differ vastly in breathability, longevity, and upkeep.

### Film Forming Finishes

A film-forming finish creates a coating or “film” on top of the wood surface. This coating helps protect the wood by reducing the effects of weathering. These finishes can be painted or sprayed on and need to be stripped and reapplied at the first sign of bubbling or cracking. Film-forming finishes are commonly used on interior furniture, away from the elements. Since the finish does not penetrate the wood, the natural occurrence of expansion and contraction will create cracks in the film, eventually peeling. The cracks and peeled finish expose the unprotected wood to moisture and sunlight, causing advanced deterioration. Hence, film-forming finishes are not normally recommended for use on exterior tropical hardwood.

### **Polyurethane Finishes**

Polyurethane finishes (sprayed or brushed on) are commonly used on cabinets and furniture. Inside a building, these types of finishes can last longer because there is not a high variability of moisture and therefore the wood is not moving as much. Polyurethane finishes should never be used on exterior decks, wood siding, or exterior furniture.

### **Marine-Spar Varnish**

Sailors have historically needed something to protect their boats while allowing for the natural flexing of wood being exposed to sun, salt, and water. Oil was added to a solvent and resin to create a flexible varnish that could expand and contract. Although developed with the aquatic life in mind, marine-spar varnishes only create a barrier between the wood and the water. Many marine-spar varnishes on the market today act like saran wrap that needs to be frequently reapplied to prevent peeling. Marine-spar varnishes can be a useful tool in aquatic applications if selected, applied, and maintained properly.

### **Penetrating Oil Wood Stain**

Penetrating oil wood stain is a type of finish that absorbs into the wood and does not fail as often or as quickly as film-forming finishes because it allows the wood to move. This type of stain is typically the best for exterior furniture because it does not peel or flake off over time. Even a low-quality penetrating oil will simply grey out or weather over time. Care is needed though, since over-applying a penetrating can turn it into a film-forming finish that has the potential to peel or flake off over time. In order to apply penetrating oil over a previously applied film-forming finish, the old finish will need to be sanded off. Once cleaned down to bare wood, then the new penetrating oil wood stain can be applied.

### **Premium-Quality Pure Tung Oil Stain**

The most advanced, penetrating oil wood stain available uses pure tung oil as its base. Additional treatments are added to prevent any fungal or mildew growth, protect from UV rays in sunlight, and provide other enhancements. This type of oil stain provides superior protection for exterior wood applications, such as decking, siding, and outdoor furniture. It is guaranteed by the manufacturer to look good for at least two years, at which point a simple recoating is all that is needed (i.e., no sanding or pressure washing required).

## **SUSTAINABLE WOOD FOR EXTERIORS**

Wood has been widely recognized as a renewable, natural material that has less embodied energy than other building materials. Embodied energy is defined as the amount of energy that a product requires from the point of extracting the raw material, through its processing or manufacture, and its final transportation to a construction site. This so-called “cradle-to-gate” analysis of wood clearly shows that less energy is required to harvest, process, and transport wood products when compared with heavier, more energy-intensive building products, such as steel or concrete. Hence, wood is deemed to have less embodied energy as a product.

Recently, wood composite materials have been developed in response to reduced quality wood availability. These products have been presented as an alternative to solid wood products by combining wood fibers with synthetic fibers and resins. Wood composite materials have been touted as environmentally friendly since they can be made from recycled content. However, the correct recycled plastics can be difficult to source and sort, which often leads companies to resort to using newly created plastic to create a wood composite. If a company manages to find a recycled plastic source, it often includes petroleum-based plastics in its mix. In fact, there are many solid plastic PVC products containing no wood fiber at all. Most of these PVC and composites are not recyclable, eventually creating even more plastic waste. These products have a much higher embodied energy content than wood, reducing their environmental sustainability. Further, the structural support systems for PVC and composite decking and cladding must be carefully designed and constructed since they are not as strong as wood. Most notably, the plastic content makes these products expand and contract, especially in length, due to thermal conditions, whereas wood has a negligible amount of thermal movement.

## **LEGALITY AND SUSTAINABILITY FOR TROPICAL HARDWOOD**

Architects need to properly specify the type of wood for projects on our client's behalf, and therefore we need to reference reliable third-party sources who focus in these areas. When dealing with wood that comes from international sources, there are some specific specification criteria that can be referenced. First is to assure that it is being legally imported. This point is discussed as follows.

### **U.S. Lacey Act**

In the year 1900, the United States government recognized a need to prevent the trafficking of illegal wildlife and related items into this country. This recognition led Congress and President McKinley to sign into law the Lacey Act. In 2008, that law was amended to include plants and plant products that include timber, wood products, and paper. This was a landmark move, making the United States the first country in the world to ban trade in illegally sourced wood and plant products. This is now the minimum requirement that all wood imported into the United States must meet to be considered a legal import. As a result, and in compliance with the Lacey Act, a statement in architectural specifications needs to indicate that all wood from non-U.S. sources is legally imported.

The U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) is the agency charged with enforcing this law. It works with other organizations, such as the Fish and Wildlife Service (FWS) and CITES, to focus on two aspects of the law. First is the legality requirement. This means that any wood imported into the United States must have met all of the laws that exist in the country of origin of that wood. For example, if a particular country bans the cutting of wood in a particular area or of a particular type, it is deemed illegal and rejected from entry into the United States. Ignorance of the laws of those countries is not a defense and applies regardless of who did not comply (i.e., the importer, the exporter, the sawmill, the forester, or any other party). The second focus is on proper documentation for wood imports. This involves filing paperwork with APHIS that declares information about the wood, including the scientific name (genus, species), the value of the wood, the quantity in a shipment, and the country of origin where the wood was harvested.

The United States has a long history of effectively enforcing the Lacey Act. Penalties can be severe and include forfeiture of the shipment, significant fines, and even jail time for violators. The law recognizes different levels of violation as well as a standard of reasonable “due care.” This means companies or organizations involved in professions or industries directly related to wood imports are reasonably expected to know how to comply with all relevant laws. Those tangentially involved, such as shipping companies, can still be implicated but are not necessarily held to the same standard of due care.

### **Legal Wood per ASTM and LEED**

As a means to help the building industry with a resource to identify legal wood, a 2016 pilot credit was released by LEED as “a means to test LEED’s ability to address illegal wood in the building industry.” This pilot credit relies on ASTM Standard D7612–10: Standard Practice for Categorizing Wood and Wood-Based Products According to Their Fiber Sources as an objective basis to differentiate among 1) noncontroversial (i.e., legal) sources of forest products; 2) responsible sources of forest products (i.e., noncontroversial sources together with certified procurement systems or from forests managed using responsible practices); and 3) certified sources of forest products (i.e., noncontroversial sources together with a certified chain of custody). According to ASTM, the purpose of this standard and practice is “to provide wood products manufacturers, distributors, and retailers with a system to provide clear, objective information to communicate to consumers regarding product conformance to different wood-fiber tracing systems within specific forest management or certification programs. It provides a structure that segregates the different types of labels and tracing systems in use among major forest certification standards and other voluntary and regulatory standards governing the production of forest products.”

Under the LEED Legal Wood Pilot credit, (which is focused on legality more than sustainability), two of the three referenced categories are needed to meet the credit requirements. First, 100 percent of all wood is verified to be from legal sources as defined by ASTM D7612-10. These components include, at a minimum, structural framing and general dimensional framing, flooring, subflooring, doors, and finishes. Second, 70 percent of all wood (based on cost) used on the project is from responsible sources as defined by ASTM D7612-10. These components include, at a minimum, structural framing and general dimensional framing, flooring, subflooring, doors, and finishes.



**Tropical hardwood that is legal and sustainable is used on a variety of buildings in North America.**

### **SVLK (Sistem Verifikasi Legalitas Kayu)**

Some countries undertake their own programs to regulate and certify that wood being exported from their country is legal. A good example is the Sistem Verifikasi Legalitas Kayu (SVLK) certification, which is Indonesia's national timber legality assurance system. In order for any wood to be exported, this mandatory certification attests to its legality and can also indicate its sustainability, all based on a national multi-stakeholder consensus system. Since a good deal of batu hardwood is imported from Indonesia, this certification is important for that species.

Beyond legality, there are separate, independent organizations that look to higher standards of sustainability for wood. These organizations have typically identified three main criteria for sustainable wood. The first is to source wood that comes from an actively managed forest that uses sustainable practices, such as selective harvesting, natural regeneration, and minimal impact logging means. The second is documentation to identify the type of wood and trees that are being harvested and the precise locations where they were cut. Third is an established procedure to document a chain of custody that tracks harvested trees on their journey to a mill, through distribution, and ultimately to a construction site. All of these are important because it means there is independent, verifiable information that the wood used in a building comes from legitimate and sustainable sources rather than poorly managed or clear-cut forests. All of this is directly relevant to the environment because actively managed forests sequester more carbon dioxide and help reduce the amount of greenhouse gasses in the atmosphere. Then, ideally, we need to increase the overall footprint of well-managed, sustainable forests not just for wood sourcing but also for the health of the planet.

Some of the organizations involved in sustainable wood are summarized as follows.

### **The Forest Stewardship Council**

The Forest Stewardship Council (FSC) is probably the best-known reference for sustainable forest management, wood harvesting, and delivery of wood products. In part, this is because it is the only organization that has been recognized by the U.S. Green Building Council for LEED certification. This has not been without some controversy since there are other organizations that

provide similar functions and are more common in certain parts of the world. Nonetheless, it is common to specify wood that is FSC certified and request chain-of-custody documentation indicating that the wood delivered to a project site has indeed been tracked all the way back to a certified, sustainably managed forest. This has worked well for softwood lumber in the United States and Canada, but since FSC has a smaller presence in places like South America and especially in Southeast Asia, it should not be the only organization considered for tropical hardwood certification—it simply may not be available in certain parts of the world. It has been observed that the vast majority of LEED-certified projects have not pursued the credit for certified wood for any number of unknown reasons. Hence, not having FSC certification available may not be a deterrent in achieving LEED certification.

### **The Sustainable Forestry Initiative (SFI)**

The Sustainable Forestry Initiative (SFI) is also a well-known and recognized organization that operates in the United States and Canada. It offers standards that are updated periodically on the three main areas of sustainable wood products: forest management, fiber sourcing, and chain of custody. In addition, it provides rules and guidance on how SFI product labels should be used and procedures for identifying the products in written materials.



**The Programme for the Endorsement of Forest Certification (PEFC) is the largest forest certification system in the world.**

### **The Programme for the Endorsement of Forest Certification**

Lesser known in the United States, the Programme for the Endorsement of Forest Certification (PEFC) is an international, nonprofit, nongovernmental organization dedicated to promoting sustainable forest management through independent third-party certification. According to its website, “with 44 endorsed national certification systems and over 300 million hectares of certified forests, PEFC is the world’s largest forest certification system.” Unlike some other organizations, it works much more with small, nonindustrial private forests, with more than 19,800 companies currently holding PEFC chain-of-custody certification. The organization also points out that it “works throughout the entire forest supply chain to promote good practice in the forest and to ensure that timber and non-timber forest products are produced with respect for the highest ecological, social, and ethical standards.” It provides an “eco-label” that is earned so customers and consumers are able to identify products from sustainably managed forests. Further, it acts as an umbrella organization, for national forest certification systems in dozens of countries. In order to be certified under PEFC, each national forest certification system is subjected to rigorous third-party assessments to show compliance with PEFC Sustainability Benchmarks, thus assuring it meets international sustainability requirements.

## ONLINE PORTION

When designing with and specifying tropical hardwood, it is important to recognize that there are different standards available that can and should be referenced compared to those that are solely used for North American wood products. This is true whether the building project is pursuing LEED certification or not, particularly since the international standards are more relevant and may even be more stringent.

### **CONCLUSION**

Wood is a very desirable and sustainable building product. However, as concerns are raised over the use and availability of certain species, new ones are being sought out and increasingly used for projects of all types around the world. Architects seeking the natural appearance of wood for exteriors coupled with long-term durability are turning to many options in tropical hardwoods that are sourced and certified as sustainable by a variety of very credible independent organizations. In the process, they are creating appealing, sustainable, and durable buildings that their clients will enjoy for many years to come.