

American Hardwoods: Durable, Natural Products for Green Buildings

Designers appreciate the eco-aesthetics of this timeless material.

Hardwood floors, cabinets, furniture, and trim have brought warmth and beauty into the built environment for centuries. With more than 20 species offering aesthetics, sustainability, durability, and ease of maintenance, American hardwoods are a component of occupant-centered design and architecture, and part of the green building movement that is gathering steam in commercial, institutional and residential settings. Thanks to non-toxic cleaning products and wood finishes that are low in volatile organic compounds (VOCs), American hardwood floors and woodwork are increasingly specified in buildings where sustainability, low life-cycle costing and enhancing health and well-being are design priorities.

Hardwoods are deciduous trees with broad leaves; they produce a fruit or nut and generally go dormant in the winter. American forests grow hundreds of varieties of hardwood trees that thrive in this country's temperate climates. The most prevalent hardwood species in the United States is oak: Together, red and white oak represent 52 percent of all hardwood trees growing in U.S. forests.

For smart and cost-effective specifying of hardwoods, the first step is understanding their physical characteristics. The tree's newest wood, closest to the bark, is lighter in color and without knots or character markings. This is the highest grade, most expensive lumber. The oldest wood toward the center of the tree is darker, denser and more character-marked. Eco-effective designs make fullest use of both clear and character-marked wood and reflect the tree's entire history. By using only wood that is free of knots and other visible marks, designers not only miss opportunities for visual richness, but also significant ways to reduce costs.

American hardwoods are temperate and prized for the wide variety of their grain patterns. Distinct growing seasons produce annual growth rings and thus characteristic grain patterns when the log is

sawn into the lumber. In contrast, tropical species do not have distinct growing seasons and as a result the planks are more visually uniform and patternless.



Learning OBJECTIVES

Interiors & Sources Continuing Education Series articles allow design practitioners to earn continuing education unit credits through the pages of the magazine. Use the following learning objectives to focus your study while reading this issue's article. To receive credit, read the article and turn to page 40 and follow the instructions.

After reading this article, you should be able to:

- ▶ Explain how American hardwoods contribute to green design
- ▶ Understand hardwood sustainability
- ▶ Identify healthy hardwood finishes and maintenance methods

Maple floors and other hardwoods are integral to the healthy home environment created for Tias and Surya Little, two internationally renowned Yoga instructors, by Paula Baker-Laporte, AIA. The 1,300 square-foot Santa Fe home features a yoga/meditation room, tatami bedroom, and covered porch for outdoor practice and meditation.

PHOTOGRAPH © 2006 LAURIE E. DICKSON PHOTOGRAPHY

In flat- or plain-sawn hardwood boards, growth rings are parallel to the board's surface, creating the distinctive flame-shaped, arch or cathedral grain pattern. Some 95 percent of all commercial U.S. hardwood lumber is flat-sawn, which produces the most lumber and the widest boards at the lowest cost. In quarter-sawn lumber, the growth rings are perpendicular to the board's broad face, producing a vertical and uniform grain pattern that is popular in decorative applications such as cabinet faces or wainscoting.

HEALTHY DESIGN IN ACTION

As interest in healthy and green design grows, American hardwoods are increasingly specified for their durability, sustainability, aesthetics and their superior life-cycle.

And it's not only environmentally-oriented residential designers who specify hardwood products. When commissioning the design of the 120,000-square-foot Lewis and Clark State Office Building in Jefferson City, the Missouri Department of Natural Resources sought out Houston-based BNIM Architects to build a structure that showcases local materials and cost-effective green design strategies. For high-traffic areas such as the atrium lobby, BNIM selected oak from the Midwest. "We used solid white and red oak for flooring in the common areas," explains Kimberly Hickson, AIA, principal and manager of BNIM's Houston office. "With any wood, if we are specifying it for flooring, we are looking at it for its durability."

Since its completion in March of 2005, the building has achieved LEED-Platinum certification and provides a template for the state, along with Missouri companies, to build environmentally-responsible and cost-effective facilities.

Healthcare design is also turning to American hardwoods to "warm up" interiors, creating homelike environments that promote healing while standing up to rigorous requirements for durability, indoor environmental air quality and infection control. Peter Syrett, AIA, principal, Guenther 5 Architects, New York, believes in hardwoods in hospital design. He specified cherry for the 28,000-square-foot Patrick H. Dollard Discovery Health Center in upstate New York—one of only two U.S. LEED-certified healthcare facilities, and New York's first medical facility to implement green building standards that meet state Department of Health requirements.

Syrett focused the use of hardwoods in patient recovery rooms, administrative offices, and detailed accents throughout the facility in applications including paneling, millwork and cabinetry. After three years, there have been no care or maintenance issues. "So much healthcare design these days is sterile and antiseptic because of the fear of using natural materials. I take the position that including natural materials makes all the difference," notes Syrett.

SUSTAINABILITY

A sustainable process is one that can be carried out over and over without negative environmental effects or impossibly high costs to anyone involved. Some designers may hesitate to specify American hardwoods out of concern for the supply of a natural resource. However, the American hardwood supply is not only sustainable, it is actually increasing. The U.S. Forest Service states that the hardwood volume in American forests increases by about 10 billion cubic feet yearly, while annual removals total only 6 billion cubic feet. Consequently, the volume of hardwoods in American forests is 90 percent larger than it was 50 years ago.



In the United States, hardwood growing areas vary according to climate and soil that favor different species—and selecting a regionally native species adds to a design's sustainability.

The issue of sustainability is trickier when applied to tropical hardwood species. While many tropical hardwoods rank high on the Janka hardness scale, density is one criterion among several to be considered when specifying hardwood products. Designers concerned with product sustainability also consider whether the wood is harvested legally and responsibly. The first steps are to determine whether the tropical species is on any CITES (Convention on International Trade in Endangered Species) lists, and whether the supplier participates in a certification system.

Beyond that, Jim Bowyer, Ph.D., of Dovetail Partners Inc., notes the International Tropical Timber Organization stated in July, 2006 that only about 5 percent of the tropical forests covered by a recent extensive study are sustainably managed.

In contrast, he says that questions about the sustainability of U.S. tree species are more easily answered because, "We would find current and trend data regarding net annual growth and removals for that tree species, as well as information about volume by age and size class and by forest ownership category. There also would be reasonable certainty that harvesting was done in accordance with municipal, county, state, and federal forest management guidelines and regulations." He elaborates in an August 2006 report titled, "Have Tropical Woods in your Product Line? How to Know If They Were Harvested Legally, Responsibly" (www.dovetailinc.org).

INDOOR AIR QUALITY

Unlike synthetic products which may contain harmful polyvinyl chloride and VOCs, American hardwood floors are non-toxic, easily cleaned and do not trap allergens. For this reason, they often are recommended by doctors for individuals with allergies or asthma. "A material that is harder

● **Hardwood floors made from locally harvested red and white oak highlight the sunny atrium at the Lewis & Clark State Office Building in Jefferson City, MO. Designed by BNIM Architects of Houston, this LEED Platinum-certified building also features paneling of regionally harvested ash. It is home to the Missouri Department of Natural Resources.**

PHOTOGRAPH © 2006 MIKE SINCLAIR



and can be cleaned easily and well is good for everybody," says Santa Fe-based Paula Baker-Laporte, AIA, principal and owner of Baker-Laporte and Associates. "Hardwoods have the perfect combination of durability and give. A hardwood floor, depending on its installation, is much more giving than a concrete or tile floor. It's kinder to the body."

● **The Patrick H. Dollard Discovery Health Center in Harris, NY, designed by Guenther 5 Architects in New York, is one of two LEED-certified healthcare facilities in the United States. Locally harvested cherry was specified throughout the hospital, including this pediatric waiting area, because it is sustainable and supports a healthy indoor environment.**

PHOTOGRAPH © DAVID S. ALLEE

FINISHES

The type of finish selected can further influence indoor air quality. Surface finishes are durable, moisture-resistant, easy to maintain and appropriate for many applications. They include oil-based urethane, water-based urethane, moisture-cured urethane and conversion varnish. Some polyurethane finishes contain aluminum oxide to enhance a floor's abrasion-resistance qualities.

A growing trend is toward the use of factory-finished hardwood flooring, millwork, and casework products because factory finishing offers better quality control, enhanced cost-effectiveness and enhanced job site indoor air quality.

For example, Baker-Laporte recommends a factory UV floor finish for people who are very chemically sensitive. "Pre-finished materials are off-gassed under controlled conditions and the client receives an inert product," she elaborates. "In the case of healthy people without chemical sensitivities, there are many low- or no-VOC finishes that work within the parameters of healthy design."

For on-site finishing, the best option remains polyurethane. Today's polyurethane finishes make American hardwoods an easy-to-maintain choice, even in kitchens—once considered out-of-bounds for solid wood flooring. According to the National Wood Flooring Association, a urethane finish is best for hardwood flooring in kitchens, with the number of coats required for optimal performance dependent on the type of urethane finish selected. For best results, two coats of moisture-cured urethane should be applied, three coats of oil-based urethane, or four coats of water-based urethane. Tung oil will likely perform well but requires more maintenance.

Waterborne finishes, however, are not suitable for finishing casework, millwork or flooring onsite, according to the Architectural

Woodwork Institute (AWI). AWI cautions that "governments, owners, and design professionals who insist on waterborne finishes at this time in their development must assume the responsibility for the inherent risk that the finish will not appear and/or perform as well as a comparable solvent-based product."

At the Dollard Discovery Health Center, a low-VOC finish was used to seal and preserve the woodwork. "The indoor air quality issues surrounding hardwoods are very good," says Syrett. "Guenther 5 uses an index similar to William McDonough's, where healthy materials are given a 'green' rating and materials to avoid are given a 'red' classification. We place hardwoods in the green category as long as the substrate is done right and a proper sealer/finish is used."

In the Lewis and Clark Building, the design team specified two field-applied low-VOC finishes, both meeting SCAQMD (South Coast Air Quality Management District) Rule 1168. The purpose of Rule 1168 is to reduce emissions of VOCs and to eliminate emissions of chloroform, ethylene dichloride, methylene chloride, perchloroethylene, and trichloroethylene from the application of adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, or any other primers.

Beyond surface finishes, there are acrylic impregnated pre-finished wood flooring products. Through a high-pressure treatment, acrylic and color are forced into the pores throughout the wood, creating an extremely hard surface. Among the most expensive finished products, acrylic impregnated floors are used in ultra high-traffic commercial, institutional or healthcare settings for an extremely hard, durable barrier to dirt, moisture and wear.

"We reserved the acrylic impregnated woods primarily for hardwood flooring in our hospitals as well as some of our corporate environments," says Scott McFadden, vice president and director of design at Maregatti Interiors, Indianapolis. "We have used a catalyzed finish on some of these hardwoods and wood veneers, wherever we're going to have any sort of water coming in contact. For instance, we've used catalyzed finish in a serving area within a hospital, mainly so that it can hold up and withstand the steam that is coming off the food. Typically, throughout all of our regular corridors we really have used a very light stain or else just a clear finish with just a polyurethane-type sealer."

LIFE-CYCLE COST

Based on manufacturers' published maintenance data/life-cycle costs, and conversations with manufacturers' representatives, Sue Tartaglio, interior designer at Burt Hill in Butler, PA, developed a life-cycle cost comparison of a dozen frequently used synthetic and natural flooring products. Her matrix (see chart on page 39) indicates that in facilities with a lifetime use of more than 15 years, hardwood flooring—while it may have higher upfront costs—has significantly lower life-cycle costs.

In comparison, average installed costs per square foot range from \$1.45 for vinyl comp tile, to \$12 for bamboo and hardwood, with linoleum, cork, rubber, sheet vinyl, carpet and ceramic tile falling in between. Since the comparison considers useable product life, replacement, cleaning and labor costs over 15 years, products with some of the lowest initial costs wind up having among the highest total life-cycle costs. In fact, hardwood, rubber and bamboo flooring have the lowest total cost at 15 years among the dozen flooring materials compared.

However, in using bamboo, designers should note that of the more than 1,200 species of fast-growing grasses known as bamboo, the Moso bamboo species is considered optimal for use in flooring. Even



This contemporary dining room features a harmonious mix of American hardwoods. White oak floors, which are slightly darker in tone, showcase the lighter hues of the maple shelving and built-ins that line a hallway leading to the kitchen.

PHOTOGRAPHY © TRIPP SMITH

so, there are a few caveats: The bamboo should be properly aged and only the middle section of each stalk used in order to deliver the proper strength and moisture content. Suppliers should be questioned as to whether the bamboo plantations use pesticides and chemical fertilizers, and asked what type of resin is used to bond the grass stalks in the flooring manufacturing process.

“What I like about a wood floor as opposed to any other floor is if you want to change it you just have to sand it,” says noted kitchen designer Deborah Krasner. “With other floors, you have to make a huge investment and essentially replace the entire floor covering.”

CLEANING

Integral to a product’s green status and sustainability are its non-toxic care and ease of cleaning. Mike Sawchuk, vice president and general manager of Enviro-Solutions, offers the following eco-friendly guidelines for keeping hardwood floors clean:

LIFE-CYCLE COST COMPARISONS

Sue Tartaglio, interior designer at Burt Hill in Butler, PA, developed this life-cycle cost comparison of a dozen frequently used synthetic and natural flooring products. Despite their higher upfront costs, hardwood and bamboo flooring are shown to have the lowest life-cycle costs for facilities with a lifetime use of 15 years or more.

| MATERIAL | ARCHITECTURAL REMARKS | USEABLE PRODUCT LIFE ⁵ | INST. COST (PER SQ. FT.) ¹ | AVE. INST. COST (PER 1,000 SQ. FT.) | TIMES REPLACED IN 15 YEARS | MATERIAL COST AFTER 15 YEARS | CLEANING/LABOR \$ AFTER 15 YEARS ² (PER 1,000 SQ. FT.) | TOTAL COST IN 15 YEARS |
|---------------------------------------|--|-----------------------------------|---------------------------------------|-------------------------------------|----------------------------|------------------------------|---|------------------------|
| Vinyl Comp. Tile (VCT) | Requires at least five coats of finish | 15 years | \$1.45 | \$1,450.00 | 0 | \$1,450.00 | \$45,000.00 | \$46,450.00 |
| Sheet Vinyl | Requires some finish | 20 years | \$4.23 | \$4,230.00 | 0 | \$4,230.00 | \$58,500.00 | \$62,730.00 |
| NF Sheet Vinyl | No additional finish required ⁶ | 20 years | \$4.23 | \$4,230.00 | 0 | \$4,230.00 | \$18,000.00 | \$22,230.00 |
| Linoleum | Requires some finish ⁶ | 40 years | \$4.75 | \$4,750.00 | 0 | \$4,750.00 | \$18,000.00 | \$22,750.00 |
| Cork | Requires some finish | 50+ years | \$11.00 | \$11,000.00 | 0 | \$11,000.00 | \$7,500.00 | \$18,500.00 |
| Rubber | No additional finish required | 20+ years | \$6.00 | \$6,000.00 | 0 | \$6,000.00 | \$9,000.00 | \$15,000.00 |
| Carpet (broadloom)³ | Organic pat.; 6-6 nylon yarn | 4-6 years | \$2.77 | \$2,770.00 | 3 | \$8,310.00 | \$24,750.00 | \$33,060.00 |
| Carpet (broadloom)⁴ | Organic pat.; 6-6 nylon | 4-6 years | \$4.45 | \$4,450.00 | 3 | \$13,350.00 | \$24,750.00 | \$38,100.00 |
| Carpet Tile | Ease of replacement | 10 years | \$3.89 | \$3,890.00 | 1 | \$3,890.00 | \$24,750.00 | \$28,640.00 |
| Bamboo | Readily renewable product | 25+ years | \$12.00 | \$12,000.00 | 0 | \$12,000.00 | \$1,500.00 | \$13,500.00 |
| Ceramic Tile | Bumpy ride; grout lines stain | 15-20+ years | \$8.00 | \$8,000.00 | 0 | \$8,000.00 | \$27,000.00 | \$35,000.00 |
| Hardwood | Engineered product considered | 25 years | \$12.00 | \$12,000.00 | 0 | \$12,000.00 | \$3,000.00 | \$15,000.00 |

NOTES:

- ¹ Basic installation—no angles or patterns.
- ² Includes materials and labor. Based on number of cleanings required per year. Most resilient products and carpet are cleaned three times per year. Hardwood and bamboo just need to be damp mopped—refinishing of these products is once every four to five years, due to the wear layer.
- ³ Medium quality and durability.
- ⁴ High end quality and durability.

⁵ This life depends on proper maintenance. As is the case with carpet tile, the end user gets tired of the color/pattern long before the tiles “ugly out”.

⁶ With the factory applied urethane finish, no additional wax or sealer is required after installation. However, depending on the location, some additional finish will be necessary to augment the original finish, due to wear and tear on the product. Higher use areas will require this sooner than lower use areas.

- ▶ Warm soapy water should not be used to clean hardwood floors because the soap may leave a film that could become slippery when wet
- ▶ Consider cleaning products that are either Green Seal or EcoLogo Certified
- ▶ Use pH neutral cleaners
- ▶ Use an effective matting system at each entrance, because "Approximately 80 percent of soils are walked into a building on the soles of footwear," says Sawchuk
- ▶ Dusting frequently with a microfiber mop typically will cut chemical use and waste by 80 percent, increasing performance up to six times, and reducing labor fatigue by up to 70 percent

THE FUTURE IS HEALTHY DESIGN

In coming years, healthy green design will likely gather momentum as designers and clients witness the growing body of research on natural materials and their contributions to occupant well-being in buildings of all types.

"We're all in the early stages of learning about these issues," says Anjali Joseph of the Center for Health Design, predicting that researchers will increasingly explore the benefits of natural materials.

Baker-Laporte concludes, "The fact that there was an indoor air quality team has really pushed healthy design into the mainstream. More and more, I see tremendous change. You see it in the rating systems and in advertising which creates the demand for it from the client. Healthy design is clearly registering on people's radar." ●

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1. What characteristics of hardwoods contribute to green design?

2. What is the sustainability record of American hardwoods?

3. How do flooring materials compare in terms of life-cycle cost?

4. Name three ways hardwoods affect indoor air quality.

5. What are four elements critical to cleaning hardwoods?
