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Making the Most of Real Woods

Decorative hardwood plywood—the responsible way to specify rare and precious species.

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Ever since mankind began building and furnishing interior spaces, we've been trying to maximize the yield and performance of the natural materials that go into them. Wood—being one of the most universal and easy to work with building materials (not to mention one of the most beautiful)—has been "value engineered" since the beginning of recorded time.

Hardwood plywood panels add character and warmth in this contemporary setting. View larger

We know that the Egyptians sliced logs to create veneers and laminated wood panels because fine inlays of ebony and ivory were found in Tutankhamen's tomb. Wood, apparently, was considered precious enough in ancient Egypt to accompany the king into the next world. We also know that Chinese craftsmen sliced wood and glued layers back together to build furniture a thousand years ago, and early iterations of modern plywood were created by English and French in the 17th and 18th centuries.

The 1905 World's Fair in Portland, Oregon, was the impetus for the very first industrially produced plywood panels. Portland Manufacturing Co.'s three-ply panels were instantly in demand from door, cabinet and trunk manufacturers. The introduction of waterproof adhesives opened up new markets for plywood in housing exteriors, interiors and floors—including troop barracks in the major theaters of World War II. Veneer-core plywood was even used to build some of the fighter planes that won that war.

Continuing Education:

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 one hour of continuing education credit (0.1 CEU) as approved by IDCEC, read the article and then log in to take the test associated with this article.

After reading this article, you should be able to:

- Discuss the benefits of different types of plywood core construction.
- Explain how different methods of cutting veneers leads to various visual effects.
- Identify what qualifies as a "no-added urea-formaldehyde" decorative hardwood plywood panel.
- Explain the veneer grading system as specified by the ANSI/HPVA HP-1 -2004 standard.

Log in to take the test associated with this article

ENGINEERED TO PERFORM

For construction and furniture fabrication, plywood is a vast improvement on natural wood. By slicing lumber, or

timber, into thinner slices of veneer and recombining them, we are able to use lower grades or lesser species of wood in the core for structural strength, and save the more decorative species and higher "face" grades for architectural and furniture surfaces. Compared to solid wood, sliced veneers exponentially increase the available square footage of precious woodgrains.

The layers of veneer, usually less than 1/8-inch thick, are glued together so their respective grains alternate at right angles from layer to layer. This "cross-grain" construction gives the finished plywood panel balanced strength and stiffness throughout its length and width; improves dimensional stability; increases screw-holding ability; and reduces wood's natural tendency to warp and split by distributing flaws and imperfections. Plywood is usually manufactured with an odd number of layers so the grain on both faces runs the same direction, as it would with solid wood.

There two general classes of plywood: construction and industrial plywood; and hardwood and decorative plywood (covered by separate standards). Construction and industrial plywood is covered by the National Institute of Standards and Technology Product Standard PS 1-95. Hardwood and decorative plywood is covered by ANSI/HPVA HP-1-2004. Each standard recognizes different exposure durability classifications based primarily on the moisture resistance of the glue and the grade of veneer used. [See sidebar articles for further discussion on grading product standards.]

DECORATIVE HARDWOOD PLYWOOD—GETTING TO THE CORE

Decorative hardwood plywood cores are mostly veneer (66 percent of the panels sold in North America), but may also be MDF (16 percent), particleboard (13 percent), or agrifiber and other materials.

Veneer core is made from multiple plies of veneer peeled from quality logs with limited aesthetic characteristics, and glued together with the grain direction alternating at right angles. Compared to MDF (medium density fiberboard) and particleboard, its advantages include higher strength, lighter weight (typically 70 pounds at ¾-inch thick), and excellent screw-holding properties. Disadvantages include potential variation in panel thickness; core textures may telegraph through the surface layer; and the edges must be covered.

MDF cores are wood chips steamed and refined to fiber bundles, bonded, formed into a mat, pressed and then sanded to a desired thickness. Advantages include a smooth surface, uniform thickness, and reasonable screw-holding ability. Disadvantages would be that it's heavy (100 pounds at ¾-inch thick), not as strong as veneer core, and the perception that it is not real wood.

Particleboard cores are made from wood chips ground into small particles, bonded, mat formed, pressed and sanded to a desired thickness. Advantages include a smooth, uniform thickness and reasonable screw-holding ability. Cons would be that it's heavy (100 pounds for ¾-inch panel), not as strong as veneer core or MDF, and again, the perception that it is not real wood.

It should be noted here that both particleboard and MDF utilize wood fiber left over from other lumber and woodworking processes—materials that would otherwise be landfilled or burned.

Specialty cores are also available. Combi-core panels use thin MDF below the faces for higher surface quality and dimensional stability, and veneers at the center for strength and weight. Multi-ply cores use more plies of thinner veneers to provide a European-style decorative edge.

Plywood thickness can range from 5/32 to 1-½ inches, with ¾ for 50 percent of U.S. domestic production. Typical panel dimensions are 4 foot by 8 foot, although you can also specify 4 foot by 9 foot, 4 foot by 10 foot, and in some cases 5 foot by 8 foot. The woodgrain typically runs the direction of the panel length, although special counter-front panels are available with grain running width-wise.

Face, Back and Inner Ply Grades of Veneer, as Defined by the ANSI/HPVA HP-1-2004 Standard

The "face" is the better side of any plywood panel in which the outer plies are of different veneer grades. If both sides are the same grade veneer, they're both face surfaces.

The side opposite the face of a panel, or the poorer side of a panel in any grade of plywood, is the "back." Back veneers have a separate grading system, as do veneers used in the core of the panel.

There are six face grades in the product standard:

- AA is the highest grade, with very limited allowance for size and presence of natural characteristics
- A is the next highest grade, allowing slightly more and larger natural characteristics
- B, C, D, and E follow, each allowing for progressively more and larger natural characteristics

FACE VALUE

Hardwood plywood is a practical, responsible way to specify real wood for furniture, fixtures and architectural millwork. Popular species include red oak, birch, maple, cherry, ash, pine, mahogany, walnut, white oak and teak, but you can get almost any wood you want. Some suppliers even offer prefinished and ready-to-paint panels, and most recommend their panels for use in vertical and low-wear horizontal surfaces.

The face grade ratings of different woods and veneer cuts vary, given the characteristics unique to each species. The character of these species is further interpreted by how the veneers are cut from the logs, and how they are recombined.

Plywood Classifications as Defined by Product Standard PS 1-95

The exposure durability classifications for construction and industrial plywood specified in PS-1 are exterior (exposure 1), intermediate glue (exposure 2), and interior.

Exterior plywood is bonded with exterior (waterproof) glue and is composed of C-grade or better veneers throughout. Exposure 1 plywood is bonded with exterior glue, but it may include D -grade face veneers. Exposure 2 plywood is made with glue of intermediate resistance to moisture. Interior-type plywood may be bonded with interior, intermediate, or exterior (waterproof) glue. D-grade veneer is allowed on inner and back plies of certain interior-type grades.

The exposure durability classifications for hardwood and decorative plywood specified in ANSI/HPVA HP-1-2004 are, in decreasing order of moisture resistance, as follows: technical (exterior), type I (exterior), type II (interior), and type III (interior). Hardwood and decorative plywood are not typically used in applications where structural performance is a prominent concern. Therefore, most of the remaining discussion of plywood performance will concern construction and industrial plywood.

First, veneers are cut from logs in several different ways:

- Rotary-cut veneers: The entire log is peeled, producing a continuous ribbon of veneer.

There are four back grades, which naturally allow for more imperfections like sapwood, discoloration and stains, mineral streaks, burls, and larger knots:

- 1 is the highest back grade, which allows no combined knotholes and repaired knots
- 2 and 3 are mid-range back grades, which limit the number of combined knotholes and repaired knots
- 4 is the equivalent of a veneer reject grade, allowing an unlimited number of combined knotholes and repaired knots

There are four inner ply grades intended for classification of inner ply veneers, with limitations on openings and splits:

- J and K are the higher grades and are permitted under the face of B-grade and higher panels
- L is a lower grade permitted under C-grade and lower faces
- M is suitable for only inner ply applications

Two-sided panels may be specified.

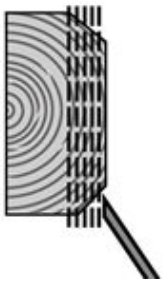
- A panel may be specified with a face grade on both sides (e.g., A-B PS cherry will have an "A" grade face on one side and a "B" grade face [technically a back] on the other).
- A panel may also be specified with a face grade from one species on one side and a face grade from a different species on the other (e.g., A-A PS cherry/sap maple).

The grading process is performed by highly trained and experienced graders who have demonstrated a thorough understanding of veneer grades and standards. Faces and backs are sorted according to number and distribution of attributes, color considerations, component count, matching type, and special characteristics as listed in the HP-1-2004 product standard.

Because wood is, in the end, a natural and varied material, the standard leaves a little room for subjectivity. Section 3.3.1 includes a note that ends with this statement: "Because of the inherent individuality of trees, consideration should be given to the overall appearance of the veneer face to determine the appropriate grade for that veneer."

This is why there is some overlap between the bottom of one grade and the top of the next one down. This overlap increases as we move down the grade scale.

- Plain-sliced veneers: The log is cut in half, lengthwise. Each half is then sliced lengthwise producing a veneer with a unique grain pattern.



- Rift-sliced veneers: The log is cut into quarters, lengthwise, then sliced at a 90-degree angle to the grain. This produces a fine pencil stripe effect. Both plain- and rift-sliced veneers are reserved for high-grade "fancy" panels.

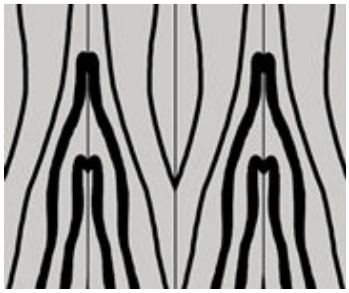
- Half-round sliced veneers: This is a variation of rotary cutting. This effect results from the log being mounted off center in the lathe so only one side of the log is sliced at a time.

- Quarter-sliced veneers: The quarter log is mounted so the growth rings strike the cutting knife at right angles. This produces a series of stripes in the veneer.

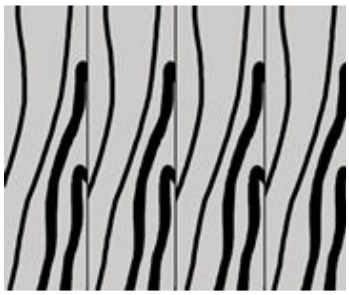
The way sheets of veneer are then spliced back together (or left whole) further determines the look of the finished panel.

- Whole-piece veneers: Continuous pieces of veneer are peeled from a log using a rotary process.

- Book-matched veneers: Every other strip of veneer is turned over, producing a grain pattern that is matched at the veneer joint.



- Slip-matched veneers: Each strip is laid out, side by side (without turning over). This produces a repetitive pattern.



- Spliced veneers: Several pieces of veneer varying in width are glued together to form a whole sheet. The way they are laid out determines the final look of the veneer.

GREEN IS A GIVEN

Designers are drawn to wood for several reasons. It evokes a rich heritage of fine architectural millwork and furniture. The character of the grain adds visual interest without being distracting. It can be finished in any number of gorgeous, saturated colors. Up close, no other material has quite the same depth and life. It is familiar, even comforting, but never boring.

But most of all, wood is natural.

As environmentally friendly products become the new norm, wood's bona fides as a natural material carry more and more weight. Trees, of course, are a renewable resource, and some suppliers now offer FSC-certified hardwood plywood.

To turn wood into an engineered panel, however, some type of resin-based binder or adhesive must be introduced. This is where things can get a little sticky.

The most economical, durable, reliable and easy-to-handle wood adhesives have historically been manufactured with formaldehyde. Formaldehyde (CHOH or CH_2O) is a colorless, pungent gas and common volatile organic compound (VOC). It is used as a component in many common products, including disinfectants and preservatives, clothing and textiles, as well as plastics and coatings.

When reacted with urea, formaldehyde produces a hard thermoset resin. These urea-formaldehyde (UF) glues are commonly used in permanent adhesives such as those used in hardwood plywood, particleboard and MDF. UF glues can "offgas" for a period of time after manufacturing, although surfacing a panel on all sides can significantly reduce emissions.

Formaldehyde occurs naturally. People and plants, including trees, produce small amounts of formaldehyde on a daily basis. In abnormally high concentrations, however, it has been linked to cancer and respiratory maladies in humans—a growing concern as more people spend more of their lives indoors.

Consumers and the design community have demanded better indoor air quality (IAQ), and government regulations have codified increasingly stringent standards, most notably in the CARB Phase 1 and CARB Phase 2 regulations. [See sidebar for more on CARB.]

Plywood and composite wood manufacturers have responded by offering panels that emit formaldehyde levels well below current and pending IAQ standards, including some made with "no-added urea-formaldehyde" (NAUF) glues.

Examples of NAUF adhesives include:

1. Poly vinyl acetate (PVA), aka white glue
    - Already in heavy use within window and door industries; good for face lamination
    - More expensive than UF, especially in veneer core construction
    - No composite cores are manufactured with PVA
2. Soy-protein-based adhesives
    - Similar to UF in terms of workability
    - Price competitive with UF in veneer core construction
    - Soy-bonded particleboard now available
3. Phenol-formaldehyde (PF)
    - PF resins are used to make circuit boards and pool balls; they are the earliest form of plastic resin (e.g., Bakelite, most popularly used in vintage tabletop radios and appliance knobs, is a PF resin)
    - Different chemistry than UF (all formaldehyde is "tied up" chemically)
    - Dark color and other factors make PF suitable only as an adhesive for veneer-core blanks, MDF, and particleboard cores
    - PVA or soy typically employed as a decorative veneer lamination adhesive for NAUF construction
4. Polymeric methyl diphenyl isocyanate (MDI)
    - Commonly known as "super glue"
    - Requires careful handling as it is toxic in its uncured form
    - Well-established market for MDI-bonded MDF
    - Agrifiber substrates utilize this adhesive; however, supply of these blanks for lamination is limited

About CARB

The California Air Resources Board (CARB) is a department of the California Environmental Protection Agency. On April 26, 2007, CARB approved an airborne toxic control measure (ATCM) to reduce formaldehyde emissions from composite wood products, including hardwood plywood, particleboard, medium density fiberboard (MDF), thin medium density fiberboard, and also cabinets, furniture and other finished products made with composite wood products.

The first set of formaldehyde emissions limits went into effect January 1, 2009. CARB Phase 2 requirements, requiring even lower formaldehyde emissions levels for veneer-core hardwood plywood, went into effect on January 1, 2010. The deadline for raw particleboard and MDF to meet these levels is January 1, 2011. For hardwood plywood with a composite core, the deadline is July 1, 2012.

Many plywood and composite panel producers in North America already offer materials that meet CARB 2 requirements through the use of no-added urea-formaldehyde adhesives and other innovations. For more information, go to www.arb.ca.gov/toxics/compwood/compwood.htm.

LEEDING INNOVATION

Decorative hardwood plywood producers are also responding to A&D specifiers who are striving for LEED certification of their projects. The total number of points available from plywood specification depends on the core type, decorative veneer species, and where the panel is manufactured.

Relevant LEED points available:

IEQ 4.4 Low Emitting Materials—Composite Wood and Agrifiber Products
1 Point
Purpose: Reduce quantity of odorous, irritating and/or harmful contaminants for comfort and well-being of occupants.

MR 4 Recycled Content
2-3 Points possible with innovation
Purpose: Incorporate recycled content materials to reduce impacts resulting from extraction and processing of virgin materials.

MR 5 Local Materials
2-3 Points possible with innovation
Purpose: Support use of indigenous resources and reduce environmental impact of transportation.

MR 7 FSC-Certified Wood
1-2 Points possible with innovation
Purpose: Encourage environmentally responsible forest management.

Decorative hardwood plywood offers unmatched aesthetic value for commercial and residential interiors and furniture, and the new NAUF materials on the market have struck a resonant chord with the next generation of manufacturers.

From traditional to contemporary, commercial to residential, decorative hardwood plywood brings the timeless elegance of real wood to any specification. And with NAUF and FSC-certified products now on the market, you don't have to sacrifice beauty for environmental responsibility.

Additional Resources:

"Properties of Structural Panel Products," by Roland Hernandez, Forest Products Laboratory, 2007