GOODWIN Heart Pine Company
River Recovered Heart Pine Specialists™

Architectural and Design Uses of Reclaimed Wood

Presenter:

Welcome to Reclaimed Woods by Goodwin. George Goodwin is the original River Recovered specialist. For 36 years we've recovered logs from river bottoms. These were some of the first logs to be cut over 125 years ago from America's virgin forest, so the wood is denser and has a richer patina. We offer a complete line of flooring, stair parts and millworks… solid or engineered… unfinished or pre-finished.

George's vision for Goodwin has always been to partner with the design build team. Our COO, Andrew, has 40+ years of manufacturing, install and finish expertise. Andrew works with architects and designers on specifications and builders and flooring professionals on technical expertise.

Our Production Manager's mechanical expertise controls the quality of your wood from proper kiln drying, to precision milling to grading by established standards. This attention to detail simplifies the installation to save you money.

George locates salvaged wood to offer any grade you want. He rescues Wild Black Cherry, Mahogany after hurricanes and finds sustainably harvested exotics from community managed forests in Central America that are often forest certified.

Who should attend?
Building design professionals who specify reclaimed wood in residential or commercial applications.

What benefits are gained by attending?:

- **Learn the history of America's first forests and evaluate variations in grades and know what to anticipate when specifying reclaimed and antique woods.**
- **Compare characteristics of reclaimed and antique woods with more available standing timber.**
- **Analyze wood science and manufacturing variations to insure that specifications simplify installation; e.g., know when engineered wood products are well-made to avoid problems**
- **Understand installation and finish specifics for various uses to ensure long term success of the wood products**

Why Reclaimed Wood Floors?

Wood floors are the best choice for the environment for several reasons.

- Manufacturing is cleaner. Steel products give off 24 times the amount of harmful chemicals than wood product manufacturing. Concrete leaches a great deal of carbon dioxide.
- Wood requires less energy to manufacture. Brick takes four times more energy, concrete six times and steel 40 times more energy to manufacture than wood.
- Wood actually conserves energy. It takes 15" of concrete to equal the insulation qualities of just one inch of wood.

Wood certification is a growing trend. Regulations on cutting over harvested species began in the 1980's and spawned tree plantations of Teak and various species of Mahogany like woods. Another result was forest certification beginning in Europe. Today almost 10% of the world's forests are certified sustainable; 39% in North America, 54% in Europe, but only 8% in the rest of the world.

Most of the certified forests are in the Boreal forest regions where we are already managing the forests for the long term, and not in the Tropical forests where we are having deforestation problems. There is good news in a study published by the National Academy of Sciences founded by Lincoln in 1863, using satellite data to scientifically prove where deforestation is occurring. Previously data were self-reported by countries to the FAO, Food and Agriculture Organization, making the data suspect. Developed nations can now work together with fact based data to help undeveloped areas. Policies that promote increased agricultural yields on previously cleared tropical forest areas are beginning to show results.

Reclaimed Wood <u>is</u> recycling.

River-reclaimed logs were lost once and presumed gone forever… waiting perfectly preserved. Beams from industrial revolution warehouses are another wonderful source. Existing wood floors have an extended life span and can often be reused. Many antique floors are in homes of the 18th or 19th century and are still walked on every day. They offer tremendous design diversity and the look of an old floor can be completely transformed with stains, faux finishes and inlays.

Health and Happiness

Wood floors are the healthy choice. They require fewer chemicals to clean than other floor coverings and they don't trap dust, fumes or mold in the fibers or grout. Wood is a good floor choice for anyone with allergies. Depending on the sub floor or underlayment a wood floor can be better for your spine and joints. Wood gives a little and is easier on your legs and feet, more or less depending on the installation type.

As 'green' building has become more prominent, more products are available with environmentally certified 'green' faces and backers. International currencies make it much less costly to send wood from America to China to be made into flooring and then ship it back to the United States. These products may not all be using the NAF or 'no added formaldehyde' glues. When the author of the Idiots Guide to Green Living tested her engineered wood floor for formaldehyde it read .23 to .51 ppm versus the .1 that was established by the 1960's in Swedish and various other studies to be the highest safe level. The California Air Regulatory Board has now adopted that standard for composite wood. Look for a product with certified formaldehyde emissions from glues and backers.

Reclaimed Wood Manufacturing

Reclaimed wood floors, manufactured without cutting trees, are a niche industry and are often made by small companies such as the one pictured in the slides. Reclaimed woods generally require more labor and craftsmanship. There can be 100 nails or more in an old stud, all of which have to be carefully located and removed.

The wood must be carefully sawn to isolate the fractures in a log or beam that may have been growing for hundreds of years. It takes extra time to render the highest quality timber and keep waste to a minimum. The lumber must be air-dried depending on thickness and carefully kiln dried to set a moisture content baseline for proper acclimation to the expected average RH and temperature of the building. Reclaimed wood is often graded multiple times at sawing, after kiln-drying, after milling and finally during packaging to ensure that you receive the grade you ordered.

Engineered wood flooring uses a smaller amount of high quality or rare wood for the face. Some of the less well made engineered flooring contains smaller pieces not suitable for use in solid flooring, resulting in a chopped up look. However, a well-made engineered floor can be produced from full size boards and maintain the same aesthetically pleasing look and same average length as solid.

A wear layer on engineered wood that is comparable to a solid wood floor can be achieved using a precision 'frame' saw instead of slicing or peeling the faces; however, a thicker wear layer requires even more attention to the details of the profile and balance of the milling. One example is the location of the tongue and groove; setting them too high on a plywood-backed product or not using the same wood on the bottom of a balanced construction when using a thicker wear layer increases the risk that the flooring will not remain flat.

Diversity Available

Reclaimed woods are steeped in history. All of the antebellum plantations built along the Mississippi in the early 1800s were made entirely of old-growth Heart Cypress and are still toured today. Settler's cabins across the South, Victorian mansions up the eastern seaboard and hotels and palaces all over Europe were built from the once vast old-growth Heart Pine ecosystem. Then Redwood and Doug Fir supported the country's expansion as people moved westward.

There is tremendous diversity available including: Oak, Beech, Cedar, Cherry, Chestnut, Doug Fir, Maple, Redwood, Heart Cypress, Hemlock, Poplar, Spruce, Walnut and White Pine, among other species. To help ensure you receive wood that is reclaimed, ask for documentation on the source and approximate age of the tree when the wood was harvested. Age may be the most important factor, particularly in antique reclaimed wood, and can generally be determined by the growth rings in the heartwood. (See *Hardwood Floors Magazine* articles*: Antique Shopping* for more detail on terms and *Old-Growth or Not* for help determining the age of old growth per specie).

Grades, grain patterns and distressed milling options often set reclaimed and especially antique woods apart. It requires larger logs or beams and wastes some wood to make vertical grain with only pinstriped grain patterns. Plain sawn wood is much more commonly available and has arches and much more movement in the grain pattern and is less formal in appearance.

Grades can vary from highly character with cracks, checks and various markings to mid-grades to select to clear and in between. Be sure to ask for the details on grades including: grain pattern, heartwood content, maximum knot size and approximate number per 100 square feet, growth rings per inch on average, color variation degree, nail holes and bolt holes and how many to expect per

100 square feet, widths available and many other characteristics that the manufacturer thinks important to share.

Distress marks include saw kerfs that are artificially introduced today (circular saws waste much more wood and have all but been abandoned in developed countries). Wire brushes can be used to emphasize the early and late wood differentiation (see Antique Shopping for details) and introduce a pronounced raised grain pattern. "Hand scraped" is most often done on a molder with specially scalloped knives and often gives a repeated pattern appearance on more commercially available flooring. Real hand scraping can be done onsite like it was 100 years ago for a more natural look. Many scraping patterns are available from deeply scalloped to a 'foot worn' appearance.

Antique Heart Pine… its history and its reclamation

Antique Heart Pine is the most frequently specified reclaimed wood today. American's interest in historic preservation has resulted in a tremendous increase in popularity of reclaimed woods. The caissons of the Brooklyn Bridge, Independence Hall and Jefferson's Monticello are just a few examples of Antique Heart Pine construction that has survived for centuries.

Reclaimed wood manufacturers have seen a ten-fold increase in orders and there is an increase of many times more than that in the number of manufacturers who now advertise reclaimed woods. The problem with this beautiful wood, if there is one, is that there are no standards. Standards for Heart Pine were last published in 1924.

If there is one point to be made, it is that Antique Heart Pine does not come from standing trees. All of the few remaining original growth trees… trees old enough to produce mostly heartwood are protected. Antique Heart Pine comes primarily from beams out of old warehouses or from logs that sank 100 years ago.

River-Reclaimed

In Florida the Fish & Game, Water Management and EPA came together to create an environmental permit process to ensure that everyone who pulls logs preserves the underwater habitat. The logs off the river bottom are rare, perfectly preserved and full of resin and life. We'll show a video load of logs recently recovered from the historic Suwannee River in North Florida and another on the Penobscot River in Maine.

According to the Forest Service logs in the South were likely cut with a broad axe before 1885 as evidenced by the V-shaped or cone shaped bottom. The steam engine arrived down South about then and loggers switched to the two-man crosscut saw or whipsaw instead of axes as they could load logs faster. Logs cut after the mid-1880's usually have a flat bottom instead of a V-shape.

Before the American Revolution, longleaf pine… the source of heart pine… dominated the landscape in the South. If you look at a map of the U.S., the longleaf ecosystem ran from the southern tip of Virginia to the eastern tip of Texas, primarily along the coastal plain. According to the Forest Service, the longleaf ecosystem mapped here was once the largest continuous forest on the North American continent, with estimates of 85 to 95 million acres.

150 years ago you couldn't go anywhere in the South without running into naval stores activity. White pine was running out up North and it was discovered that longleaf pine was harder and more

durable. Longleaf also became valuable for its resin…a raw material used in paints, soap, weatherproofing, shoe polish and medicines. Baseball pitchers used rosin and so did ballerinas for their toe shoes.

Men would scrape the bark every few weeks and collect the resin in boxes in the base of the tree and later in clay cups that did less damage to the trees. The resin was then collected in barrels and taken to a still to make turpentine. Longleaf pine was the reason the U.S. was the world leader in naval stores until the middle of the twentieth century.
By 1850 the South had constructed only 2,000 miles of railroad and the best way to get logs to downstream sawmills was to use the rivers. The common method for timbering was to cut trees with axes and drag logs with oxen or mule teams to the riverbanks, often using big wheel wagons.

As more and more people moved to the South, lumber companies had to take their crews further inland in search of more heart pine. Loggers dug manmade canals like this one shown near Tallahassee, FL to bring inland logs to the river.

Later in the 19th century as industrial America began to flex its muscles, it was heart pine that provided not only flooring and interior wood for homes, but also joists for the factories, timbers for bridges, warehouses, railroad cars and wharves. Longleaf was shipped all up the Eastern seaboard and over to Europe for all the old Victorian hotels and palaces. Even the tall ships shown here at this Fernandina, FL port and many others like it were all made of longleaf pine.

With this incredible progress came the heartbreaking part of the longleaf pine story. Of the once 85 to 95 million acres, less than 10,000 acres of old-growth heart pine remain today. What was once 41% of the entire landmass of the deep South now covers less than 2% of its original range. Groups such as The Longleaf Alliance are helping landowners who want to learn how to replant longleaf. While longleaf can be a superior producer, particularly if you have a 40-year rotation, the conditions for slow growth over hundreds of years probably will never exist again. The remaining river logs and beams are a limited supply of a rare and beautiful product.

Amazingly enough, the few remaining longleaf ecosystems are still the most diverse forest on the North American continent often sustaining over 60 species per square meter in some locations. The protected forest shown here is maintained today primarily for quail hunting. It is open and park-like now just as it has been for centuries, with a diverse ground cover of plants and animals. Original-growth is the term we use today to describe the few remaining forests that were growing when Columbus landed. Old growth is today a relative term. In today's forest, a forty-year-old pine tree might be called old growth.

Many of the trees cut during the early part of the 20th century were 300, 400,or 500 years old. It might take up to 30 years for a tree to put on just one inch of girth. It seems true in our experience that often the densest and best logs were the ones that slipped loose and sank to the river bottoms. Many of the logs we recover show the 'cat faces' or scrapes from where they were turpentined on two sides and continued to grow. Some show lightning strikes that healed over.

These logs are rich in history and as it turns out offer a source of information not available anywhere else. The U.S. is participating in an international effort to monitor the health of the world's forests. We save the river log ends for a longleaf forester and dendrochronologist to study the weather patterns from the tree rings and determine the fire history in the South… information that is needed to provide a baseline for monitoring U.S. forests today.

Divers retrieve each log carefully by hand, so there is no disturbance to the riverbed environment. They become trained in river habitat protection and must pass surprise inspections. Florida's Dead Head Logging Permit is an environmental model that other states are attempting to implement. In this video a river log recovery diver, who has worked throughout the southeast continuously since 1976 tells what its like to pull these old logs.

Design Uses

Styles abound in uses of reclaimed woods from modern, to traditional, to western to au naturel. You can obtain any stair component, millwork or trim pattern, lumber for furniture or built ins to complement your reclaimed wood flooring or paneling.

Installation trends are more toward engineered wood products every year. Engineered products are much easier on the construction cycle and often do not require the higher degree of craftsmanship that solid wood demands. Engineered wood can be installed with some less attention to relative humidity and moisture control in the site. If they are prefinished it is still best to leave them to the end of the construction process. Whether nailed down, glued to the concrete or floated, engineered wood floors are less demanding than their solid counterparts.

Engineered wood, however, only performs well within one to two percent moisture content of that at which it was manufactured. Solid wood can be acclimated to extremely dry or wet climates prior to installation and work well for the long-term. This is not the case with engineered, making it all the more important to use proper vapor retarders or barriers. See 'The Beauty of Engineered Wood' from Wood Source magazine for more details.

How do you know the wood is Antique?

The USDA Forest Service gives a definition of 'old-growth' as "the approximate age at which old-growth features begin to appear is about one-half the maximum age of the predominant tree species." Longleaf pine, or antique heart pine, can live 500 years or longer. Foresters agree it takes at least 200 years for the tree to become even 2/3rds heartwood and be considered 'true' old growth. In the case of Heart Cypress this could be at least 500 years, and 150 years for White Pine.

The antique heart cypress is more rare than antique heart pine today. These were the millennium giants that were growing right along the riverbanks and were the first to be cut. Of the Bald Cypress tree, it is one of the few surviving prehistoric species. Cypress logs, estimated by scientists to be at least 100,000 years old, were unearthed in excavations for the Mayflower Hotel, in Washington, DC. Through centuries of adaptation to its environment, Cypress has developed an inherent resistance to destructive forces not found in other woods. According to the Center for Wood Anatomy Research at the USDA Forest Service, "The heartwood of old-growth cypress timber is one of our most decay-resistant woods, but second-growth timber is only moderately decay resistant." Also see *Sinker Cypress: Treasures of a Lost Landscape*, LSU.

Today, heart pine is cherished for its natural beauty, hardness and durability. When sawn, there are three distinct grain patterns achieved: vertical, select, and curly are shown together in this flooring and corner cabinet.

- Vertical grain, sometimes referred to as quartersawn or pin-striped grain, is cut no more than 45 degrees perpendicular to the face. It requires twice as much sawing and thus wastes

some lumber to produce this more formal grain pattern. It can be seen here in the floor and trim around the door panels and in the bead board in the back of a cabinet pictured.
- Select grain is an arching or flame grain pattern that is sawn flat from the log and can be seen in the cabinet doors. It is the most popular grain pattern seen in wood floors and this method of sawing can achieve planks up to 10”-12” wide.
- Curly grain is a rare, natural burled grain, found in approximately 1 out of every 400 logs pulled from the rivers and is seen a little bit here in the crown moulding of the cabinet.

Curly grain is shown in a partners’ desk created by a designer in New Mexico. She had a longleaf pine curly log slabbed and sawn to create this desk in the George Nakashima style with butterfly joinery. You can see the natural river worn edges of the log in the desk top. The trestle members show the wane of the tree and the feet show the ax marks from when the tree was originally felled.

A Variety of Grades and Grain Patterns

- This designer’s bedroom in southern California uses craftsman style columns and uses a few boards of a darker color heart pine to create a simply inlay in the River-Recovered™ floor.
- Heart Pine from pilings driven into the Savannah River when General Oglethorpe was building the port in the early 1700’s has a darker color than most Antique Heart Pine. It is as though you were getting a floor the color of George Washington’s in Mount Vernon without waiting 250 years for it to turn color.
- Papa Hemingway’s Key West house has a ‘new’ River-Recovered® Vertical grain Heart Pine floor to replace the one that was damaged in a storm. The Vertical grain shows nothing but pinstripes… none of the arching or flame grain typical of the majority of Antique Heart Pine available today.
- A National Wood Floor Association award winning floor was hand scraped instead of sanded to give the wood more texture and light. Hand scraping offers a look that cannot be achieved by machines. A hand scraped and oiled wood floor will hide minor blemishes or scrapes from pet nails, although it may require refinishing by hand versus machine.
- Stair parts are available in turned balusters or newels to match almost any standard stair part more commonly available in oak. Or you can have custom stair parts of mouldings made to match for historic preservation by having knives ground to the pattern you need.
- Demand for original-growth heart pine has grown considerably in the last 20 years along with increased interest in historic preservation and green building efforts. The only other way to get heart pine is by salvaging timbers from buildings such as old factories.
- The heart pine floor shown here is in the newly restored Customs House in Key West, Florida and it came from the Chicago Ice Plant which had been built just two years after the historic Chicago fire in 1871.
- For those who want a character or rustic look there are grades for that as well. The ‘character’ grades include larger knots, may have considerable nail staining and sapwood and many find them a good choice for a beach home or mountain retreat at a more economical price.

According to ‘Longleaf Pine’, published by the Forest Service in 1946, even a 200-year-old longleaf will average only 65% heartwood. It is the heartwood that contains most of the resin and longleaf has more resin that any of the 200+ species of pines. It is this resin that makes longleaf hard, durable and that gives longleaf its rich, red color.

The best grades of Antique Heart Pine are mostly heartwood. The heart portion of the tree contains from 7 to 24% resin while the sapwood, or non-heart portion, contains only 1 to 3% resin. So it is the heartwood that is most desirable, yet all the 200 years and older trees are protected and cannot

be cut. A 75 to 90 year old longleaf pine may have only 30 to 35% heartwood. These standing trees, even when sawn for heart wood, do not have the high-resin content of the original growth logs and do not offer the same patina and rich color.

The sapwood of the longleaf pine is the lighter colored wood on the outer perimeter of the log. It does not deepen in color and is not as hard as the heartwood. The sapwood does not offer the durability seen in all heart floors that are over 200 years old and still in good condition. The best grades do not contain any sapwood. Lesser grades can have up to 50% sapwood and may today still be called heart pine.

Comparison Shopping Can Be Confusing

Quarter sawn may not be all vertical grain. Some call it 'linear grain'. Wide planks are said to have 75% or 85% vertical grain. This refers to the existence of the arching grain in the center of each board that is increasing surrounded by vertical grain on either side of center in many boards as the width of a heart pine floor increases. Kiln drying is essential for floors going into homes with modern heating and air conditioning systems. And beware of those who tell you to order a good bit extra. With quality grading that should not be required. You may need to order a small 'cutting' allowance, but should not need to order extra for waste if you specify the grade that you want.

Knots are infrequent in the better grades of Antique Heart Pine. The longleaf pine was tall and slender with all the branches at the top of the tree and had relatively few knots for pine in general. Slight checking is natural in Antique Heart Pine due to the strong grain and high-resin, but this should sand out and not be noticeable after installation. Pitch pockets are crystallized resin and should generally be solid or can be easily filled. Nail holes in demolition salvage are generally no more than ¼" in the better grades.

River Recovered heart pine has fewer knots and more heartwood than building reclaimed. Most of the knots are near the center of the log. The only time that limbs were down low was when the tree was young. Most of the clear wood on the outer portion of the log was cut away to make beams.

The heartwood is highly photo reactive and will be a lighter color right after it is milled. It begins to turn the rich, red color almost immediately and will be noticeably darker within several weeks. This color change occurs in many other woods, for example Cherry is pink when first milled but turns a red, brown over some weeks or months. To be sure you are buying the quality of Antique Heart Pine that will give you this rich color look for two characteristics:

- The growth rings should be dense, averaging 6 or 8 growth rings per inch in the best grades.
- At least one-third of the wood should be in the darkest of the pair that make up a growth ring. Called late wood as it grew denser later in the growing season, the late wood contains most of the resin.

Pause for Sample Matching Exercise, page 12

Installation tips

Expect to use more sandpaper with Antique Heart Pine. Make sure the sub floor is as flat as possible and start with a lower grit paper, beginning with a diagonal cut with the sander. Get the first cut really flat. This will make the rest of the sanding process much easier. As with all wider plank you need to keep a tight nail schedule, no more than 6 to 8 inches apart. Use a nail gun, not a staple gun, as the pressure may break the tongues and let the wood move too much. For more installation and

finish tips see the '*The Guide to Owning Heart Pine', 'Up to the Minute Tips on Installing and Finishing Antique Woods' and 'Manufacturer Guidelines'*.

When installing over a concrete slab, it's important to test for moisture with the right kind of meter. The old-fashioned calcium chloride tests only measure the RH in the top couple of inches of concrete. Use an ASTM 2170-11 type concrete meter that gives a true RH reading. And beware that some of the new surface coats that help screed quickly and get crews home before dark require scuffing up the concrete to make it porous enough for glue adhesion. Even an old slab can move considerable moisture, so test. And with engineered wood flooring that can't handle as much moisture variation, it's cheap insurance to always use a vapor retarder. Regardless of the moisture in the slab today, consider what could happen later on. See Howard Kanare's "Concrete and Moisture" paper from the Portland Cement Association to understand why this is the only reliable test.

Consult the manufacturer's detailed guidelines. A few points need to be priority:

1. The moisture content of the wood floor and the sub-floor need to match the expected indoor temperature and relative humidity once construction is complete. Refer to regional guidelines, your manufacturer or consult the National Wood Flooring Association.
2. If nailing, use enough nails to prevent the floor from moving too much, or if gluing or floating consider appropriate vapor retarders or barriers. Installers are accustomed to narrow strip oak and do not often realize that if nailing a 9" floor you need to nail every 2", no more than 1-1/2" from the end of the board… 7" nail every 3", 5" nail every 4", 3" every 6".
3. Nails hold the floor down on one side; therefore, it moves more on the groove side that is not held down. If you begin the installation in the middle of a large room, spline between the two middle boards and work outward to either wall you cut the wood's shrink/ swell in half.
4. Advantech is good for the construction cycle; however, does not hold nails well for the long term. Consider every other trowel width of glue and nailing when installing over Advantech.
5. Back sealing the boards with cheap polyurethane has very little down side and a potential high upside if you expect wide swings in temperature and humidity of second homes. There are many variations of this technique. There are many problem avoidance techniques such as this one. If your site has specific concerns contact our COO, Andrew St. James, or call the National Wood Floor Association for further assistance at any time.

Engineered Wood Flooring versus Solid Wood

To understand the limitations of solid wood floor and the behavior of its engineered counterpart, it's helpful to understand the basic structure of wood. Wood takes on and gives off moisture over a significant period of time. This is a seasonal change not a daily change. It's okay to be at the beach and open the windows and doors at night and turn on the AC in the day so long as you install the wood floor when the building is close to its ultimate RH in the MC in the wood floor matches the building RH and the building envelope doesn't incur large changes you're fine.

Wood is composed mostly of very long vertical cells with a smaller number of ray cells that go from the center to the outside. Wood cells have "free" water inside them that goes away with kiln drying. The main ingredient in the cell walls is cellulose that attracts water molecules. This type of water is called 'bound' water and it's this moisture that causes the seasonal shrink/swell.

Solid wood shrink/swell varies with the grain orientation. Plain sawn with the arching grain pattern shows the largest increase/decrease with changes in RH. Vertical or quarter sawn shows about half the expansion or contraction of plain sawn. There are about 8 theories as to why this is so. One

involves the ray cells The shrink/swell in solid wood is 50 to 100 times greater across the face than down the length of the board.

When you engineer wood using cross ply construction the shrink/swell is dominated by the longitudinal direction, or the direction that is vertical when the tree was growing, so the shrink/swell is reduced across the face by 10 to 20 times. It's important to mention that it's increased by 5 times down the length of an engineered floor so that's why so many of the engineered floors, especially those with thinner wear layers are 3' to 5' in length. Solid wood will acclimate to any condition so long as the conditions were accounted for during installation and you don't expect huge changes. In the islands with 75% RH if the wood goes in at 14% it's fine, or in the mid-west if solid wood goes in at 6% it's fine.

What most people don't know about engineered wood floors is that they only perform well within +/- 2% of the MC at which they were manufactured. A fellow in AZ who says his RH is 17% in Winter needs engineered wood floor made at about 4-6%. The Southeastern US market generally needs 8-9%. The other important consideration is careful acclimation with the backer before gluing.

Vapor barriers are even more important with engineered wood floors. You don't have to be so concerned about the expansion you often get with solid when construction is still going, but even if the concrete is dry you might want to seal it under engineered wood flooring in case water gets in at a later time. Some of the better elastomeric glues are some more expensive but they do a much better job of sealing than the cheaper glues.

Prefinished or Onsite Finish?
If you choose prefinished wood flooring you will want a micro beveled edge, however slight. Any variation in height from one board to the next depending on sub floor conditions will allow the finish to chip and the finish to fail.

There are newer finishes that are easy to maintain onsite without calling in the professionals. These finishes tend to have less sheen and look very natural. The problem seems to be that home owners don't want any maintenance and tend to prefer polyurethane that requires a flooring professional to screen and recoat, or even sand and refinish, when the floors are scratched.

Wood floor finishes are complex chemicals that require someone who applies them regularly to get a good result. If you want a prefinished floor with a natural look consider the penetrating hardening wax oils from Europe if you don't mind annual or semi-annual cleaning.

Why Should You Use Reclaimed Wood?
Why should you use reclaimed woods… they are not only rare and beautiful, but are durable, hard, 'green' and offer a tremendous diversity in designs? Antique Heart Pine is shown here along with Antique Heart Cypress. Other reclaimed woods that you hear of being reclaimed in fewer quantities include: Oak, Chestnut, Redwood, Heart Cypress and Douglas fir.

While a reclaimed wood floor may seem more costly given the expense involved in recovery and manufacturing, the wood, heart pine in particular, has lasted in buildings for centuries. Prices vary widely depending upon grade and may range from under $5.00 to over $20.00. You can buy less costly flooring. Ask for a certified product with no added formaldehyde in the glues and backer. And get your reclaimed wood grade in writing to guarantee that you get what you specify.

The major problem facing professionals today with using heart pine and other reclaimed or original growth or antique woods is the lack of consistent grading standards. Many years ago we were fortunate to meet an architect who helped found the American Institute of Architect's Committee on the Environment. Gail Lindsey, FAIA, was helpful in getting a few of the established reclaimed wood floor manufacturers to agree on some grading terminology. Hear a little of what Gail has to say. Then continue your education by exploring the cross match and case studies and the quiz.

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Antique Shopping

Hardwood Floors Magazine, August 2002

Terms Commonly Used to Grade Reclaimed Wood

Checks	Surface checks occur naturally in Heart Pine. If the product is properly air-dried and slowly kiln-dried, checks can be sanded out or filled during floor installation. Furniture grade heart pine should mill out.
Grain pattern	There are three distinct grain patterns: plain sawn, vertical and burl. Plain sawn has an arching grain. Vertical has pinstripes (no growth rings over 45 degrees perpendicular to the face). Curly/burl is the rarest.
Growth rings	The pair of light and dark growth rings denotes a growing season, or years for the most part. The highest grades of heart pine require an average of eight growth rings per inch. Other grades may average six growth rings per inch or less. Dense growth with at least 1/3rd in the dark ring means stronger wood. Longleaf pine often lived 400 or 500 years or more.
Hardness	The scale used to measure wood hardness is called the Janka ("yahn-kah") scale. The Janka measure for Heart Pine is 1225, compared to red oak at 1290. New Heart Pine is about one-half as hard and comparable to Southern Yellow Pine at 670. To measure a 4mm steel ball is embedded halfway into the wood.
Heart content	Heartwood is formed when sapwood becomes inactive and is infused with additional resin compounds or other extractives depending on the specie. It develops slowly in the center of the tree as the tree matures. The older the tree, the higher the heart content. According to the Forest Service a 200-year-old longleaf pine averages only 65% heart content. Longleaf heartwood turns a rich color when exposed to light and oxygen. As heart content decreases, color tones can vary widely from pale red to yellow.
Kiln drying	A process by which moisture is removed from wood with heat and dehumidification. This ensures the wood can easily acclimate to a building interior and avoid excessive shrinkage when properly installed.
Knots	Clear is the highest grade and has no knots larger than a rare ½" 'pin knot'. Standard knots occur infrequently in the next best grade, often called select or select and better, and may be up to 1-1/2". A 'pith knot' can be either a pin or a standard knot that has a small hole through the knot.
Longleaf pine	Longleaf (Pinus palustris) is the legendary 'antique heart pine' wood. The Longleaf ecosystem was once the largest contiguous forest on the North American continent. It is the quantity of resin in the heartwood that gives antique heart pine its uncommon hardness and durability. It takes 90 to 125 years to develop any significant amount of heartwood. Most of the trees were 200 to 500 years old when originally cut.
Nail staining	Caused when the metal "bleeds" around the nail hole. Nail holes are ¼" in the select grades of Heart Pine, but may be larger in other grades. They can be filled onsite.
Natural Color	Heartwood is often lighter in color when first cut and turns a deeper color when exposed to oxygen and ultraviolet light. Beginning almost immediately, the heartwood will ripen and will continue to richen in color over the first several months. The heartwood portion of building salvaged heart pine is usually already red except for some 'yellow heart' areas. These areas commonly occur next to a more resinous area that may have prevented the 'yellow heart' area from oxidizing. Once cut the yellow heart will turn red also. If you want to retain the initial light color a finish with UV inhibitor may slow the change.
Pitch pockets	Small pockets of crystallized resin occur seldom in Heart Pine. In the best grades pitch pockets will be no larger than 1/8" wide, but can be up to 3/8" or more in other grades.
Resin	Oleoresin, the type of resin from longleaf pines, made the U.S. the world leader in naval stores production until the middle of the 20th century. Longleaf sapwood contains from 1 to 3% resin while the heartwood contains from 7 to 24% resins. The resin build-up is mostly in the latewood or the dark ring of the pair that make up a growth ring. The percentage of latewood is the factor most closely linked with weight and strength.[1] Longleaf has the heaviest concentration of resin of any of the pines.
Sapwood	Sapwood (non-heart) is the lighter colored wood on the outer perimeter of the log. It does not deepen in color and is not as hard as the heartwood. The best grades do not contain any sapwood. Lesser grades can have up to 50% sapwood and may today still be called heart pine.

[1] Longleaf Pine, Wahlenberg, 1946, USDA Publication, page 38

COMPARING HEART PINE SOURCES AND GRADES

Antique Heart Pine vs. New Heart Pine

- A high heartwood content that makes the wood a rich red color and that makes it hard
- Knots generally infrequent and smaller
- Growth rings are denser, 200 to 500 year old trees with many growth rings per inch
- Hardness compares to Red Oak

- Varying sapwood, may have no heartwood
- Sapwood has much less resin content and is softer and less durable
- Variable knot size and frequency
- Generally fewer growth rings per inch
- Hardness compares to Southern Yellow Pine

River Recovered Heart Pine vs. Building Salvaged Heart Pine

- Resins smell more like turpentine and may be more challenging to sand
- The clear wood that occurs on the outer perimeter of the log is still present
- Is initially a lighter color as the wood has not already oxidized

- May have some nail holes and slight staining to prove the wood's part in history
- May be some lighter in weight
- Even the heartwood may have some 'yellow heart' areas, often next to a resinous streak, that have been prevented from oxidizing

GRAIN PATTERNS

Vertical Grain vs. Select Grain

- No growth rings more than 45 degrees perpendicular to the face of the board
- Boards have vertical pin stripes
- A rectangle is cut off one side of center of the log, turned on its side and resawn into boards
- Requires larger logs, twice as much sawing and involves more waste

- Growth rings are in the direction of the face of the board
- Boards have arching grain patterns
- Boards are sliced through the log in one pass of the saw
- The boards have vertical grain on the outside edges with arching grain in the center

Cross Match Exercise

(See above for helpful hints)

1. A. River Recovered Vertical Heart Pine Clear (pinstriped, resinous smell, no knots over ½")
2. B. Salvage Vertical Heart Pine (pinstriped, somewhat lighter weight than river)
3. C. Midnight Heart Pine With Knot (darker colored pine, larger knots)
4. E. Pitch Pocket (crystallized resin in an opening in the grain of the wood)
5. F. River Recovered Select Heart Pine Clear (arching grain, no knots on piece, pitch smell)
6. G. 75% Heart Content (1" of light colored sap wood every 4" or so of heart)
7. I. 95% Heart Content (1/2" of light colored sap wood every 10" or so of heart)
8. J. Salvage Select Heart Pine Clear (arching grain, no knots over ½", lighter weight than River)
9. K. 50% Heart Content (one-half yellow sap wood, one-half darker red and harder heartwood)
10. L. Salvage Heart Pine With Nail Hole (nail hole, generally not over 1/8")
11. M. River Recovered Heart Pine With a Small Pin Knot (1/2" knot, pitch smell)
12. N. Salvage Heart Pine With Nail Stain (black ferrous stain)
13. O. River Recovered Heart Pine With "Pith" Knot (small hole in knot)

Case Study on Specifying Heart Pine for Historic Restoration

Communication is essential when specifying a project. This is particularly so in the specialty woods industry where there are no industry standards. The following case study depicts many problems that can occur when working on a project.

Questions to consider:

1. How should full specifications be explored with suppliers for antique wood?
2. When a complex project is at stake, how can communications be facilitated at all levels?
3. How much time should be allotted when ordering a large quantity of highly specified wood that was last available commercially over 100 years ago?

A fire was ignited by work on the roof and burned a home built in the early 1880s, leaving only the chimney. The owners decided to reconstruct the home to its original splendor.

Fortunately, the owners had photographs of architectural details and furniture in the original home. Antique heart pine was used in over 80 percent of the surfaces. There was a comparison home next door built by the same architect with the same grade of wood that aided in the reconstruction. Architects, contractors, a restoration project management firm and a millwork shop were retained. The millwork shop began to locate wood.

A special competitive price was requested for building salvaged antique heart pine flooring, all 7' and longer with no further stated specifications.

Once the flooring was ordered additional specifications were made:

- 7' and longer
- Center match milling—non standard (milled wood that did not meet the grade would not be as saleable without a standard flooring match)
- 'Clear', absolutely no knots (much more difficult in building reclaimed)
- No nail holes, yet building salvage is full of nails
- Custom 3" face (3-1/4" face is standard from a 4" board, an 8 percent loss)

The supplier met the specs for the original quotation despite the fact that the value was 85 percent more than the quotation.

Six weeks after the floor had been shipped the restoration manager called to say, "The wood doesn't meet specs."

The supplier's representatives visited the site and found rejected heart pine flooring stacked on the ground under a leaky tarp in the front yard. The comparison home next door had knots and resin content the same as the rejected flooring. The restoration coordinator explained that the wood had to be stained, so they could not use the resinous boards— *an unstated specification.*

The owners are back in their home and the story made centerfold in *Architectural Digest*. Lessons learned for suppliers involved in providing restoration quality heart pine are that they need a quotation process that includes:

- team review of all quotations,
- customer signoff including detailed specifications of orders, and
- A detailed checklist of grade questions including: Color matching, Grain matching, Resin content, Knot size, Lengths, Growth rings, Face width, Milling patterns, and finishing plans.

Ref: Eric Batchelor Millworks, Brooklyn, NY

Case Study on Repairing Water Damaged Wood Flooring

Wood is made up of millions of cells that take on and give off water continuously.

Questions to consider:

1. How do you know the site is dry enough?
2. How should the flooring contractor work with the restoration contractor?
3. What can you do when the wood floor goes in too wet or too dry?
4. What are similar lessons to apply to other antique woods that are specified for restoration?

The toilet leaked in an 1885 home and ran for hours on the second floor. The plaster ceiling below had begun to fall down.

A restoration contractor was hired and they retained a wood flooring installation company. The contractor removed the wood flooring and the ceiling below. They then 'dried' the house following company procedures, reinstalled the 'plaster' ceiling and the flooring installer was called in.

The wood floor installation was rushed in order to have the home ready for the holiday season. The winter was relatively dry and the home heating equipment kept the relative humidity low in the home.

The wood floor was installed at 8-9% moisture content and was nailed directly to the original joists with no vapor retarder underneath. The thick antique wood joists were not completely dry and two to three months later the wood floor began to cup.

A wood flooring inspector was called to document moisture readings in the wood floor and joists in various locations around the home; both replaced flooring and original flooring.

A pin type meter was required as antique heart pine or any resinous wood can generate erroneous readings with a pin less meter. Pin less meters measure specific gravity rather than resistance and the specific gravity of resinous wood varies.

Measurements at successive ¼" depths showed 11% at the top of the wood floor and 20% into the joists in the upstairs floor that was replaced. Measurements in other parts of the house showed 12% at the top and 14% at the bottom.

The wood floor had been installed at too low a moisture content and the joists and/or plaster were too wet. Another consideration was balancing the air-conditioner as the relative humidity was also high in the home.

A few floor boards were removed and the finish was abraded to let fans and dehumidification remove the excess moisture in the joists. The air conditioning system was repaired and relief joints were cut into the floor once it was at the ultimate moisture content for the home.

- The restoration contractor modified their drying procedures.
- The flooring installer learned proper moisture measurement procedures.
- Both parties learned about proper acclimation with moisture measurement, not just time.
- Vapor retarders in 'wet' situations were explained to all trades.

Ref: Classic Renovations, Winter Park, Fl

Case Study on Wood Flooring in Commercial Applications

Wood flooring can give a commercial office, loft or retail space a warm and inviting look. Often there are additional specifications to consider from the sub floor, to sound, to even the color and matching components that may be more intensely specified than in a home.

Questions to consider:

1. How do you attenuate the sound transmission for 2nd floor or above installations?
2. What if your client wants the wood floor to have specific or long lengths on a concrete sub floor?
3. How do you match cabinetry or other color considerations on antique reclaimed wood floors?

When a holding company for an old family lumber company wanted antique heart pine on the 3rd floor the specs included:
- control the sound transmission
- match the color of the furniture
- match the height of doors at 1" overall
- include long lengths not practical in engineered wood flooring

Sound transmission can be attenuated using several different methods; from gluing cork to the sub floor and the wood floor to the cork using the same strength glue, to a whole solution system such as Sika. All require craftsmanship beyond a typical installation.

The National Wood Floor Association recommends the Sika system; a sound dampening mat with slots for sound dampening glue. The mat and/or glue must also fill all joints around the perimeter of the room to avoid sound traveling.

Some choose to 'float' an engineered wood floor over a sound dampening mat, perhaps using a 'click and lock' tongue and groove system. Most flooring professionals cannot achieve a quality and lasting installation with these systems. They are more appropriate for 'do it yourself' or where the floor is not planned to last the lifetime of the building.

There are many, many ways to achieve a particular color; natural penetrating hardening oils with no VOCs, aniline dyes that aren't so environmentally friendly, paints or stains that are 'floated' onto wood that has been sealed first or combination systems. Sanding differences will often make wood take stain differently. Therefore, the person who provides the samples should be the person who will do the coloration.

Plywood over concrete with ¾" solid wood on top was too high. Engineered wood flooring wasn't practical given the lengths desired. Solid wood had to be glued to the concrete to meet height and length specs.

The Sika system is designed to achieve this; however, all boards must be straight. Any crook means that board has to be saved for a nail down job where it can be levered into place. Antique heart pine is fairly straight. Most species require 30-35% extra wood.

Engineered wood floors shrink and swell 5 times less across the face; however, they do so 5 times more down the length of the board. Most engineered wood floors are fairly short pieces with a much shorter average length.

You can purchase a well-made engineered wood floor with the same average length as a solid wood floor; however, it won't have the longest lengths possible in a solid wood floor. In this case, the owners required very long lengths to emulate an old, old floor; requiring highly stable solid wood flooring.

Ref: Buck Lumber Co, Charleston, SC.