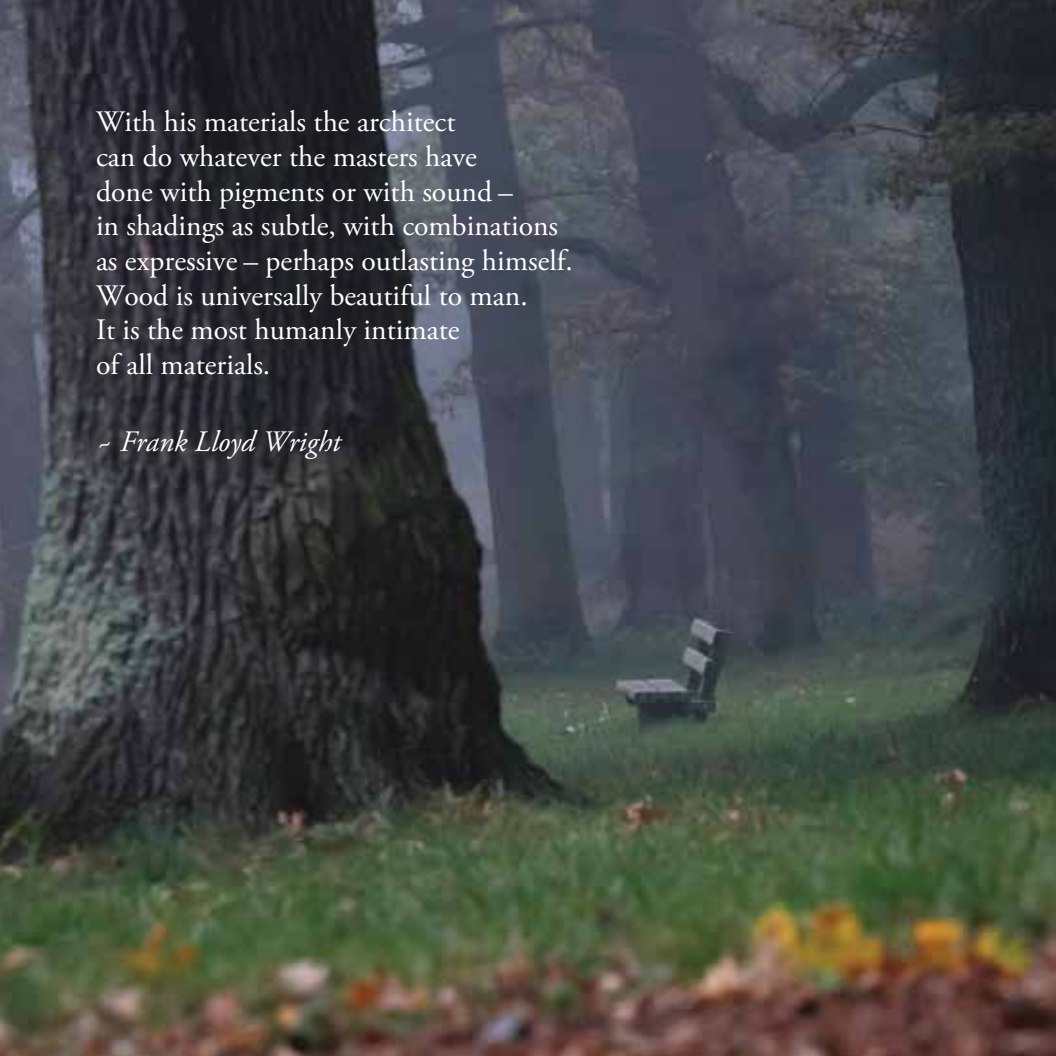
American HARDWOODS *Collection*

Abundant
Renewing
Sustainable

American Hardwoods™
www.HardwoodInfo.com



With his materials the architect
can do whatever the masters have
done with pigments or with sound –
in shadings as subtle, with combinations
as expressive – perhaps outlasting himself.
Wood is universally beautiful to man.
It is the most humanly intimate
of all materials.

~ Frank Lloyd Wright

American HARDWOODS

For centuries, American Hardwoods have been providing beauty and authenticity, warmth and integrity, lasting aesthetic and functional value to countless structures in a variety of applications. As a resource, they are abundant, renewing and sustainable, and an excellent choice for eco-effective design and building. Eco-conscious specifiers should know that:

■ **We are not running out of trees:** Harvesting levels are far below the levels of growth. Nearly twice as much hardwood grows each year than is harvested in the U.S. For this reason, the volume of hardwoods in American forests today is **131 percent** larger than it was in 1953.

■ **Professional foresters practice the science of silviculture:** Their hardwood forest management plans reflect the profession's best practices for long-term sustainable timber production, while also addressing water quality, wildlife habitat, biodiversity, forest aesthetics and recreational opportunities.

■ **Harvesting best practices:** Foresters adapt their harvesting methods to the climatic conditions and unique requirements of each location. Quite often, the preferred harvesting method is single-tree selection, where foresters mark individual trees for removal and a crew follows later to take down the marked trees. In practice for decades, this harvesting method improves growing conditions while enhancing the habitat for wildlife.

■ **Responsible manufacturing:** Once taken to a sawmill for primary processing, virtually every part of a log is used, and advanced manufacturing technology ensures the least wood waste and the greatest yield of lumber.

Most hardwood forestland in the continental United States is in the eastern half of the country; the equivalent of hardwood trees covering every square inch of New York, Pennsylvania, Ohio, Indiana, Illinois, West Virginia, North and South Carolina and Georgia. It is the home of the oaks, maples, cherry, ash, poplar and scores of other hardwood species, many of which grow nowhere else in the world.

■ Of all temperate forests in the world, North American forests have the most diverse hardwood species. They vary in appearance and durability, with some species more plentiful than others because of their natural occurrence.

■ Each species requires a particular set of conditions to thrive. Each needs specific types of soil and nutrients, and certain amounts of moisture, warmth, shade or sunlight. These requirements dictate the forest management best practices and harvesting methods.

■ Of the 20 most prevalent American species, the red oak group is the most abundant growing in the eastern hardwood forests and by far the most common genus, accounting for more than 30 percent of all hardwood volume. The maples are next in abundance, followed in lesser degree by poplar, ash, cherry and alder.

■ Some species have been and will continue to be relatively more plentiful than others because that is how they occur in nature.

Collectively, across all hardwood trees in all American hardwood forests, there is twice as much new wood growth as there is wood removed through harvesting. The volume of hardwood growing stock in American forests is 425 billion cubic feet, and they are adding growth of 10.7 billion cubic feet a year. This compares to annual removal of 4.5 billion cubic feet.

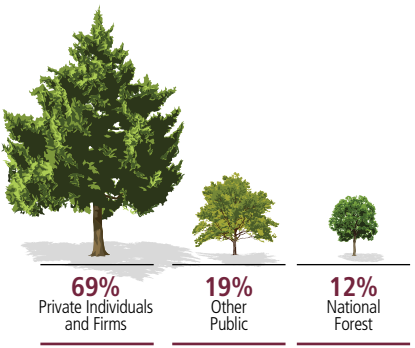
"Sustainability" is meeting today's needs, without compromising the ability of future generations to meet their needs. With hardwood growth well exceeding removal, the U.S. supply of hardwoods for flooring, furniture, cabinetry, and millwork is—by definition—sustainable now and for future generations.

The U.S. Department of Agriculture Forest Service's Forest Inventory and Analysis program collects annual information on the status, health, and trends of forests across all land ownerships. They are responsible for this renewing and eminently sustainable resource. This official census of U.S. forest owners is the National Woodland Owner Survey. Its aim is to increase our understanding of timberland ownership and the future of those forests. And it tells us that of the 521 million acres of timberland in the United States, 69 percent is privately owned—by families, individuals, corporations and other private groups. National forests, as well as Federal, State and other public owners, account for the remaining 31 percent.

Under their collective stewardship, the volume of hardwood in American forests has increased 131 percent since 1953. This is attributable to the responsible forest management practices they regularly employ.

Most American hardwood forests are not uniform plantations or even-aged, single species mono-cultures. They are complex ecosystems that are home to a diversity of tree species of varying ages: sprout, seedling and sapling, mature and aging; dying and decaying, which support a large variety of understory growth.

Timberland Ownership in the Eastern United States

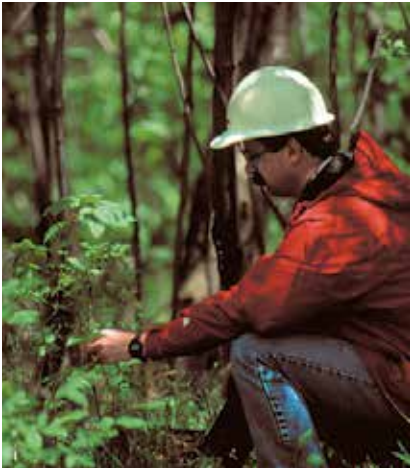


Every day in the hardwood forests, professional foresters practice the complex science of silviculture—the art and science of controlling the establishment, growth, composition, health and quality of forests to meet diverse needs and values.

They adapt their practices and methods to the unique requirements and conditions of each site:

- What are the landowners' objectives?
- What is the species mix?
- How much new growth is there already?
- Are seeds well-distributed?
- Is there a stream or a slope?
- Are any trees diseased or dead?
- How will we minimize soil erosion and avoid damage to unharvested trees and other vegetation?

In the U.S., sustainable forestry and good stewardship are part of our heritage and culture. And unlike other parts of the world, in the U.S., all forestry operations are subject to federal, state and local laws and regulations designed to sustain the resource and protect water quality, wildlife, biodiversity and forest aesthetics.



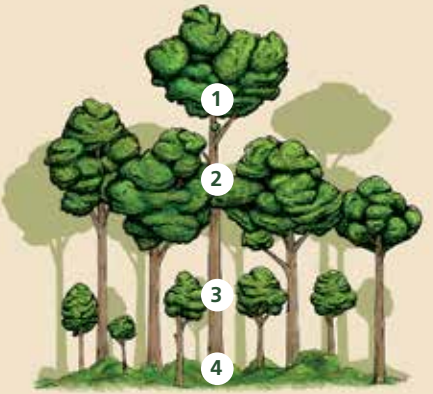
So, who is responsible for this renewing and eminently sustainable resource? Those who own the forestland, their foresters and the responsible forest management practices they employ.

Ongoing REPLENISHMENT

In a hardwood forest, trees compete for the water and sunlight that come through the forest canopy—the leafy "roof" over the forest floor. Single-tree selection reduces this competition. Carefully removing individual trees creates openings in the canopy, allowing more precipitation, sunlight and nutrients to reach the forest floor. No longer suppressed by larger trees, seedlings are free to grow vigorously and saplings sprout out of the tree stumps. A few years later, the forester returns to the site to remove the least desirable saplings, allowing the hardiest to grow.

The forest floor vegetation thrives also, ensuring a healthy environment for birds and other wildlife. In this healthy eco-system, trees reproduce naturally and prolifically. Foresters work with the timeline that nature dictates. With their help, forest regeneration happens and sustained supply and ongoing replenishment are the result.

Forest STRATIFICATION



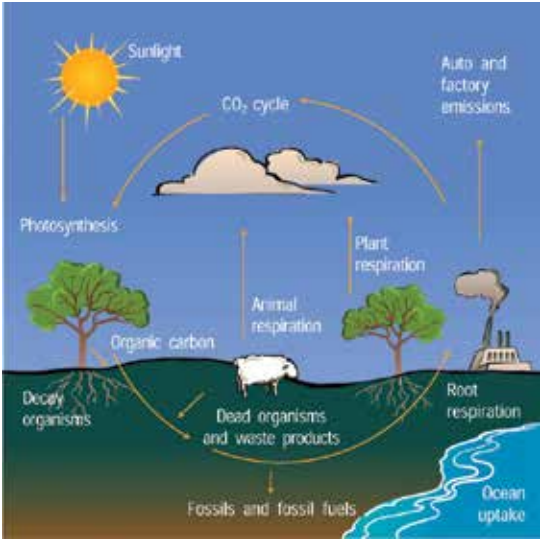
1. **Emergent –** A tree that grows above the general level of the forest canopy. These trees are exposed to the strongest sun and winds.
2. **Canopy –** This level forms the roof of the forest with crowns of the dominant trees and other vegetation.
3. **Understory –** This level receives little light. Many of these trees tolerate shade and remain at this level; others grow and replace older, fallen trees.
4. **Forest Floor –** This lowest level is made up of tree seedlings, dead leaves and needles, grasses, ferns, flowers, fungi and decaying plants and logs.

The Incredible Facts
ABOUT WOOD AND CARBON

Growing trees remove carbon dioxide from the atmosphere and separate the carbon and oxygen atoms. They return the oxygen to the air, and use just the right amount of carbon to grow trunk, branches and leaves. This process reduces greenhouse gases in the atmosphere.

To grow a pound of wood, a tree uses 1.47 pounds of carbon dioxide and releases 1.07 pounds of oxygen. The unused carbon is stored or sequestered for the life of the tree and the products made thereof.

How much of wood's dry weight is carbon? **49 percent!** So, about one half of the weight of wood products in any building project—structural beams, window frames, furniture, flooring, cabinetry, and doors—contributes to the long-term sequestration of carbon.



Wood products make up 47 percent of all industrial raw materials manufactured in the U.S., but consume only 4 percent of the energy required to manufacture those materials.

Other materials cannot say the same. Their manufacturing processes not only produce great amounts of carbon, they require great amounts of energy.

The chart below compares the amount of energy required to produce one ton of cement, glass, steel or aluminum to the production of one ton of wood:

Cement	5x more energy
Glass	14x more energy
Steel	24x more energy
Aluminum	126x more energy

Engineered Wood Association, www.apawood.org

Net Carbon (C) Emissions in Producing a Ton of Various Materials

Material	Net Carbon Emissions (kg C/metric ton)[a b]	Net Carbon Emissions Including Carbon Storage within Material (kg C/metric ton)[c]
Framing lumber	33	-457
Medium density fiberboard *(virgin fiber)*	60	-382
Brick	88	88
Glass	154	154
Recycled Steel *(100% from scrap)*	220	220
Concrete	265	265
Concrete block[d]	291	291
Recycled aluminum *(100% recycled content)*	309	309
Steel *(virgin)*	694	694
Plastic	2,502	2,502
Aluminum *(virgin)*	4,532	4,532

[a] Values are based on life cycle assessment and include gathering and processing of raw materials, primary and secondary processing and transportation.
[b] Source: USEPA (2006).
[c] A carbon content of 49 percent is assumed for wood.
[d] Derived based on EPA value for concrete and consideration of additional steps involved in making blocks.

Once trees are harvested and taken to the sawmill for primary processing, advanced manufacturing technology ensures the least wood waste and greatest yield of lumber. Over 3 million products are made from trees and every part of the log is utilized.

- Tree bark is processed into mulch and soil conditioners.
- Sawdust fuels the boilers that operate dry kilns or is sold for animal bedding.
- Trimmings are chipped and processed into paper and other products.
- Small pieces are recovered and processed into wood components.

The next steps are taken by responsible architects, designers and specifiers engaged in the practice of sustainable design and building.

Sustainable design recognizes that no sawing method is superior. Each produces a distinctly different grain pattern and utilizes each log differently. Regardless of the sawing method, all hardwood will expand and contract as it reaches balance with the relative humidity of its environment, and should be stored and handled properly at the job site.

Flat-Sawn

The angle at which the saw meets a tree's growth rings is what determines figure or grain pattern. In flat-sawing, logs are cut from the outside inward. Growth rings are parallel to the board's surface and create the flame-shaped, arch, or cathedral grain pattern. In comparison to other sawing methods, flat-sawing is less complicated and yields wider boards.

Quarter-Sawn

With quarter-sawing, the log is actually cut into quarters and each quarter is then cut from the inside outward, alternating faces until the last piece is too small to be a usable board. This sawing method is a slower, more technically complicated process, resulting in more expensive lumber.

The growth rings in the first several cuts are perpendicular to the broad face of the board, resulting in a straight-grained appearance. With each successive cut, the angle of the growth rings gets sharper. And when it reaches 30-60 degrees to the board's surface, the vertical graining shows little or no figure. This look is often referred to as "rift." This sawing method yields fewer and narrower boards per log.

Celebrating DIVERSITY

For centuries, American hardwood forests have provided more than 20 species suitable for cabinetry, flooring, millwork, furniture and many other applications. But for reasons of current fashion, custom or convention, many of them are unexplored or under-utilized, despite their commercial availability. By overlooking the wealth of hardwood possibilities, architects, designers and specifiers may well be limiting their repertoire. By taking a fresh look, eco-inspired design will:

- Recognize and take advantage of the beauty of the entire palette of species, and find fresh expressions for this plentiful resource.

- Celebrate natural variety in coloration and character markings by making full use of the resource and reflecting the tree's entire history. (Example, the concealed portions of cabinetry or built-ins need not be made of high grade and costly clear lumber.)

- Respect a material's origin, avoid waste, and make the appropriate connection between source product and final application. (Example: a hardwood tree may be 55 feet tall and 24 inches in diameter, but today's high-yield sawing methods will not produce 24-inch boards.)

The next generation of American Hardwoods is growing right now. Eco-inspired designs will embrace the distinctive signatures of natural materials precisely because they are not mass-produced and artificially uniform.

When trees mature, it is fair and moral that they are cut for man's use, as they would soon decay and return to the earth.

Trees have the yearning to live again, perhaps to provide the beauty, strength and utility to serve man and even to become an object of great artistic worth.

~ *George Nakashima*



American HARDWOODS *Species Profiles*




Species Profile

Alder

Alnus rubra

DISTRIBUTION Principally the Pacific Northwest, where it is the most abundant commercial hardwood.

GENERAL DESCRIPTION Alder, a relative of birch, is almost white when freshly cut, but quickly changes with exposure to air, becoming light brown with a yellow or reddish tinge. Heartwood is formed only in trees of advanced age and there is no visible boundary between sap and heartwood. The wood is fairly straight-grained with a uniform texture.

WORKING PROPERTIES Alder machines well and is excellent for turning. It nails, screws and glues well, and can be sanded, painted, or stained to a good finish. When stained, it blends with walnut or cherry. It dries easily with little degrade and has good dimensional stability after drying.

PHYSICAL PROPERTIES Alder is a relatively soft hardwood of medium density that has low bending strength, shock resistance, and stiffness.

AVAILABILITY Available in dimension stock and lumber.

MAIN USES Furniture, kitchen cabinets, doors, shutters, moulding, panel stock, turnings, carvings, and kitchen utensils.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Ash

Fraxinus spp

DISTRIBUTION Throughout the Eastern U.S.

GENERAL DESCRIPTION The sapwood is light-colored to nearly white and the heartwood varies from grayish or light brown, to pale yellow streaked with brown. The wood is generally straight-grained with a coarse uniform texture. The degree and availability of light-colored sapwood, and other properties, will vary according to the growing regions.

WORKING PROPERTIES Ash machines well, is good in nailing, screwing and gluing, and can be stained to a very good finish. It dries fairly easily with minimal degrade, and there is little movement in performance.

PHYSICAL PROPERTIES Ash has very good overall strength properties relative to its weight. It has excellent shock resistance and is good for steam bending.

AVAILABILITY Readily available.

MAIN USES Furniture, flooring, doors, architectural millwork and moulding, kitchen cabinets, paneling, tool handles, baseball bats, sporting equipment, and turnings. It is particularly suitable for food and liquid containers since there is no odor or taste.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Aspen

Populus tremuloides
Other Name: Popple

DISTRIBUTION Commercially in the Northeast.

GENERAL DESCRIPTION Sapwood is white, blending into the light brown heartwood. The contrast between sap and heartwood is small. The wood is straight-grained and has a fine, uniform texture.

WORKING PROPERTIES Aspen does not split when nailed, it machines easily with a slightly fuzzy surface, and turns, bores, and sands well. It takes paint and stain well to produce a good finish, although care is required where the surface is fuzzy. It has low-to-moderate shrinkage and good dimensional stability.

PHYSICAL PROPERTIES Aspen is light and soft, with low bending strength and stiffness, and medium shock resistance. It has a very low-bending classification.

AVAILABILITY Limited, and rarely available in thick stock.

MAIN USES Furniture parts (drawer sides), doors, moulding, picture frames, millwork, toys, kitchen utensils, and matchsticks. Specialized uses include sauna laths, due to its low conductivity of heat, and chopsticks.

CLEAR

LIGHT

MEDIUM

DARK

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Basswood

Tilia americana
Other Name: Linden

DISTRIBUTION Principally the Northern and Lake states.

GENERAL DESCRIPTION The sapwood of basswood is usually quite large and creamy white in color, merging into the heartwood which is pale to reddish brown, sometimes with darker streaks. The wood has an indistinct grain that is straight and has a fine, uniform texture.

WORKING PROPERTIES Basswood machines well and is easy to work with hand tools, making it a premier carving wood. It nails, screws, and glues fairly well and can be sanded, and stained, to a good, smooth finish. It dries fairly rapidly with little distortion or degrade. It has fairly high shrinkage but good dimensional stability when dry.

PHYSICAL PROPERTIES Basswood is light and soft with generally low strength properties and a poor steam-bending classification.

AVAILABILITY Reasonable availability.

MAIN USES Carvings, turnings, furniture, pattern-making, moulding, millwork, and musical instruments. Specialized uses are Venetian blinds and shutters.

CLEAR

LIGHT

MEDIUM

DARK

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Birch

Betula alleghaniensis

DISTRIBUTION Eastern U.S., principally Northern and Lake states.

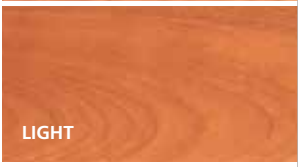
GENERAL DESCRIPTION Birch has a white sapwood and light reddish brown heartwood. The wood is generally straight-grained with a fine, uniform texture, and is generally characterized by a plain, often curly or wavy pattern.

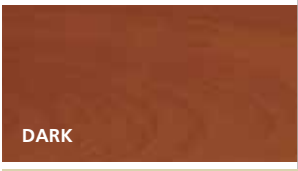
WORKING PROPERTIES The wood works fairly easily, glues well with care, takes stain extremely well, and nails and screws satisfactorily where pre-boring is advised. It dries rather slowly with little degrade, but it has moderately high shrinkage, so is susceptible to movement in performance.

PHYSICAL PROPERTIES Birch is a heavy wood, hard, and strong. It has very good benign properties, with good crushing strength and shock resistance.

AVAILABILITY Reasonable availability, but more limited if selected for color.

MAIN USES Furniture, millwork and paneling, doors, flooring, kitchen cabinets, turnings, and toys.





MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Cherry

Prunus serotina

DISTRIBUTION Throughout Midwestern and Eastern U.S. Main commercial areas: Pennsylvania, Virginia, West Virginia, and New York.

GENERAL DESCRIPTION The heartwood of cherry varies from rich red to reddish brown and will darken with age and on exposure to light. In contrast, the sapwood is creamy white. The wood has a straight-grain, a fine, uniform, satiny and smooth texture, and naturally may contain brown pith flecks and small gum pockets.

WORKING PROPERTIES Cherry is easy to machine, nails and glues well, and when sanded and stained, it produces an excellent, smooth finish. It dries fairly quickly with moderately high shrinkage, but dimensionally is stable after kiln-drying.

PHYSICAL PROPERTIES Cherry is of medium density with good bending properties, has low stiffness, and medium strength and shock resistance.

AVAILABILITY Readily available.

MAIN USES Fine furniture and cabinet making, moulding and millwork, kitchen cabinets, paneling, flooring, doors, boat interiors, musical instruments, turnings, and carvings.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Cottonwood

Populus deltoides

DISTRIBUTION Eastern U.S. Main commercial areas: Middle and Southern states.

GENERAL DESCRIPTION The sapwood is white and may contain brown streaks, while the heartwood may be pale-to-light brown. It is a diffuse, porous wood with a coarse texture. The wood is generally straight-grained and contains relatively few defects. Cottonwood is a true poplar; therefore, has similar characteristics and properties to aspen.

WORKING PROPERTIES General machinability is fair, although tension wood is frequently present and can cause a fuzzy surface when cut, which in turn will require additional care when finishing. The wood glues well and has good resistance to splitting when nailing and screwing. It dries easily but may still have a tendency to warp, with slight movement in performance.

PHYSICAL PROPERTIES Cottonwood is relatively light in weight. The wood is soft, and weak in bending and compression, and low in shock resistance.

AVAILABILITY Widely available.

MAIN USES Furniture, furniture arts, millwork and moulding, toys, and kitchen utensils. Specialized uses are Venetian blinds, shutters, and caskets.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Cypress

Taxodium distichum
Other Names: Bald, red, or yellow cypress

DISTRIBUTION Most cypress trees are native to the South. They are found primarily in wet, swampy areas along the Atlantic Coastal Plain from Delaware to Florida, and west along the Gulf of Mexico to the border of Texas and Mexico. Cypress also thrives along the Mississippi Valley from the Louisiana delta to southern Indiana.

GENERAL DESCRIPTION The sapwood is pale yellow white with the heartwood varying in color from light to dark or reddish brown.

WORKING PROPERTIES Cypress machines well, planes easily, and resists warping. Pre-boring at board edges will help prevent splitting. It nails and scores very well. It glues well, sands easily, and readily accepts finishes.

PHYSICAL PROPERTIES Cypress is a softwood, but it grows alongside hardwoods and traditionally has been grouped and manufactured with hardwoods.

AVAILABILITY Readily available.

MAIN USES Exterior siding, shutters, shingles, trim, fence posts, interior paneling, moulding, millwork, cabinetry, flooring, furniture, beams, and columns.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Elm

Ulmus rubra

DISTRIBUTION Eastern to Midwest U.S.

GENERAL DESCRIPTION Red elm has a grayish white to light brown narrow sapwood, with heartwood that is reddish brown to dark brown in color. The grain can be straight, but is often interlocked, and has a coarse texture.

WORKING PROPERTIES The wood of red elm is fairly easy to work. It nails, screws, and glues well, and can be sanded and stained to a good finish. It dries well with minimum degrade and little movement in performance.

PHYSICAL PROPERTIES Elm is moderately heavy, hard and stiff with excellent bending and shock resistance. It is difficult to split because of its interlocked grain.

AVAILABILITY Available.

MAIN USES Furniture, cabinet making, flooring, millwork, paneling, and caskets.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Gum

Liquidamber styraciflua
Other Names: Redgum, sapgum, and sweetgum

DISTRIBUTION The gums are an important part of the Eastern hardwood forests, and are found throughout the Southeastern U.S.

GENERAL DESCRIPTION The sapwood tends to be wide and is white to light pink, while the heartwood is reddish brown, often with darker streaks. The wood has irregular grain, usually interlocked, which produces an attractive figure with a fine, uniform texture.

WORKING PROPERTIES The wood is easy to work, with both hand and machine tools. It nails, screws, and glues well, takes stain easily, and can be sanded to an excellent finish. It dries rapidly with a strong tendency to warp and twist. It has a high shrinkage, and is susceptible to movement in performance.

PHYSICAL PROPERTIES American gum is moderately hard, stiff, and heavy, and has a low steam-bending classification.

AVAILABILITY Readily available, often separated for color and sold as sapgum (sapwood) and redgum (heartwood).

MAIN USES Cabinet making, furniture parts, doors, millwork, strips and moulding, turnings, and rail ties. Good substitute for walnut when stained.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Hackberry

Celtis occidentalis
Other Name: Sugarberry

DISTRIBUTION Eastern U.S.

GENERAL DESCRIPTION Hackberry is closely related to sugarberry (Celtis laevigata) and is a member of the elm family. There is little difference between sapwood and heartwood which is yellowish grey to light brown with yellow streaks. The wood is very susceptible to blue staining before and after kiln-drying, and has irregular grain, occasionally straight but sometimes interlocked, with a fine, uniform texture.

WORKING PROPERTIES The wood planes and turn well and is intermediate in its ability to hold nails and screws, and stains satisfactorily. Hackberry dries readily with minimal degrade. It has a fairly high shrinkage and is most suitable in cut stock (small/short pieces).

PHYSICAL PROPERTIES Hackberry is moderately hard, heavy, and has medium bending strength, high shock resistance, but is low in stiffness. It has a good steam-bending classification.

AVAILABILITY Reasonable.

MAIN USES Furniture, kitchen cabinets, millwork, doors, and moulding.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Hickory/Pecan

Carya spp

DISTRIBUTION Eastern U.S. Principal commercial areas: Central and Southern states.

GENERAL DESCRIPTION The hickories are an important group within the eastern hardwood forests. Botanically they are split into two groups: the true hickories and the pecan hickories (fruit-bearing). The wood is virtually the same for both and is usually sold together. The sapwood of hickory is white, tinged with brown, while the heartwood is pale to reddish brown.

WORKING PROPERTIES The heaviest of American hardwoods, the hickories can be difficult to machine and glue, and are very hard to work with hand tools; therefore, care is needed. They hold nails and screws well, but there is a tendency to split, so pre-boring is advised. The wood can be sanded to a good finish, can be difficult to dry, and has high shrinkage.

PHYSICAL PROPERTIES Hickories are well-known for their very good strength and shock resistance, as well as excellent steam-bending properties.

AVAILABILITY Readily available.

MAIN USES Tool handles, furniture, cabinetry, flooring, wooden ladders, dowels, and sporting goods.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Hard Maple

Acer saccharum, Acer nigrum
Other Names: Sugar maple, black maple

DISTRIBUTION Eastern U.S., mainly Mid-Atlantic and Lake states. It is a cold-weather tree favoring a more northerly climate.

GENERAL DESCRIPTION The sapwood is a creamy white with a slight reddish brown tinge, and the heartwood varies from light to dark reddish brown. The wood has a close, fine texture and is generally straight-grained.

WORKING PROPERTIES Hard maple dries slowly with high shrinkage, so it can be susceptible to movement in performance. Pre-boring is recommended when nailing and screwing. With care, it machines well, turns well, glues satisfactorily and can be stained to an outstanding finish. The wood polishes well and is suitable for enamel finishes and brown tones.

PHYSICAL PROPERTIES The wood is hard and heavy with good strength properties. In particular, it has high resistance to abrasion and wear. It also has good steam-bending properties.

AVAILABILITY Widely available.

MAIN USES Flooring, furniture, paneling, ballroom and gymnasium floors, kitchen cabinets, worktops, table tops, butcher blocks, kitchenware and toys. Can also be used in millwork, stairs, handrails, moulding, and doors.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Pacific Coast Maple

Acer macrophyllum

Other Name: Big leaf maple

DISTRIBUTION Principally Pacific Northwest where it is an abundant commercial hardwood. It grows scattered or in small groves and its average height is 60 feet.

GENERAL DESCRIPTION Its color is pale pinkish-brown to almost white. Generally there is no marked difference between the sapwood and the heartwood. Its fine grain is similar to birch and cherry with respect to growth-ring contrast. It dries easily with little degrade and has good dimensional stability after drying.

WORKING PROPERTIES It machines well and is excellent for turning. It nails, screws, and glues well, and can be sanded, stained or painted to a good finish.

PHYSICAL PROPERTIES Pacific Coast Maple has medium density, but is slightly harder than eastern soft maple. It has medium-bending strength, shock resistance, and stiffness.

AVAILABILITY Available as lumber and dimension stock.

MAIN USES Furniture, kitchen cabinets, doors, shutters, moulding, panel stock, turnings, carvings, and kitchen utensils.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Soft Maple

Acer rubrum, Acer saccharinum

Other Names: Red maple, silver maple, box elder

DISTRIBUTION Throughout Eastern U.S.

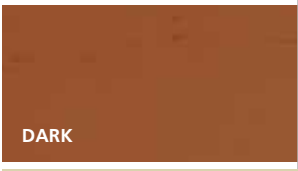
GENERAL DESCRIPTION Soft maple is very similar to hard maple in most respects. Generally, the sapwood is greyish-white, sometimes with darker-colored pith flecks. The heartwood varies from light-to-dark reddish brown. The wood is usually straight-grained. The lumber is generally sold unselected for color.

WORKING PROPERTIES The wood machines well and can be stained to an excellent finish. It glues, screws, and nails satisfactorily; it also polishes well and is suitable for enamel finishes and brown tones. It dries slowly with minimal degrade and there is little movement in performance.

PHYSICAL PROPERTIES Soft maple is about 25 percent less hard than hard maple, has medium-bending and crushing strength, and is low in stiffness and shock resistance. It has good steam-bending properties.

AVAILABILITY Readily available.

MAIN USES Furniture, paneling and millwork, kitchen cabinets, moulding, doors, musical instruments, and turnings. It is often used as a substitute for hard maple or stained to resemble other species.



MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Red Oak

Quercus spp

DISTRIBUTION Widespread throughout Eastern U.S. Oaks are, by far, the most abundant species group growing in the Eastern hardwood forests. Red oaks grow more abundantly than white oaks. The red oak group comprises many species, of which about eight are commercial.

GENERAL DESCRIPTION The sapwood of red oak is white to light brown and the heartwood is a pinkish-reddish brown. The wood is similar in general appearance to white oak, but with a slightly less-pronounced figure due to the smaller rays. The wood is mostly straight-grained, with a coarse texture.

WORKING PROPERTIES It machines well. Pre-boring is recommended for nailing and screwing. It can be stained to a golden finish, with a wide range of finish tones.

PHYSICAL PROPERTIES Red oak is hard and heavy, with medium-bending strength and stiffness and high-crushing strength.

AVAILABILITY Abundant. It is the most widely used species.

MAIN USES Furniture, flooring, architectural millwork and moulding, doors, kitchen cabinets, paneling, and caskets.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

White Oak

Quercus spp

DISTRIBUTION Widespread throughout Eastern U.S. The white oak group comprises many species; of which about eight are commercial.

GENERAL DESCRIPTION The sapwood is light-colored and the heartwood is light-to-dark brown. White oak is mostly straight-grained with a medium-to-coarse texture. Having longer rays than red oak, white oak has more figure.

WORKING PROPERTIES It machines well, nails and screws well, although pre-boring is advised. Due to its reaction with iron, galvanized nails are recommended. Its adhesive properties are variable. The wood dries slowly, but stains to a good finish.

PHYSICAL PROPERTIES White oak is a hard and heavy wood with a medium-bending and crushing strength, low in stiffness, but very good in steam-bending. It has great wear-resistance.

AVAILABILITY Readily available, but not as abundant as red oak.

MAIN USES Furniture, flooring, architectural millwork, moulding, doors, kitchen cabinets, paneling, barrel staves (tight cooperage), and caskets.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Poplar

Liriodendron tulipifera
Other Names: Yellow poplar, tulip wood

DISTRIBUTION Widespread throughout Eastern U.S.

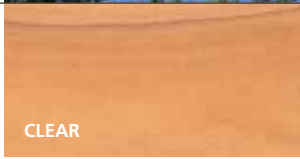
GENERAL DESCRIPTION The sapwood is creamy white and may be streaked, and the heartwood varies from pale yellowish-brown to olive green. The green color in the heartwood will tend to darken on exposure to light and turn brown. The wood has a medium-to-fine texture and is straight-grained.

WORKING PROPERTIES It is a versatile wood that is easy to machine, plane, turn, glue, and bore. It dries easily with minimal movement in performance and has little tendency to split when nailed. It takes and holds paint, enamel, and stain exceptionally well.

PHYSICAL PROPERTIES Poplar is a medium-density wood with low-bending, shock resistance, stiffness, and compression values. It has a medium steam-bending classification.

AVAILABILITY Very widely available.

MAIN USES Light construction, furniture, kitchen cabinets, doors, paneling, moulding and millwork, edge-glued panels, turnings, and carvings.



MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Sycamore

Platanus occidentalis
Other Name: Buttonwood

DISTRIBUTION Throughout Eastern U.S.

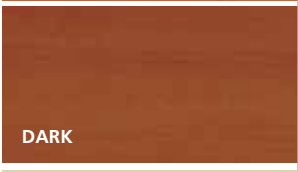
GENERAL DESCRIPTION The sapwood is white to light yellow, while the heartwood is light-to-dark brown. The wood has a fine, close texture with interlocked grain. It contrasts well with other species.

WORKING PROPERTIES The wood machines well, but high-speed cutters are needed to prevent chipping. It is resistant to splitting due to the interlocked grain. It glues well and stains with care to an excellent finish. It dries fairly rapidly, with a tendency to warp. It has moderate shrinkage and little movement in performance.

PHYSICAL PROPERTIES Sycamore is classified as moderate in weight, hardness, stiffness, and shock resistance. It turns well on a lathe and has good bending qualities.

AVAILABILITY Reasonable availability.

MAIN USES Furniture, furniture parts (drawer sides), millwork, paneling and moulding, flooring, kitchenware, butcher blocks, toys, and fruit crates.



MACHINING
NAILING
SCREWING
GLUING
FINISHING

Species Profile

Walnut

Juglans nigra

DISTRIBUTION Throughout Eastern U.S. Principal commercial region is the Central states.

GENERAL DESCRIPTION The sapwood is creamy white, while the heartwood is light brown to dark chocolate brown, occasionally with a purplish cast and darker streaks. It is usually supplied steamed, to darken the sapwood. The wood is generally straight-grained; sometimes with wavy or curly grain that produces an attractive and decorative figure.

WORKING PROPERTIES It works easily with hand and machine tools, and nails, screws, and glues well. It holds paint and stain very well for an exceptional finish and is readily polished. It dries slowly, and care is needed to avoid kiln degrade. It has good dimensional stability.

PHYSICAL PROPERTIES Walnut is a tough hardwood of medium density, with moderate bending and crushing strengths, and low stiffness. It has a good steam-bending classification.

AVAILABILITY Reasonable availability.

MAIN USES Furniture, cabinets, architectural millwork, doors, flooring, paneling, and gun stocks. It is a favored wood for use in contrast with lighter-colored species.

MACHINING
NAILING
SCREWING
GLUING
FINISHING

Strength and Mechanical Properties (inch-pound)[a]

Common Species Names	Moisture Content	Specific Gravity (b)	Modulus of Rupture *lbf/in²*	Static Bending Modulus of Elasticity (c) *10⁶ lbf/in²*	Work to Maximum Load *in-lbf/in³*
Alder	Green - 12%	0.37 - 0.41	6,500 - 9,800	1.17 - 1.38	8.0 - 8.4
Ash	Green - 12%	0.45 - 0.60	6,000 - 15,000	1.04 - 1.74	11.8 - 16.6
Aspen	Green - 12%	0.35 - 0.39	5,100 - 9,100	0.86 - 1.43	5.7 - 7.7
Basswood	Green - 12%	0.32 - 0.37	5,000 - 8,700	1.04 - 1.46	5.3 - 7.2
Birch	Green - 12%	0.48 - 0.65	6,400 - 16,900	1.17 - 2.17	15.7 - 20.8
Cherry	Green - 12%	0.47 - 0.50	8,000 - 12,300	1.31 - 1.49	11.4 - 12.8
Cottonwood	Green - 12%	0.31 - 0.40	3,900 - 8,500	0.75 - 1.37	4.2 - 7.4
Cypress	Green - 12%	0.42 - 0.46	6,600 - 10,600	1.18 - 1.44	6.6 - 8.2
Elm	Green - 12%	0.46 - 0.63	7,200 - 14,800	1.11 - 1.54	11.8 - 19.8
Gum	Green - 12%	0.46 - 0.52	7,100 - 12,500	1.20 - 1.64	10.1 - 11.9
Hackberry	Green - 12%	0.49 - 0.53	6,500 - 11,000	0.95 - 1.19	12.8 - 14.5
Hickory/Pecan	Green - 12%	0.56 - 0.75	9,100 - 20,200	1.29 - 2.26	13.8 - 31.7
Hard Maple	Green - 12%	0.52 - 0.63	7,900 - 15,800	1.33 - 1.83	12.5 - 16.5
Pacific Coast Maple	Green - 12%	0.44 - 0.48	7,400 - 10,700	1.10 - 1.45	7.8 - 8.7
Soft Maple	Green - 12%	0.44 - 0.54	5,800 - 13,400	0.94 - 1.64	8.3 - 12.5
Red Oak	Green - 12%	0.52 - 0.69	6,900 - 18,100	1.14 - 2.28	8.0 - 21.5
White Oak	Green - 12%	0.57 - 0.88	7,200 - 18,400	0.88 - 2.05	9.4 - 19.2
Poplar	Green - 12%	0.40 - 0.42	6,000 - 10,100	1.22 - 1.58	7.5 - 8.8
Sycamore	Green - 12%	0.46 - 0.49	6,500 - 10,000	1.06 - 1.42	7.5 - 8.5
Walnut	Green - 12%	0.51 - 0.55	9,500 - 14,600	1.42 - 1.66	10.7 - 14.6

[a] Results of tests on small clear specimens in the green and air-dried conditions. Definition of properties; impact bending is height of drop that causes complete failure, using 0.71-kg (50-lb) hammer; compression parallel to grain is also called maximum crushing strength; compression perpendicular to grain is fiber stress at proportional limit; shear is maximum shearing strength; tension is maximum tensile strength; and side hardness is hardness measured when load is perpendicular to grain.

Impact Bending to Grain *in*	Compression Parallel to Grain *lbf/in²*	Compression Perpendicular to Grain *lbf/in²*	Shear Parallel to Grain *lbf/in²*	Tension Perpendicular to Grain *lbf/in²*	Side Hardness *lbf*
20 - 20	2,960 - 5,820	250 - 440	770 - 1,080	390 - 420	440 - 590
– - 43	2,300 - 7,410	350 - 1,420	860 - 2,030	– - 940	– - 1,320
– - 22	2,140 - 5,300	180 - 450	660 - 1,080	– - 260	– - 350
16	2,220 - 4,730	170 - 370	600 - 990	280 - 350	250 - 410
34 - 55	2,360 - 8,540	270 - 1,080	840 - 2,240	– - 950	560 - 1,470
29 - 33	3,540 - 7,110	360 - 690	1,130 - 1,700	560 - 570	660 - 950
– - 22	1,690 - 4,910	140 - 380	500 - 1,040	– - 580	– - 430
24 - 25	3,580 - 6,360	400 - 730	810 - 1,000	270 - 300	390 - 510
38 - 56	2,910 - 7,050	360 - 1,230	1,000 - 1,920	– - 660	620 - 1,320
32 - 36	3,040 - 6,320	370 - 620	990 - 1,600	540 - 760	600 - 850
43 - 48	2,650 - 5,440	400 - 890	1,070 - 1,590	580 - 630	700 - 880
– - 104	3,920 - 9,210	760 - 1,980	– - 2,430	– - 680	– - 2,140
39 - 48	3,270 - 7,830	600 - 1,470	1,130 - 2,330	– - 720	840 - 1,450
23 - 28	3,240 - 5,950	450 - 750	1,110 - 1,730	540 - 600	620 - 850
25 - 32	2,490 - 6,540	370 - 1,000	1,050 - 1,850	– - 600	590 - 950
26 - 54	3,000 - 8,740	550 - 1,250	930 - 2,080	– - 1,050	860 - 1,510
– - 50	3,290 - 8,900	530 - 2,840	1,210 - 2,660	– - 940	– - 1,620
24 - 26	2,660 - 5,540	270 - 500	790 - 1,190	510 - 540	440 - 540
26	2,920 - 5,380	360 - 700	1,000 - 1,470	630 - 720	610 - 770
34 - 37	4,300 - 7,580	490 - 1,010	1,220 - 1,370	570 - 690	900 - 1,010

[b] Specific gravity is based on weight when ovendry and volume when green or at 12 percent moisture content.

[c] Modulus of elasticity measured from a simply supported, center-loaded beam, on a span depth ratio of 14/1. To correct for shear deflection, the modulus can be increased by 10 percent.

Note: lbf is pound force.

Source: Wood Handbook, Wood as an Engineering Material, USDA Forest Service

American Hardwoods™

www.HardwoodInfo.com