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Wood density chart

The density of wood varies depending on the type of wood and its moisture content, but on average, the density of dry wood typically falls in the range of 300 to 900 kilograms per cubic meter (kg/m3).The following table provides a comprehensive list of density values for different wood types at 12% moisture content, measured at room temperature (approximately 20°C or 68°F) and 1 atmospheric (atm) pressure. (1 atm = 101,325 Pa) Click on the icon to switch between SI (kg/m3) and US customary/Imperial (lb/ft3) units.Density of Common WoodAfromosia690Ash (black)530Ash (blue)650Ash (green)610Ash (white)640Aspen (quaking)420Balsa110 - 140Balsam poplar330 - 465Basswood (American)320 - 590Beech (American)720Beech (blue)720Berlinia, ebiara720Birch (paper)600Birch (silver)550Birch (sweet)710Birch (yellow)660Black wattle720Bluegum (southern)820 - 980Boxelder510Bucida (oxhorn)1100Buckeye (yellow)380Butternut400Cedar (eastern red)490Cedar (northern white)300 - 315Cedar (southern white)350Cedar (tropical)370 - 700Cedar (western red)370Cherry (black)560Cherry (wild red)425Chestnut (American)480Corkwood210Cottonwood (black)380Cottonwood (eastern)450Cypress480 - 510Danta, kotibe800Dogwood800Douglas fir (coast)510 - 545Ebony (India)980Ebony (Mauritius)770Elm (American)550 - 660Elm (rock)660 - 800Elm (slippery)570Eucalyptus (jarrah)790Eucalyptus (karri)830Eucalyptus (mahogany)1060Fir (balsam)410Fir (white)415Greenheart1060 - 1230Gum (red)530Hairi510Hemlock (eastern)430 - 450Hemlock (mountain)480Hemlock (western)440 - 465Hickory (bigleaf)810Hickory (mockernut)820Hickory (pignut)770 - 840Hickory (shagbark)840Hornbeam760Iroko800Ironwood (black)1080Juniper (alligator)580Lapacho, bethabara, ipe1060 - 1200Larch (western)590 - 610Locust (black)710Locust (honey)670Magnolia (cucumber tree)520Magnolia (sweetbay)465Mahogany660 - 850Mahogany (Africa)670Mahogany (India)540Maple (bigleaf)545Maple (black)640Maple (red)610Maple (silver, creek)530Maple (sugar)680 - 700Oak (black)670Oak (bur)670Oak (canyon live)840Oak (chestnut)740Oak (laurel)700Oak (live)980Oak (northern red)705Oak (pin)680Oak (post)750Oak (scarlet)750Oak (swamp chestnut)760Oak (swamp white)790Oak (white)770Oboto660 - 865Persimmon (common)710Pine (eastern white)370 - 430Pine (jack)460Pine (lobolly)590Pine (longleaf)640Pine (patula)480 - 610Pine (pitch)540Pine (ponderosa)420 - 450Pine (red)470 - 500Pine (shortleaf)540 - 580Pine (western white)420 - 430Poplar (yellow)430Red cedar (Australian)510Redwood (young growth)380 - 450Rosewood (Brazilian)850Rosewood (Indian)850Sassafras470Satinwood (Sri Lanka)1030Silver fir (Pacific)430Sourwood590Spruce (black)430Spruce (red)410 - 450Spruce (white)450Sycamore400 - 600Tamarack560Teak (India)580Thuja315Tupelo (black)550 - 560Walnut (black)560 - 610Willow (black)400 - 600 These values are approximate and can vary depending on the specific species, moisture content, and other factors.

For thousands of years, wood has been used for construction, and for making tools, weapons, and furniture. Most simply described, wood is the structural tissue found in the stems and roots of trees. And as you can imagine, not every wood is the same. Some types of wood are more suitable for construction than others, depending on their physical properties—which include density, texture, strength, hardness, stiffness, moisture content, potential for shrinkage, deformation, splitting, and flammability. There are two primary types of wood—hardwood and softwood—and both are used in different types of construction projects. The basic difference between the two classifications is not in their actual hardness. Hardwood and softwood are distinguished in terms of their reproduction: hardwood comes from deciduous trees, which produces seeds with a covering (think walnut, maple and oak); while softwood comes from gymnosperm trees, which have needles and produce cones (think conifers such as spruce and pine). Wood density measures the amount of actual wood material in a unit volume of wood. The way we reach that measurement is to calculate the ratio between an oven-dry or air-dried mass of wood (that is, the lightest it will ever get) divided by the green volume of the wood (when it’s freshly cut and has its largest possible water volume) to find its moisture content. The density of wood differs depending on tree species and tree growth environment. Even the parts of the tree have different densities: branches usually have a lower wood density compared to the trunk. “Wood density” and “specific gravity” are terms that are often used interchangeably, although they are slightly different concepts. Specific gravity is a measurement that uses the density of water (expressed as a baseline of 1.00) as a way to express the ratio of a wood’s density as compared to water. Professional builder and craftsman Jordan Smith explains: “‘Specific Gravity’ is a shorthand way of saying how dense a material is as compared to water. Technically specific gravity is the measure of a wood’s density as compared to water. If wood were the same density as water, the specific gravity would be 1.00. If it’s less than one—and most wood is less than one—then it’s going to float.” Learn all about the properties of wood and how wood is used in construction in the MT Copeland course on Wood Materials. Taught by professional builder Jordan Smith, the course covers topics that range from wood hardness and shear strength to joists and laminated veneer lumber. In order to calculate a wood’s bending strength, we have to determine a measurement called the “Modulus of Rupture,” frequently abbreviated as MOR. Essentially, it is the measure of the strength of a piece of wood loaded with a block perpendicular to the grain until it breaks. Both MOR and compressive strength are measured in pounds per inch. For thousands of years, wood has been used for construction, and for making tools, weapons, and furniture. Most simply described, wood is the structural tissue found in the stems and roots of trees. And as you can imagine, not every wood is the same. Some types of wood are more suitable for construction than others, depending on their physical properties—which include density, texture, strength, hardness, stiffness, moisture content, potential for shrinkage, deformation, splitting, and flammability. There are two primary types of wood—hardwood and softwood—and both are used in different types of construction projects. The basic difference between the two classifications is not in their actual hardness. 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Essentially, it is the measure of the strength of a piece of wood loaded with a block perpendicular to the grain until it breaks. Both MOR and compressive strength are measured in pounds per inch.Jordan suggests thinking of a piece of wood marked with two points. “Press on the wood until it breaks,” Jordan says. “The point at which it snaps is the modulus of rupture, or the measure of the amount of weight you can place on a piece of wood before it breaks. The stronger the wood, the higher the MOR number, and the more weight it takes before it ruptures.” Builders take this number into account when considering the strength of woods for different projects.A wood’s density or specific gravity also affects how it holds a fastener. The more dense the fiber—the more fiber that we have per unit area—the more bite that wood will have on a friction based fastener like a nail. But denser woods are also more likely to split if a large fastener is driven into them. Less dense woods—with fewer fibers to be pushed apart by a large fastener—will not hold a small nail as tightly, but they’re less likely to snap if a large fastener is driven into them. The top three woods by density are:Black Ironwood: A rare wood with a density as high as 1.42 g/cm3 (88 lbs. per cubic foot) Itin: a small South American tree related to mesquite: .98 g/cm3 (61 lbs. per cubic foot)African Blackwood: Considered by some to be the original ebony: 1.08 g/cm3 (67 lbs. per cubic foot)The least dense woods are:Balsa: With cells full of water, balsa lumber is very soft and light, with a density of only 0.11 gm g/cm3 (around 7 lbs. per cubic foot)Bamboo: An evergreen perennial, technically a grass: .38 – .85 g/cm3 (23.72 – 53 pounds per cubic foot)Basswood: Also known as a linden or tillia, it’s well-known as a light, low-density choice for woodworkers: .32 g/cm3 (20 pounds per cubic foot)Density is expressed in the units of mass divided by volume, such as grams per centimeters cubed (g/cm3), kilograms per meter cubed (kg/m3), or pounds per cubic foot (lb/ft3). The higher the number, the more dense the wood. MT Copeland offers video-based online classes that give you a foundation in construction fundamentals with real-world applications. Classes include professionally produced videos taught by practicing craftspeople, and supplementary downloads like quizzes, blueprints, and other materials to help you master the skills. Wood Density and Specific Gravity The Following chart will tell you how much weight you can expect from your wood selection. A simple comparison of the lb/ft3 of cedar and any other species will tell you what you can expect in added weight. In the following chart (chart 1) you will note that cedar weights 23 lbs/ft3. Adding cherry wood will double the weight of any section made from cherry at 43-56lbs/ft3. Hardwoods are much more challenging to work with so keep in mind that not only will they add weight but will require extra work in milling, trimming and much more sanding and sandpaper. Solid Density (103 kg/m3) (lb/ft3) Alder 0.4 – 0.7 26 – 42 Afrormosia 0.71 Agba 0.51 Apple 0.65 – 0.85 41 – 52 Ash, white 0.65 – 0.85 40 – 53 Ash, black 0.54 33 Ash, European 0.71 Aspen 0.42 26 Balsa 0.16 7 – 9 Bamboo 0.3 – 0.4 19 – 25 Basswood 0.3 – 0.6 20 – 37 Beech 0.7 – 0.9 32 – 56 Birch, British 0.67 42 Birch, European 0.67 Box 0.95 – 1.2 59 – 72 Butternut 0.38 24 Cedar of Lebanon 0.58 Cedar, western red 0.38 23 Cherry, European 0.63 43- 56 Chestnut, sweet 0.56 30 Cottonwood 0.41 25 Cypress 0.51 32 Dogwood 0.75 47 Douglas Fir 0.53 33 Ebony 1.1 – 1.3 69 – 83 Elm, American 0.57 35 Elm, English 0.55 – 0.6 34 – 37 Elm, Dutch 0.56 Elm, Wych 0.69 Elm, Rock 0.82 50 Gaboon 0.43 Greenheart 1.04 Gum, Black 0.59 36 Gum, Blue 0.82 50 Gum, Red 0.54 35 Hackberry 0.62 38 Hemlock, western 0.50 Hickory 0.83 37 – 58 Holly 0.75 47 Iroko 0.66 Juniper 0.55 35 Keruing 0.74 Larch 0.5 – 0.55 31 – 35 Lignum Vitae 1.17 – 1.33 73 – 83 Lime, European 0.56 Locust 0.65 – 0.7 42 – 44 Logwood 0.9 57 Madrone 0.74 45 Magnolia 0.57 35 Mahogany, African 0.5 – 0.85 31 – 53 Mahogany, Cuban 0.66 40 Mahogany, Honduras 0.65 41 Mahogany, Spanish 0.85 53 Maple 0.6 – 0.75 39 – 47 Meranti, dark red 0.71 Myrtle 0.66 40 Oak 0.6 – 0.9 37 – 56 Oak, American Red 0.74 45 Oak, American White 0.77 47 Oak, English Brown 0.74 45 Obeche 0.39 Oregon Pine 0.53 33 Parana Pine 0.56 35 Pear 0.6 – 0.7 38 – 45 Pecan 0.77 47 Persimmon 0.9 55 Philippine Red Luan 0.59 36 Pine, pitch 0.67 52 – 53 Pine, Corsican 0.51 Pine, radiata 0.48 Pine, Scots 0.51 Pine, white 0.35 – 0.5 22 – 31 Pine, yellow 0.42 23 – 37 Plane, European 0.64 Plum 0.65 – 0.8 41 – 49 Poplar 0.35 – 0.5 22 – 31 Ramin 0.67 Redwood, American 0.45 28 Redwood, European 0.51 32 Rosewood, Bolivian 0.82 50 Rosewood, East Indian 0.90 55 Sapele 0.64 Satinwood 0.95 59 Spruce 0.4 – 0.7 25 – 44 Spruce, Canadian 0.45 28 Spruce, Norway 0.43 Spruce, Sitka 0.45 28 Spruce, western white 0.45 Sycamore 0.4 – 0.6 24 – 37 Tanguile 0.64 39 Teak, Indian 0.65 – 0.9 41 – 55 Teak, African 0.98 61 Teak, Burma 0.74 45 Utile 0.66 Walnut 0.65 – 0.7 40 – 43 Walnut, Amer Black 0.63 38 Walnut, Claro 0.49 30 Walnut, European 0.57 35 Water gum 1 62 Whitewood, European 0.47 Willow 0.4 – 0.6 24 – 37 Yew 0.67 Zebrawood Densities of seasoned & dry wood are indicated in the table below: Wood Species - Densities Wood SpecieDensity(kg/m3) Alder 420 - 680 Afrormosia 710 Agba 510 Apple 650 - 850 Ash, white 650 - 850 Ash, black 540 Ash, European 710 Aspen 420 Balsa 110 - 140 Bamboo 310 - 400 Basswood 320 - 590 Beech 700 - 900 Birch 510 - 770 Birch, British 670 Birch, European 670 Blue gum 1000 Box 950 - 1160 Butternut 380 Cedar 490 - 570 Cedar of Lebanon 580 Cedar, western red 380 Cherry 630 - 900 Cherry, European 630 Chestnut, sweet 560 Cottonwood 410 Cypress 510 Dogwood 760 Douglas Fir 530 Ebony 1110 - 1330 Elm 540 - 600 Elm, American 570 Elm, English 550 - 600 Elm, Dutch 560 Elm, Wych 690 Elm, Rock 820 Gaboon 430 Greenheart 1040 Gum, Black 590 Gum, Blue 820 Gum, Red 540 Hackberry 620 Hemlock, western 500 Hickory 600 - 930 Holly 760 Iroko 660 Juniper 560 Keruing 740 Larch 500 - 560 Lignum Vitae 1170 - 1330 Lime, European 560 Locust 670 - 710 Logwood 910 Madrone 740 Magnolia 570 Mahogany, African 500 - 850 Mahogany, Cuban 660 Mahogany, Honduras 650 Mahogany, Spanish 850 Maple 620 - 750 Meranti, dark red 710 Myrtle 660 Oak 600 - 900 Oak, American Red 740 Oak, American White 770 Oak, English Brown 740 Obeche 390 Oregon Pine 530 Parana Pine 560 Pear 610 - 730 Pecan 770 Persimmon 900 Philippine Red Luan 590 Pine, pitch 830 850 Pine, Corsican 510 Pine, radiata 480 Pine, Scots 510 Pine, white 350 - 500 Pine, yellow 420 Plane, European 640 Plum 660 - 780 Poplar 350 - 500 Ramin 670 Redwood, American 450 Redwood, European 510 Rosewood, Bolivian 820 Rosewood, East Indian 900 Sapele 640 Satinwood 950 Spruce 480 - 780 Spruce, Canadian 450 Spruce, Norway 430 Spruce, Sitka 450 Spruce, western white 450 Sycamore 400 - 600 Tanguile 640 Teak, Indian 660 - 980 Teak, African 980 Teak, Burma 740 Utile 660 Walnut 640 - 700 Walnut, Amer Black 630 Walnut, Claro 490 Walnut, European 570 Water gum 1000 Whitewood, European 470 Willow 400 - 600 Yew 670 Zebrawood 790 1 kg/m3 = 0.001 g/cm3 = 0.0005780 oz/in3 = 0.16036 oz/gal (Imperial) = 0.1335 oz/gal (U.S.) = 0.0624 lb/ft3 = 0.000036127 lb/in3 = 1.6856 lb/yd3 = 0.010022 lb/gal (Imperial) = 0.008345 lb/gal (U.S) = 0.0007525 ton/yd3 Lumber dimensions Mass and density in the Imperial system Unit Converter After felling, timber will lose moisture to align itself with the atmospheric conditions. Moisture content should be lower than 20% to stop fungal attack. Seasoning is the name of the process where moisture content is reduced to the appropriate level for proposed use. Shrinkage will occurs as a result of the moisture loss - typical 3-4% across the grain. Calculate angles with a straight board across carpenter's square. Board feet is used as a volume measurement of lumber. Densities of common products - Imperial and SI-units. The difference between density, specific weight, and specific gravity. Including formulas, definitions, and reference values for common substances. The cord unit for purchasing fuel wood. Common sizing of glue-laminated timber. Species of hardwood vs. softwood. Hardwood and softwood drill speed chart. Sizing of hardwood lumber. Lumber and surface finishing abbreviations. Weights of green, kiln dried and pressure treated lumber boards. Grading of lumber in North America Use a miter saw angle protractor for precise angle calculations in woodworking and construction. Measure and cut perfect angles effortlessly. Allowable withdrawal load for nail and spikes. Grit sizes ranging 12 - 600. Strength classes, bending stress and mean density of hardwood and softwood Rough lumber, surfaced lumber (dressed), worked lumber, shop and factory lumber and yard lumber. Nominal and minimum-dressed lumber sizes. Densities of selected solids. Basic size, area, moments of inertia and section modulus for timber - metric units. Properties of structural lumber. Trees species and relative water demand. Height of trees commonly used in towns and urban areas. Combustion of wood and firewood heat values for species like Pine, Elm, Hickory and more. Red Spruce, Longleaf Pine and Douglas Fir - moisture content and their compressive strength. The density of wood versus moisture content. Combustion heat values for wet and dry wood - Btu/pounds, kJ/kg and kcal/kg. Safe loads for wood columns. Soft and hardwood - the Janka Hardness scale. Weight supported by a double or triple wood headers. Allowable withdrawal load force. Weight of green and air-dried fire wood. Density, fibre stress, compressive strength and modulus of elasticity of clear wood, panel and structural timber products. 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