

Wood-Frame Construction

Wood-frame construction has been the system of choice for many years. It has also been the subject of much research into the optimum value engineered framing design. For the most part, this research has been focused on the downward loads on the structure (e.g., dead load and snow load). More recently, as a result of the losses associated with Atlantic hurricanes, the capacity of the building to withstand uplift has become an important subject.

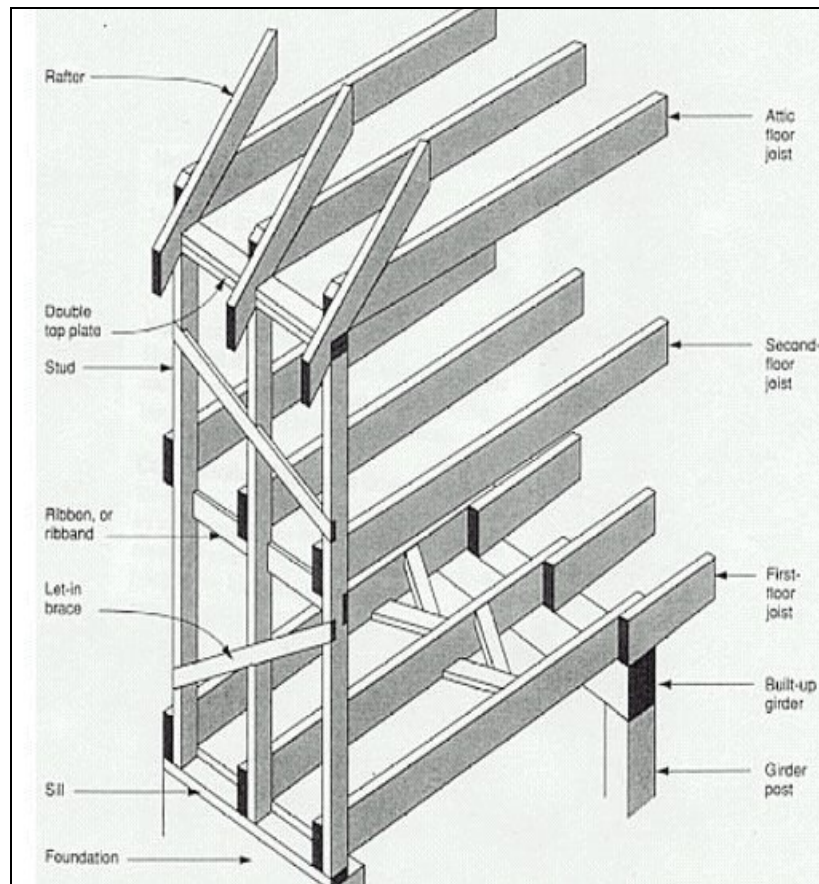
The lumber saving and plywood saving techniques to be discussed are focused on reducing both labor and material in wood-frame house construction while maintaining house quality and value.

Platform vs Balloon Framing

Platform framing refers to the erection of a home one story at a time. In the case of a two-story building, the first-floor walls are erected and the floor system for the second story is set on top of the walls. The result is a one-story high “platform” on which to begin erection of the second story walls.



With **balloon framing**, studs run full height from sill-plate on the first floor to the top plate, to a maximum of 20 feet. This method was popular before the 1930s and is still used on occasion for stucco and other masonry-walled two-story houses because such structures shrink and settle more uniformly than do platform structures. However, balloon framing is more dangerous to erect, and the long, straight wall studs required have grown increasingly expensive and scarce.

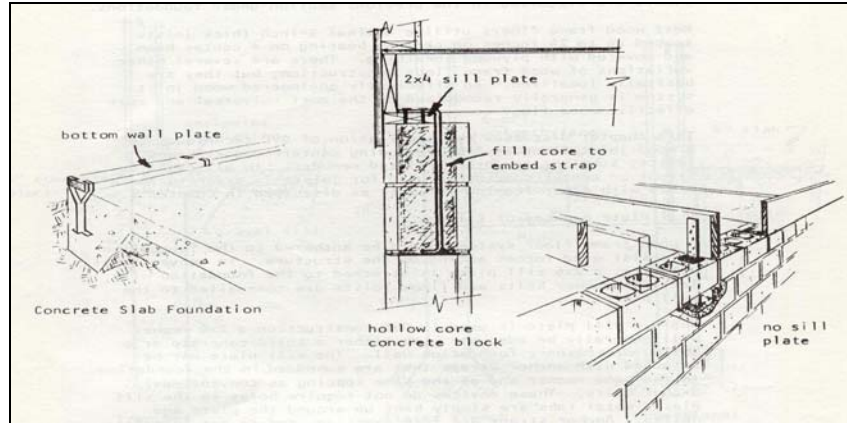


Balloon Framing with Full-height Studs

Special Topics About Wood-Frame Construction

Sill Plate - A wood-frame wall or floor system should be attached to the slab or foundation stem wall in order to resist lateral wind forces. In slab-on-grade foundations, the practice involves installing anchor bolts every 4 feet, drilling holes in the pressure-treated sill plate (aka, sole plate) to match the bolt spacing, and installing the plate with large washers and nuts. The plate is a pressure treated 2x4 or 2x6 to match the wall system it will support. A labor saving option is to use a tie-down strap rather than anchor bolts. The straps are imbedded in the concrete slab and simply bent over and attached to the sole plate when it is installed.

In concrete masonry stem walls, the anchor bolts or straps must be imbedded in filled cores of the block. Attachment of the floor joists or the plate to the foundation is done in a fashion like the slab attachment. Traditionally, a 2x6 pressure treated sill plate is installed on top of the stem wall beneath the floor joists. A lumber and cost saving option is to use a 2x4 pressure treated plate.



Sill Plate Attachment: Metal Straps or Anchor Bolts are Imbedded in Slab or in Filled Cores of the CMU Stem Wall

Glue-Nailed Floor Design - Wood-framed floor systems that use a plywood subfloor properly glued to the floor joists with a structural adhesive function like a composite T-beam. The result is that the allowable span is greatly increased. Thus, using a glue-nailed floor system design may allow the builder to use a smaller member to carry the load for a given span. The result is a reduction in cost and less lumber is used.

Mid-height Blocking – **Mid-height blocking is required as a fire stop in two-story “balloon” construction.** However, balloon construction in two-story homes is seldom, if ever, used in Florida. It has been used in the northwest. The top and bottom plates in the more conventional “platform” construction provide the necessary fire stop protection.

There was a time when mid-height blocking was installed for lateral bracing in platform construction. However, lateral bracing of studs is provided adequately by even minimal wall covering materials such as drywall.

Roof Sheathing – Plywood or oriented strandboard are typically installed as the roof sheathing. The common thicknesses for the sheathing range from 3/4-inch to 1/2-inch. Support for the sheathing in mid-span between the 24-inch-spaced trusses is required. This support can be provided by **H-clips**. The clip also provides 1/8-inch spacing between the panels of sheathing material to accommodate the expansion of the panel without buckling.

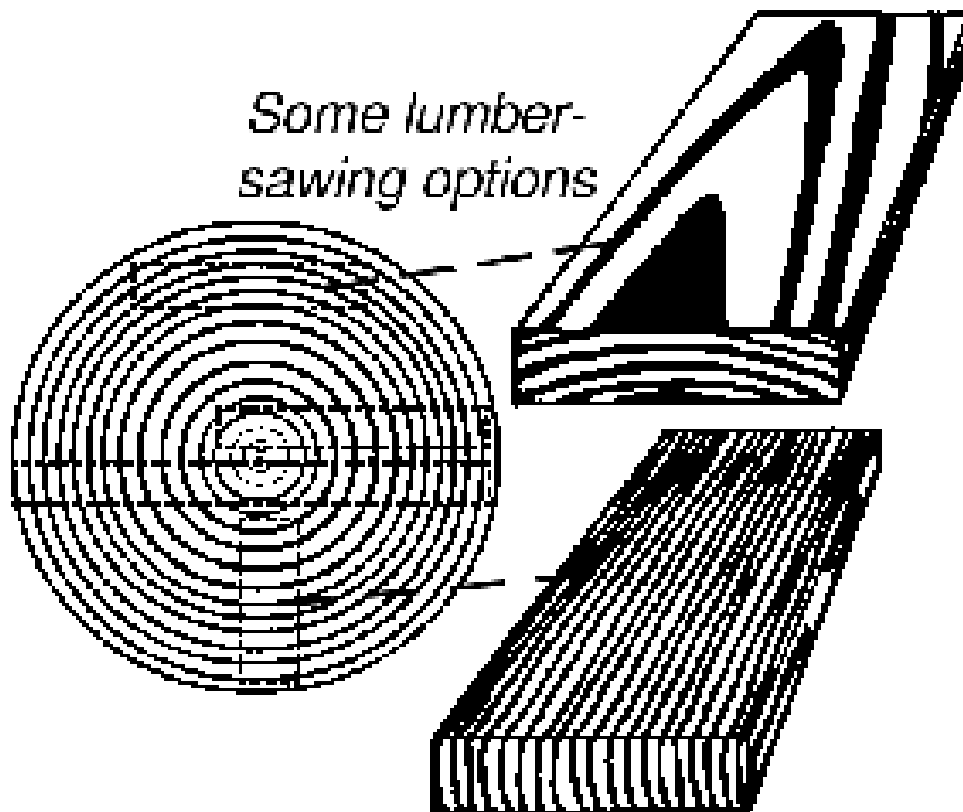
Juvenile Wood

Wood laid down close to the pith is called juvenile wood. In the case of a seedling, the entire plant would be called juvenile wood. In general, juvenile wood is found in the first 5 to 20 years of growth. The reason for discussing juvenile wood is the fact that it is very unstable and behaves badly as it ages and as its moisture content changes. Dimension lumber with evidence of juvenile wood appearing on the cross-section or plain-view will have a tendency to bow, warp, or twist.

In conifers, juvenile wood, compared with mature wood, has:

- lower strength,
- higher longitudinal shrinkage,
- lower specific gravity,
- more compression wood,
- thinner cell walls,
- greater fibril angle, and
- lower cellulose content,
- higher lignin content. and
- lower percentage of latewood,

All trees have juvenile wood, but it had little significance when the timber supply was primarily old-growth trees grown in natural forest conditions. In these trees, the juvenile wood core was small because early growth was suppressed by competition from surrounding trees. Additionally, the percentage of juvenile wood in the total volume was small because larger trees were harvested. Now, improved trees grown on intensively managed plantations reach saw-timber size and are harvested at a younger age. Because diameter growth is generally greatest during the years juvenile wood is produced, the juvenile wood core may be a very significant part of the harvest.



Lumber Sawn from Different Sections of the Log can have Different Amounts of Juvenile Wood Present.

Lumber Grades

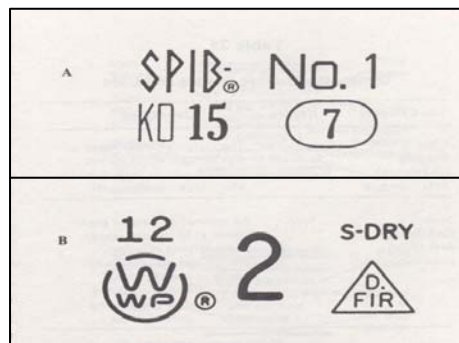
Softwood lumber is divided into three size categories:

- a. 1- to 2-inch thick called “**Boards**”
- b. 2- to 4-inches thick called “**Dimension lumber**”
- c. 5-inches or thicker called “**Timbers**”

Dimension lumber is sold by **grade, species group, and size** and each piece must show an official grade stamp.

A lumber grade stamp shows:

- **Logo of Quality Control (QC) agency,**
- **Mill number or name,**
- **Species,**
- **Seasoning condition at time of manufacture, and**
- **Lumber Grade.**



Lumber Grade Stamp Examples

- a. Upper stamp by Southern Pine Inspection Bureau
- b. Lower stamp by Western Wood Products

Moisture Content

The lumber grade stamp includes an indicator of the moisture content (MC) such as:

- **S-GRN** **Unseasoned, over 19% moisture**
- **S-DRY** **19% or less moisture content**
- **MC-15** **15% or less moisture content**

The Southern Yellow Pine (SYP) producers use KD-19 or KD-15 to indicate the kiln-dried (KD) moisture content. Lumber is produced in “Dry” and “Green” sizes. The moisture content of “Green” lumber is elevated and the lumber is swollen. Once Green lumber reaches 19% moisture content (MC), it is the same size as Dry lumber.

Lumber Grades and Uses

Common lumber grades and uses are presented in the following table.

Use	Grade	Comment
Light framing	Construction, Standard, Utility	Use where high strength not required (studs, plates, sills, cripples, blocking)
Studs (2x2 to 4x6) up to 10 feet	Stud, Standard or Better	All-purpose grade for 10-ft or shorter lumber. Stud grade suited for all stud uses including load-bearing walls.
Structural - Light framing (2x2 to 4x4)	Select structural, No. 1, No. 2, and No. 3	Grades for higher bending strength ratios. Typically for trusses, concrete pier wall forms
Structural – Joists and planks (to 4x16)	Select structural, No. 1, No. 2, and No. 3	Used primarily as floor/ceiling joists and roof rafters. First three grades commonly sold as “No. 2 & Better.”

Pressure Treated Lumber

There are three broad classes of preservatives used for the pressure-treating process:

- **Waterborne** – for residential, commercial, marine, agricultural, recreational, and industrial applications.
- **Creosote and creosote/coal-tar mixtures** – for railroad ties, pilings, and utility poles.
- **Pentachlorophenol (aka, “penta”)** – for industrial applications and utility poles.

The waterborne preservatives are preferred for residential, commercial, and marine building applications because they are clean, odorless, and paintable and they are EPA-registered for both interior and exterior use without a sealer. The commonly used waterborne preservatives have been copper chromated arsenate (CCA), alkaline copper quaternary (ACQ-C, ACQ-D, & ACQ-D Carbonate), and Copper azole (CA-B & CBA-A).

The pressure-treated wood industry, however, announced a voluntary transition from copper chromated arsenate (CCA-C) to alternative preservative systems for residential use, effective **31 December 2003**.

To make the new preservatives effective, their copper content has been boosted substantially -- from around 18% to 96% in some cases. Because alkaline copper quaternary (ACQ) and copper azole (CA) contain so much more copper, you can expect to pay from 15% to 35% more than you paid for CCA lumber. The cost varies because the amount of chemical treatment varies. CCA wasn't that expensive, so most CCA lumber was given a maximum dose of preservatives and rated for “ground contact”.

To keep down the cost of the new pressure-treated wood, manufacturers will produce different levels of protection (i.e., chemical-retention levels) for different end uses. End-use categories will be marked on the tags stapled to the end of the board, but in general, they'll be determined by the dimension of the lumber itself. The lowest chemical-

retention level will be for 5/4 stock, or decking. One level higher will be 2x lumber, or above ground. Ground contact will be 4x and 6x lumber, and other stock will be treated for permanent wood foundations (PWF, or structural members).

Although most of the time this system of categorizing chemical-retention levels will jibe with the actual end use, **a reasonable potential exists for accidental misuse**. You need to make sure you're using ground-contact lumber if that's what you need.

Nail & Fastener Corrosion

Some replacement alternatives are more corrosive than CCA-C and the corrosive content from one piece of lumber to another may vary. Over time, the durability and load-carrying capacity of metal fasteners and connectors can vary widely. This warning includes flashing, fasteners (nails & screws), joist hangers, hinges, post anchors, truss plates, anchor straps, etc. Many variables affect the rate of degradation. It is impossible to predict accurately if or when any significant corrosion will begin to reach a critical level.

Accordingly, the wood industry recommends stainless steel or hot-dip galvanized products for use with all pressure-treated wood applications. Note that stainless steel products are substantially more expensive than similar hot-dip galvanized products.

The pressure-treated wood products reach the market with a variety of trade names:

- Sodium Borate (SBX) also called Disodium Octaborate tetrahydrate (DOT)
Advance Guard, SillBor, Tim-bor, Pac-Bor, TimberSaver PT, Smart Guard, Hi-Bor, Cal-Bor, DuraBor, DuraSill, Composibor
- Alkaline Copper Quaternary (ACQ-C, ACQ-D, ACQ-D Carbonate)
Preserve, Nature Wood, Preserve Plus
- Copper Azole (CA-B, CBAA)
Natural Select, Wolmanized Natural Select
- Sodium Silicate Borate (SBX with NaSiO₂)
Envirosafe Plus
- Ammoniacal Copper Zinc Arsenate (ACZA) Chemonite

Presently, four preservatives dominate in commercial construction:

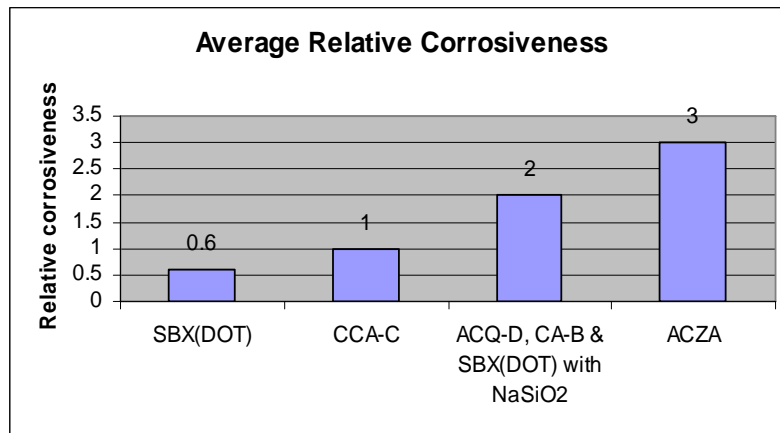
- CCA (chromated copper arsenate) protects timbers, poles, and piling used in certain industrial and marine applications.
- Wood treated with either copper azole or alkaline copper quaternary is used for common dimension lumber. These are the types of treated wood found in lumber yards and home centers.
- Borates are effective and economical **in applications not exposed to water**, such as sill plate. Borate-treated wood is not suitable for outdoor use.

Metal in contact with PT lumber must be corrosion resistant. These metal products include flashing, fasteners, joist hangers, hinges, post anchors, truss plates, anchor straps, etc. Historically, fasteners have been recommended to be hot-dip galvanized or stainless

steel for use in contact with pressure-treated lumber. This general statement has become more specific with the advent of the new alternative preservatives:

- Hot-dip galvanized fasteners meeting **ASTM153 – 2 ounces** of coating per square foot, minimum.
- Hot-dip galvanized connectors meeting **ASTM653, Class G185 – 1.85** ounces of coating per square foot, minimum.
- Fasteners & connectors (e.g., joist hanger and nails) used together should have the same coating level.
- For maximum protection – Type 304 and 316 stainless steel products are recommended but are acknowledged to have substantially higher cost.

Simpson Strong-tie Company, Inc. conducted a series of corrosion test using 1,760 coated plates and 3,000 coated fasteners. The following chart shows the relative corrosiveness of the various preservatives.



The conclusions drawn from these tests were:

- ACQ-D (Carbonate), CA-B, and SBX (DOT) with NaSiO₂ treated wood average twice as corrosive as CCA-C
- During testing Types 304 and 316 stainless steel samples showed no signs of corrosion.
- Connectors should meet ASTM G185 with 1.85 ounces of coating per square foot.
- Fasteners should be either stainless steel or meet ASTM 153 with 2 ounces of coating per square foot.

Fire Retardant Treated Roof Sheathing

Fire retardant treated (FRT) wood has been used for decades, mandated by building codes attempting to limit the spread of fire and reduce smoke generation in commercial and institutional buildings and in multi-family housing. Typical applications include framing, trusses, roof sheathing, blocking, and shelving. It is also specified for projects where not required by codes but where the benefits of passive fire protection may be desirable. For example, FRT wood may allow construction without sprinklers, a welcome omission in rooms containing electronic equipment that could be harmed by sprinkler activation. The properties of FRT wood are also appealing in buildings where valuable property is housed.

Openings in Non-load-bearing Walls – Window and door openings in load-bearing walls require a structural header to maintain the load path down the wall through the studs. Where there are no floor or roof loads, there is no reason to use a structural header and “jack” studs. The gable-end walls of a house built with engineered wood trusses are essentially non-load-bearing walls since the trusses and floor joists likely bear on the front and rear walls. Window and door openings in these walls can be framed with a single stud on either side of the opening and a single member across the head.



Degraded Plywood Sheathing from FRT Treatment Chemical and Solar Heating of Roof System

Some FRTs protect against termite attack such as Dricon® brand of FRT which boasts EPA-registered protection against termites and fungal decay. With this framing, building owners get a benefit even if a fire never occurs, as they hope will be the case.

The majority of sales of FRT wood is for interior, weather-protected uses, but there are related products that perform successfully in exposed applications, such as decks, balconies, covered walkways, and stairways. Codes are looking closer at these products as more buildings are erected in crowded urban areas and in wildland areas remote from fire protection services.

Mold Resistance

Currently (2006-2007) interest is high in mold prevention, or, at least, mold management. Building occupants have mold concerns, and contractors worry about mold liability. It has been reported that some 10,000 mold-related lawsuits have been filed in the U.S. Mold-resistant framing can help minimize the growth of mold and the likelihood of liability claims. To this end, manufacturers of wood treatments have introduced anti-mold coatings for framing lumber, trusses, and engineered wood products. The best of these are applied by spray or dip at central locations where the coverage can be controlled and quality monitored, rather than being applied at each jobsite. Buyers should look for

brands that are reliably certified for low chemical emissions; it does not make sense to trade a potential mold problem for a potential air quality problem. Mold-resistant coatings usually contain a colorant (such as blue) for ready identification of treated material during construction.



This mold-resistant wood coating product is called Bluwood.

PUNDLE

