Lumber, Framing And Heavy Timber

A preparatory course assembled for the
Architectural Record Examinations

Data accumulated from Kent Ballast's "Architecture Exam Review," and various sources of the Internet

(This is only for educational purposes)

AVANT-GARDE ENGINEERING LLC
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INTRODUCTION

- There are two main categories of carpentry; Rough and finish. As the names suggest, rough would be what goes into structure, exposed or hidden, and naturally, all that is non exposed woodwork. Rough carpentry is what we also can categorize as "Lumber and framing" and "Heavy timber" construction.
- We need to distinguish however some of those terms:
  - Wood is the substance in its natural form, with fibers set at a specific formation.
  - Lumber is the same product after it undergoes a process of cutting, sawing and preparing it to be used as construction material.
  - Timber is the same as Lumber, but at a minimum of 5" sectional dimension.

LUMBER

- Characteristics: It is a very versatile material, it is natural and plentiful, available to most of the northern and western countries, carries excellent thermal insulation qualities, and for the most part is considered esthetically pleasing. It does lack in terms of uniformity and structural strength when it is compared to manufactured products. It is also susceptible to dimensional changes due to moisture content variations.

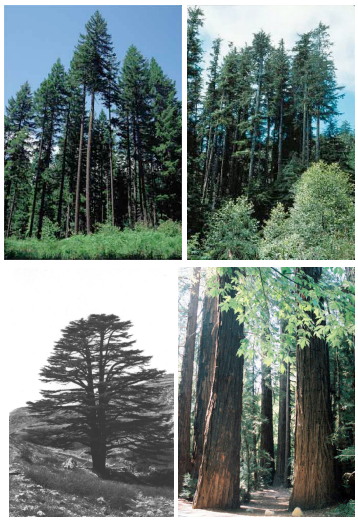
  These disadvantages have been addressed largely through the industry and products like glued laminated elements or plywood have been produced to alleviate problems while keeping the advantages of wood.

LUMBER

- Types of Lumber:
  - There are two specific types of wood, Softwood and Hardwood. Although the names suggest some sort of reference to the strength of these two types, this is only a deceiving use of terms. Instead of having anything to do with material strength, the use of "hard/soft" is an unfortunate way of classifying lumber as deriving from coniferous or deciduous trees respectively.
  - In fact it is Softwoods are mostly used for rough carpentry. For finish carpentry we can see both softwood and hardwood being used.

LUMBER

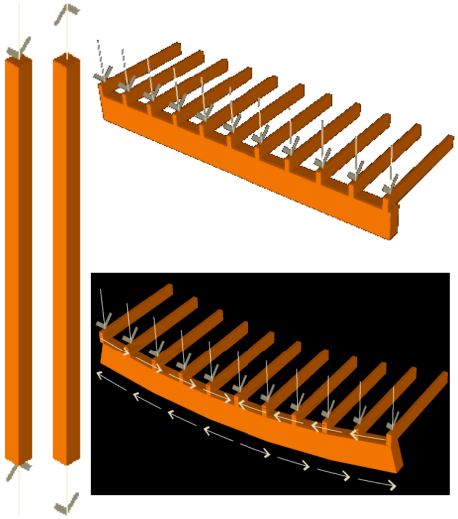
- Types of Lumber cont.:
  - There is a plethora of types of softwood and hardwood accessible throughout the world. Southern Pine and Douglas fir (also known as Oregon Pine) are the types mostly used for rough carpentry. Other types also used are the Hem-fir, eastern white pine, and hemlock.
  - Since resistance to moisture would be necessary sometimes, Redwood and cedar are ideal for exterior applications.



See ASTM C 270
Image Sources: http://www.softwood.org, http://www.bigsurcalifornia.org, March 2008

LUMBER

- Lumber as Structural element:
  - Wood is strongest when the load is applied parallel to the direction of the grain, like when used as a column.
  - It is slightly less strong in tension along the grain and….
  - even weaker when compressive forces are applied perpendicular to the grain.
  - Wood is weakest when fibers are bent along the grain. Fibers tend to slip. When bent, this produces horizontal shear and most of the times this effect governs the design parameters.
  - It is a bundle of straws! Always think of it in these terms!



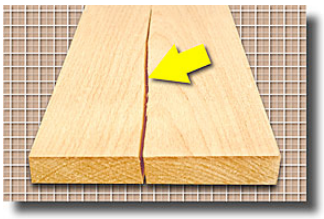
LUMBER

- Blemishes:
  - Wood is a natural element, and one can not anticipate biologically produced material to have quality control applied from the "factory"! Also, during the manufacturing processes of sawing and planing more defects can occur.
  - Knots are the most frequent of the blemishes we can anticipate to encounter. These are classified according to quality, size, and occurrence, and there are more than 10 types of knots

Wood Knot
Image Source: http://vistawallpapers.wordpress.com March 2008

LUMBER

- Blemishes cont.:
  - A *check* is a separation of the fibers that takes place across or through the annual growth rings and it happens because of irregular seasoning.
  - A split is comparable to a check with the only difference that the separation extends to the edge of the piece of lumber.
  - A *pitch pocket* is an open space between growth rings and it becomes a resin pocket.



Pitch pocket on trunk
Image Sources: http://www.cascadehardwood.com, http://www.voruidoso.com, March 2008

LUMBER

- Blemishes cont.:
  - A *shake* is a lengthwise separation of the wood fibers and it takes place through or between the growth rings
  - A *wane* is the presence of bark or absence of wood, due to any cause, at the edge or corner of an otherwise rectangular piece of lumber.
  - A *cup* is a deformation of the lumber from true plane along the width of the board.

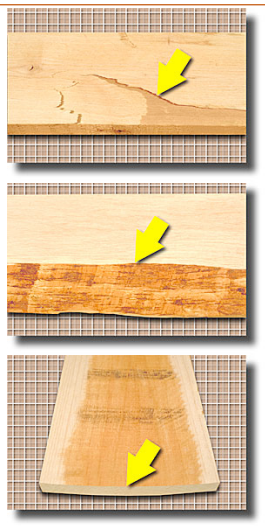
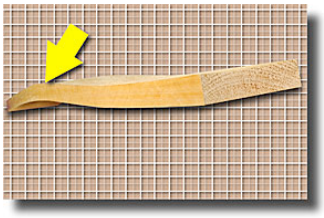


Image Source: http://www.cascadehardwood.com, March 2008

LUMBER

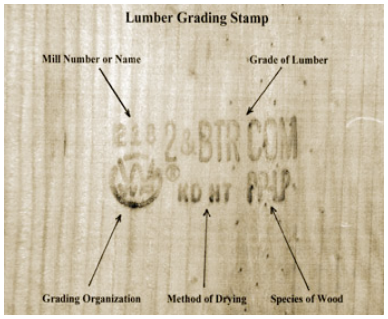
- Blemishes cont.:
  - A *warp* is a defect due to manufacturing, caused by shrinkage and uneven drying of portions of the lumber.
  - A *bow warp* is a deviation parallel to the length of the lumber in line with its flat side.
  - A *crook warp* is a deviation parallel to the length of the lumber perpendicular its flat side.



Source: http://www.cascadehardwood.com, March 2008

LUMBER

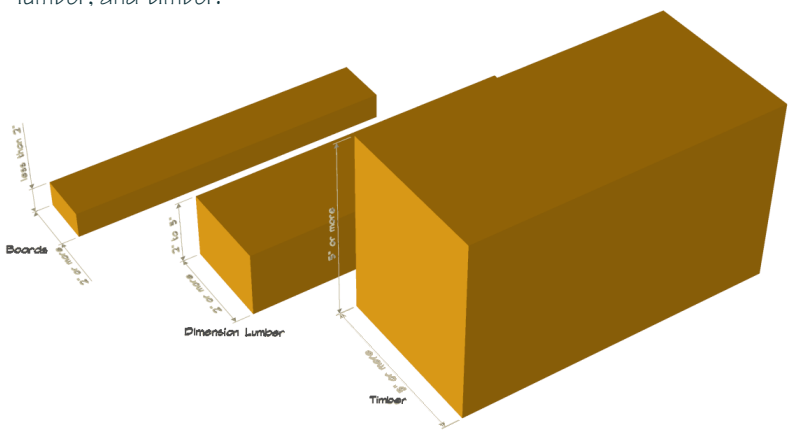
- Grading: Since variations in quality are anticipated, lumber needs to be classified to allow the user to determine what type of lumber needs to be used.
  - For structural lumber the primary concern is the structural strength, which is affected by knots, splits and other defects.
  - For finish lumber, what matters is appearances.
  - There are two primary classifications of softwood lumber: "yard lumber," used for structural purposes and rough framing, and "factory and shop lumber," used for making door and window frames and other finish elements.



Lumber Grading Stamp
Image Source: http://www.dannylipford.com, March 2008

LUMBER

- Grading cont.:
  - Yard lumber classification is further grouped into: boards, dimension lumber, and timber.



LUMBER

- Grading cont.:
  - The five standardized groups based on nominal dimensions are the following:
  1. 2" to 4" thick by 2" to 4" wide is a group that includes elements like 2 x 2.
  2. 2" to 4" thick by 4" wide is a group that includes elements like 2 x 4 which are usually subdivided into grades of construction, standard, and utility.
  3. 2" to 4" thick by 5" wide or wider is a group that includes elements like 2 x 6, 2 x 8 etc., but not 2 x 4.
  4. *Beams and stingers* are members 5" wide or more, having depth more than 2" greater than their width.
  5. *Posts and timbers* are elements at least 5" x 5" with a depth not exceeding their width by 2"

LUMBER

- Grading cont.:
  - Lumber grading used for structural purposes or rough carpentry is carried on at the sawmill, either by a machine or visually. The "allowable stress" values are published in tables by agencies that are certified by the American Lumber Standards Committee.

Machine-sorting lumber by size
Source: http://livingindryden.org, March 2008

LUMBER

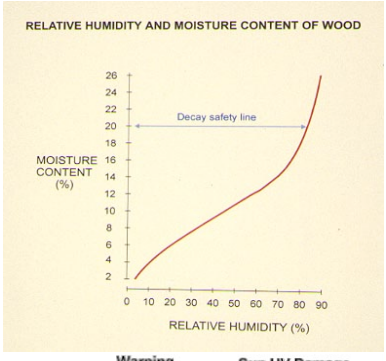
- Dimensioning:
  - Lumber in rough carpentry is categorized according to its nominal dimensions, like 2 x 4 or 2 x 6 etc. However, the actual size after milling, planing, and of course, drying, the actual size of the elements is shrunk.
  - Lumber is priced and specified in orders by a board foot which actually translates to a nominal size of 12 x 12 x 1.

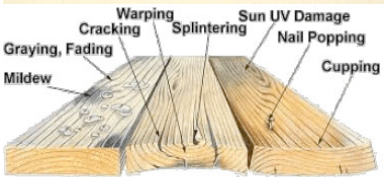
Nominal and Actual sizes of lumber

Nominal size	Standard Dressed Size
1 x 2	¾ x 1½
1 x 4	¾ x 3½
1 x 6	¾ x 5½
1 x 8	¾ x 7½
2 x 2	1½ x 1½
2 x 4	1½ x 3½
2 x 6	1½ x 5½
2 x 8	1½ x 7½
2 x 10	1½ x 9½
2 x 12	1½ x 11½
4 x 4	3½ x 3½
4 x 6	3½ x 5½
4 x 8	3½ x 7½
4 x 10	3½ x 9½
4 x 12	3½ x 11½
4 x 14	3½ x 13½
6 x 6	5½ x 5½
6 x 8	5½ x 7½
6 x 10	5½ x 9½

LUMBER

- Moisture:
- Moisture content is defined as the weight of moisture contained in wood divided by the weight of wood if totally dried in oven. The significance of moisture content is important as it is a variable that determines an anticipated shrinkage over time.
- Moisture exists in the cell cavities and within the cell walls. When the cell walls are completely saturated but there is no moisture in the cell cavities, the *fiber saturation* point is reached. That would be an approximate 30% moisture content in all types of wood.

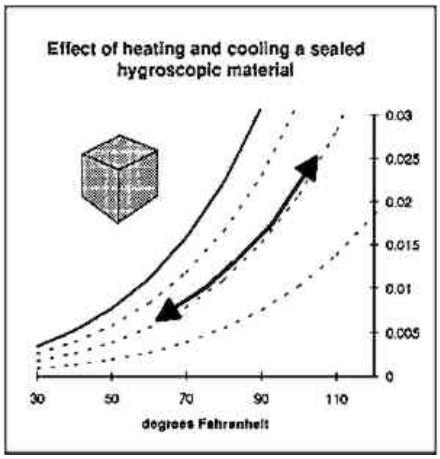




Machine-sorting lumber by size
Source: http://www.arnoldpowerwash.com/images/figure1.jpg, March 2008

LUMBER

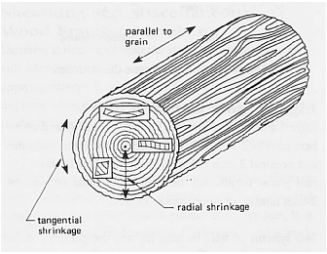
- Moisture:
  - Wood is considered to be in ideal moisture level when its moisture content is identical to the humidity of the environment, so that there will be no issues of shrinkage or swelling.
  - What we consider to be *dry Lumber* moisture content should not exceed 19%. *Kiln dry* lumber can not exceed 15% in moisture content. For design purposes, assumed moisture content is 19%. If exceeded, the strength of the lumber is assessed lower.



Psychrometric chart showing effect of heating and cooling a sealed hygroscopic material such as wood. The moisture content follows lines of constant moisture content, which are roughly concurrent with lines of constant relative humidity
Source: http://aic.stanford.edu/jaic/articles/jaic33-02-011.html, March 2008

LUMBER

- Moisture:
  - Wood shrinks most in the direction perpendicular to the grain and very little parallel to the grain. When considered perpendicular to the grain, wood shrinks most in the direction of the annual growth rings (tangentially) and about half as much across the rings (radially). The position in the log where a piece of lumber is cut also affects its shrinkage characteristics.
  - In detailing wood, an allowance must be made for the wood's shrinking and swelling during use regardless of its initial moisture content. Of particular importance is the accumulated change in dimension of a series of wood members placed one on top of the next. The total shrinkage may result in sagging floors, cracked plaster, distortion of door openings, and nail pops in gypsum board walls.



Ballast, D.K.: *Architecture Exam Review, Volume II Nonstructural Topics, Professional Publications, Belmont, CA, 1998. pp. 18-5-18-9*

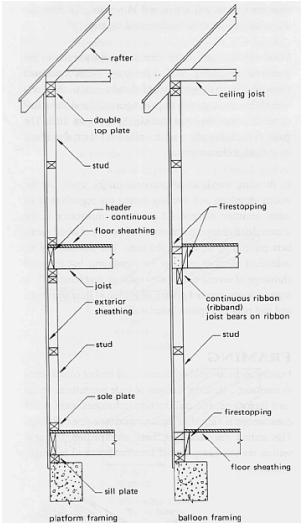
FRAMING

- Framing is the composition of wood components (lumber and timber) to construct a building.
- Structural strength limitations , methods of construction and code restrictions allow only small to medium size buildings to be designed out of wood.

Interior of a wood frame construction
Source: http://blog.sweetgeorgiayarns.com/archives/images/2006/07/2006-07-04_back.jpg, March 2008

FRAMING

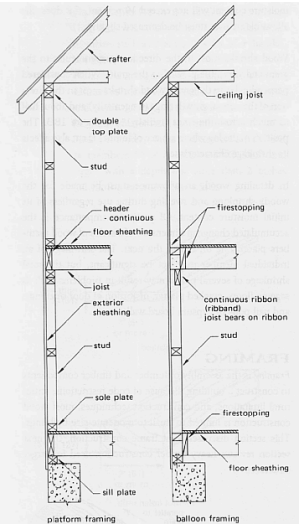
- Light frame construction:
  - Light frame construction uses small, closely spaced members such as 2 x 4 or 2 x 6 studs for walls and partitions and nominal 2" thick members for floor and roof joists. Beams may be built-up sections of nominal 2" lumber, or heavy timber or steel.
  - Two systems of wall framing include the platform frame (also called western framing) and the balloon frame. The essential difference is that the platform frame uses separate studs for each floor of the building, with the top plates, floor joists, and floor framing of the second level being constructed before the second-floor wall studs are erected. The balloon frame uses continuous wall studs from foundation to second-floor ceiling.



Ballast, D.K.: *Architecture Exam Review, Volume II Nonstructural Topics, Professional Publications, Belmont, CA, 1998. pp. 18-5-18-9*

FRAMING

- Light frame construction cont.:
  - Platform frame has the advantage that each floor can be completed and used for constructing the next floor, costing less as shorter studs are less costly.
  - The balloon frame on the other hand allows for minimized vertical shrinkage because most of the construction is parallel to the direction of the grain where wood shrinkage is the least.



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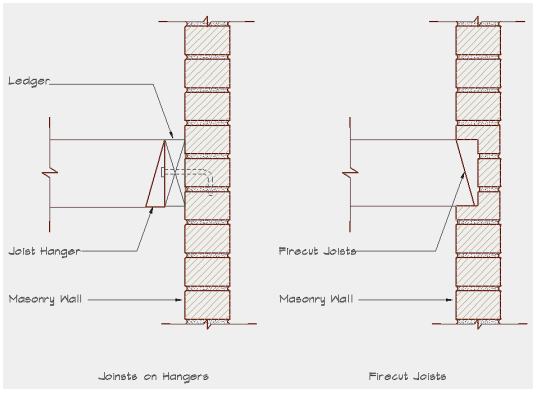
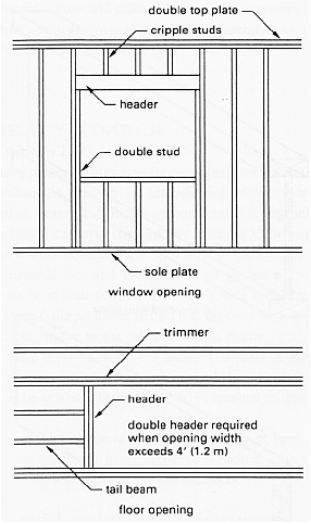
FRAMING

- Light frame construction cont.:
  - When wood joists are framed into masonry walls instead of wood stud walls, they must rest on metal hangers attached to wood ledger strips anchored to the masonry or be fire cut.
  - A fire cut is required to prevent the masonry from being pushed up and out if the wood member should collapse during a fire.



FRAMING

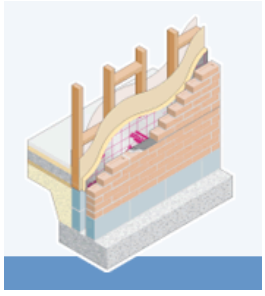
- Openings:
  - Openings in wood construction are required for doors, windows, stairs, and similar conditions. Because light frame construction consists of many small, closely spaced members carrying the loads, eliminating any of these studs or joists affects the structural integrity of the building. As a result, framing of openings must be capable of transferring loads from one cut member to other members.
  - The size of header over a window opening depends on the span and usually consists of double 2-inch-wide member (commonly expressed as 2 x) bearing on studs at either side of the opening.

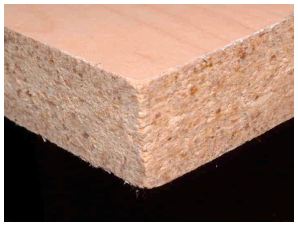


Two typical methods of framing vertical and horizontal openings
Ballast, D.K.: *Architecture Exam Review, Volume II Nonstructural Topics, Professional Publications, Belmont, CA, 1998. pp. 18-5-18-9*

FRAMING

- Sheathing and composite materials:
  - *Sheathing* is thin panel material attached to framing to provide lateral support, increase rigidity, and provide a base for applying exterior finishes. For structural purposes, sheathing most often consists of plywood or particleboard nailed to the wood studs or joists. In situations where lateral stability is not critical, insulating sheathing may be used.
  - *Particle board* is composed of small wood particles, or chips of various sizes mixed together in a binder and formed under pressure into a panel It is available in several thicknesses in 4' x 8' sheets and is available in low-, medium-, and high-density forms. It is generally utilized for backing and framing of finish carpentry as it is cheaper and dimensionally reliable.



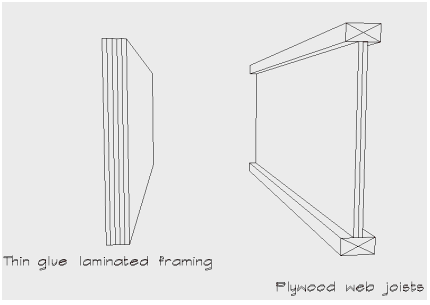


FRAMING

- Sheathing and composite materials cont.:
  - Medium-density Fiberboard (MDF) is a panel product made of wood particles reduced to fibers in a moderate pressure steam vessel and then combined with resin and bonded under heat and pressure.
  - Hardboard is a panel of inter-felted fibers consolidated under heat and pressure to a density of 31 lb/ft^3

FRAMING

- Sheathing and composite materials cont.:
  - Sometimes also called *laminated veneer lumber*, *thin glued-laminated* framing is a strong and dimensionally reliable element that can be used geometries similar to solid framing lumber.
  - *Plywood web joists* would be the geometrical equivalent to the metal I-beam, but structurally used in a way similar to standard solid wood joists, though they can be even deeper, as they can take much higher loads than solid wood joists. They can be viewed as a very efficient structural wood product.



FRAMING

- Sheathing and composite materials cont.:
  - Bridging is a method of bracing between joists that reinforces the joist against lateral torsional buckling. For this method, either solid wood of 1" x 3" cross members, or metal can be installed at intervals of 8' maximum, unless top and bottom ends of the structural element are continuously supported
  - Blocking is a type of wood framing installed between the major structural elements (studs or joists), providing additional rigidity. Usually, this is done by affixing short pieces of lumber perpendicular to joists. Edge blocking is placed at intersections of walls and ceiling framing, accommodating a nailing base for gypsum wallboard.

FRAMING

- Sheathing and composite materials cont.:
  - Firestops are barriers installed at concealed spaces of combustible construction and their purpose is to prevent the spreading of fire caused by drafts. 2" thick wood members can be used for that purpose.

FRAMING

- Plywood:
  - Plywood consists of sheets of thin veneer glued together to arm a rigid panel. Sheets are made in standard 4' x 8' sizes in thicknesses of **1/4, 3/8, 1/2, 5**/8, and **3/4** inch. These are the most readily available, although other panel sizes and thicknesses are available.
  - Plywood is graded in two ways:
  - 1: By span rating is one grading method, used for most structural applications, including Sheathing. The span rating is a measure of the strength and stiffness of the plywood parallel to the face grain. The rating consists of two numbers, such as 36/26. The first number gives the maximum spacing in inches for roof supports under average loading conditions, and the second number gives the maximum spacing in inches for floor supports under average residential loading. These spacings are allowed if the face grain is perpendicular to the direction of the supports and if the panels are continuous over three supports.

Ballast, D.K.: *Architecture Exam Review, Volume II Nonstructural Topics, Professional Publications, Belmont, CA, 1998. pp. 18-5-18-9*

FRAMING

- Plywood:
  - Structural plywood is also classified according to the species of wood used. There are five groups. Structural I plywood is made only from woods in group 1; Structural II can be made from woods in groups 1, 2, and 3.
  - 2: The other way plywood is graded is by the quality of the face veneer. Veneer grades are classified as N, A, B, C, and D. *N grade* indicates natural finish made from all heartwood or all sapwood, is free from defects and is only available on special order.
    - *A grade* is smooth and paintable with few knots or other blemishes and is the best grade commonly available.
    - *B grade* allows for plugged knotholes but has a smooth surface.
    - *C grade* allows small knotholes and some splits, and
    - *D grade* allows for larger knotholes.

    Plywood should be specified with exterior glue for outdoor locations.

Ballast, D.K.: *Architecture Exam Review, Volume II Nonstructural Topics, Professional Publications, Belmont, CA, 1998. pp. 18-5-18-9*

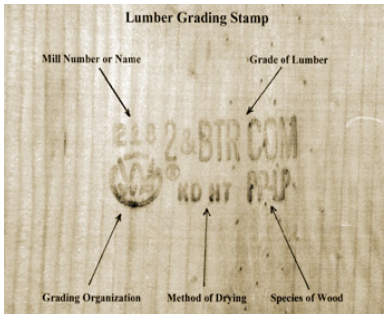
FRAMING

- Plywood:
  - Special types of plywood are also produced. These include patterned panels for exterior finish siding, marine plywood that has special glues, and overlaid plywood with a surface of resin-impregnated paper to provide a smooth surface.

Ballast, D.K.: *Architecture Exam Review, Volume II Nonstructural Topics, Professional Publications, Belmont, CA, 1998. pp. 18-5-18-9*

LUMBER

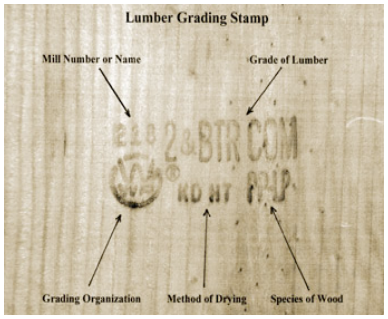
- Grading: Softwoods:
- from best to worst:
  - # 1 (construction grade)
  - #2 (standard grade)
  - #3 (utility grade)
  - #4 (economy grade)
- Softwood lumber that is graded for appearance is used mainly for facing boards and other finish work. The highest quality appearance lumber is known as "finish" followed by "select." Each category is graded from best to worst as:
- A (clear with no knots)
- B (a few minor defects, often combined with A as B & Better)
- C (some small tight knots)
- D (a few knots and defects)



Lumber Grading Stamp
Image Source: http://www.dannylipford.com, March 2008

LUMBER

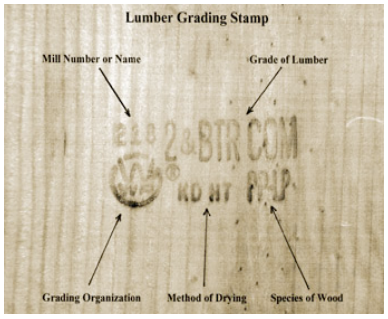
- Some specialty softwoods— such as redwood and western cedar— are graded on the amount of rot resistant heartwood as well as defects. The more common grades of redwood are:
- Clear all heart (no defects and all heartwood on the graded side)
- Heart B (heartwood with a few knots allowed)
- Construction Heart (heartwood with larger knots allowed)
- Deck Heart (similar to construction heart, but graded for strength)
- Clear (no defects but some sapwood)
- Construction common (knots and sapwood allowed)



Lumber Grading Stamp
Image Source: http://www.dannylipford.com, March 2008

LUMBER

- Softwood lumber contains a stamp indicating the name or number of the mill where the lumber was processed, the species of wood, how it was dried, the grade it received, and the organization that certified the grading. Some of the common species abbreviations found on softwoods are:
- D FIR (Douglas fir)
- DOUG FIR-L (Douglas fir or larch)
- HEM-FIR (hemlock or fir)
- IWP (Idaho white pine)
- PP (ponderosa pine)
- PP-LP (ponderosa pine or lodgepole pine)
- S-P-F (spruce, pine, or fir)
- SYP (Southern yellow pine)
- WEST CDR (Western cedar)

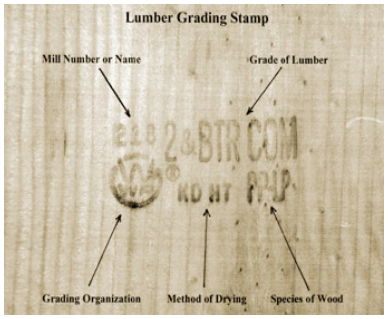


Lumber Grading Stamp
Image Source: http://www.dannylipford.com, March 2008

LUMBER

- Hardwoods:

- Hardwoods— such as oak, cherry, walnut, and poplar— are graded based on the amount of clear material that can be obtained from the board. Since they are often sold rough, hardwoods are usually not stamped. The grades from best to worst include:
- FAS (Firsts and Seconds, must be 6" or wider and 8' or longer with 83% of the board clear)
- Select (similar to FAS but allows boards as narrow as 4" x 6')
- #1 Common (3" x 4' and larger with 67% clear)
- #2 Common (same as #1 but with only 50% clear)



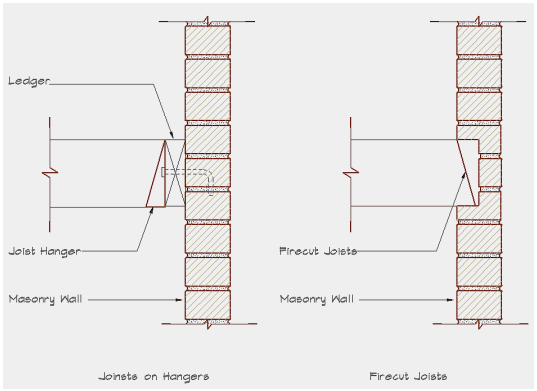
Lumber Grading Stamp
Image Source: http://www.dannylipford.com, March 2008

HEAVY TIMBER

- Heavy timber construction consists of interior structural members made of large solid or laminated wood members. Exterior walls may be designed of a number of materials, including timber. What defines heavy timber construction is the structural members.
- Due to limited availability and costs, true solid timber is rare. Instead glued laminated members are used for what would be contemporary heavy timber construction.

INTRODUCTION

- Codes require interior columns to be at least 8" x 8" nominal and girders at least 10" deep and 1/2' wide.
- For fire protection, girders framed into masonry must be firecut.
- Floor decking must have at least 3" nominal thickness and no concealed spaces below.
- Roof decking must have at least 2" nominal thickness



HEAVY TIMBER

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- Due to limited availability and costs, true solid timber is rare. Instead glued laminated members are used for what would be contemporary heavy timber construction.

HEAVY TIMBER

- Glued Laminated Construction:
- These members are built of a series of glued pieces. Due to the way they are fabricated, *Glulams* can withstand forces higher than those that natural timber elements would, allowing them to take higher stresses or to be applied for longer spans. That is the result of being fabricated under set conditions in a factory. Although what makes them structurally more efficient than natural timber is their resistance to stresses applied perpendicularly to the laminations, Glulams can be used in other directions according to the requirements of the design.
- Although we see them mostly in rectangular forms, *Glulams* can be formed in arches, pitched shapes or other custom forms.

Glulam Beam of Architectural Appearance Grade (ARCH) offers a smooth, attractive finish. Most of the voids associated with the natural characteristics of the lumber are filled to give it an improved finish.

HEAVY TIMBER

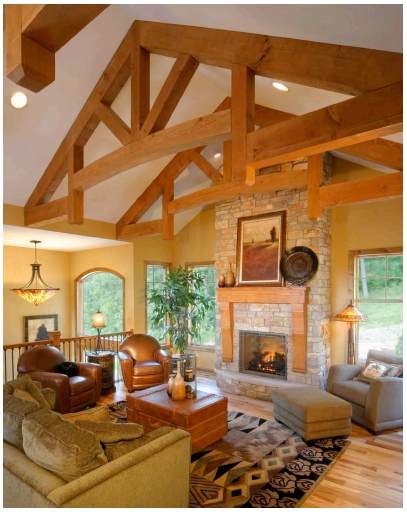
- Glued Laminated Construction cont.:
- *Glulams* are manufactured in standard sizes.
  - Depths are based on a module of 1 1/2" unless tight curves need to be formed in which case the module is divided in two, i.e. 3/4".
  - Widths are given like all other types of wood elements in nominal sizes which translate to slightly smaller actual sizes.

Glulam beam sizes

Nominal	Actual
4"	3 ⅛"
6"	5 ⅛"
8"	6 ¾"
10"	8 ¾"
12"	10 ¾"
14"	12 ¼"

HEAVY TIMBER

- Glued Laminated Construction cont.:
- *Glulams* are designated in three standard grades: *industrial* , *architectural*, and *premium*. These grades do not signify anything in terms of structural quality. Instead, all these designations indicate is the finish of the product in order to be used at different designed spaces.



HEAVY TIMBER

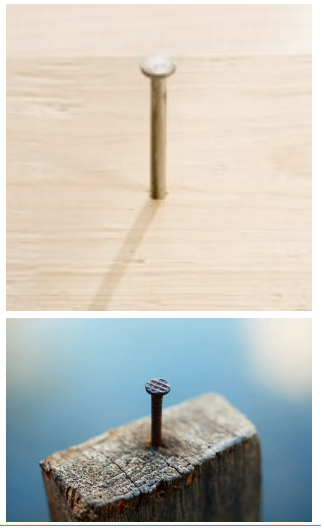
- Planking:
- *Planking or Decking* is solid or laminated timber that incorporates tongue and groove edging so that pieces are engaged and stresses can be transferred. Planking is intended for elements to span between beams, unlike sheathing which is intended to be spanning between joists.
- Thicknesses are nominal at 2", 3", 4", and 5". Actual sizes actually vary according to the manufacturer.
- Planking serves as finished floor, finished ceiling, and it has a very attractive appearance. However, it does not provide space for insulation, electrical conduits or mechanical services.

FASTENERS

- There is a series of them:
- Nails:
  - Nails are the most common and also the weakest type of wood fasteners. The most common nail types used for construction purposes are the:
    - *wire nails*,
    - the *box nails* and
    - the *wire spikes*.
  - Measurement is based on "penny weight" and there are several sizes and weights. For engineering purposes there are tables that indicate the withdrawal resistance and shear resistance for the different sizes and determine a minimum depth nails need to penetrate.
  - Typically, nailing schedules found in the building code, give clear specifications of sizes and penetration of nails

FASTENERS

- There is a series of them:
- Nails cont:
  - Typically, nailing schedules found in the building code, give clear specifications of sizes and penetration of nails into studs, plates, joists to headers etc. Those are safe enough to follow.
  - Orientations of nails within wood members are also important in terms of stability.
    - The preferable orientation is to have the nails (or screws or any other fastener) loaded laterally in side grain where the holding power is greatest.
    - The least desirable is to have the fastener inserted parallel to the grain.

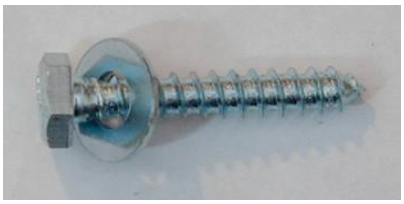


FASTENERS

- Screws:
  - Wood screws are available in sizes from no. 0 (0.060-inch shank diameter) to no. 24 (0.372-inch shank diameter) and in lengths from 1/4 to 5 inches. The most common types are flat head and round head. Because of the threaded design of screws, they offer better holding power and can be removed and replaced more easily than nails. As with nails, screws are best used laterally loaded in side grain rather than in withdrawal from side grain or end grain. Lead holes, slightly smaller than the diameter of the screw, must be drilled into the wood to permit the proper insertion of the screw and to prevent splitting of the wood.

FASTENERS

- Screws:
  - A lag screw is threaded with a pointed end like a wood screw but has a head like a bolt. It is inserted by drilling lead holes and screwing the fastener into the wood with a wrench. A washer is used between the head and the wood.
    Sizes range from 1/4 to 11/4 inches in diameter and from 1 to 16 inches in length. Diameters are measured at the non-threaded shank portion of the screw.

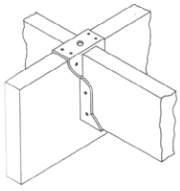


FASTENERS

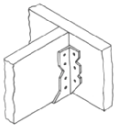
- Bolts:
- Bolts are one of the most common forms of wood connectors for joints of moderate to heavy loading. Bolt sizes range from 1/4 to 1 inch (6 to 25 mm) in diameter and from 1/2 to 6 inches (13 to 152 mm) in length. Washers must be used under the head and nut of the bolt to prevent crushing the wood and to distribute the load.
- The design requirements for bolted joints are a little more complicated than those for screwed or nailed joints. The allowable design values and the spacing of bolts are affected by such variables as the thicknesses of the main and side members, the ratio of bolt length in the main member to the bolt diameter, and the number of members joined.

FASTENERS

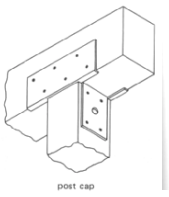
- Metal Fasteners:
- Because wood is such a common building material, there are dozens of types of special fasteners and connectors especially designed to make assembly easy, fast, and structurally sound. Hardware is available for both standard sizes of wood members and special members such as wood truss joists.



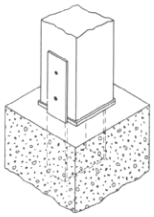
saddle hanger



joist hanger



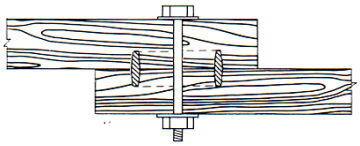
post cap



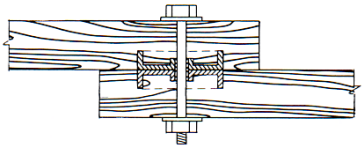
post base

FASTENERS

- Metal Fasteners cont.:
- Besides the lightweight connectors, there are special timber connectors used for heavy timber construction and for assembling wood trusses. Two of the most common types are split rings and shear plates.
- Split rings are either 2 1/2" or 4" in diameter and are cut through in one place in the circumference to form a tongue and slot. The ring is beveled from the central portion toward the edges. Grooves are cut in each piece of the wood members to be joined so that half the ring is in each section. The members are held together with a bolt concentric with the ring.



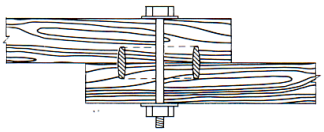
(a) split ring connector



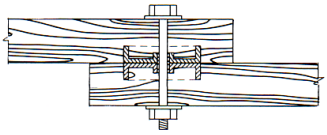
(b) shear plate connector

FASTENERS

- Metal Fasteners cont.:
- Shear plates come in 2 5/8" or 4" in diameter. They are flat plates with a flange extending from the face of the plate. They incorporate a hole in the middle through which either a 3/4" or 7/8" bolt is placed to hold the two members together. The plates are inserted in precut grooves in a piece of wood so that they are flush with one surface.
- Shear plate connections can hold two pieces of wood or one piece of wood and a steel plate.
- Split ring connectors and shear plates can transfer heavier loads than other fasteners and are often used in connecting truss members.
- Shear plates are predominantly advantageous for constructions that will be disassembled.



(a) split ring connector



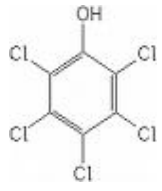
(b) shear plate connector

WOOD TREATMENT

- Wood is relatively durable if it is kept dry. Woods actually carry their own defenses in terms of resin, to protect them from moisture and parasites. Nevertheless, as it is an organic material it is subjected to weathering and decay. Fungi, moisture, parasites, and fire are the most common sources of damage.
- One method of treatment is *pressure treatment* as preservatives are forced into the cells of the wood. In fact, for some special conditions like marine use or insects, pressure treatment is the only method to be specified.

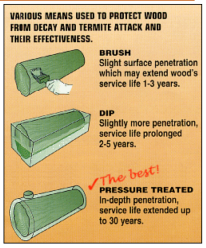
WOOD TREATMENT

- There are two types of wood preservatives: oil and water based salts.
  - Creosote is one of the most common oil treatments based on coal tar. It is non soluble to water and it is very effective against insects. It does however produce an unpleasant odor and a dark appearance on the timber.
  - Pentachlorophenol is one of the water repellent solutions used for lumber above ground or in contact with the ground. It can be applied by brushing, dipping or pressure treatment and carried by oil-borne or gas-borne solutions. Gas-borne solutions allow painting or gluing of the wood after treatment.



WOOD TREATMENT

- Oil and water based salts.
  - Water borne salts comprise among others, acid copper chromate, ammonia-cal copper arsenate, and chromated copper arsenate. When there is significant moisture or the wood is in direct contact with the soil, these salts do not perform very well. Their advantages are the absence of odors and the fact that they are non staining, allowing the wood to be painted.
  - On fire-protective treatment there are two types that can be applied:
    - The first is salt solutions that contain ammonium and phosphates,
    - The second is intumescent paint which when exposed to fire it generates inert air bubbles that delay the combustion.



FINISH CARPENTRY AND ARCHITECTURAL WOODWORK

A preparatory course assembled for the
Architectural Record Examinations

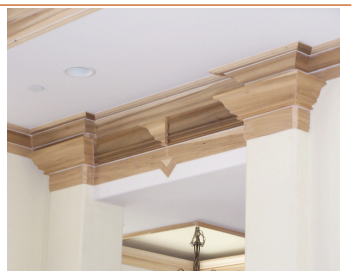
Data accumulated from Kent Ballast's "Architecture Exam Review," and various sources of the Internet

(This is only for educational purposes)

AVANT-GARDE ENGINEERING LLC
CONSULTING ARCHITECTS/ENGINEERS

INTRODUCTION

- Finish carpentry is what can be referred to as finalized exposed wood work. That is usually non structural although very often structural timber is treated to be exposed wood work. For finish carpentry we would mostly refer to siding, framing, interior trims, cabinetry or paneling.
- Architectural woodwork and finish carpentry may overlap. However, the former is usually what we may refer to as elements that are usually fabricated within controlled factory conditions.



Custom Built Lintel Incorporating Crown / Removal and replacement of siding
Image Sources: http://www.t-newman.com/images/100_0215.jpg, http://home.rochester.rr.com/daveyespos/reSidingHouse.jpg, March 2008

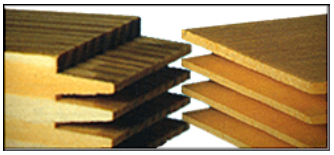
FINISH CARPENTRY

- Wood species and grading:
  - There are dozens of species of hardwoods that are available. Due to costs however, much fewer are commonly used, some of which are: Red and white oak, walnut, cherry, mahogany, birch, poplar, ash, redwood, and maple.
  - Finish carpentry and architectural woodwork and structural lumber are graded differently. Although the grading varies amongst the various species, generally there are three categories: Selects, Finish, and Paneling, with grading applied within each category. This is based on the standards of the Western Wood Products Association (WWPA).

Birch, Oak and Cherry examples
Images Source: http://www.withk obson.com/March 2008

FINISH CARPENTRY

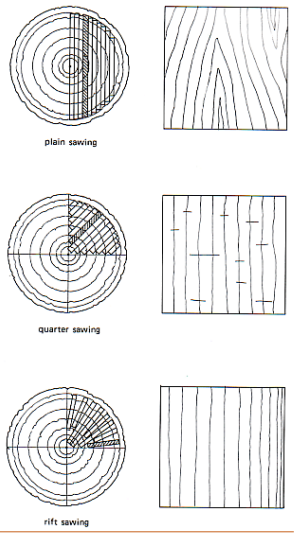
- Wood species and grading cont.:
  - Furthermore, there is another type of specification that can be applied for grading: Wood can be distinguished as heartwood (center parts that have died and have become genetically resistant to decay) and sapwood (perimeter which is living wood in a growing tree).
  - For softwood types there is a method of manufacturing trims at specified lengths, called *fingerjointed*. The ends of short pieces are cut as seen in the illustration and glued. That method produces wood that is destined to be painted.



A section of a branch showing 27 annual growth rings, pale sapwood and dark heartwood, and pith (center dark spot). The dark radial lines are small knots.
Image Source: http://www.answers.com/topic/wood March 2008

FINISH CARPENTRY

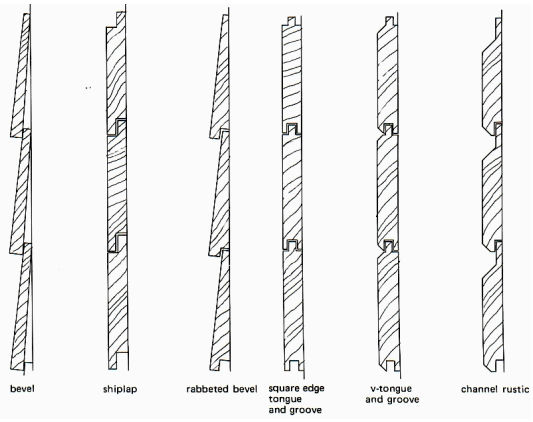
- Lumber Cuts:
- There are three methods of cutting solid stock:
  - Plain or flat Sawing:
  - Quartersawing:
  - Rift Sawing:
  - As there is variation in cost, some types of wood may not be available in all types of cut. Availability of cuts should be verified before project specifications are set.



5 Sawing board methods –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-3.

FINISH CARPENTRY

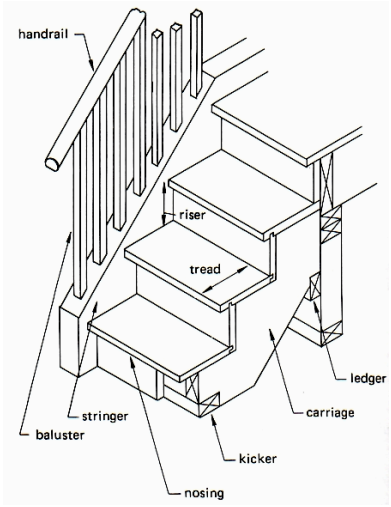
- Siding:
- Wood siding consists of an arrangement of boards set in parallel formation.
- When siding is applied over wood, plywood, or particle board sheathing, a layer of building paper is applied to enhance water resistance. If fiberboard or insulating sheathing, a high density vapor barrier such as Tyvek is applied.
- For wood siding, wood that is most resistant to moisture is preferred such as redwood, cedar, Douglas fir, pine etc.



6 Types of wood siding –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-4.

FINISH CARPENTRY

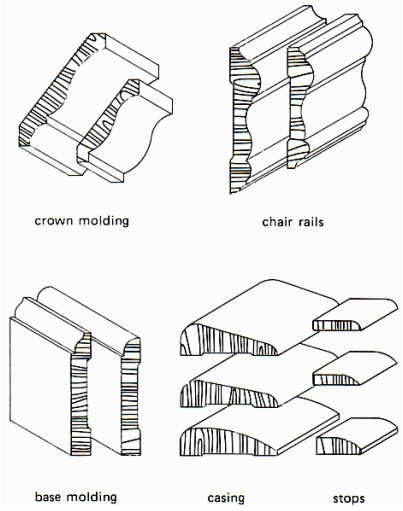
- Wood stairs and Trims:
- Wood stairs are considered finish carpentry even though they can range from utilitarian to elaborate sculptural elements within the built environment.
- Trims are used to finish the joints between dissimilar materials, to close off gaps between elements that may be visible, and to provide an ornamental treatment to the staircases.



Stair construction elements –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-4.

FINISH CARPENTRY

- Wood stairs and Trims cont.:
- For utilitarian staircases not much elaboration is anticipated. However, simple rectangular shapes can be applied at any level.
- There is however a multiplicity of standard shapes that carry elaborate curves and can be applied to different parts.
- Even more ornate shapes can be produced through the combination of standard shapes, or custom milled based on specific profiles.



Interior trim elements –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-5.

ARCHITECTURAL WOODWORK

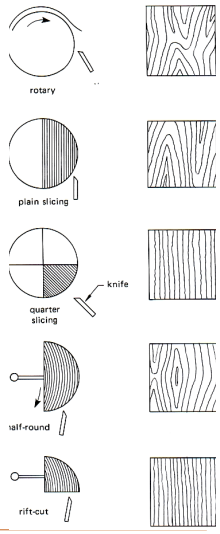
- Architectural woodwork is custom specified. It consists of shop fabricated components applied to interior finishes, cabinetry, paneling, custom specified doors and frames, shelving, furniture etc. Architectural woodwork provides the opportunity to create fine carpentry as the product is fabricated in controlled conditions.
- Lumber for Architectural woodwork is graded differently than finish carpentry, as standards are set by the Architectural Woodwork institute (AWI) and they are published in their own Quality Standards, Guide Specifications and their Quality Certification Program booklet.
- Based on the percentage of wood used, lumber is classified as Grade I, II, and III. Every grade has a set of limitations on the allowable blemishes.
- Premium, custom and economy are the grades applied for the finished appearance, tolerances and the construction standards of completed components.
  - For example, the maximum gap between premium, custom and economy cabinet door varies by 1/32", i.e. premium has max gap 3/32", custom has 1/8", and economy has 5/32". All these are available in the AWI Quality Standards booklet.

ARCHITECTURAL WOODWORK

- Lumber and veneers:
- There is a wider range of solid or veneer for architectural woodwork than for finish carpentry. Wood comes from worldwide sources and varies in availability and cost. However, due to the higher costs and limited availability of some prime types of wood, much of the architectural woodwork is made from skin deep veneer.

ARCHITECTURAL WOODWORK

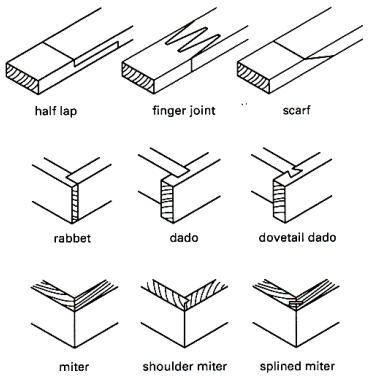
- Veneer cuts:
  - Similar to the solid stock, the cut of the veneer affects its final appearance. There are five methods:
  - Rotary slicing gives a pattern that is not favored for fine quality finishes although it is admittedly the most economic of all the methods; the log is set on a lathe and turned against a peeling blade that produces a continuous pattern.
  - The plain slicing and the quarter slicing are similar to the plain sawing and quarter sawing of solid stock.
  - Half round is similar to rotary but the log is cut longitudinally and veneer is cut slightly across the growth rings, yielding a pattern that shows characteristics of rotary and plain sliced veneers.
  - Rift slicing is applied to a quarter section of the log at 15° angle to the growth ring, resulting in a straight grain pattern. It is usually applied to oak to eliminate the markings perpendicular to the direction of the grain



11 Interior trim elements –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-6.

ARCHITECTURAL WOODWORK

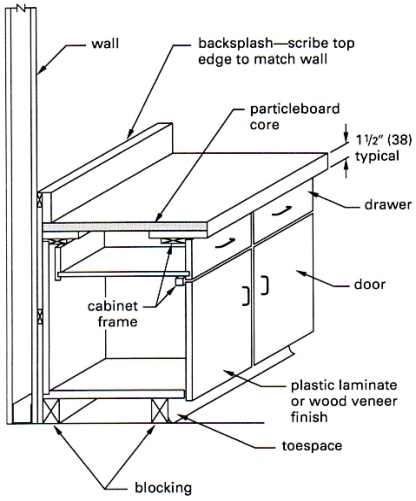
- Joinery:
- The objective set by designers and craftsmen is to eliminate the use of mechanical fasteners like nails, screws or bolts, giving as seamless an appearance as possible. Adhesives are used in most cases to a great extent. However, in some cases blind nailing or concealed fasteners are applied.



12 Examples of common wood joints –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-7.

ARCHITECTURAL WOODWORK

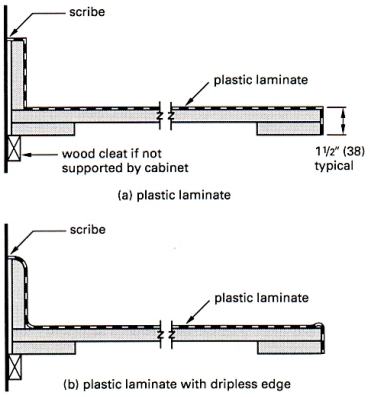
- Cabinetwork:
- Architectural woodwork is built in the shop as assemblies and set in place at the site. There are several methods of detailing door and drawer fronts but cabinet frames are standard.



Typical wood cabinetry –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-7.

ARCHITECTURAL WOODWORK

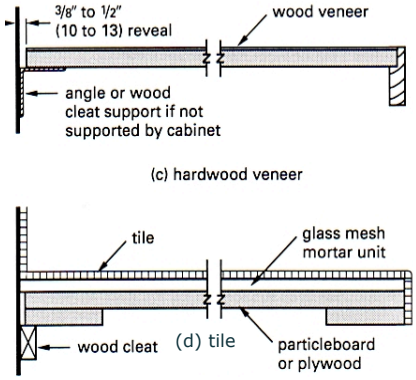
- Cabinetwork cont.:
- Countertops are built separately and are assembled to the rest of the cabinets on site. That is because they are built in single lengths and thus they are much longer than individual cabinets.
- Also, by being installed separately, the workers have the opportunity to fit the countertop on the wall with more precision. That is done with the use of a *scribe piece* which is an oversized piece of lamination that is trimmed to adjust to any potential irregularities.
- There are dozens of variations of sizes, materials etc.

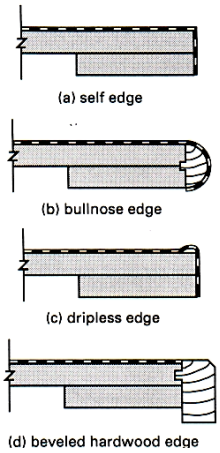


Typical countertop details –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-7.

ARCHITECTURAL WOODWORK

- Cabinetwork cont.:

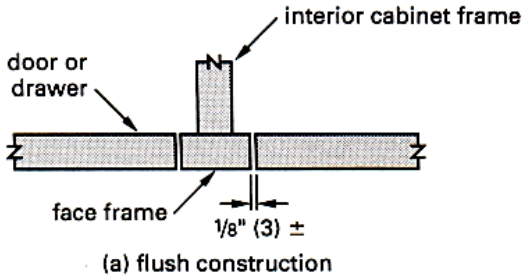




Typical countertop details –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-7.

ARCHITECTURAL WOODWORK

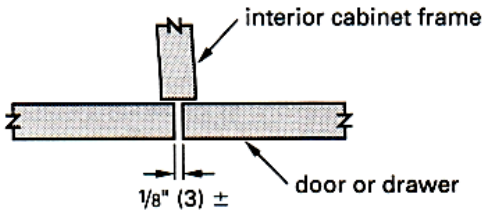
- Cabinetwork cont.:
- *Flush construction* requires the face of the moving parts (doors and drawers) to be installed flush with the frame. This requires a lot of extra care for perfect alignment and thus it becomes very expensive.
- Also after some sagging occurs the misalignment will result in malfunctions.



Types of Cabinet Door Framing –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-8.

ARCHITECTURAL WOODWORK

- Cabinetwork cont.:
- In *Flush overlay* construction the fronts of doors and drawers overlap the face of the frame. Edges are separated by a distance of approximately 1/8". Thus only doors and drawers are visible. Again, a lot of care needs to be taken to assure proper alignment and function.

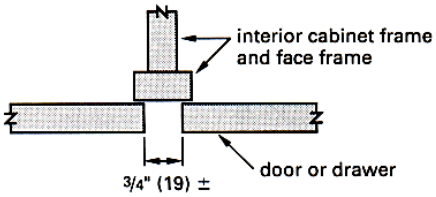


(b) flush overlay construction

Types of Cabinet Door Framing – 17
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-8.

ARCHITECTURAL WOODWORK

- Cabinetwork cont.:
- With *Reveal overlay* construction the fronts of doors and drawers overlap the face of the frame but are separated enough (3/4" approximately) to reveal the face of the frame behind. This type of cabinetry construction is less expensive as minor misalignment or eventual sagging will not be as noticeable.

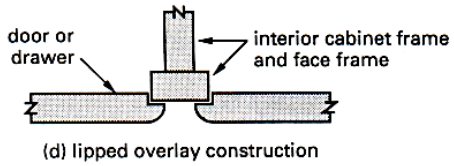


(c) reveal overlay construction

Types of Cabinet Door Framing – 18
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-8.

ARCHITECTURAL WOODWORK

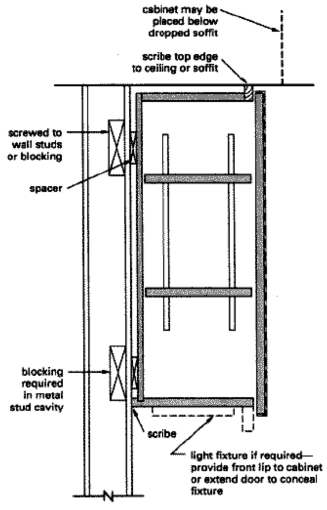
- Cabinetwork cont.:
- *Lipped overlay* construction is a variation of Reveal overlay as the moving parts overlap the frame and embrace the angle of the joint.
- Upper cabinets are very similar in construction to the Lower cabinets. The only differences are in the depth, the underside of the cabinetry because it is visible, and the location of the handles.



Types of Cabinet Door Framing –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-8.

ARCHITECTURAL WOODWORK

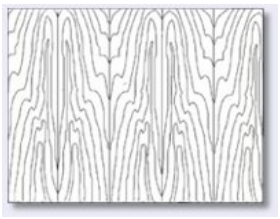
- Cabinetwork cont.:
- Also in upper cabinetry there is a difference in the method of affixing it to the wall. In residential buildings, the cabinets are affixed by screwing the back side and the wall through to the wooden studs (given the fact that the structure is wooden).
- In commercial buildings where metal studs are most likely to be used, wood blocking is applied within the cavity (installed while the wall is erected) providing a solid base for attaching the cabinetry to the walls.



Typical countertop plastic laminate edge treatments –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-9.

ARCHITECTURAL WOODWORK

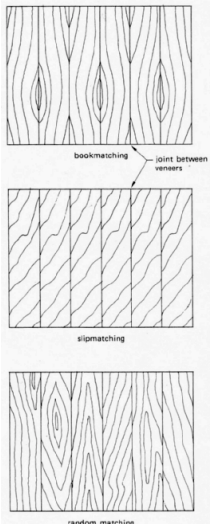
- Flush Paneling:
  - Architectural woodwork paneling includes flush or raised panel constructions used to cover vertical surfaces. As mentioned before, large, flat areas like paneling are built of thin wood veneers glued to backing panels of particleboard or plywood.
    In addition to the way the veneer is cut, there are several methods of matching adjacent pieces of veneer and veneer panels in a room that affect the final appearance of the work.
  - The three considerations, in increasing order of scale, are matching between adjacent veneer leaves, matching veneers within a panel, and matching panels within a room.



Example of bookmatching –
Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-9.

ARCHITECTURAL WOODWORK

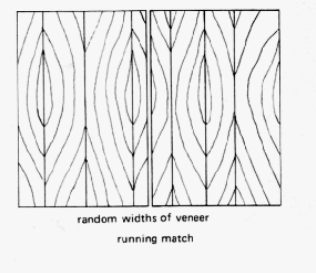
- Flush Paneling cont.:
- Matching adjacent veneer leaves:
  - Bookmatching:
    - This is the most common. As the veneers are sliced off the log, every other piece is turned over so that adjacent leaves form a symmetrical grain pattern.
  - Slipmatching:
    - With slip *matching*, consecutive pieces are placed side by side with the same face sides being exposed.
  - Random Matching:
    - places veneers in no particular sequence, and even veneers from different flitches may be used.



Typical countertop plastic laminate edge treatments –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-8.

ARCHITECTURAL WOODWORK

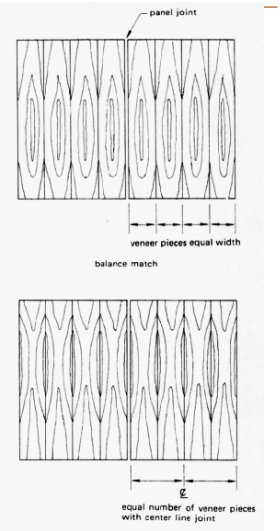
- Flush Paneling cont.:
- Installing Veneers:
  - Veneers must be glued to rigid panels to make installation possible. The method of doing this is the next consideration in specifying paneling. If the veneers are bookmatched, there are three ways of matching veneers within a panel.
  - Running match:
    - This simply alternates bookmatched veneer pieces regardless of their width or how many must be used to complete a panel. Any portion left over from the last leaf of one panel is used as the starting piece for the next.



Typical countertop plastic laminate edge treatments –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-8.

ARCHITECTURAL WOODWORK

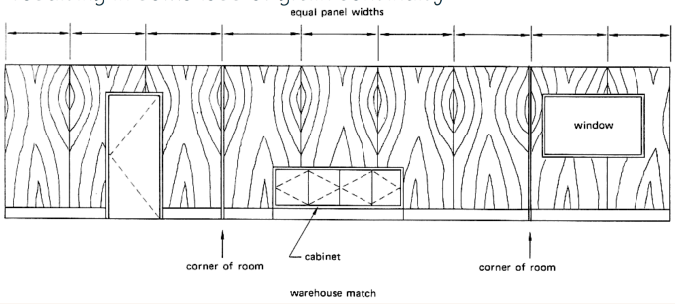
- Flush Paneling cont.:
- Installing Veneers:
  - Balance match:
    - A *balance match* utilizes veneer pieces trimmed to equal widths in each panel.
  - Center match:
    - A center *match* has an even number of veneer leaves of uniform width so that there is a veneer joint in the center of the panel.



Typical countertop plastic laminate edge treatments –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-8.

ARCHITECTURAL WOODWORK

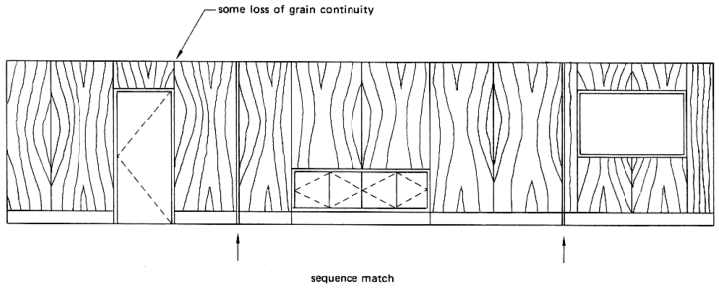
- Flush Paneling cont.:
- Installing Panels: There are also three ways panels can be assembled within a room to complete a project.
  - Warehouse match: The first and least expensive method. Premanufactured panels, normally 4 feet wide by 8 or 10 feet long are assembled from a single fitch that yields from six to twelve panels. They are field cut to fit around doors, windows, and other obstructions, resulting in some loss of grain continuity



Matching panels within a room –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-11.

ARCHITECTURAL WOODWORK

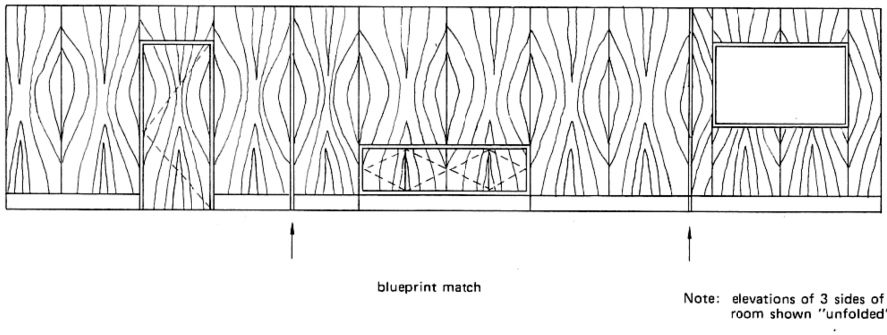
- Flush Paneling cont.:
  - Sequence match: The second method, uses panels of uniform width manufactured for a specific job and with the veneers arranged in sequence. If some panels must be trimmed to fit around doors or other obstructions, there is a moderate loss of grain continuity



Matching panels in a Room –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-11.

ARCHITECTURAL WOODWORK

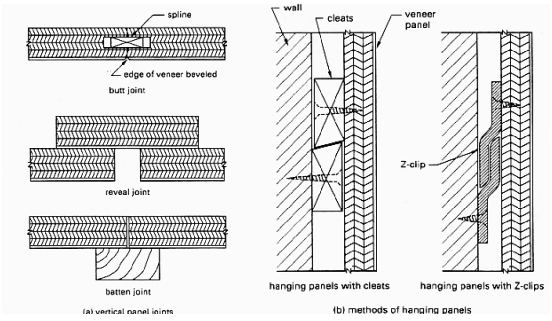
- Flush Paneling cont.:
  - Blueprint match: The third and most expensive method is called *blueprint matching*. Here the panels are manufactured to precisely fit the room and line up with every obstruction so that grain continuity is not interrupted. Veneers from the same fitch are matched over doors, cabinets, and other items covered with paneling.



Matching panels in a room –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-11.

ARCHITECTURAL WOODWORK

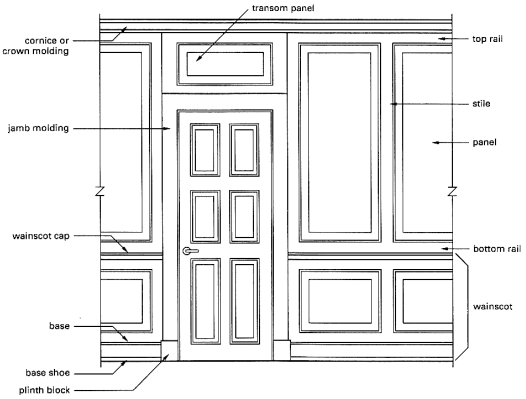
- Flush Paneling cont.:
  - Joints of flush paneling may be constructed in a number of ways depending on the finish appearance desired.
  - Paneling is hung on a wall with either steel Z-clips or wood cleats cut at an angle to allow the individual panels to be slipped over the hanger, which is anchored to the wall structure.



Joints of flush paneling –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-12.

ARCHITECTURAL WOODWORK

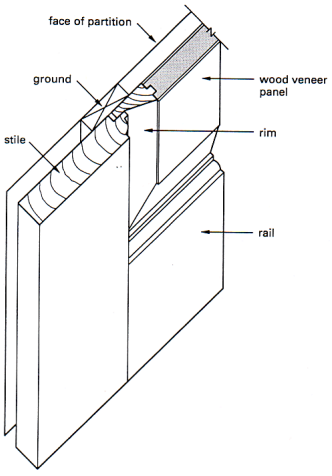
- Stile and Rail Paneling:
  - Stile and rail panel construction consists of a frame of solid wood that contains individual panels. Along with various types of molding and matching doors, raised panel construction is used to detail a traditional wood-paneled room interior.
  - Traditionally, the panels were also made from solid wood, but today it is more common for the panels to be veneered.



Stile and Rail Panel construction –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-13.

ARCHITECTURAL WOODWORK

- Stile and Rail Paneling cont.:
  - The vertical frame pieces are called the stiles and the horizontal members are the rails. The panels are held in place with grooves cut in the sides of the frames or with individual molding pieces, called sticking. The panels are set in the molding loosely to allow the panel to expand and contract with changes in the moisture content.
  - Stile and rail paneling may be hung on walls with wood cleats or metal Z-clips as with flush paneling, but if extensive molding is used the panels can be screwed to wood grounds behind the paneling and the fasteners concealed with the molding. Individual panels are joined with dowels or splines to keep the edges flush.



Stile and Rail components –
Image Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics*, 4th Edition, Belmont, CA, 1998, pg19-14.

ARCHITECTURAL WOODWORK

- Laminates:
  - A common finishing material used with architectural woodwork is *high-pressure decorative laminate (HPDL)*. This is a thin sheet material made by impregnating several layers of kraft paper with phenolic resins and overlaying the paper with a patterned or colored sheet and a layer of melamine resin.
  - The entire assembly is placed in a hot press under high pressure where the various layers fuse together. Plastic laminates are used for countertops, wall paneling, cabinets, shelving, and furniture.

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-13.

ARCHITECTURAL WOODWORK

- Laminates cont.:
  - Because laminates are very thin, they must be adhered to panel substrates such as plywood or particleboard. Smaller pieces can be glued to solid pieces of lumber.
  - There are several types and thicknesses of plastic laminate, the most common being a general-purpose type that is 0.050 inches thick. It is used for both vertical and horizontal applications. A post-forming type, 0.040 inches thick, is manufactured so it can be heated and bent to a small radius.

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-13.

ARCHITECTURAL WOODWORK

- Laminates cont.:
- When plastic laminate is applied to large surfaces of paneling, it must be balanced with a backing sheet to inhibit moisture absorption and to attain structural balance so that the panel does not warp.
  There are several types of high-pressure decorative laminates manufactured for specific purposes. Although these generally cost more, they fill specific needs for some construction.
  - *Colorthrough laminates.* These laminates are manufactured with decorative papers throughout the thickness so that the resulting sheet is a solid color. This eliminates the dark line visible at the edges of sheets when they are trimmed.
  - *Fire-rated laminates.* These finishes comply with Class 1 or A ratings as long as the appropriate substrates and adhesives are selected.
  - *Chemical-resistant laminates.* Special formulation of the laminate materials give these products additional resistance to strong chemicals found in laboratories, medical facilities, and photographic studios. They are available in horizontal as well as vertical thicknesses and can be post formed for curved surfaces.

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-14.

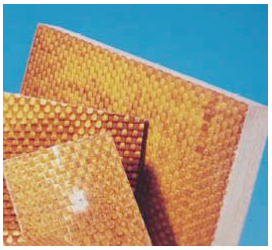
ARCHITECTURAL WOODWORK

- Laminates cont.:
  - *Static-dissipative* laminates. For areas where static control is required, such as in hospital operating rooms, electronic manufacturing plants, and computer rooms, these laminates provide a conductive layer in the sheet. When connected to suitable grounding they prevent the buildup of static charges and continuously channel them away
  - *Metal-faced laminates.* A limited number of metal finishes are available. They do not have the same wear resistance as real metal, so they should only be used on vertical surfaces subject to little abuse. They can be fabricated with standard woodworking equipment and cost much less than real metal. However, it is difficult to fabricate small, detailed items with finely crafted edges.
  - *Natural wood laminates.* Thin veneers of actual wood are bonded to the standard type of laminate kraft papers and resins with this product. The laminate can be specified to provide untreated wood ready for finishing or with a protective layer of melamine resin.

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-14.

ARCHITECTURAL WOODWORK

- Laminates cont.:
  - Another type of laminate product is *thermoset decorative paneling*. It is made by pressing a decorative overlay from thermoset polyester or melamine resin-impregnated saturated sheet onto a cellulosic substrate such as particleboard or fiberboard. This paneling differs from high-pressure decorative laminates in that the decorative surface is fused to the substrate of particleboard rather than being a thin veneer that must be adhesive-bonded to another substrate.
  - Because the process is usually done with pressures lower than HPDLs, these products are sometimes called 'low-pressure laminates" or melamine. The manufacturers that produce thermoset decorative panels form the American Laminators Association (ALA) and use the trade name Permalam® to identify them.



Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-14.

ARCHITECTURAL WOODWORK

- Laminates cont.:
  - Because the decorative surface is part of the substrate, the potential problem of delamination is eliminated and the panels come ready to be fabricated. Generally, the cost of thermoset panels is less than HPDL.
  - However, there are currently several disadvantages to thermoset decorative panels. The choices of colors, textures, and grades are limited.
  - Thermoset panels cannot be post formed for curves, and they should not be used for high-wear horizontal surfaces such as countertops. Only a limited number of Class I or A fire-rated panels are available from a few manufacturers. Thermoset panels are typically used for furniture, fixtures, and kitchen cabinets or where resistance to heavy use is not required.

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-14.

ARCHITECTURAL WOODWORK

- Standing and running trim:

  These are similar to standard molding sections applied as finish carpentry items. Unlike moldings, however, standing and running trim are custom-fabricated to meet the requirements of a specific project.
  - *Standing trim* is woodwork of fixed length intended to be installed as a single piece of wood. Examples include door frame trim, door stops, window casing, and similar items.
  - *Running trim* is woodwork of continuing length that must be installed in several pieces fitted end to end such as base molding, cornices, chair rails, and soffits.

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-14.

ARCHITECTURAL WOODWORK

- Standing and running trim cont.:
  - Rails are gripping or protection surfaces on corridor walls of hospitals and the like and guard rails at glass openings.
  - The *profile* of trim, or its *cross-sectional shape*, can be identical to the many standard shapes available in premanufactured molding, or custom profiles can be milled.

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-14.

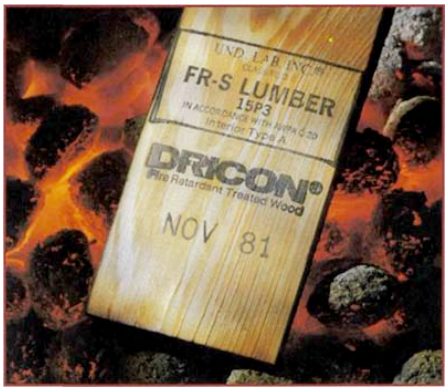
ARCHITECTURAL WOODWORK

- Code Requirements:
  - The various model building codes set limits on the flame- spread ratings of interior finishes based on the occupancy of the building and the use area within the building. In general, most of the model building codes regulate the use of woodwork as wall or ceiling finish, but do not regulate the use of wood in furniture, cabinets, or trim. This includes cabinets attached to the structure.
  - Interior finish is defined in the Uniform Building Code (and Similarly in other model codes) as wall and ceiling finish including wainscoting, paneling, or other finish applied structurally or for decoration, acoustical correction, surface insulation, or similar purposes. Requirements do not apply to trim, defined as picture molds, chair rails, baseboards, and handrails; to doors and windows or their frames; or to materials that are less than 1/28" (0.91mm) thick cemented to the surface of walls or ceilings.

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-15.

ARCHITECTURAL WOODWORK

- Code Requirements:
  - There are three flame-spread groupings, corresponding to flame-spread ratings of 0— 25, 26— 75, and 76— 200, respectively.
  - Different wood species have different flame-spread ratings, but very few have ratings less than 75, so wood is generally considered a Class III material unless it is treated with a fire retardant. However, treating often darkens the wood and makes it difficult to finish.



Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-15.

FINISHES

- Finish is used on woodwork to protect it from moisture, chemicals, and contact and to enhance its appearance. Woodwork can either be field finished or factory finished. Because more control can be achieved with a factory finish this is the preferred method, although minor cabinet and trim work is often field finished in single-family residential and small commercial construction. For high-quality woodwork, field finishing is generally limited to minor touch-up and repair.

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-15.

FINISHES

- Prior to finishing, the wood must be sanded properly and filled, if desired. On many open-grain woods such as oak, mahogany, and teak, a filler should be applied prior to finishing to give a more uniform appearance to the woodwork, but it is not required. Other types of surface preparation are also possible depending on the aesthetic effect desired. The wood may be bleached to lighten it or to provide uniformity of color. Wood may also be mechanically or physically distressed to give it an antique or aged appearance. Shading or toning can also be used to change the color of the wood and subsequent finishing operations.

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-15.

FINISHES

- **Transparent Finishes:**
  - These include lacquer, varnish, vinyl, penetrating oils, polyurethane and polyester.
- **Opaque Finishes:**
  - These include lacquer, varnish, polyurethane, and polyester. They should only be used on closed-grain woods and medium density fiberboard where sheet materials are applied.
- **Stains:**
  - Prior to applying the final finish, wood may be stained to modify its color. There are solvent and water based stains. The former dry quickly but are less uniform. The latter are more uniform but they raise the grain. Both are penetrating and very difficult to remove

Source: Ballast, David, K.: *Architecture Exam Review, Volume II: Nonstructural Topics,* 4th Edition, Belmont, CA, 1998, pg19-16.