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# History of Residential Windows and Patio Doors

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- Substrates
- Wood Utilization
- Adhesives/Sealants
- Wood Preservatives
- Product Types
- Design
- Glass Technology
- Pre-Finish
- Energy Efficiency



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# Substrates



Eastern white pine was the primary wood species used 70 years ago

- Wood window businesses developed in the midwest 70+ years ago partly due to the availability of Eastern white pine

Ponderosa pine became more widely used as a replacement for Eastern white pine as those timber sources became more scarce

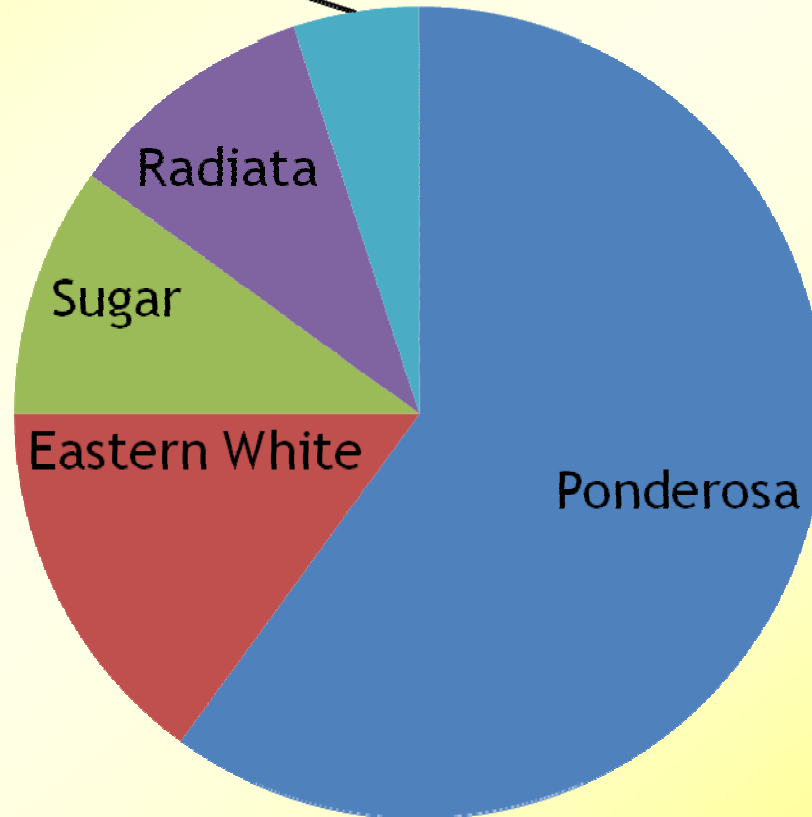
- Ponderosa, Eastern white, Sugar, and Radiata are primary wood types used in pine windows and doors

**Different pines are used interchangeably**



Southern yellow

## Pines Used in U.S. Window/Door





Alternative hardwood species are also being offered as Premium Woods for windows and doors

- Red alder
  - Red alder was viewed as a “weed species” and needed to be removed from the forest areas so desirable wood species could grow
  - Currently, Red alder is viewed as a popular alternative wood choice due to its rustic characteristics
- Other premium woods such as Mahogany, Oak, and Maple are now part of standard product offerings
  - Pine is the primary wood type used

**Premium wood types offered in addition to pine**



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# Wood Utilization



- 1870 - 1940 solid wood was common
  - Long length pine lumber was readily available and inexpensive
  - Old growth trees made up much of the supply
  - Lumber was exceptionally wide and clear
- Today, secondary growth makes up the majority of supply
  - Lumber width decreased
  - Higher % of lower lumber grades
  - Trees are harvested based on forest management plans that satisfy economic, environmental, and social needs

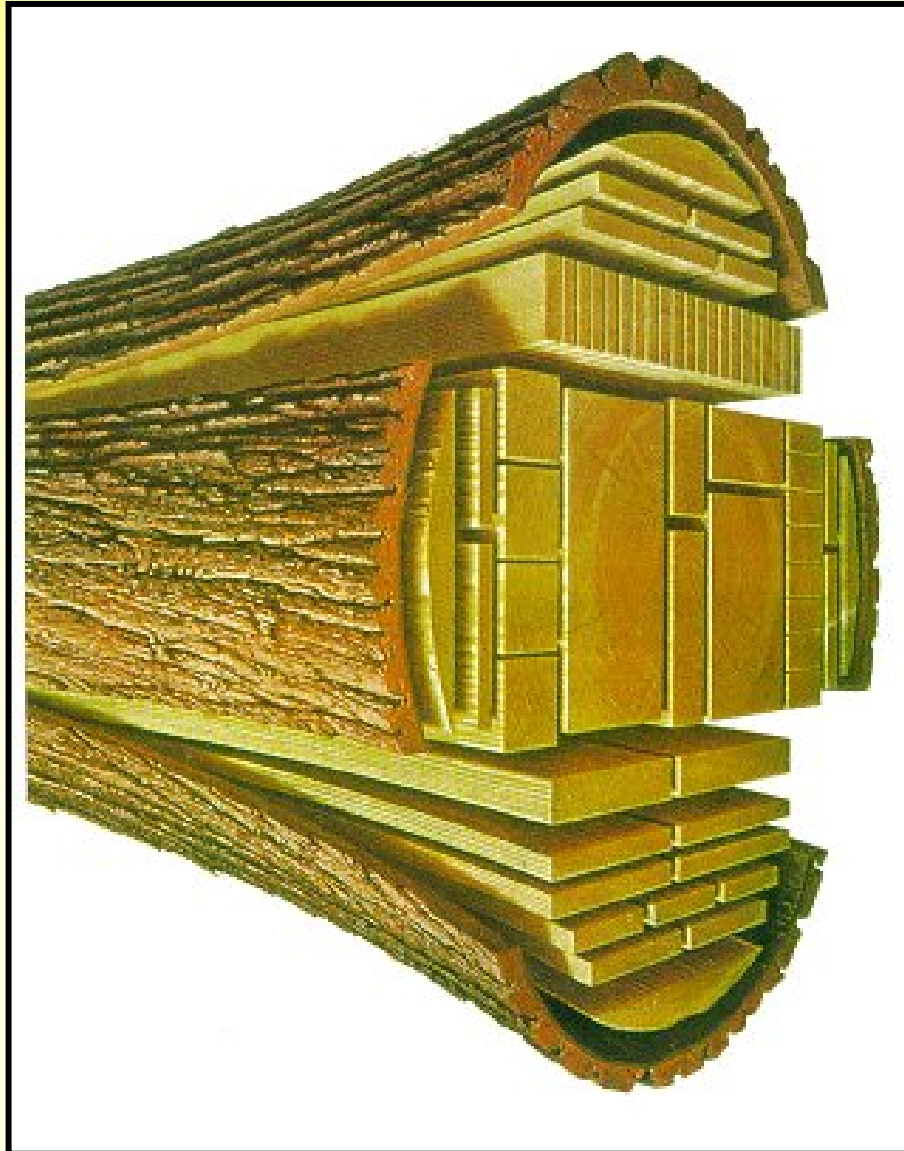
**Wood utilization is a high priority**





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# Wood Utilization





- 1890 - 1920 Hardwood veneers were introduced in doors first which changed their construction method
  - Veneers served to stabilize the core and reduce warp
  - Veneers allowed doors to be produced more inexpensively
  - Exterior doors did not perform well due to the poor quality of the glue available
  - Softwood veneers were available 15 years later

**Veneers initiated engineered wood products**



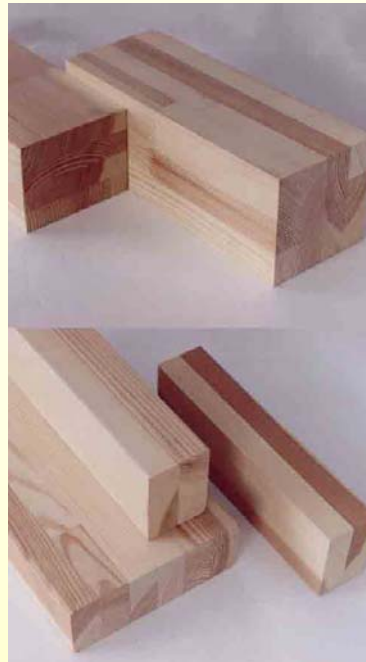
- Current designs contain upgraded parts
  - Finger-jointed and edge glued wood is common in many areas not seen when the product is installed
  - LVL and composite wood products are being used in wood parts to provide additional strength, stability and increase fiber utilization
  - Identifying yield saving opportunities in the entire supply chain (tree to end product) is a focus

**Incorporating upgraded parts has increased yield**



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# Wood Utilization





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# Adhesives and Sealants



- Poly Vinyl Acetate Adhesives (PVAc) are commonly used today in window and door wood components
  - Used alone or combined with traditional mechanical methods of joining wood such as nails and screws
- Several types of sealants are used to serve as a barrier to environmental elements
  - Butyls
  - Silicones
  - Urethanes

**Adhesives and Sealants used throughout products**



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# Wood Preservatives



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# Wood Preservatives

- Originally no wood preservatives were used
- Early wood preservatives functioned as both a fungicide and insecticide
- They are commonly colorless and do not cause grain raise or dimensional change

**Performance of new wood preservatives continue to improve**





- 2<sup>nd</sup> generation of wood preservatives included Tri-n-butyltin oxide (TBT) and 3-iodo-2-propynyl butyl carbamate (IPBC)
- New generation of wood preservatives
  - Multiple active ingredients
- Environmental, safety, performance, cost, and manufacturing processes drive changes in wood preservatives
  - Waterborne

**Wood preservatives continue to develop and improve**



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# Product Types



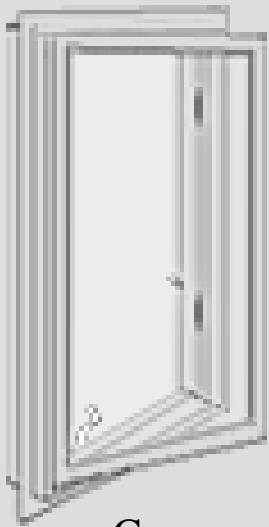
- Windows before 1700 were often fixed and did not operate or open
- Hinged casements were earliest windows in buildings constructed during European settlement that opened like a door
- Double hung windows became more popular in the 18<sup>th</sup> century

**Casement and Double Hung are the most common types**

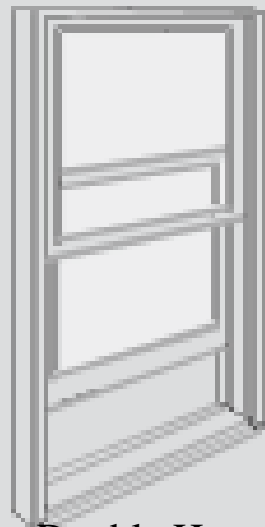


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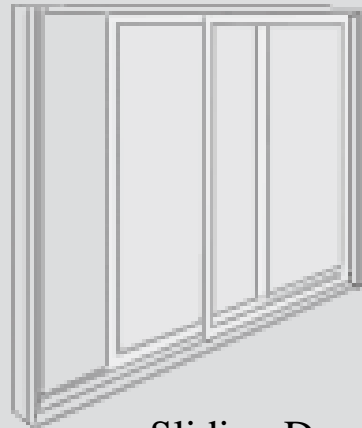
# Product Types



Casement



Double Hung



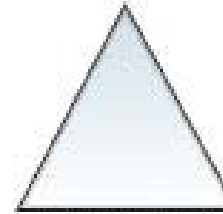
Sliding Door



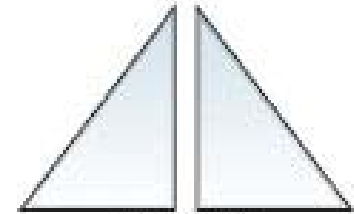
Hinged Door



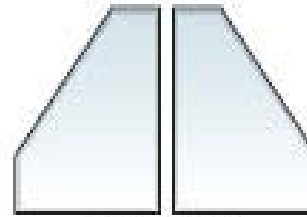
Triangle Isosceles



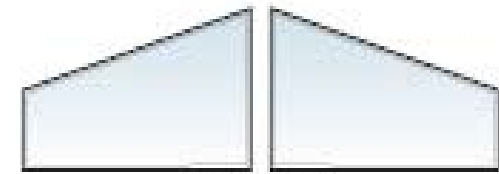
Triangle Equilateral



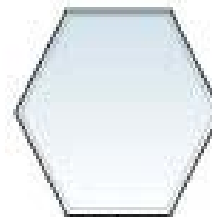
Triangle LH-RH



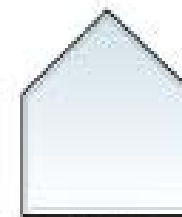
Pentagon LH-RH



Trapezoid LH-RH



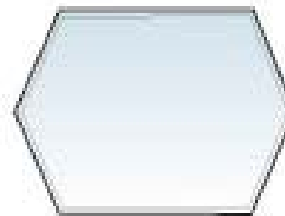
Hexagon



Pentagon



Octagon



Hexagon w/Leg



Equilateral Pentagon



Octagon w/Leg



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# Design



- Most standards in windows were set by the early 1900's
  - Sash thickness
    - Before 1900, window sash standard thickness was 1 3/8"
    - After 1900, 1 3/4" to 2 1/2" became more common

More glass panes, energy efficiency drove change



## Type of meeting rail

Intersection of dbl hung upper and lower check rail

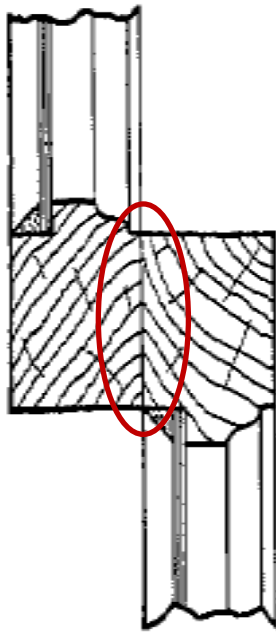


FIG. 1  
PLAIN RAIL

Before 1840

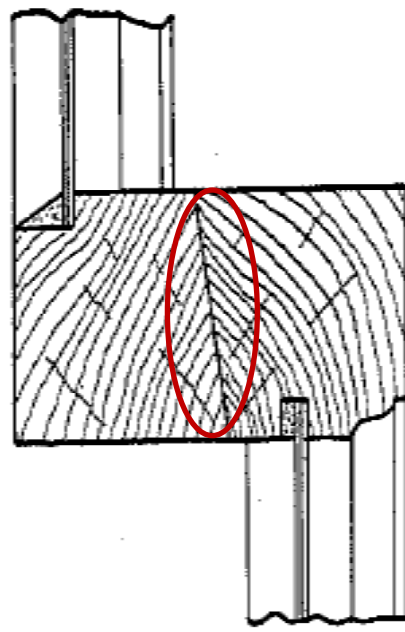


FIG. 2  
BEVEL CHECK RAIL

1840 - 1930

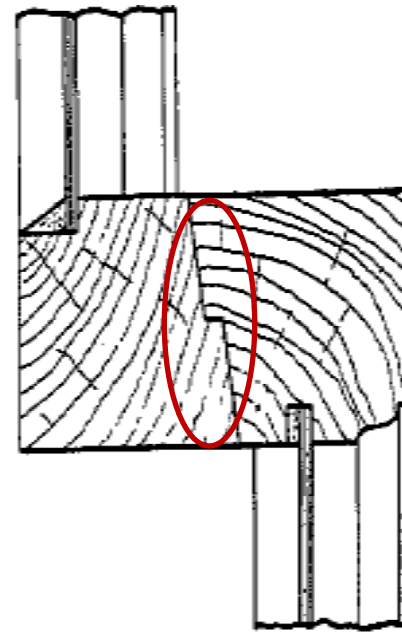


FIG. 3  
RABBETED CHECK RAIL

After 1930



- After 1920, mass produced windows were standardized
  - No profiles other than the Ogee were offered
  - Thickness and joinery remained standardized



**Ogee Profile**

**1890-1920 known as Transitional Period**





- 1930's: Metal industries were in search of new markets and used arguments that wood rots, warps, shrinks, and swells
  - Was less expensive, viewed as more durable than wood products
  - More expensive over time and high energy efficiency was difficult to achieve

**Metal used primarily in commercial applications**



- Wood windows and doors were wood exterior until the 1960's when aluminum cladding was introduced
- Aluminum clad is commonly used for exterior covering of wood windows and doors
- Painted aluminum clad performs well in exterior environments and significantly reduces maintenance compared to wood exterior

**Exterior Aluminum Clad is a preferred option**



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# Glass Technology



- Glass did not become common in ordinary homes until the 17<sup>th</sup> century
- During 18<sup>th</sup> century, larger panes of glass were developed
- Early windows and doors were single glass design that offered only a barrier to exterior
- Glass was the primary focus of energy efficiency

**Developments include size, options, energy efficiency**



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# Prefinish



- Interior prefinished products from the factory have become more popular
  - Prefinishing components in the factory provides many benefits vs finishing an entire assembled unit in the field
- Different interior stain and paint colors are now being applied in the factory instead of by the end customer
  - Improve quality and reduce cost and time

**More value-added processes performed in factory**



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# Energy Efficiency



- Double glass pane offered additional protection from exterior
- Insulated glass was introduced with 2 panes of glass with an insulating gas such as argon to increase the energy efficiency
- Low-E coatings applied to glass are used to further increase energy efficiency

Coatings are applied to glass surfaces to reduce U-Value





- Mylar film is being used within insulated glass panes to improve energy efficiency of insulated glass
  - Sheet of plastic applied to I.G. to take the place of a 3<sup>rd</sup> glass pane
- Thermal breaks from exterior to interior in order to eliminate heat sinking materials
  - Use different frame materials in transition from exterior to interior

**Glass is not the only material impacting energy efficiency**



Analyze entire window or door as a system to calculate U-Value

- Government program "Windows 6" allows manufacturer to input thermal rating of all materials used
- Calculates U-Value for entire window/door assembly

Solar Heat Gain Coefficient (SHGC)

- Amt. of energy that passes thru product

**Entire window system is used to calculate U-Value/SHGC**



- Substrates: engineered wood products used strategically
- Energy Efficiency: new standards/codes
- Pre-finish: more value-add processes in manufacturing
- Material Utilization: reduce waste, increase recovery
- Design: energy efficiency, ease of use, performance
- Wood Preservatives: long-term performance, health/safety/environmental profile, water-borne



- For more industry information visit the Wood Window & Door Manufacturers Association (WDMA) at [www.wdma.com](http://www.wdma.com) or the American Architectural Manufacturers Association (AAMA) at [www.aamanet.org](http://www.aamanet.org).