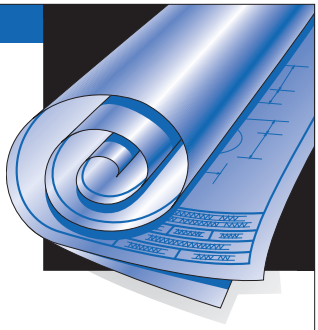

Controlling Decay in Wood Construction

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As evidenced by buildings worldwide, wood construction can provide centuries of service life. However, as a natural, organic material, wood is susceptible to degradation by organisms under certain conditions. Decay fungi are probably the most significant organisms responsible for degradation of wood. Degradation by fungi is commonly referred to as rot, decay, brown rot, or "dry rot."

DECAY FUNGI

Fungi are low forms of plant life that derive their nutrition by using other organic materials as food rather than producing it themselves as green plants do. For practical purposes, fungi can be separated into decay fungi and nondecay fungi. Nondecay fungi include stains and molds. Distinctions are as follows:

Decay Fungi

- Digest wood cell walls
- Can lead to severe structural degradation in advanced stages
- If present on surface, may appear as brown or white thread-like mats
- Are active throughout the wood material during advanced stages
- In advanced stages, rot can disintegrate the wood; appearance may be brown with cube-like fractures, or whitish with punky, crumbly surface.
- Sometimes fungi fruiting bodies, which appear as mushrooms, are apparent on surface

Molds and Stains

- Digest nutrients on wood surface or in wood cell cavities
- Do not cause significant structural degradation
- Appear as fuzzy or powdery surface growth
- Color varies from light shades to black
- Molds affect surface only and can be removed with diluted household bleach (see APA Technical Note, *Mildew Discoloration of Wood Siding,* Form L805 and APA Guide, *Build a Better Home: Mold and Mildew,* Form A525).

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CONDITIONS THAT SUPPORT DECAY

Decay is spread by microscopic spores which are produced by the fruiting bodies of fungi. Spores are always present in the atmosphere but need proper conditions to begin their growth. Under suitable conditions, the fungi spores grow into thread-like hyphae that spread throughout the host material and may ultimately produce fruiting bodies which produce spores for further propagation.

Like all organisms, there are certain threshold conditions necessary for survival and propagation of decay fungi. The following reviews the environmental conditions necessary for decay growth.

Temperature

Decay fungi flourish within a temperature range of 50 to 90°F. Their growth is limited at temperatures outside this range. The elevated temperatures used in production of structural panels and in kiln drying of lumber are sufficient to kill decay organisms that may have been originally present in the wood. However, reinfestation will occur if suitable conditions exist after manufacture.

Food

Decay fungi use a wide variety of organic matter as food, including most wood species. However, the heartwood of some species such as cedar and redwood have natural decay resistance. Availability of structural panels and glued laminated timber produced from naturally durable species should be verified prior to specifying. Preservative-treated wood products, which essentially prevent decay by making the food source poisonous to the fungi, are also available. Where high decay hazard is anticipated, preservative treated or naturally durable woods should be specified.

Oxygen

In some cases, such as when wood is permanently submerged in water, lack of oxygen may prevent decay. If changing water levels expose the wood for periods of time, however, there may be enough oxygen for decay fungi to grow. In typical wood construction, ample oxygen is available for decay fungi growth.

Moisture

Decay growth in wood requires prolonged conditions where wood moisture content is in excess of 20 to 25 percent. **In wood construction, limiting moisture is the primary method of preventing decay fungi growth. Proper design, construction and maintenance is geared toward keeping wood moisture content below the threshold which supports decay growth.**

The moisture content of wood components is a function of:

- *Moisture content of the product.* Following are typical moisture content values of wood products when manufactured:

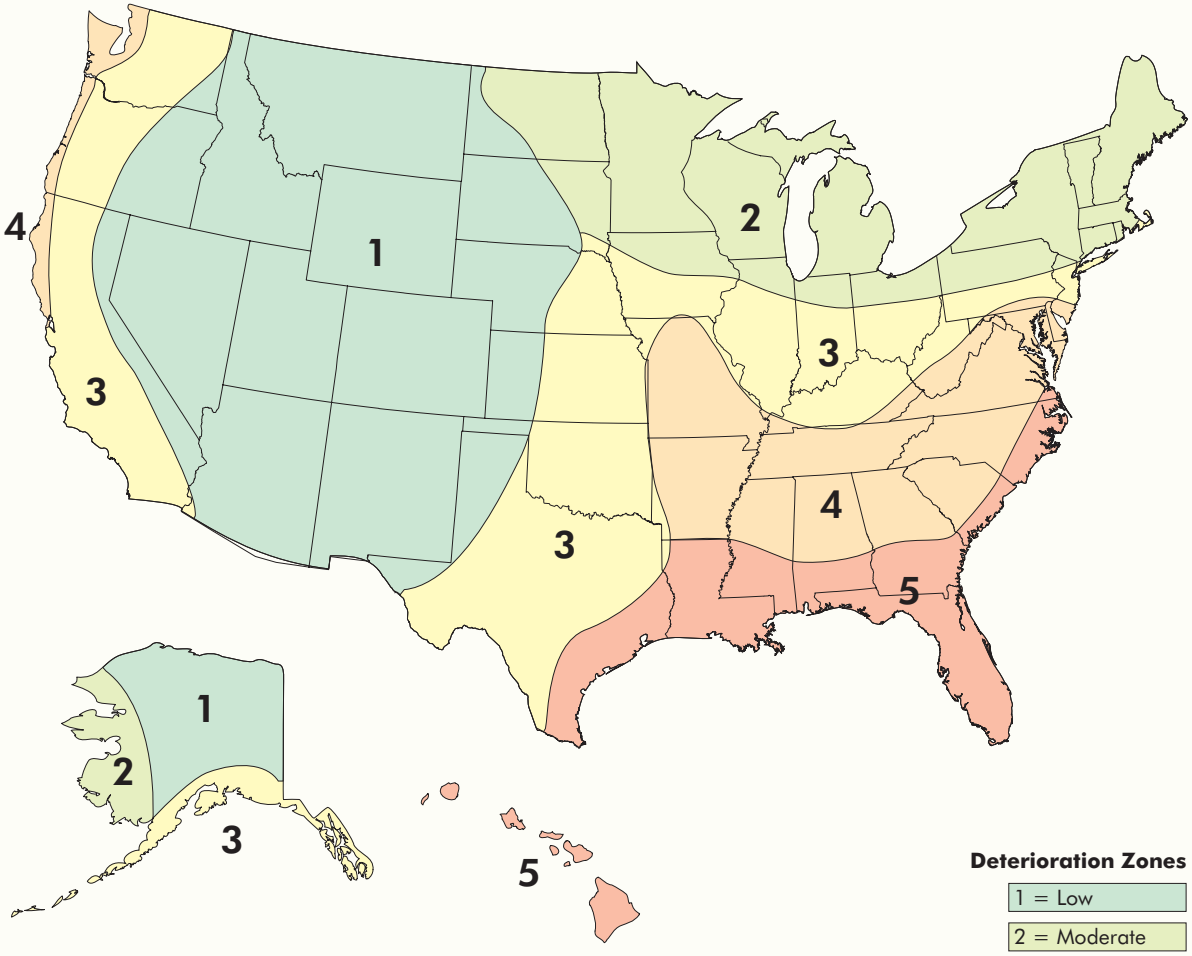
Structural panels	2-6%
Glulam	8-12%
Lumber	
Green	20-50% or higher
Dry	19% or lower

- *Humidity.* Eventually, wood will equilibrate to approximately 8 - 14 percent moisture content during service in most geographical locations if unwetted by rain or condensation. Exact moisture content is primarily a function of relative humidity. The time it takes for wood to equilibrate is a function of size and can be substantial for large timbers and glulam.

- *Direct wetting.* Exposure to direct wetting leads to elevated surface moisture content over the short term and high moisture content throughout the entire wood member if prolonged. Due to the large exposed surface area, structural panels exposed to two days of rain wetting may lead to a moisture content of 50 percent or more.
- *Condensation.* Most wood components used in construction are ultimately protected from direct exposure to weather. However, some components may be subject to wetting from condensation (see APA Technical Note, *Condensation – Causes and Control*, Form L805).
- *Climate.* Wood products exposed to weather vary considerably in moisture content as they are always seeking equilibrium with changing humidities or undergoing moisture cycling from wetting due to rain or snow. Climate conditions affect decay potential of wood used above ground and exposed to weather. In areas of high rainfall or high humidity, the moisture content may be elevated. For such cases, good design and construction practices combined with the use of preservative-treated or naturally durable woods will minimize risk of decay and help assure good performance. Figure 1, excerpted from the American Wood Protection Association (AWPA) Standard U1, indicates relative decay potential.

FIGURE 1

POTENTIAL FOR DETERIORATION OF WOOD



Notes:
Lines defining area are approximate only.
Local conditions may be more or less severe than indicated by the region classification.
Source: American Wood Protection Association (AWPA) Standard U1.

DECAY CONTROL IN WOOD CONSTRUCTION

The primary method of preventing decay fungi in wood construction involves keeping the wood below the threshold moisture content needed for decay. The following discussion provides an overview of proper design, storage, construction, and maintenance details that minimize the potential of reaching this moisture level.

Floors

Since floors are enclosed by the building envelope, they are generally at low risk of decay except in circumstances where they are over a soil crawl space or where plumbing leaks lead to localized wet spots. Adherence to the following provisions will help assure good performance.

- *Ventilation.* The International Residential Code (IRC) and the International Building Code (IBC) require a ratio of 1 square foot of net free ventilation for every 150 square feet of floor area. The ventilation requirements can be reduced to 1 square foot for every 1,500 square feet of floor area when a Class I vapor retarder ground cover is placed over exposed soil in a crawl space. See Section 1203.3 of the 2009 IBC and Section R408 of the 2009 IRC for additional options and details.
- *Distance Between Grade and Nearest Untreated Wood.* Codes typically require a distance of at least 6 inches between the grade and nearest untreated wood. All wood in contact with the ground or below grade should be preservative treated.
- *Treated Sill Plates.* Wood members in contact with concrete foundations should be preservative treated or of naturally durable species.

Roofs

Wood roof members may be exposed to moisture from leaks, from moisture introduced at the time of construction, and from moisture generated from condensation. Attention to design and construction details can significantly reduce these moisture hazards as noted below.

- *Ventilation/Vapor Retarders.* The 2009 IRC requires 1 square foot of net free ventilation for every 150 square feet of attic area. This provision can be reduced to 1 square foot for every 300 square feet when a Class I or II ceiling vapor retarder is used. The same reduction applies for sloped (pitched) roofs, when at least 50 percent and not more than 80 percent of the required vent area is located in the upper portion of the space to be ventilated, and at least 3 feet above eave vents. See Section 1203.2 of the 2009 IBC and Section R806 of the 2009 IRC for additional options and details.
- *Low Slope Roofs.* It is often impractical to ventilate low slope roofs since they generally do not contain ventable attic space. Experience has shown that low slope roofs in commercial buildings can perform adequately even with minimal ventilation. These unique cases demand attention to other details to minimize entrapment or accumulation of moisture in the roof cavity. Attention to the following provisions minimizes decay hazard.

  a. *Moisture Content of Wood Components.* The limited size of the roof cavity (located between the roofing membrane and the lower ceiling or insulation membrane) increases sensitivity to entrapped moisture introduced during construction. It is therefore important to specify the use of air or kiln dried lumber and to allow a period of drying after roofing and prior to installation of the insulation and ceiling if the panels were wetted during construction.

b. *Moisture Accumulation Due to Condensation.* Condensation in roofs is primarily dependent upon two factors: the roof deck temperature which can cause a condensation surface if it drops below the dew point, and the amount of moisture vapor accumulation in the roof cavity. The potential for moisture accumulation in the roof cavity depends upon entrapped moisture discussed above and interior humidity conditions. Interior moisture sources include such things as human occupancy, moisture generated during manufacturing, and moisture infiltration into the building. In some cases, additional venting to outside of the building and use of vapor retarders are needed to avoid accumulated moisture that can lead to condensation. (APA Technical Note, *Moisture Control in Low Slope Roofs*, Form R525, provides further information.)

- *After Installation.* Once installed, protect panels as soon as possible with roofing felt or finish roofing material. If panels were wetted prior to roofing installation, allow some time for drying prior to installing the insulation and/or vapor retarder under the roof deck. Handheld moisture content meters are available for making a quick assessment of moisture conditions of the wood components. Target moisture content is below 18 percent.

Walls

Wood components used in walls may be subjected to moisture generated from condensation or moisture intrusion. Proper design, construction and maintenance prevent these causes of moisture problems.

- *Vapor Retarders.* Condensation may occur in the inside wall sheathing in cold winter climates when moist air comes in contact with a cooler surface. Such moisture can come from inside the home from sources such as cooking, clothes dryers, and showers. Installing exhaust fans over cooking stoves and in high humidity areas such as bathrooms or laundry rooms can help vent excess moisture to the outside. Clothes dryers should also exhaust to the outside.

  Additionally, a vapor retarder should be installed on the warm side of the wall. Failure to protect the wall cavity from water vapor can result in condensation and elevated moisture content of the wall sheathing and studs. See APA Technical Note, *Condensation – Causes and Control*, Form X485, and APA Guide, *Build Energy Efficient Walls,* Form J440, for more detailed information.

- *Moisture Intrusion.* Performance problems with walls can arise when the weather resistance of the exterior finish system degrades and allows moisture intrusion. APA has become aware of reports regarding moisture problems involving Exterior Insulated Finish Systems (EIFS) and stucco systems which have lost their moisture resistance. While APA has not investigated the accuracy of these reports, some building experts have attributed these moisture problems to installation shortcomings such as lack of building paper and inadequate flashing around doors and windows. Wood structural panel sheathing requires protection from exposure to permanent moisture when used in wall systems. Technical Bulletin TB-202 provides a review of APA use recommendations in exterior siding systems (see referenced literature at the end of this Technical Note).

Exposed Application

Exposed products, such as siding, are often fully exposed to weather, and thus they have increased susceptibility to elevated moisture conditions. Although siding products will often experience moisture contents above the threshold value needed to support decay on an intermittent basis, wood-based siding products have a good history of performance due to the fact that they dry below this threshold value before decay can take hold. Proper architectural detailing, use of flashing and caulking, and adherence to the manufacturer's installation recommendations are essential for proper performance. For example, if trim is improperly installed around siding, it may trap moisture and/or reduce the drying ability of the siding. This can lead to long-term moisture accumulation that causes decay.

Exposed end grain of wood products warrants special consideration such as flashings or other means of protection, since the high capillarity of end grain increases water absorption. Use sealants and protective flashing on the end grain of glued laminated timbers exposed to the elements. See APA Technical Note, *Glulam Connections Details,* EWS T300, for more detailed information.

Storage

Like all building materials, structural wood products should be properly stored, handled and installed to assure superior performance. Products stored outdoors should be stacked on a level area and supported by 4x4 stringers or other blocking. The stack of wood products should be covered loosely with plastic sheets or tarps so that the wood products are protected from rain, yet exposed to air circulation. Clear plastic coverings should not be used to cover glued laminated timber, due to the possibility of discoloration from exposure to ultraviolet sun rays.

Preservative Treatment

Preservative-treated wood products which are pressure-impregnated in accordance with standards of the American Wood Protection Association should be specified for applications that involve high decay hazard. Review other available literature from APA for proper specification.

REMEDIAL ACTIONS

If decay of wood products is suspected, an inspection should be made by a trained professional, especially if the decay involves structural elements. If decay of wood products has occurred, it is imperative to identify and correct the source of moisture. If the source of moisture is eliminated and the wood products are dried down below the threshold moisture content for decay, then the decay will not progress. Although it is usually advisable to remove the decayed areas, it is not always necessary if the moisture source is completely eliminated and the structural integrity is not compromised. Reduction of the moisture content will stop the decay progression but will not kill the decay, as spores will still be present. The decayed area will re-establish its growth if the moisture content once again exceeds 20 to 25 percent.

OTHER AVAILABLE APA LITERATURE

APA *Engineered Wood Construction Guide* (E30)

APA Data File: *Preservative-Treated Plywood* (Q220)

APA Technical Note: *Condensation – Causes and Control* (X485)

APA Technical Note: *Mildew Discoloration of Wood Siding* (L805)

APA Design/Construction Guide: *Nonresidential Roof Systems* (A310)

APA Technical Bulletin: *Use of Structural Panels in Stucco and EIFS Wall Systems TB-202,* (W202)

APA Builder Tips: *Proper Storage and Handling of APA Trademarked Panels* (U450)

APA Guide: *Build Energy Efficient Walls* (J440)

APA Data File: *Installation of Stucco Exterior Finish Over Structural Wood Panel Wall Sheathing* (Q370)

APA Product Guide: *Glulam* (EWS X440)

APA Builder Tips: *Proper Storage and Handling of Glulam Beams* (EWS R540)

APA Technical Note: *Preservative Treatment of Glued Laminated Timber* (EWS S580)

APA Technical Note: *Moisture Control in Low Slope Roofs* (R525)

Controlling Decay in Wood Construction

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