

PRESERVATION TECHNOLOGY UPDATE

The Use of Fire-Rated Wooden Shingles on Historic Buildings

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Many historic buildings were roofed with wooden shingles, a combustible building product. Concerned about protecting architectural resources from destruction by fire, some local jurisdictions may ban the use of combustible materials or require the use of fire-retardant materials, such as fire-rated wooden shingles, in place of combustible materials. While most local codes accept untreated wooden shingles in residential areas, for commercial or municipal buildings fire-rated wooden shingles are generally required. For historic buildings, fire-rated shingles can provide additional protection to irreplaceable resources. Although many Federally-owned historic buildings are generally not governed by specific codes, it is important to design and detail restoration work with long-term protection of the historic resource in mind.

Over the last 20 years, a number of commercial treatments for wood shingles have been developed to address fire code requirements. This article discusses the various classifications of rated wooden shingles, how shingles are treated, the effectiveness of these treatments, and some installation assemblies to meet rated construction. For purposes of this discussion, the term shingle will be used to describe both sawn shingles and commercially split wooden shakes. The fire-retardant treatments are the same for both sawn and split products. The intent of fire-retardant-treated materials is to slow down the spread of fire, thus buying precious time for fire fighters and escaping inhabitants. Fire-retardant materials generally will not be ignited by burning embers but will eventually burn in the presence of active flames.

The requirements for the use of specific building materials and for their performance in a fire ultimately rests with the local inspector, often the fire marshal. While there are three major building codes used throughout the United States (B.O.C.A.; Southern; and Uniform), the interpretation of these codes and the implementation of special local requirements rest with local building permit departments. It is, therefore, important to consult with these officials. In addition, there are a number of model preservation codes that do permit, through special variances, the continued use of "authentic" materials on historic buildings that would not be approved for new construction. Wooden shingles may fit that special exemption category if the building is located in an area that was designated for non-combustible materials. With special construction details, fire-rated wooden shingles are permitted in some Class A non-combustible material areas.

The criteria and testing procedures for fire-rated shingles have been established by the Underwriters' Laboratory, Inc., and are known collectively as UL-790. These test standards have been adopted by the American Society for Testing Materials (ASTM-E108), the National Fire Protection Association (NFPA-256) and the International Conference of Building Officials (Uniform Building Code Standard 32-7). To determine the classification of the shingles, the materials are subjected to the following tests: intermittent-flame test; spread of flame test; burning-brand test; flying-brand test; rain test; and weathering tests. The Forest Products Laboratory of the U.S. Department of Agriculture has carried out long-term testing on a number of fire-rated shingles to determine their effective-

ness over extensive periods of time (5 years, 10 years, and accelerated testing to simulate 20 years). A listing of organizations that can provide test results or information on fire-rated shingles is provided at the end of this article.

There are generally three classifications for fire-rated roofs:

Class C
generally commercially available fire-retardant shingles that will withstand light exposure to fire.

Class B
fire-retardant materials and special roof assemblies that will withstand moderate exposure to fire.

Class A
non-combustible materials or roof assemblies that will not readily burn.

Most commercially available fire-retardant shingles are factory pressure-impregnated red cedar. Other woods, such as white cedar, pine, cypress, and oak, can be treated as well, but are generally sent to a factory after purchase from a mill or are treated at the site by the contractor. There are companies that specialize in factory preparation of wooden shingles for fire-rating; a list of such companies is generally available through local trade associations or from the mill that supplies the shingles. Colonial Williamsburg had specially made cypress shingles factory-treated for use on the reconstructed hospital building that required Class A construction (see photo).

The most effective way of making wooden shingles fire-retardant is by impregnating them at a factory, under pressure, using a variety of chemicals. These chemicals are

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proprietary to each company but are generally salt-laden and replace the moisture in wooden shingles. The wooden shingles are placed in a vacuum chamber and the moisture is drawn out. The wood cells are then penetrated with the fire-retardant chemicals and subsequently kiln-dried. As the chemicals replace the natural moisture, there is no significant change in the weight of the shingles. Chemically pressure-impregnated shingles can have a Class C rating, and in some cases, a higher Class B rating. With special roof assembly details using, for example, fire-rated gypsum drywall, Class A ratings can be obtained.

Pressure-impregnated shingles maintain their ratings for the life of the shingle. They can be trimmed or split without the need to treat the exposed edges. Pressure-impregnated shingles are labeled at the factory as to their Class rating.

Shingles can also be treated with surface-applied chemicals or can be immersed in chemicals, but these are generally *not* rated because the field applications cannot be monitored or guaranteed by the coatings manufacturers. Local inspectors, however, may accept dip-treated or painted shingles in a Class C roof. Because there is no one agency or licensing organization responsible for rating treated shingles, the approval of treated shingles often rests with the local inspector. All of the surface-applied coatings must be periodically reapplied; some as frequently as once

a year. Any raw edges must be treated if there is any site trimming of shingles. There are a few intumescent paints that are promoted to improve fire-resistance of combustible materials, but these paints are not recommended for shingles as they are thick, can trap moisture under the shingles, have a tendency to blister off in the first year, and are generally not effective over time. Because of the uncertainty over the long-term effectiveness of chemical dips and coatings, it is best to specify factory pressure-impregnated shingles if they are to be installed as part of a re-roofing job that requires a rated shingle.

Following are descriptions of various, but typical, roof assemblies using fire-rated shingles. These are general details described in various code books. If fire-rated construction is required, the owner or architect should check with local building officials for information on what is accepted. As previously mentioned, each jurisdiction may have varying requirements.

Class C roofs

Class C treated shingles on any type of sub-roofing, i.e. open shingle lath, spaced roofing boards, or solid tongue-and-groove planks or plywood.

Class B roofs

Class B treated shingles on any type of sub-roofing; or Class C treated shingles on a minimum of 1/2" plywood solid decking or 1" tongue-and-groove planks. Some jurisdictions recommend heavy building paper (30 lb. felt) or a foiltype (.002 polyethylene foil) underlayment, but ratings can be achieved without them. These underlayments directly in contact with the shingles can accelerate their deterioration by reducing the ability of the wooden units to dry.

Class A roofs

Class B treated shingles laid over a composite roof decking of a minimum 1/2" plywood nailed to rafters with 1/2" core of fire-rated gypsum panels topped with another layer of 1/2" plywood or shingle lath as nailers for shingles. Some rated assemblies also rely on the use of heavy roofing paper (30 lb. building



Pressure-impregnated fire-retardant cypress shingles were installed on the reconstructed mental hospital at Colonial Williamsburg. Photo by Rudd M. Long.

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felt). As heavy felts tend to hold moisture on the undersides of wooden shingles, it is best to avoid direct contact of these two materials.

Other rated roof sub-strates can be lightweight concrete which, on a historic building, would generally only be found on a reconstructed roof. Sprinklers for the wooden roof and underside of the eaves have also been used in areas where there is adequate water supply. There are a number of substitute materials with a Class A rating, but they rarely replicate the appearance of historic wooden shingles.

As a general note for historic buildings, in selecting a wooden shingle and a roofing system that meets the code, it is important to match the visual appearance of the historic roof. Unfortunately, there has been a tendency to use rustic shakes on a wooden roof in the misguided assumption that handsplit surfaces reflect early craftsmanship. In fact, historically rough handsplit shingles were typically dressed or smoothed with a drawknife in order for the roofing to lie flat and be weather-resistant. The introduction of sawn shingles in the 19th century greatly reduced the labor associated with a wooden roof. Unless there is documentary evidence that rustic shakes were historically on a building, they should not be specified. There are commercially available wooden shingles that match the historic appearance or which can be modified as part of the specifications. There is some concern that the chemical treatment of wooden shingles makes the product more brittle and, therefore, shortens their useful life. In fact, it is difficult to prove the claim that the life of the shingle is shortened. What appears to be true is that in the short-term the shingles are more brittle and subject to cracking upon installation. Therefore, additional shingles should be ordered (perhaps 10%) and care should be taken to avoid banging the shingles upon installation. Once installed, the treated shingles appear to last as long as untreated shingles. Fire-retardants appear to give added protection against mildew, moss, lichens, and other spores which can accelerate the

deterioration of wooden shingles. For very humid areas, special fungicides can always be used in conjunction with the fire-retardants without reducing the effectiveness of the fire protection. The tests performed by the Forest Products Laboratory indicate that over a 10-year period there is not any more shortened life in a fire-retardant treated shingle as compared to an untreated shingle.

For any roof assembly, the longevity of the shingles will depend on a number of factors. One of the most important is that the shingles be able to breathe and dry out between rains. For that reason, there must be adequate ventilation in the attic; if

insulation is used between the roof rafters, there must be ventilation channels provided. Vapor barriers on the attic side of the rafters are a good idea to reduce condensation on the underside of the shingle. Heavy building papers (30 lb. roofing felts) are not recommended to be used in contact with shingles as they can hold moisture on the back side of the wooden units and accelerate deterioration. If shingles are to be treated with special penetrating coatings to revitalize the wood cells, only vapor-permeable solutions should be used. Roofs should be kept free of leaves and branch debris, and gutters should be cleaned regularly.

There are a number of organizations that can provide additional information on fire-rated wooden shingles and roof assemblies. Following is a list of these organizations and their services:

Red Cedar Shingle and Handsplit Shake Bureau

515 116th Ave. N.E., Suite 275
Bellevue, WA 98004-5294
(206)453-1323

This trade association of mills and suppliers of red cedar roofing products has printed information on roofing, installation, and fire-rated construction. Technical questions can be addressed regarding cedar shingles and shakes, and a list of chemical treaters is available.

International Council of American Building Officials

5360 South Workman Mill Road
Whittier, CA 90601

The I.C.B.O. is a non-profit organization of building officials and county building departments across the U.S., and it has been responsible for writing the Uniform Building Code and model building codes. The I.C.B.O. also provides evaluation services of building materials, their construction, and their compliance with the building code. Many fire-rated chemical companies have had their products evaluated and approved for various class ratings.

Underwriters Laboratories, Inc.

333 Pfingsten Rd.
Northbrook, IL 60062

The Underwriters Laboratory develops standards and tests for building products. These tests are done under contract with the laboratory, and if the products meet the criteria, they receive the U.L. label. Several companies have had their fire-rated products tested and approved by the Underwriters Laboratory.

United States Department of Agriculture

Forest Products Laboratory
One Gifford Pinchot Drive
Madison, WI 53705-2398
(608) 264-5674

The Forest Products Laboratory initiates and carries out research on all types of wooden building materials, including wooden shingles. A test panel of shingles was set out in a field in Wisconsin in 1976. After 10 years of weathering, the effectiveness of fire-retardant treatments have been evaluated. A copy of this report and technical advice on wooden shingles are available.

A new publication entitled *Preservation Briefs 19: The Repair and Replacement of Historic Wooden Shingle Roofs* is available from the Preservation Assistance Division. Individual copies may be requested by telephoning (202) or FTS 343-9578.

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