BACK TO BASICS

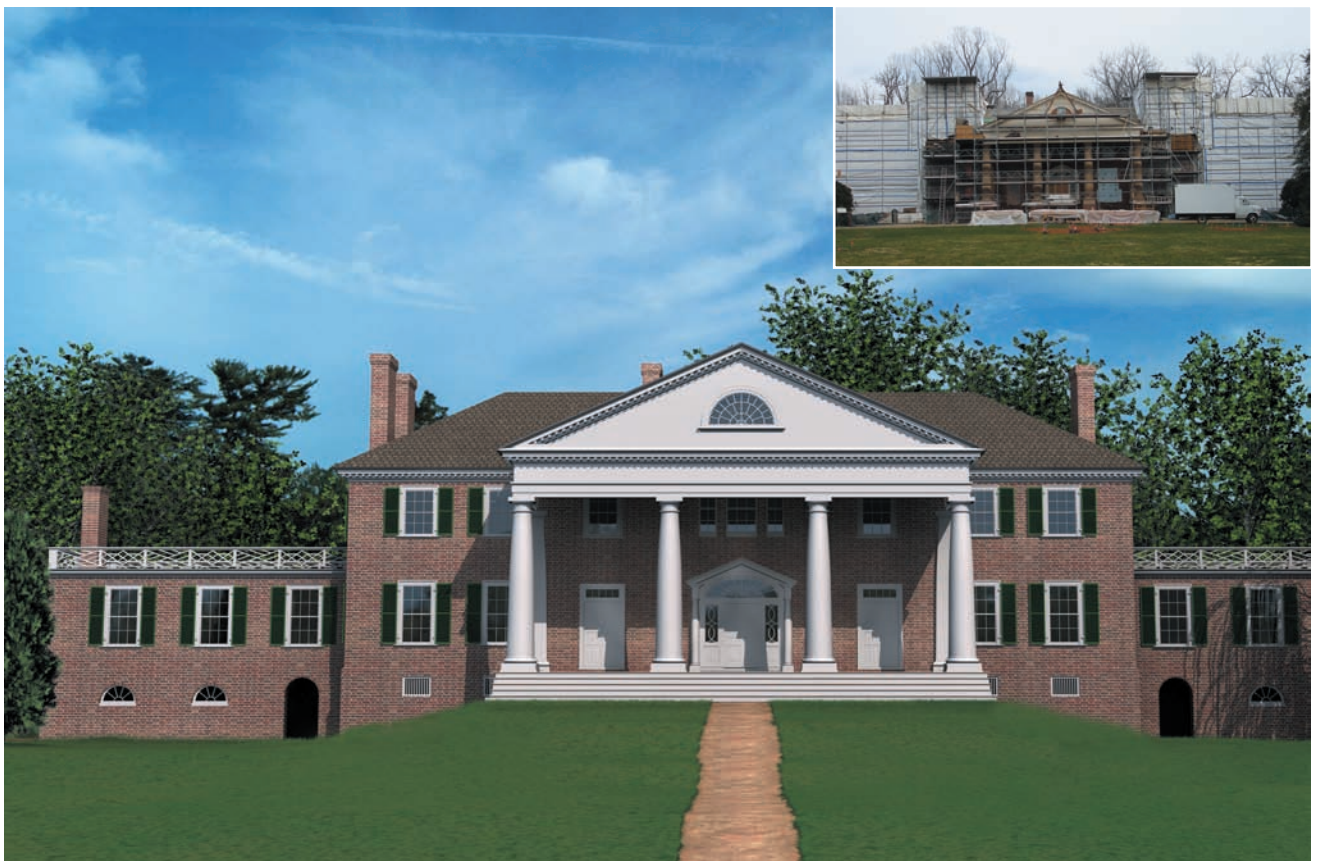
Restoring the original hip wood roof at James Madison's Montpelier required extensive framing repair before period-style cypress shingles could be added.

By Scott McBride

In 1901, industrialist William DuPont purchased Montpelier in Orange, VA, formerly the home of President James Madison and his first lady, Dolley. Times had changed in the 75 years since the Madisons entertained Jefferson and Lafayette on their columned veranda overlooking the Blue Ridge Mountains. The straightforward Georgian manor house that had originally been built by Madison's father around 1760 had sufficed for the president of a young republic, but it was inadequate for a scion of the Gilded Age. DuPont doubled the size of the structure by expanding Montpelier upward and outward.

Another century passed, and DuPont's daughter donated Montpelier to the National Trust for Historic Preservation. Restoration of the mansion to its Madison era appearance began in 2004 under the architectural direction of Mesick, Cohen, Wilson, Baker Architects of Albany, NY. After careful deconstruction of the DuPont additions, our company, Mustard Seed Master Builders, of Sperryville, VA, was called in to spearhead restoration of the roof.

The challenges were formidable. Original cornices had been sheared off to interface with the DuPont additions, and the Madison-era hip roof had been fundamentally altered. Timber trusses had begun to fail at critical points due to problems inherent to the 18th-century design, and leaky roof valleys had caused advanced structural decay. Once the framing was restored we would face the task of removing the existing copper roof and replacing it with period-authentic cypress shingles. We set up shop in the attic and went to work.

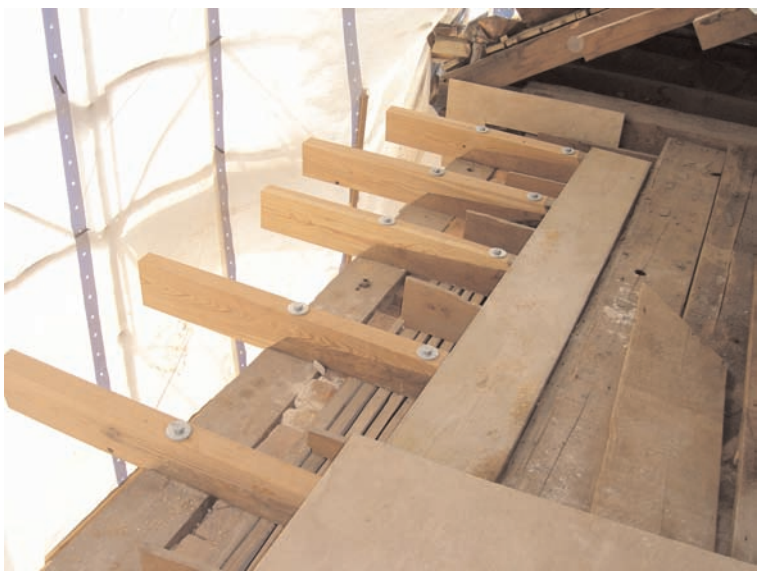


Originally constructed around 1760, the main house of James Madison's Montpelier, in Orange, VA, underwent significant alterations after it was purchased by William DuPont in 1901. A century later, it was donated to the National Trust for Historic Preservation; since 2004, it has been undergoing a restoration aimed at returning it to its Madison-era appearance.
CAD rendering: courtesy of The Montpelier Foundation and PartSense, Inc. Photo: John Jeanes, The Montpelier Foundation

Orthopedic Carpentry

A varied regimen of framing repairs was prescribed by structural engineer Dave Fischetti of DCF Engineering of Cary, NC. Where the cornice had been removed we used lag-bolted scarf joints to extend truncated ceiling joists. In the attic we replaced missing rafters in their entirety, but in some cases the DuPont carpenters had retained portions of the original common rafters to serve as shortened jack rafters. To restore these to their full length we spliced on new wood of the same species — mostly heart pine, but in some cases, oak or poplar.

Instead of scarf joinery, we connected the old and new rafter sections with internal steel knife plates secured by self-drilling steel pins. The knife-plate system was originally developed in Germany as a fire-resistant alternative to surface-mounted timber framing hardware, but we focused on another advantage: the plates required only light end-trimming of the antique timbers, whereas scarf joints would have meant cutting away a substantial amount of original fabric. Also, slotting for the plates could be done in situ, whereas fashioning scarf joints in mid-air would have been onerous at best. Our onsite testing confirmed the strength of the knife-plate system, and we used a Mafell chain-type mortising tool to plow the ¼-in.-wide slots.



To restore Montpelier's cornice, the ceiling joists that had been cut off to interface with a 1901 addition were extended. After splicing on new material with a lag-bolted scarf joint, the joist extensions were trimmed to length. *Photo: Amy Wysocki*

Montpelier's classic 18th-century roof frame consists of heavy king-post trusses interspersed with purlins and light secondary rafters. Another antique feature is Montpelier's dragon beams – heavy diagonal ceiling beams that run directly below each of the roof's four hips. This system is elegant but impractical because it concentrates extreme loads at a few key points. A serious problem occurred where both dragon beams and kingposts had been tenoned into lower chords at mid-span. This traffic jam of converging timbers resulted in a cluster of mortises that had weakened the lower chords to the point of failure. A later hand-forged iron staple had only made matters worse. To remedy the situation, Fischetti designed custom steel hangers, which we had fabricated by a machinist. We provided the machinist with a custom-fitted wooden pattern for each location to cope with the vagaries of hand-hewn framing members.

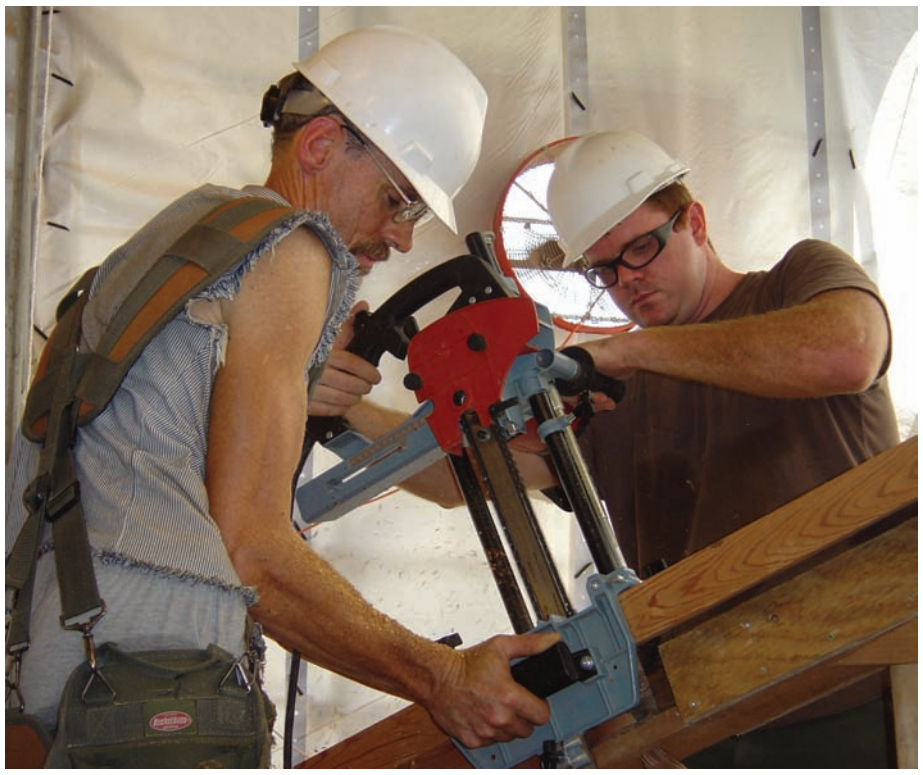
Longstanding leaks caused our biggest headaches. Water had seeped into wall plates and truss chords, turning them to mush. One of the principal tie beams connecting Montpelier's Tuscan portico to the house had rotted clean through. Repairs required extensive shoring before the ailing timbers could be operated on. After trimming back the decayed areas to sound wood we incorporated new timber by means of keyed scarf joints reinforced with through-bolts. In some cases the surgery had to be performed from within the portico entablature – a narrow chamber barely wide enough for a worker to squeeze into.

Reviving Lost Shingle Techniques

Montpelier's original shingle roof was extended twice before being replaced by standing-seam metal around 1850. Fortunately, for posterity's sake, these alterations left behind a sampling of shingles that were either recycled as shims or left behind as debris hidden in the attic.

Mark Wenger, the project's lead architectural historian, was able to infer the shingle detailing of the 1825 Madison roof based on the various shapes of the recovered shingles. He compared them to photographs of time-frozen 18th- and 19th-century roofs that had been found encapsulated within later roof expansions. He also consulted with Peter Post of Richmond, VA, the restoration contractor who ultimately supervised the shingling at Montpelier.

Post has been shingling antique roofs in the Tidewater region of Virginia for more than 30 years, including such notables as Bacon's Castle (1663) and Bowling Green (1743). The Bowling Green house has an encapsulated dormer that Post was familiar with, and it turned out to be a "Rosetta stone" that informed the shingling at Montpelier. A peculiar beveled edge on one of the recovered Montpelier shingles was identical to a type found on the



A spliced hip rafter was grooved with a chain mortiser to receive internal steel knife plates. *Photo: Amy Wysocki*

Bowling Green dormer, suggesting that Montpelier's hips had been capped with a narrow tear-drop shingle. The evidence was persuasive and the detail was adopted.

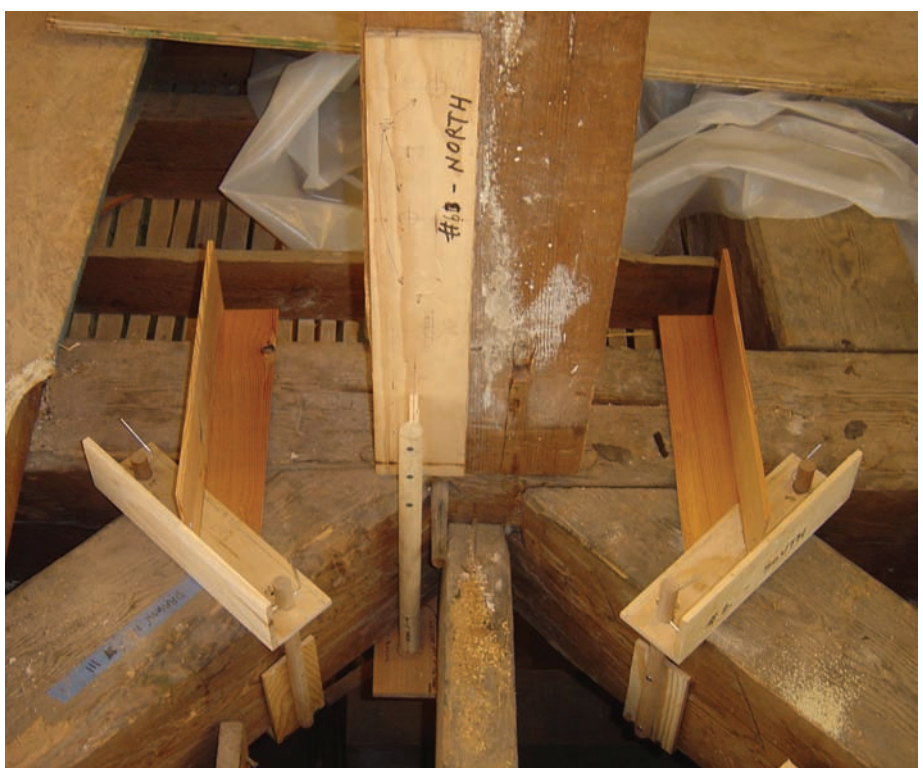
In addition to the tear-drop feature, the hips at Montpelier are "fanned" – a typical southern shingle detail of the period. Fanned hips feature progressively canted side-joints, which create a pagoda-like effect. Roof valleys of the period were fanned like the hips, but in reverse; the width of a valley shingle narrows toward the butt rather than the feather end. The technique is called "sweeping" the valley.

To research the subject of swept valleys and fanned hips, Montpelier's restoration director John Jeanes turned to the internet. He hit the jackpot when he located a technical brief describing the recent re-roofing of the Chowan County Courthouse in Edenton, NC. The brief's author, architect John L. Willers, confirmed our misgivings about the swept valley detail: though historically accurate, it seemed doomed to early failure by the geometry of its tightly spaced joints. The remedy Willers employed, and which we also resorted to, was a metal flashing woven, or interlaid, into each course at the valley. Whether this option was employed by 18th-century builders is uncertain, but the horrendous damage caused by leaky valleys at Montpelier made us unwilling to proceed without the backup protection of flashing.

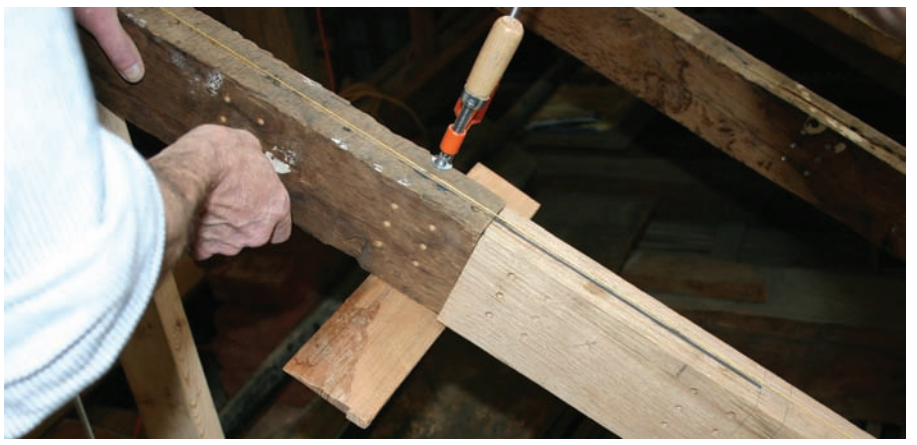
To physically rehearse the details at Montpelier, Post shingled a 12-ft. mockup that included a hip and a valley. To ventilate the shingles, we removed the 1850s solid sheathing and replaced most of it with spaced battens, but a 40-in.-wide strip of solid sheathing at the eaves was lined with EPDM rubber as a defense against ice dams. Rubber was also installed beneath valleys as further backup protection against leakage. The entire roof was underlaid with Roof Shield, a highly vapor-permeable, self-sealing membrane that lasts longer than felt. Cedar Breather was used under the shingles throughout as another way to promote drying.

All told, Montpelier's roof took over a year to restore. With her bones braced and her cap feathered with cypress, James and Dolley's home should last another 250 years. ◆

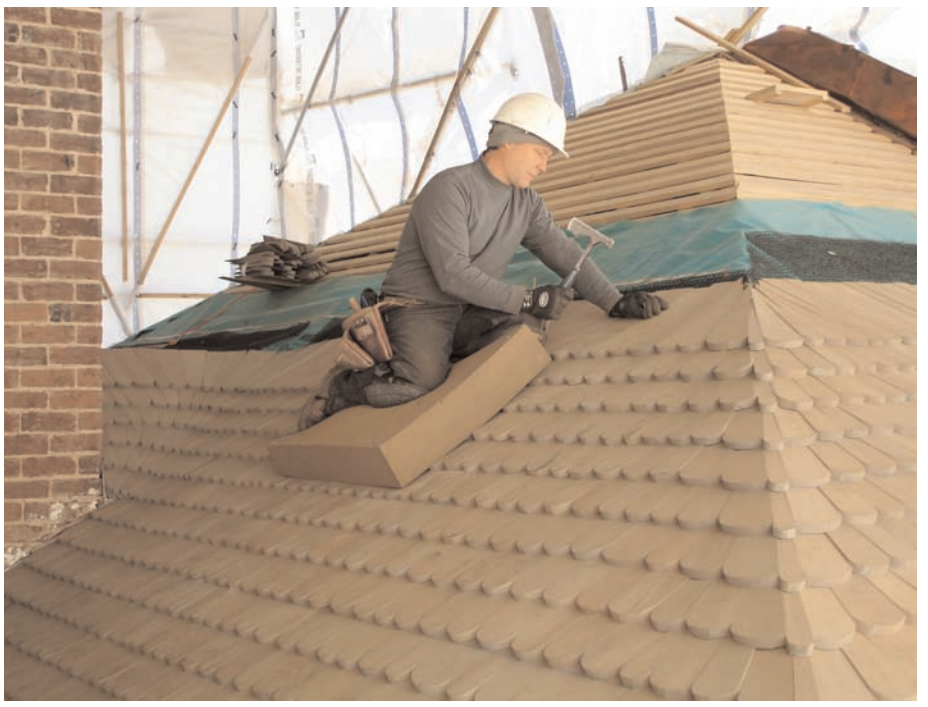
Scott McBride has been a building and restoration contractor for more than 30 years. He is also a senior contributing editor at Fine Homebuilding Magazine, *and the author of two books,* Landscaping with Wood *and* Build Like A Pro: Windows and Doors.



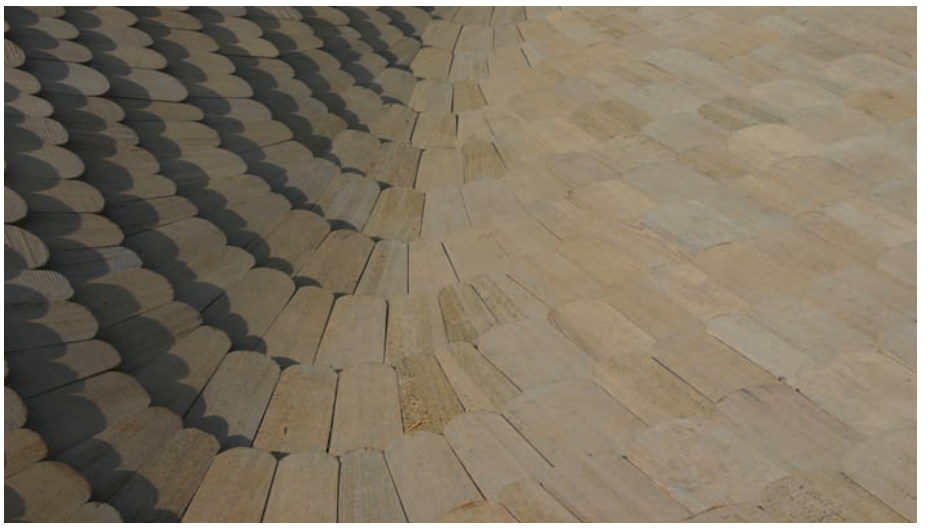
Two dragon beams, a joist and a kingpost all converge at the midpoint of the principal roof truss. The resulting mortises weakened the lower chord of the truss to the point of failure. After jacking up the truss, wooden patterns were made for specially designed steel hangers. *Photo: Amy Wysocki*



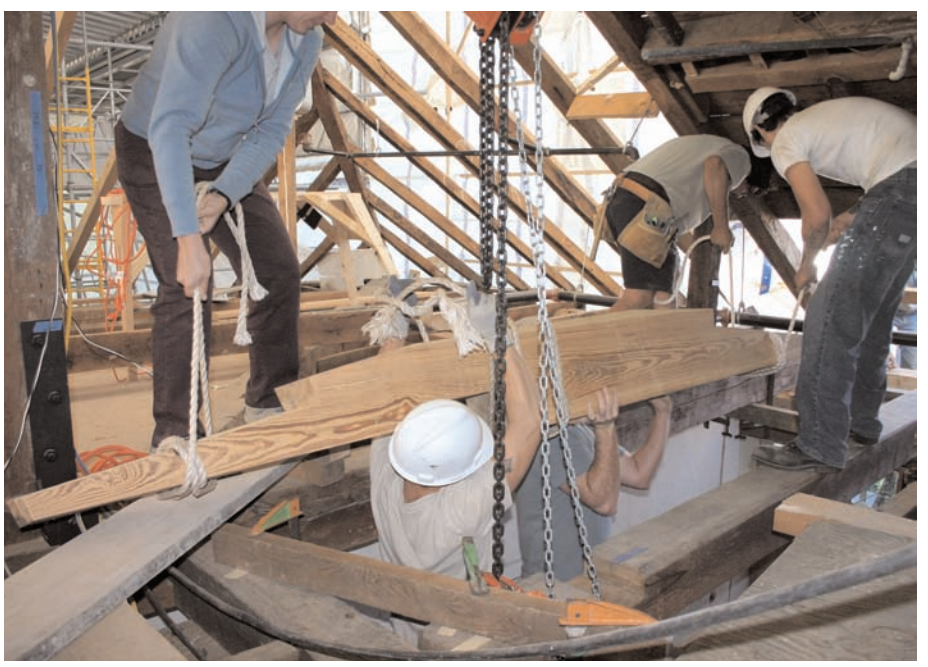
This 18th-century rafter (left) was severed in 1901 to accommodate roof alterations. A new extension (right) was attached by means of an internal steel knife plate that bridges the joint. The plate drops in from the top and is secured by four sets of self-drilling steel pins. *Photo: Maggie Wilson*



Old-growth cypress shingles were laid over new spaced battens to restore Montpelier's roof surface. The green membrane is Roof Shield, and the black mesh just above the shingles is Cedar Breather. A swept valley is visible behind the chimney at left, and a fanned hip appears on the right. The carpenter's foam rubber cushion protects shingles during installation.



Old-growth cypress shingles were used to restore Montpelier's roof surface. The valleys were "swept," a period treatment that creates a seamless transition between adjoining roof planes. A hidden leaf of stainless-steel flashing is woven into each course at the valley. *Photo: Maggie Wilson*



One of the beams that ties Montpelier's portico to the house had rotted clean through, so a 12-ft. section in the middle had to be replaced. Bolted scarf joints united replacement material with the original fabric. Reclaimed heart-pine timbers were salvaged from a textile mill in South Carolina. *Photo: Maggie Wilson*