TIMBER FRAMING

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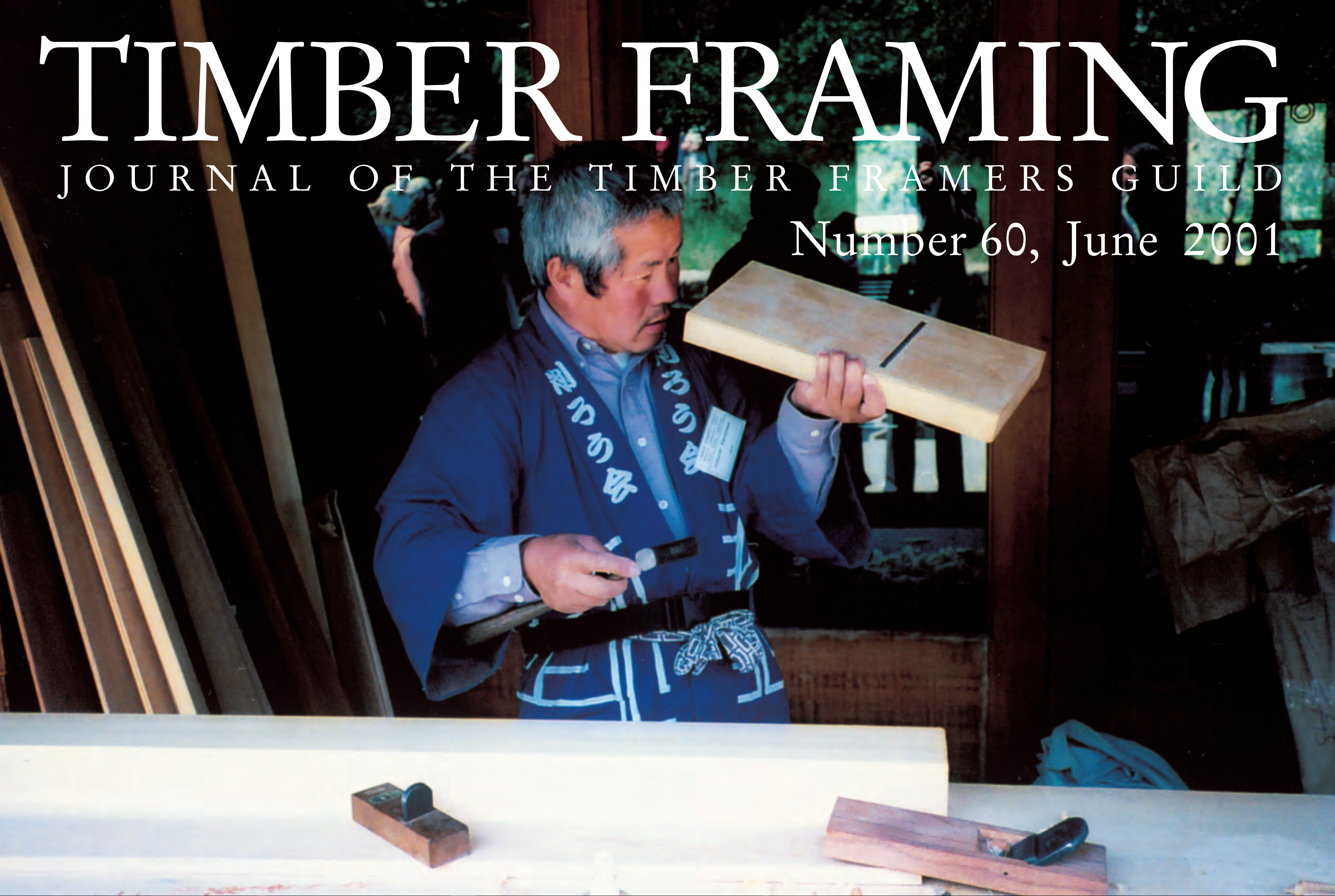

Western Conference at Asilomar

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On the cover, Hideyuki Kanazawa adjusts a wide Japanese smoothing plane, then takes a shaving from a Port Orford cedar scantling at Asilomar 2001. Photos by Ken Rower.

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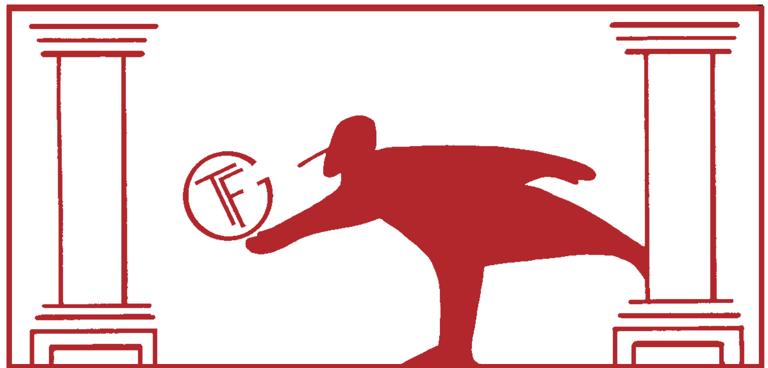


Notes & Comment

Asilomar 2001

WESTERN conferences began with Timberline '86, in the second year of the Guild's life, with about 100 framers in attendance. Of the slide show that year, Montana's Wil Wilkins said, "Not all these folks Out West just ride horses," and of the whole experience New Hampshire's Tedd Benson remarked, "I now feel impoverished with our little oak trees." By now, the influence of the West on the East, especially in the general displacement of oak by Douglas fir as the material of choice for timber framing, is as great as the influence of the East on the West, and the Western Conference draws the same 300-strong cohort as the Eastern Conference.

There is a second important way in which the West has influenced the rest of the country. It has transmitted a current of Japanese design, which, if it does not flow transparently, still makes designers and woodworkers pause, look and reflect. The organizers of this year's Western Conference in April at California's Asilomar State Park, on the point at Monterey, opened the floodgates.

IS BEAUTY in the eye of the beholder? To say so "makes it sound as if there's nothing out there," declared architect Michael Anderson, who divides his time between California, where he teaches at UC Berkeley and practices architecture in Stewart's Point under the name Laughing Moon Architecture, and England, where he teaches at Magdalene College, Cambridge. In architecture school (his was the Harvard School of Design) no one talked about beauty, Michael reported, and in English we may not even have sufficient language to do so. Japanese, by contrast, has 200 or so words to use, which Michael heard while spending 11 years in Japan, six as an apprentice carpenter in Nara. On the other hand, Japanese has no real equivalent to our "timber framing"—perhaps *kigumi* or *jikugumi*—but that is because in a Japanese carpenter's mind there is no difference of intent between, say, the delicate pull on a door and the connection between a post and a beam. Both objects take their place in the same unified system.

Such is not true in America, Michael argued. The modern American timber frame is not an ensemble player. It's a show-off, "terribly self-conscious," especially in combination with external insulating panels, which allow the exposure of three sides of wall posts. It has, Michael said bluntly, no evident system of proportioning for the eye (there may be one for the engineer). Sophistication is absent from these structures, many derived from agricultural buildings.

Haughty but frequently enough humorous—and the latter tone certainly redeemed the attack, as did numerous slides of his work in Japan, which is impurely Japanese, and often exquisite—Michael said that it was better to have it out on this subject than "to be locked in furious agreement." Once, he said, he thought of himself as a timber framer, and from Japan wrote a series of articles for this journal (see TF24-43, especially 39 and 40), hoping to awaken American timber framers still in America to this problem of beauty. But he gave up the task in 1993 and ceased to think of himself as a timber framer.

"You guys are big. You have big posts and bigger beams," he said. "Kimihiro Miyasaka calls you timber wrestlers. But it's not effeminate to use a 4x4. No one will check you for limp-wristedness." Timber framers must enter an area of greater finesse: "Girls, you already know this. Guys! You don't have to show it all at once!" In the Japanese house, Michael observed, the architecture does not flow. Interruptions are frequent: thresholds, *shoji* screens, little rooms. Matters are revealed slowly. "Why are we so compelled to show huge spaces?" Michael asked. He answered rhetorically, quoting Oscar Wilde: "We think great thoughts generally in small spaces."

The invisibility of any proportioning system in new American frames is accompanied by another inherent problem, which Michael would call "morphological" inconsistency: the clash between the shapes of the timbers and the shapes of the trim—in the first place, that there should be a distinct thing called trim or "finish," and then that it should have molded surfaces. From a Japanese viewpoint, if the larger elements of the frame show plane, rectilinear surfaces, then the smaller elements ought to as well, and they should be joined directly with the frame. All should be woven together. (What might be the most peculiar feature of new American frames enclosed in panels, the displacement of the doors and windows into a separate but adjacent plane, Michael did not specifically address, but he had high praise for a building shown by Merle Adams in the slide show that distanced the door and window plane several feet away from the timber frame, a design tactic first proposed by architect Ian Burr at Hancock '85 that avoids the discord as handsomely as does traditional Japanese or European infill in the plane of the frame.)

Detail, Michael argued, is usually absent from the American frame. A detail as he defined it is the consequence of an event, and an event is the coming together of two things. When there is a difference in the two things, for example a reveal, there is a detail. If an 8x8 post enters an 8x8 beam, there is no detail, because the surfaces are flush (at least until one of the pieces shrinks or twists away). But if the post is reduced to 7½ in. on one face, we can have a detail, and not only a detail, but also a remedy for seasoning degrade in the connection, to draw the eye to the shadow under the slightly thicker beam rather than to the gap at the post shoulder. To be fair to American framers, thoughtful ones certainly observe a descending hierarchy of sections to obtain "details," whereby a joist will be less deep than the girder it joins, a girder less thick than the post it joins, a post less broad than the beam it supports. Certainly the Japanese *chi,* the standard offset, is about an eighth of an inch, whereas Americans will observe a half-inch or an inch, but then Japanese house posts are 5-inch, spans are rarely as much as 8 ft. and the consequent scale is entirely its own.

Osamari is the Japanese term for bringing things together, with the suggestion of settling and fitting—ultimately, Michael said, "the notion of a thing settling upon itself." Old buildings can have this quality. In fact, as a building grows old, "it should become more of itself." The term includes also a sense of "gatheredness": this is what we humans do, connecting things, and there is "the great satisfaction of driving the peg, pulling it all together."

What then is Michael's remedy for us? To be very specific, for instance, cut a 4x4 in two and demonstrate for yourself the difference between a radius and a chamfer. *Look.* "Chamfers carry you around the surface of the timber. Rounded corners show you the mass of the piece." To be very general, "Stop being timber framers. Become makers of buildings. Spread continuity. Do not fear artifice or play. And seek out *osamari*, everywhere."

GUILD fund-raising auctions can offer surprises. To begin with, an inscribed bowl was presented to Brian and Janice Wormington, the latter rosy with pleasurable embarrassment, to recognize their important voluntary work on behalf of the Guild, now completed. It would be fair (if insufficient) to say that Janice invented the Guild website, and that Brian firmly pressed the Guild's Board into establishing an executive directorate, and that both website and directorate thrive. It was characteristic of Janice to offer immediately to donate the bowl to the auction.

In the course of the conference, four Japanese carpenters, shepherded by the indefatigable Ryosei Kaneko of Sierra Timberframers and assisted by several Americans who practice Japanese carpentry in California, had cut a mock temple post (*hashira*) with abacus (*daito*) and bracket (*hiramitsuto*). This powerful assembly, about chest-high and with its post planed to a fare-thee-well, was the subject of a dramatic bidding war among Chris Feddersohn (already in possession of abundant curiosities from earlier Guild auctions), Bob Sproul (who had supplied the unblemished Port Orford cedar for the job), Ross Grier (who speaks Japanese), Merle Adams (slide show comic) and Jonathan Orpin (goad). In the end, the assembly was knocked down for a grand sum to a time-share agreement between Merle's Big Timberworks in Montana and Ross Grier's Cascade Joinery in Everson, Washington. So now, not exactly like the shrine at Ise, the *hashira-daito-hiramitsuto* will be solemnly disassembled and moved every so many years to new, purified quarters in Montana or Washington State.

Catching the spirit of the evening, Kojiro Sugimura, one of the Japanese carpenters and founder of the annual planing competition *Kezurou-Kai*, took the ceremonial blue cotton shirt off his back and passed it up to the auctioneer. Visitor Sebastian Röthele, not to be outdone, threw in his traditional German carpenter's black broad-brimmed hat. And, at the suggestion of Quebec's Doug Lukian, there was an outpouring of donations in lieu of bidding, for the benefit of esteemed Guild member Mark Brandt, who has suffered a grievous blow from the Fates and is bravely facing his own demise.

CURIOUS about the capabilities of Japanese planes, I took home to Vermont some shavings from the worksite at Asilomar. When finish-planing hardwood, I have found my Stanley No. 5, its iron well sharpened on Japanese waterstones, and the area in front of the plane's mouth carefully flattened, steadily capable of taking shavings .002 in. thick. When planing Douglas fir, a very orderly material, I have found it possible to take .001, but not the full width of the iron. For general leveling work, I find a shaving of .005 in. is a fair cut, normally the full width of the iron.

Using a Starrett micrometer, here is what I found when measuring the Port Orford cedar shavings made at Asilomar with well-tuned Japanese planes. A working shaving 3 in. wide measured .003 near one edge, .005 at the middle and .002 at the other edge. (Curved iron.) A finish shaving 4 in. wide measured between .0015 and .002. A "whisper of smoke" shaving, the sort taken in competitions, and which begins to look like an illustration of wood cell structure in a textbook, measured about .00075. This shaving might have been 2 in. wide or 3; the lace had closed up on the way home.

According to Jay van Arsdale, who spoke on Japanese planes at the conference, the record for shaving thinness in Japan is 4 microns—very nearly .00016 (a micron is defined as a millionth of a meter). So, in the right conditions, these planes can take shavings a fifth as thick as the lacework affair I brought home.

I must also report that, on oak or cherry, my Stanley No. 5 leaves surfaces that feel like silk, while the Japanese planes at Asilomar left surfaces on the *hashira* that felt like glass. If you do acquire a fine Japanese plane, I suggest you acquire with it a Japanese carpenter and a good supply of Port Orford cedar. Your woodworking life will then be complete. —Ken Rower

Asilomar 2001

THE slide show at the 15th Western Conference in April revealed a wide range of woodwork by Guild members, from studio furniture to very large bamboo structures. At right, a pavilion following the line of a quarter-ellipse, designed and built by Pacific Post & Beam of San Luis Obispo, Calif., for a winery in Santa Barbara County, using 34,000 bd. ft. of recycled Douglas fir, some of the yield from a former sawmill in Washington State. No two timbers connecting the fifteen 36-ft.-wide scissors trusses share the same length or joint angle. The 7,500-sq.-ft. structure, now roofed in tile, shades steel fermenting tanks. At right below, detail of 7,000-sq.-ft. house on Flathead Lake, Montana, designed by Richard Smith of Whitefish, with timber work in the round by Centennial Timber Frames of Kalispell. Cedar timbers were pressure-washed to remove the bark and as little more as possible, then RFV-kiln dried to 15 percent without significant degrade. Below, 800-sq.-ft. recreation room, an estate outbuilding serving a swimming pool, in Tiburon, Calif., designed by Herbert Kosovitz AIA of San Francisco and framed of reclaimed Douglas fir by Timber Creations of Novato, who reported, "The valleys were no problem. The site was." At left, central post of a bandstand in Winnipeg Beach, Manitoba, designed and built of Eastern white pine by Cornerstone Timberframes in Steinbach. Six hammer-beam trusses meet at the post.

Hans Friesen

Terry Turney

Leif Calvin

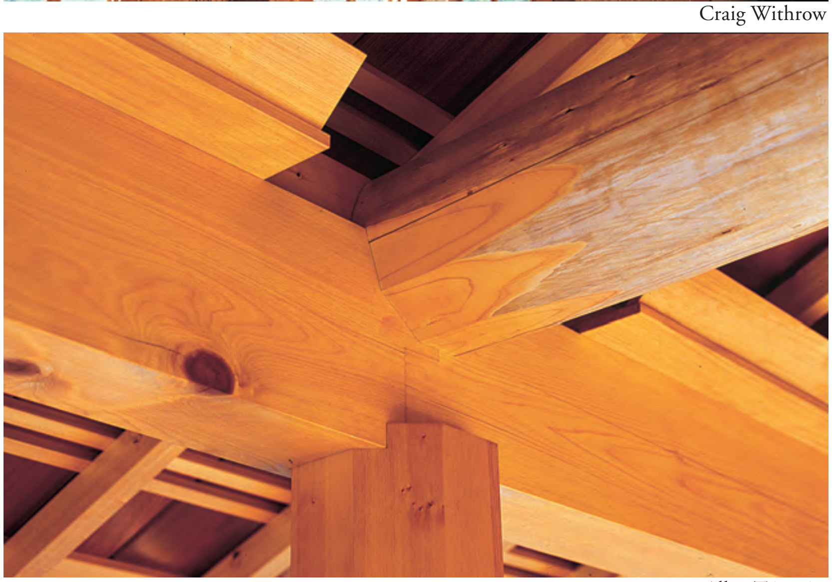
At right, post is bolted to steel hold-down anchored in masonry pier. The space beneath will be filled with stone.

Bob Jellison

George Nesbitt

Gazebo built of timbers cut from dead standing larch, Elk City, Idaho, at a Guild rendezvous, from a design by Marc Guilhemjouan of Vancouver, B.C., and Ed Levin, Hanover, N.H., and intended to encourage a disheartened rural community. The US Forest Service supplied the trees. Below, interior view of 3,000-sq.-ft. dwelling on Lopez Island, Washington, "a Berkeley house transplanted to the woods of Lopez Island," designed by Richard Berg of Port Townsend and framed of Douglas fir by The Cascade Joinery in Everson.

Craig Withrow



Allen Trigueiro

Detail of Japanese-style building 20x50 ft. designed and built by Trigueiro Design/Construction in Lafayette, Calif., of large Port Orford cedar timbers, with redwood ceiling boards. Octagonal posts are 10 in. through.

Jake Jacob

Treehouse in northwest Oregon, 300 sq. ft., built of reclaimed Douglas fir by Tree House Workshop of Seattle, Wash., "to be used by adults for reading, but now taken over by the kids." Below, house frame of Douglas fir cut from salvage logs in North Chittenden, Vt., designed and built by The Timber-Frame Workshop, E. Alstead, N.H. The 40-ft. ridge beam is unscarfed.

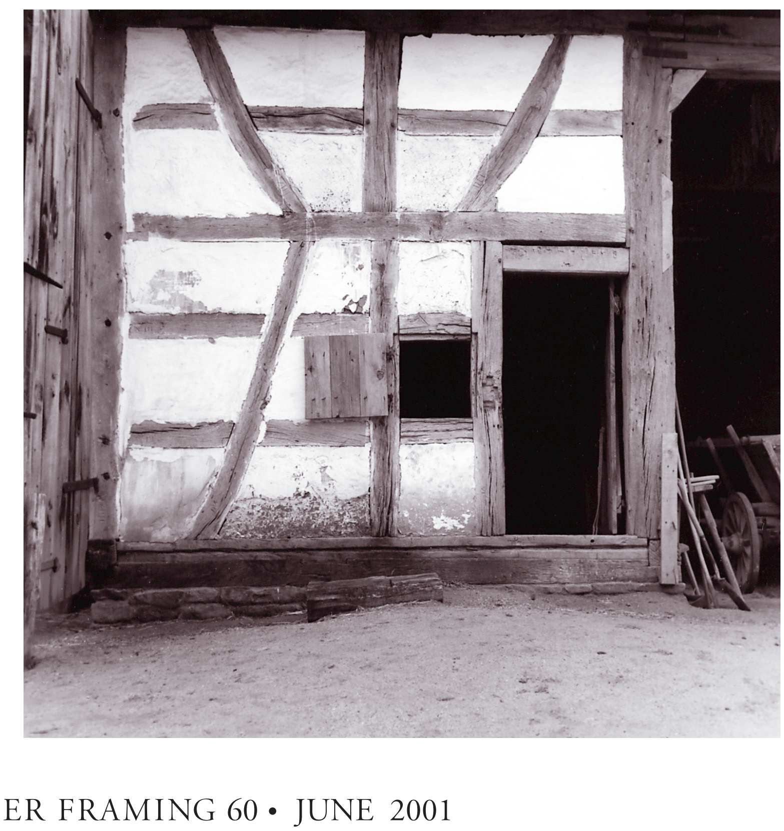
Chris Madigan

TTRAG 2001

TTRAG, the Guild's Traditional Timber Framing Research and Advisory Group, and its followers gathered in March, some 135 strong, at the Frontier Culture Museum in Staunton, Virginia. Unlike the Guild's larger and older eastern and western conferences, TTRAG's began in 1992 as small symposia for interested persons, and preserve their origins in plenary sessions exclusively. The buildings shown here, brought to the Frontier Culture Museum from Europe, then repaired, reerected and interpreted to visitors, provided useful examples of the historic building systems under discussion by presenters, especially Jörn Wingender of Nelson, B.C., who treated German carpentry, Peter McCurdy of Reading, England, who surveyed the history of English carpentry, and Henry Russell, of Bristol, England, who examined (among other matters) the state of contemporary British repair techniques.

Photos Chris Madigan

The reconstructed German farmstead at the museum, dated 1688 and originally the property of a modest subsistence farmer in the Rhineland-Palatinate, appears to have been made in part from used materials. The beavertail roof tiles, each fitted with a peg, hang from laths fastened to the rafters, and are held down by their own weight. German bracing patterns, notable in the house at lower left, vary regionally and evolved significantly over time, beginning with short foot braces that moved upward until the 18th century, when braces began running full height between sill and plate at much steeper angles, to resemble tilted studs. Throughout their history, strucural braces have been used also as decorative elements on the public faces of buildings, and designed to indicate the wealth of their owners. Below, detail of barn.



The English frame, from Hartlebury in Worcestershire, is built in the square panel style widespread in England except in the eastern counties. The style is said to have become common in the late 15th century and is distinct from the more-expensive close-studding style. Dating in part to 1630, the house has been extensively altered and repaired. Patches are visible in many exterior framing members and one exterior wall has had its framing reversed. The chimney built on the ell to the rear is dated 1692.

Note jowled corner post with down braces and horizontal webs. Bedstead with rope-slung mattress is faithful to late-17th-century style.

Gable-end framing appears to be original, repaired. Purlins, common rafters and windbraces are modern.

SIPs and SSPs are Not the Same

TIMBER FRAMERS commonly call *stressed-skin panels* the composites of wood, glue and plastic foam that sheathe the roofs and walls of many modern American timber frame buildings. But, properly defined, the term is a misnomer since, with very few exceptions, these panels lack the lumber core essential to the definition as promulgated by the American Plywood Association and accepted by code agencies in the 1960s (1). A stressed-skin panel is understood to comprise one or two skins firmly bonded by adhesives of specified structural performance to timber members of certain sizes and on-center spacing. The presence or absence of thermal insulation is irrelevant to the definition.

The panels that *do* generally surround modern American timber frames, and which comprise one or two (usually two) engineered-wood sheet skins chemically bonded to a simple plastic foam core, were originally described by the American Plywood Association as *sandwich panels* (2). Today, by agreement of the people who build them, such panels are generally called *structural insulated panels* because they have both insulating and load-bearing abilities.

Both forms of panel rely on *composite action*, which requires the core and skin or skins to act as a unit, forbidding slippage between them. The adhesives or fastenings must be effective in transferring shear forces and cannot deteriorate over time because of moisture or creep.

While many stressed-skin panels have skins attached to both edges of the framing lumber, a panel can meet the definition with one skin (Fig. 2a, facing page). Since the strength and stiffness of the stressed-skin panel are based on the composite action of the core and skin, an important requirement is that the adhesive be rigid, with known structural performance in both the short and long term.

If for some reason the adhesive between the skin and the lumber core failed to function as intended, the components of the stressed-skin panel acting individually would still safely carry some substantial percentage of the design load. While this scenario is not desirable, it demonstrates that stressed-skin panels (as we define them) are inherently robust with respect to manufacturing deficiencies in the type and application of adhesives used to connect the skin to the core. This virtue is not shared by structural insulated panels.

STRUCTURAL insulated panels (SIPs) consist of a layer of rigid insulating foam, varying from 3½ to 11¼ in. thick, sandwiched between layers of 7⁄16-in. oriented-strand board (OSB), with possibly an interior finish, such as gypsum board or tongue-and-groove paneling, added to one side. The insulating foam for SIPs can be polyurethane (including polyisocyanurate) or polystyrene (expanded or extruded). Figure 3a on the facing page shows a cross-section of a common SIP configuration. SIPs, without a core of framing lumber spaced 24 in. or less on center, are substantially different from stressed-skin panels in that 100 percent of a bending moment is assumed for design purposes to be resisted by the tension and compression capacity of the skins. In addition to relying on the adhesive bond between the two skins and the core for the needed bending strength, the core material must also transfer the shear produced by the bending loads, both in the short and long term. If the adhesive bond between the skins and core fails to function or the core material fails to function, the SIP fails.

Since the structural integrity of the SIP depends entirely upon the glue bonds between the skins and the core and the durability and structural reliability of the core material, it's obviously important for SIPs to be manufactured under accepted standards and that manufacturing procedures and quality control be subjected to third-party inspection by an approved agency. Typically, such inspections involve unannounced, regular visits to the manufacturing facility by representatives of a testing agency such as Product Fabrication Service (Madison, Wisc.), to scrutinize fabrication methods and test random samples of SIPs to ensure that the foam, OSB and the adhesion between the foam and the OSB are adequate. These third-party inspections are required in order to maintain code approval by the International Conference of Building Officials (ICBO).

Doug Anderson

Coating polystyrene panel with glue at Winter Panel, Brattleboro, Vt.

HOW can you determine if a SIP meets recognized industry standards for quality and is appropriately designed for published load ratings? First, you can request a code report from the manufacturer, or by searching the web sites of the governing code agency (e.g., www.icbo.org/icbo_es/es-search.html). The existence of a full code report for a product and its manufacturer is a reliable indication that third-party inspections have been conducted at the SIP plant and that the governing agency, such as the ICBO or the National Evaluation Service, has embraced the product as acceptable. Additionally, code-approved SIPs should display a stamp on the OSB that indicates the panel type, the code report number, the manufacturer's trademark or name and the third-party inspection agency's logo and report number. If SIPs are designed properly for their intended application, manufactured using established quality procedures and verified by third-party inspection (3), builders can be assured of structural performance similar to the solid-sawn timber and board sheathing constructions that have been used for centuries. —DAVID CARRADINE, FRANK WOESTE AND SCOTT M. KENT

David Carradine is a graduate research assistant in the department of Biological Systems Engineering, Virginia Tech University, Blacksburg, VA 24061. Frank Woeste P.E., Ph.D (fwoeste@vt.edu) is professor in that department and the author of numerous books and papers on wood construction technology. Scott M. Kent P.E. is Quality Manager, Wood Science & Technology Institute, Corvallis, Oregon 97333.

1. Plywood Design Specification Supplement 3, Design and Fabrication of Plywood Stressed-Skin Panels (updated August 1990), document available in pdf format at www. apawood.org.
2. Plywood Design Specification Supplement 4, Design and Fabrication of Plywood Sandwich Panels (March 1990), available at www.apawood.org.
3. ICBO Evaluation Service (ES) documents AC04 and AC05, acceptance criteria, respectively, for Sandwich Panels and Sandwich Panel Adhesives, are available at www.icbo.org.

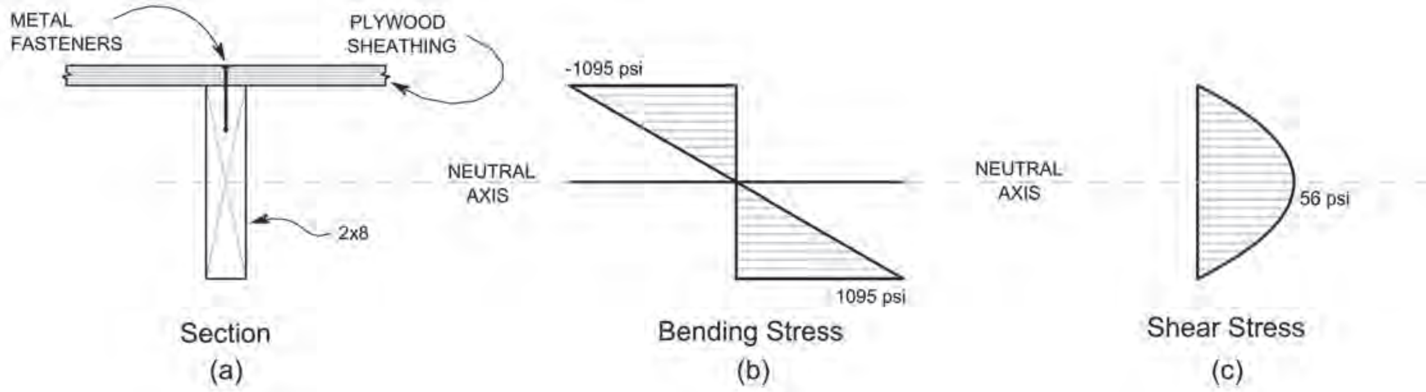


Figure 1. Bending stresses in a conventional assembly are assumed to be only in the supporting timber.

Figure 1a shows the cross-section of a nominal 2x8. If the 2x8 is loaded simply as a joist, *Figure 1b* illustrates the bending stress distribution on the cross-section. Assuming a 12-ft. span and a 50-psf load, the top half of the 2x8 is subjected to a maximum compressive stress of 1,095 psi, and the bottom half to a maximum tensile stress of 1,095 psi. At the center of the 2x8, the neutral axis, there is no compressive or tensile stress. *Figure 1c* shows the shear distribution on the cross-section. Maximum shear stress (here 56 psi) is at the mid-height of the section. For a 2x8, the allowable shear stress is called *horizontal shear*, and ranges from 70 to 100 psi for common construction species. For a beam to function adequately, the compression, tension and shear stresses produced by the external loads must be fully resisted by the material.

Drawings by Ed Levin after David Carradine

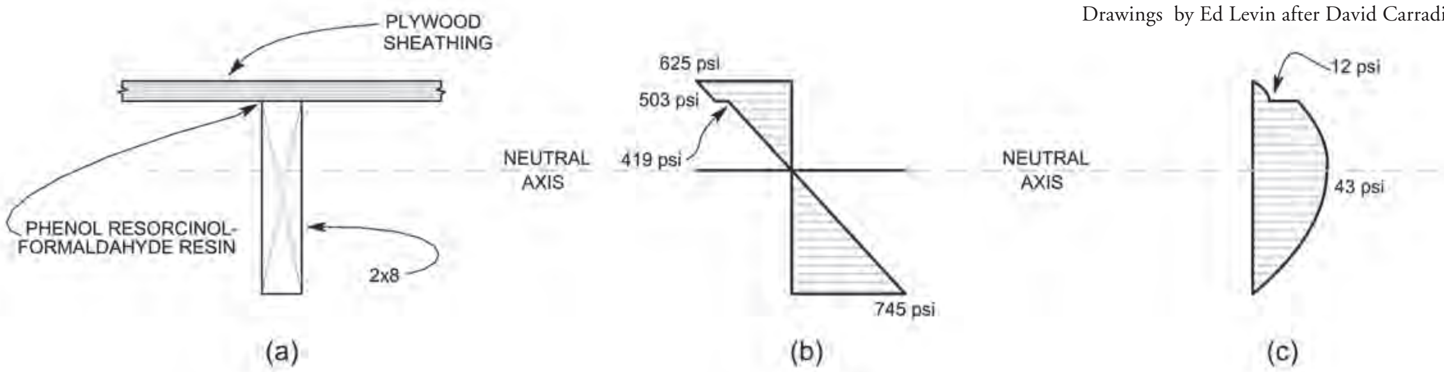


Figure 2. In a stressed-skin panel, bending stresses act in both the sheathing and the timber.

Figure 2b shows the bending stresses within a single-skin panel. Compression stress at the top of the skin is 625 psi and 503 psi at the bottom. Tensile stress at the bottom of the 2x8 is 745 psi, and 419 psi at the top. Note that the neutral axis is now not at the center as in Fig. 1, but rather falls 4.6 inches up from the bottom of the 2x8. The maximum bending stress in the 2x8 (745 psi) is significantly less than the 1,095 psi maximum observed for the traditional system. *Figure 2c* shows the distribution of shear stress in the cross-section. The skin is ⅝-in. plywood (5 plies) with face plies parallel to the timbers. The critical region for rolling shear in the plywood occurs one ply up from the bottom, where the shear stress is 12 psi. The critical shear stress in the timber at 4.6 inches up from the bottom is 43 psi. All the stresses here are less than allowable values for the plywood and assumed lumber grade and species, so the design is deemed adequate for the design loads. The significant feature of the stressed-skin panel lies in the fact that applied bending moment is shared. In the example, about 65 percent of the moment is carried by the joist, the rest resisted by the plywood skin. In case of failure of the glue bond between core and skin, one could calculate the percentage of the total design load that would be safely carried by the timber acting alone. Assuming the allowable bending stress for the 2x8 were exactly 745 psi, for this design, span and loading the timber acting alone would safely carry 67 percent of the design load.

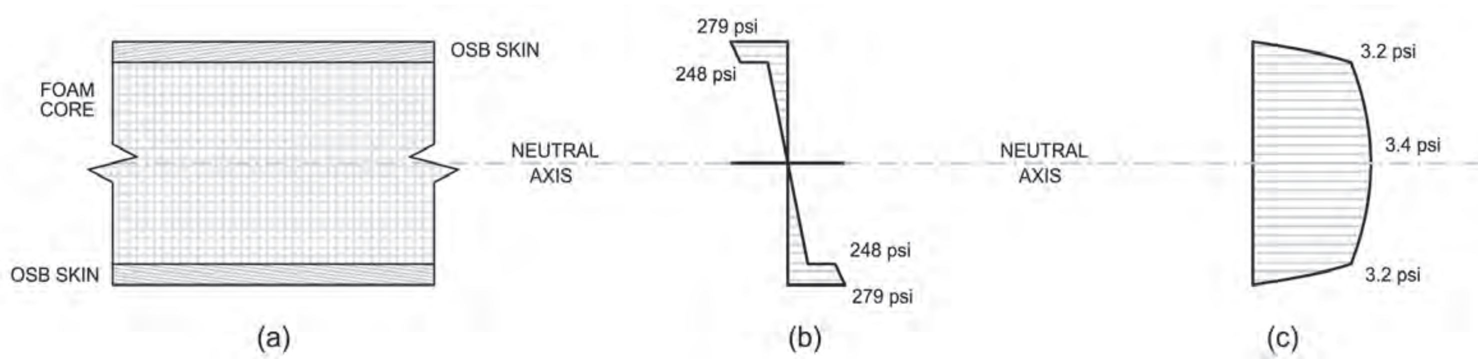


Figure 3. In a structural insulated panel (SIP), almost all the bending stresses are in the skins.

Figure 3b shows the compression and tension stresses in the skins due to bending (plus a small amount in the core material that is neglected in design). *Figure 3c* shows the distribution of shear stress throughout the cross-section. The maximum shear stress throughout the section is 3.4 psi, which is less than the allowable shear stress of the foam, assumed to be 6 psi. Although there is negligible bending stress in the core material, note however that the foam core must consistently carry shear stress from top to bottom.

HISTORIC AMERICAN TIMBER JOINERY

A Graphic Guide

VI. Scarf Joints

THIS article is last in a series of six to discuss and illustrate the joints in American traditional timber-framed buildings of the past, showing common examples with variations as well as a few interesting regional deviations. The series was developed under a grant from the National Park Service and the National Center for Preservation Technology and Training. Its contents are solely the responsibility of the author and do not represent the official position of the NPS or the NCPTT. Previous articles, which appeared consecutively in TF 55-59, covered Tying Joints:Tie below Plate, Tying Joints:Tie at Plate, Sill and Floor Joints, Wall and Brace Joints, and Roof Joinery Excluding Trusses.

WE are often amazed at the lengths of timbers found in old American structures. Plates 40 ft. long are common. Fifty-footers are encountered occasionally, and timbers 60 and 70 ft. long are not unheard of. In the great old-growth forests that once stood on this continent, trees of sufficient straightness and height were in abundance. The older structures in a given area reflect the original forest. Unbroken straight timbers run the length of the structure. For example, in a typical 18th-century New York State Dutch barn measuring 50x50, there would be 13 timbers 50 ft. long. Such timbers were obviously not difficult to procure from the original forest.

However, as the original forest was replaced by second-growth forest, and sawmills, especially those with the new, faster circular saws, replaced hewers and the relatively slow up-and-down mills, it became more economical to join or *scarf* timbers together to make the necessary long sills, plates and purlin plates. Scarfing had been common practice in Europe for several hundred years, where the original forest was long gone.

STRUCTURAL CONSIDERATIONS. Two timbers joined end to end cannot match the strength and stiffness of a single member of the same dimensions. Some ingenious scarfs have been devised that aim to do so, but the majority of joints are fairly simple, and they are limited in the forces they can resist. Scarf joints can be subjected to a number of forces.

Axial Compression. This force, acting parallel to the grain of the member and along its axis, is perhaps the easiest to resist. A simple butt joint will work. A scarfed post would sustain axial compression.

Axial Tension. Plates and tie beams must resist moderate tension. Some truss components, such as lower chords, are subject to heavy tension loading. Tension-resisting scarfs are typically longer and more complex than others.

Shear. Rarely a concern in solid members, this force becomes a consideration when timbers are notched, as in scarf joinery. A shear force develops when one side of a scarf, for example the lower part of a simple half-lap, supports the other side. Shear forces cause splitting at the notches. Splayed scarfs, which taper to produce greater depth of material under the notches, generally handle shear forces better than halved ones.

Torsion (Twisting). Scarf joints are typically subjected to only minor torsion loads. Spiral grain in an unseasoned member causes twisting as it dries. A scarf joint that is not capable of resisting twisting will open up as the timbers season. As its abutments disengage, its ability to resist other forces will be diminished.

Bending. This is the most difficult force for a scarf to resist. Members subject to bending would include plates, tie beams and spanning beams supporting floor or roof loads. Sometimes a member must resist bending from two directions. A plate, for instance, is subjected to bending in the horizontal plane from wind loads and bending in the vertical plane from the roof load. The conscientious builder locates the scarf where bending forces are low.

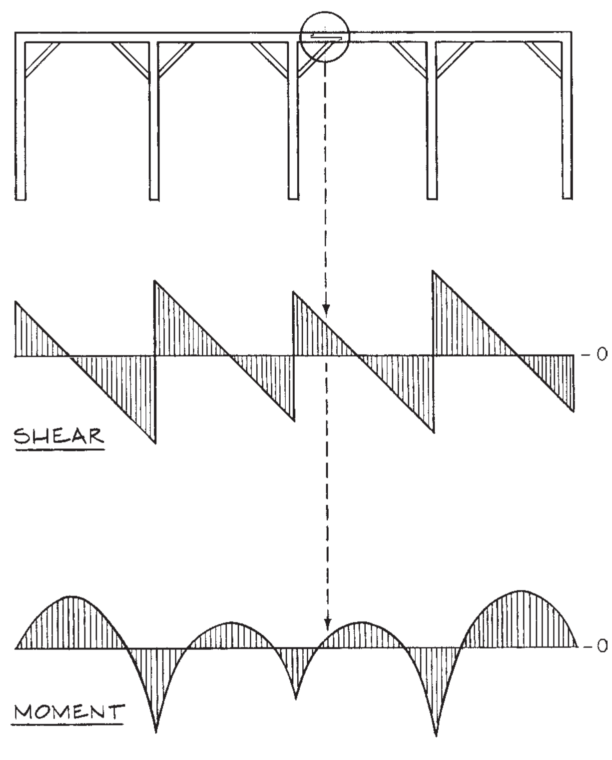


Fig. 1. Elevation of a plate continuous over five posts, showing a typical scarf location. Diagrams show resultant shear and moment values, both positive and negative, with horizontal line at zero force.

A member such as a plate or purlin plate that continues over multiple supports is much stiffer and stronger than one spanning between only two supports. The locations of the maximum and minimum moment (bending) forces are different in the continuous member. In a simple spanning member, the greatest moment occurs in the center of the span. In a continuous member, it occurs over the posts (Fig. 1, facing page).

Since it is difficult to create a scarf that handles bending forces as well as a solid timber, it makes sense to locate the scarf at a point where moment is the lowest. That is precisely where the majority of scarfs are located in old buildings. As in the illustration, the joint, additionally supported by the brace, is located where both shear and moment are low. Locating the scarf over the post, where stresses are at their maximum, would cause the plate to act like simple spanning members. Thus the plate would require a larger cross-section. Scarf location is also affected by available timber lengths and by the raising sequence of a building.

SCARF TYPES. In simplest terms, there are three classes of scarf: halved, splayed, and bridled. A halved scarf is a lap whose surfaces are parallel with the timber's. A splayed scarf has the lapped surfaces sloping. A bridled scarf takes the form of a tongue-and-fork or open mortise and tenon. Counting variations and combinations, I have found 23 different scarfs. Period builder's guides illustrate at least another ten that are likely to be found in a structure somewhere. Examples illustrated here show the common orientation found in old structures. Some examples are also turned on edge. These will be noted.

Halved Scarf. A basic halved scarf or half-lap (Fig. 2) is probably the simplest to fashion and thus the most abundant. It performs well in axial compression but depends solely on pins or bolts to resist tension and torsion. It has moderate shear strength but little bending strength. It is often found where it receives continuous support, as in a sill, or where the carpentry is of the quickly executed variety, and many such joints open up over time. The half-lap is also commonly used in repairs made to buildings *in situ.*

Halved and Undersquinted. To improve bending strength and resistance to seasoning twist, the ends of a scarf can be undersquinted (Fig. 3 below left). The angle most often encountered for the squint is 1 in 2. Shallower angles are more time consuming to cut and increase the likelihood of splitting at the notch. This joint is only slightly more work than the unsquinted version, but a considerable improvement. Pins are essential to the joint's effectiveness.

Halved and Bladed. This common scarf is found in all periods and locales. Though most often used as depicted in Fig. 4, in early Massachusetts Bay frames it is frequently found on edge. The barefaced tenons prevent twisting and improve bending and tensile strength. Some builders added extra pins in the central lapped portion. Overall length is commonly four times the depth of the timber. Variations of this scarf may present stub tenons without pins or a shortened lapped portion. In one variation, the topmost and bottommost cuts are aligned vertically and the tenons lengthened (see Cummings, Fig. 86 and Hewett, Fig. 271). Tenons are typically 1½ in. or 2 in. thick, and 4 in. or 6 in. long.

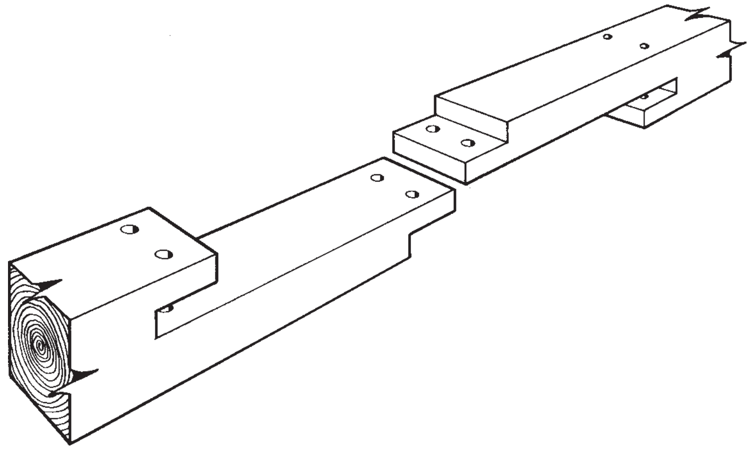


Fig. 4. Halved and bladed scarf with pinned tenons. Pins are often fitted additionally or alternatively in the central lapped portion.

Bladed and Cogged. In this unusual scarf (only one historic example found, though modern ones exist), a cog is provided in the T-shaped stub tenon (Fig. 5). This helps align the scarf and increases its bending strength against horizontal loads (such as rafter thrust), while adding some cutting time.

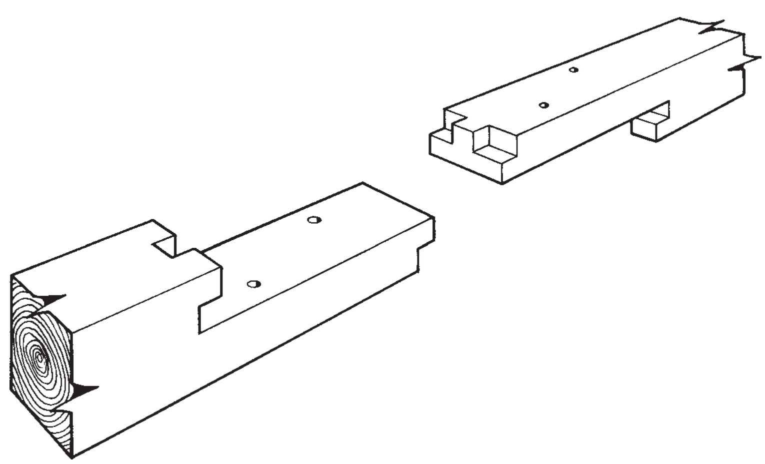
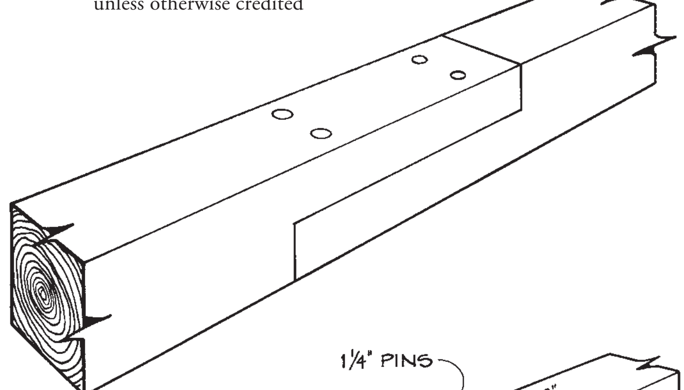
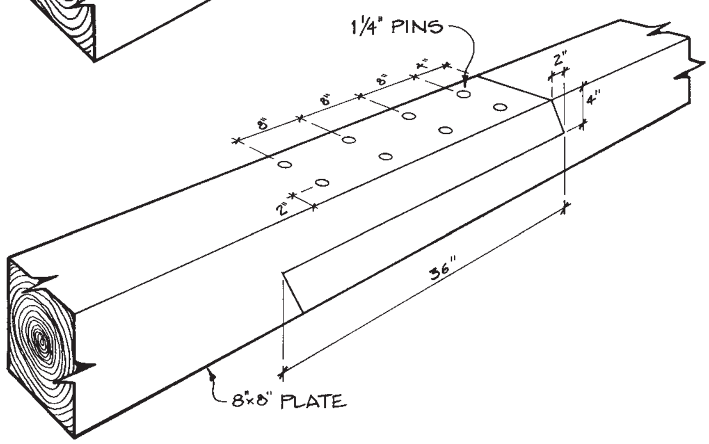


Fig. 5. Bladed and cogged scarf found in a barn along the Mohawk River in New York State. Drawn from memory.

All drawings and photos Jack A. Sobon unless otherwise credited





Figs. 2 and 3. At top (2), a halved scarf with four pins. Above (3), halved and undersquinted scarf found in an early-19th-century barn in Monterey, Massachusetts, the barn's only scarf, perhaps necessitated by some oversight in timber procurement. It has held up well despite its location in the center of the span. Note the 1-in-2 angle of the squint.

Halved and Tabled. With its center "table," this joint (Fig. 6) adds tensile capacity to the basic half lap. An iron bolt prevents twisting and displacement.

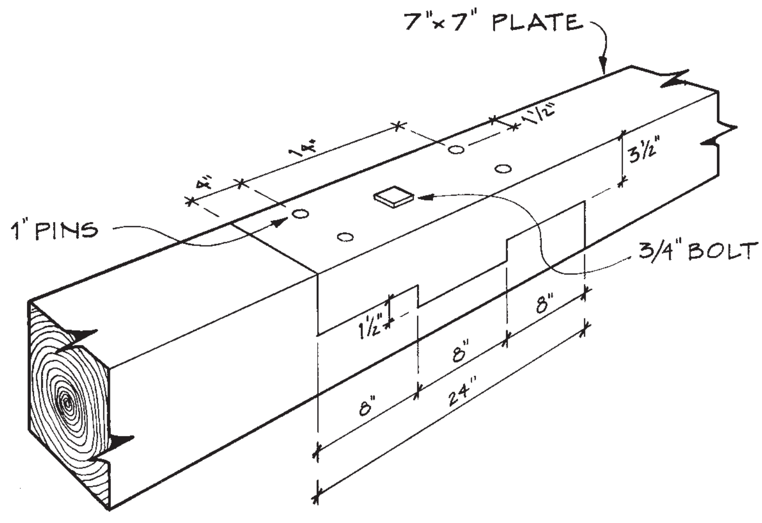
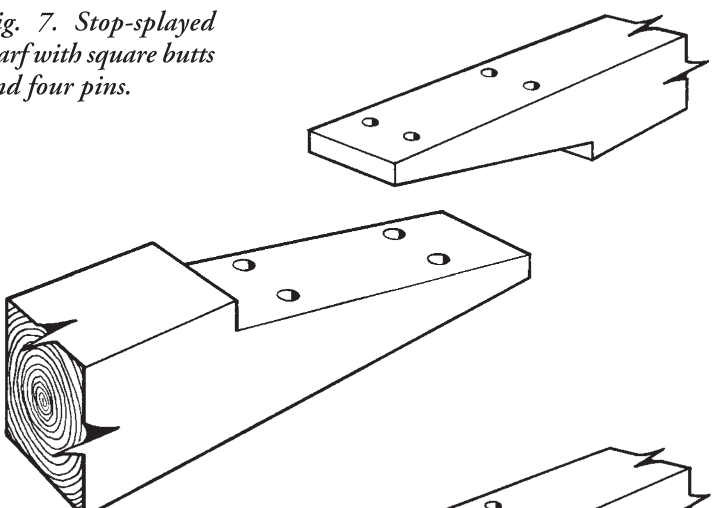


Fig. 6. Halved and tabled scarf in a 25x35-ft. three-bay 1860s barn in Windsor, Mass. This simple, effective joint relies on one bolt to keep it together.

Splayed and Stop-Splayed. In its most basic form, this scarf is simply a pair of complementary straight sloping cuts secured to each other with pins, nails or bolts. Nicknamed the *whistle cut*, it works wonderfully in shear but relies upon fasteners for resisting axial loads and twisting. (See TF 59, page 13.) In its more common form, the sloped, lapped portion is stopped before it feathers out to nothing (Fig. 7). Compared with the half-lap, shear strength is vastly improved by the sloped surface. The square abutments, typically 1½ in. or 2 in., resist axial compression. The pins provide tensile and torsion resistance.

Fig. 7. Stop-splayed scarf with square butts and four pins.



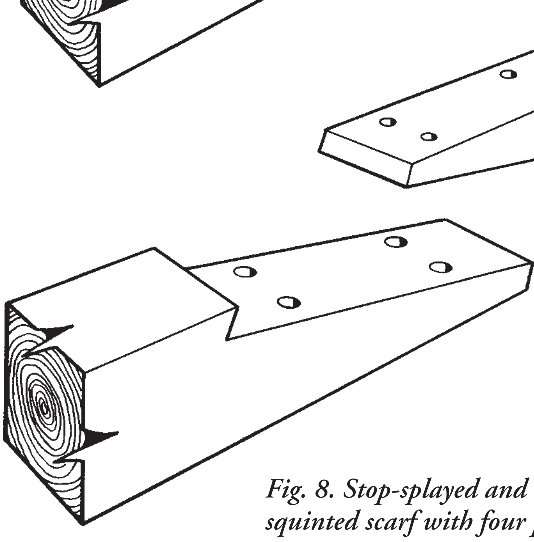


Fig. 8. Stop-splayed and under-squinted scarf with four pins.

Stop-Splayed and Undersquinted. Again by undersquinting the butts, the stop-splayed scarf (Fig. 8) is made more resistant to twisting. This scarf performs well, considering its ease of cutting.

Stop-Splayed Scissors. While based on the stop-splayed and undersquinted scarf, this variation is much stronger (Fig. 9). However, it is disproportionately more time consuming to fabricate, which accounts for its rarity.

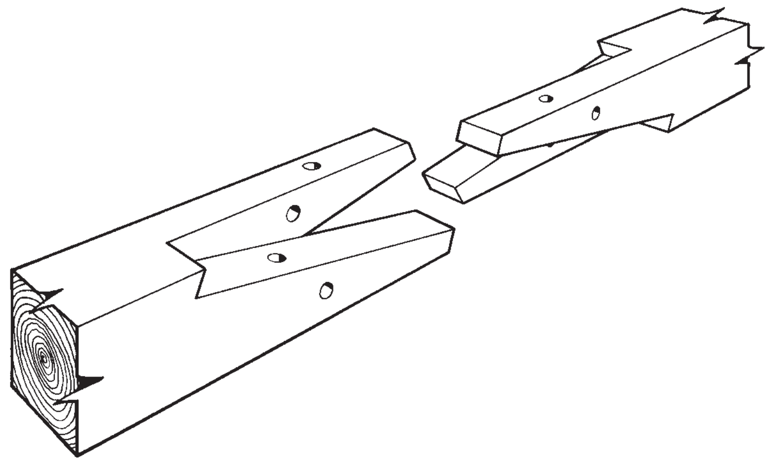


Fig. 9. Stop-splayed scissors scarf with two pins in each direction. The only known example is a 1927 repair to a house in Nantucket, Mass.

Stop-Splayed, Undersquinted and Cogged. Adding a cog to the stop-splayed and undersquinted scarf improves its bending strength in the secondary direction (Fig. 10). Only one example has been found of this type.

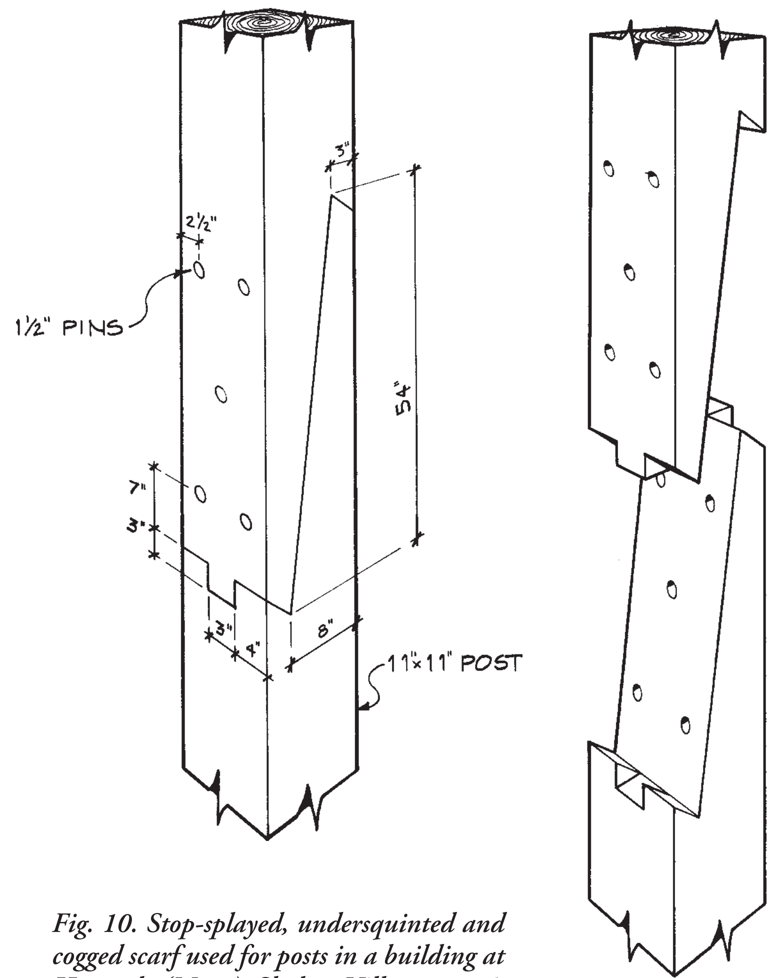


Fig. 10. Stop-splayed, undersquinted and cogged scarf used for posts in a building at Hancock (Mass.) Shaker Village, 1835. Apparently original, these joints are still tight. Note squint angle of 1 to 1.

Stop-Splayed, Undersquinted and Tabled with Wedges. A very strong scarf results when tabling and wedges are added (Fig. 11). The tensile capacity, torsion, and bending strength in both directions are greatly increased. The pins position the halves while the opposing wedges are driven and increase the joint's overall performance. The wedge thickness and the depth at the butts are usually the same, typically 1½ or 2 in. The butts need not be undersquinted. An example found at Jack's Valley, Nevada, has square butts, and bolts hold the scarf together.

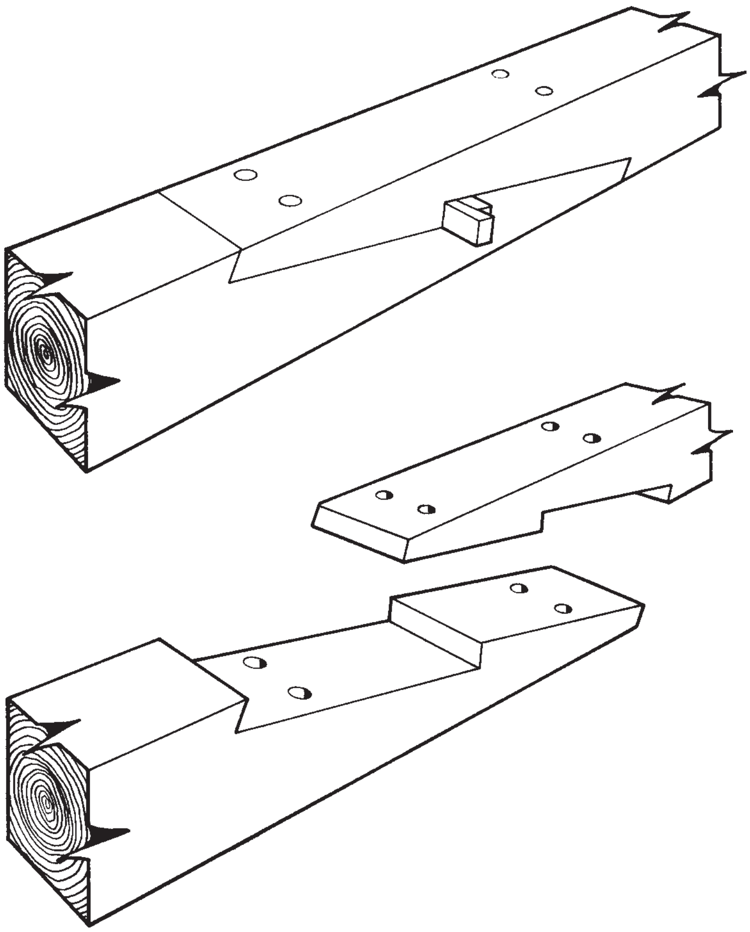


Fig. 11. Assembled and exploded views of stop-splayed, undersquinted and wedged scarf with four pins. Folding wedges pre-stress the joint.

Stop-Splayed with Wedges and Multiple Tables. By drawing out the scarf, additional tables can be added to increase tensile capacity (Fig. 12). The complexity of this scarf precludes its use except in members under great tensile loads, as in the lower chords of long-span trusses.

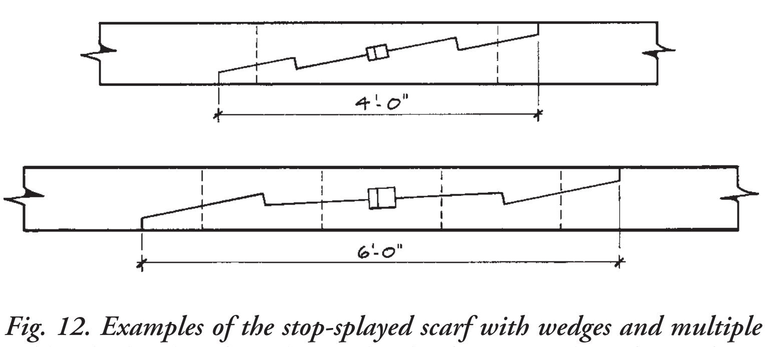


Fig. 12. Examples of the stop-splayed scarf with wedges and multiple tables, both taken from lower chords of trusses. The 4-ft. scarf was found on a late-19th-century building 40 ft. wide in Clayton, New York. The 6-ft. scarf was used in a ca.-1882 locomotive shop in Jamaica, N.Y., 64 ft. wide and 520 ft. long, and cut from 7½ x 9½ hard pine timber. Both scarfs use 1-in. bolts to keep the multiple bearing surfaces engaged. Both are designed for high tension loads.

Stop-Splayed and Bladed. By combining the bladed form with the splayed, the capacity of each is improved (Fig. 13). The tenons can be stub or long enough to be pinned. Compare Fig. 4.

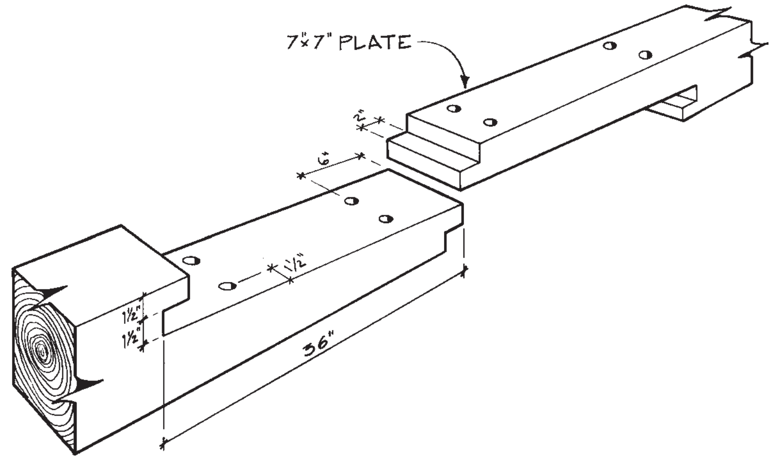


Fig. 13. Stop-splayed and bladed scarf in a late-19th-century 40x48-ft. barn in Windsor, Massachusetts, with stub tenons and four 1-in.-dia. turned pins. The slope of the splay is only 1 in 36.

Bridled. The simplest bridled joint is a tongue and fork or open mortise and tenon (Fig. 14). Though it doesn't handle loads other than axial particularly well, it still has advantages. Because it is typically fairly short, it uses less timber and can fit better between other joints. It is commonly found in ridge beam splices where the close spacing of the rafter mortises leaves little room for a conventional scarf.

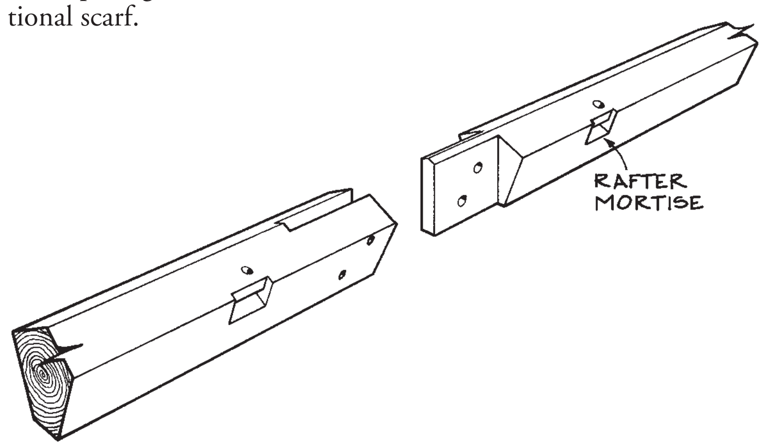


Fig. 14. Typical bridled scarf in a ridge beam. This short scarf works well where it receives frequent support from the rafters and must fit in the relatively short space between them.

Bridled and Squinted. The joint is improved by making the tenon blind on one edge and angling the abutment (Fig. 15). This

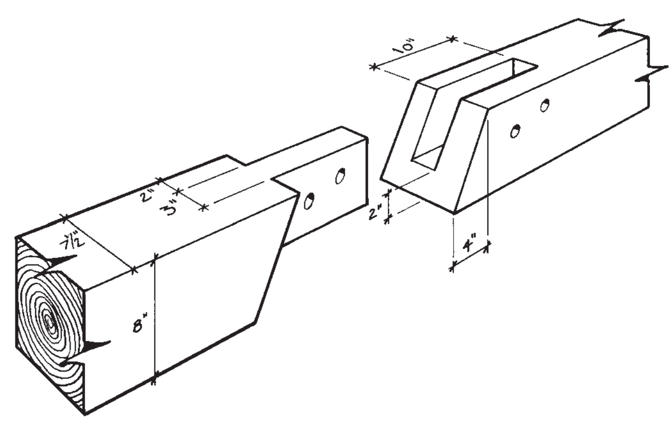


Fig. 15. Bridled and squinted scarf used (or reused) in the tie beams of the Harlow Old Fort House, Plymouth, Mass., ca. 1677.

joint is also found where the abutment slopes the opposite way (see Cummings, Fig. 87), and in that form occurs in one of the oldest timber-framed buildings in England, as a sill scarf in the Barley Barn at Cressing Temple, ca. 1200 (see Hewett, Fig. 273). The use of this particular joint in the roof of Harlow Old Fort House in Plymouth, Mass., is odd: the scarfs, which do not perform well in bending, are located about 4 ft. from the ends of 27-ft. tie beams. But tradition says the house was framed of timbers taken from the original fort in the settlement, hence the scarfs.

Tapered Bridle. This bridled scarf (Fig. 16), set flatwise, improves the shear capacity of the scarf. While it resists compression, moderate tension, and torsion, it is limited to locations where bending forces are minimal.

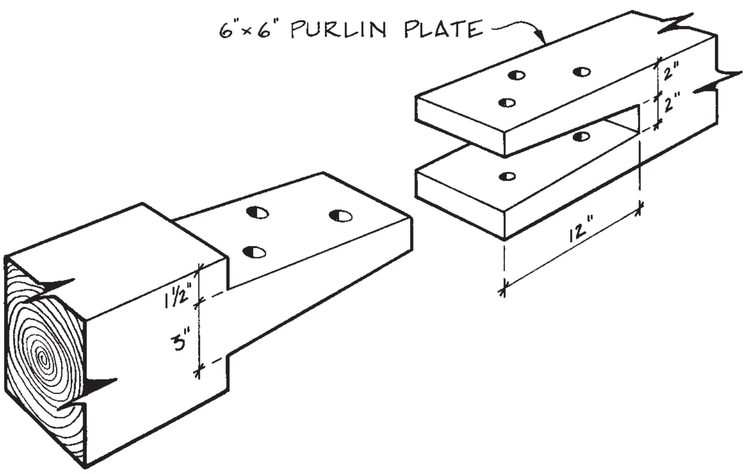


Fig. 16. Tapered bridle scarf in the purlin plates of a barn in Holliston, Massachusetts.

Tabled and Bridled with Key. Lengthening the bridle to provide a table and key improves the tensile and bending performance of the scarf (Fig. 17). Its rarity seems to indicate that the extra strength is not sufficient to warrant the extra cutting work.

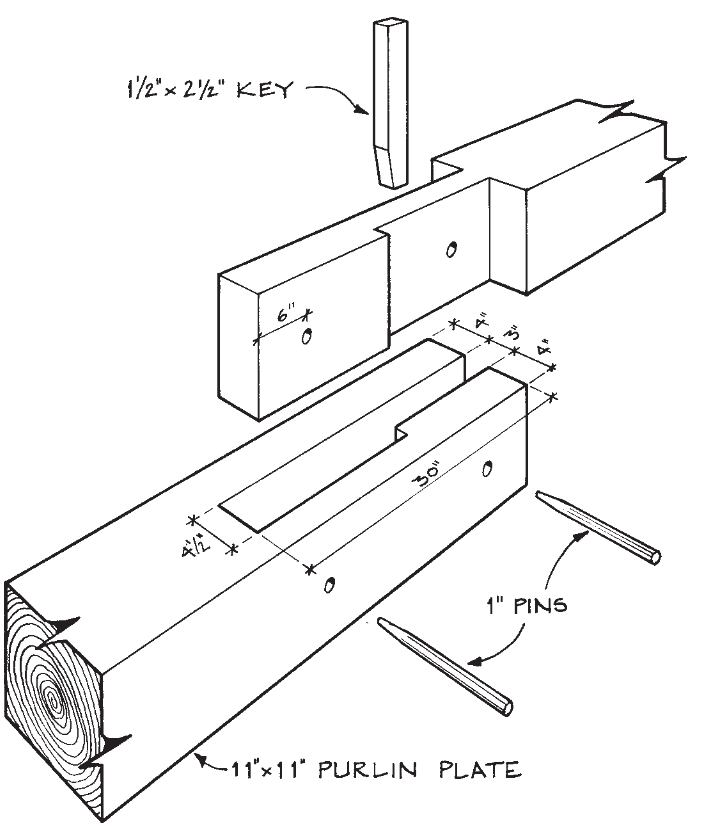


Fig. 17. Tabled and bridled scarf with key, 5-bay barn, 62x81 ft., Genoa, Nevada, ca. 1858.

Stop-Bridled Halving. Only one example of this type (Fig. 18) has been located. Though it works moderately well in most conditions, weakness in bending limits its applications.

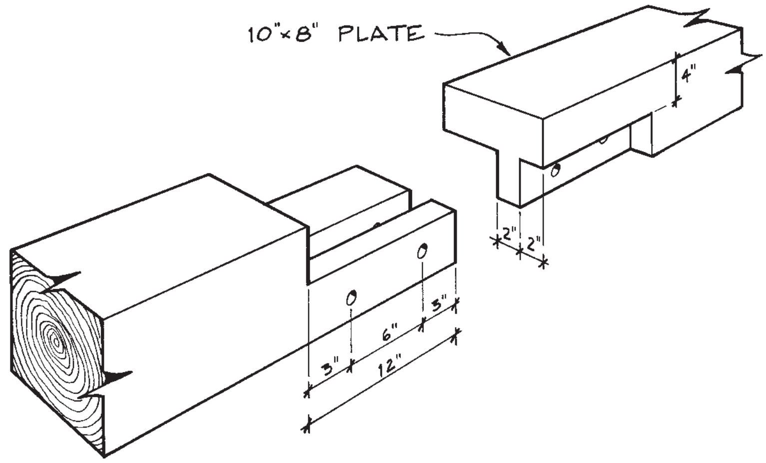


Fig. 18. Stop-Bridled Halving in a German barn, Myerstown, Penn. Located a very short distance from a post, it carried mostly shear force.

Halved and Bridled. This not uncommon form (Fig. 19) works moderately well in all ways and yet is straightforward to fabricate and assemble. Undoubtedly there are splayed varieties of this scarf as well.

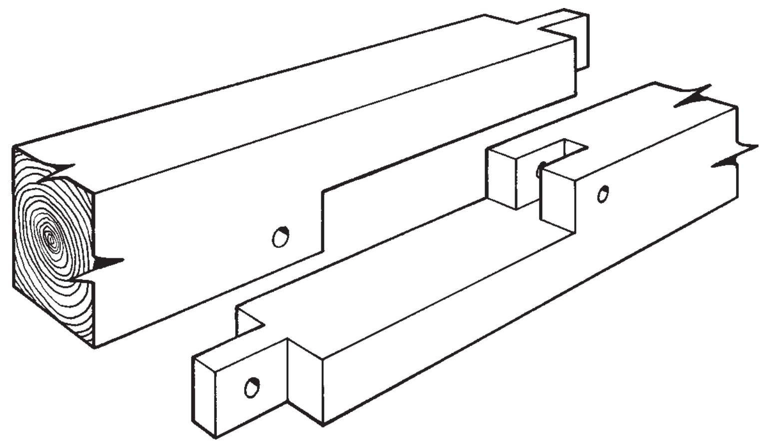
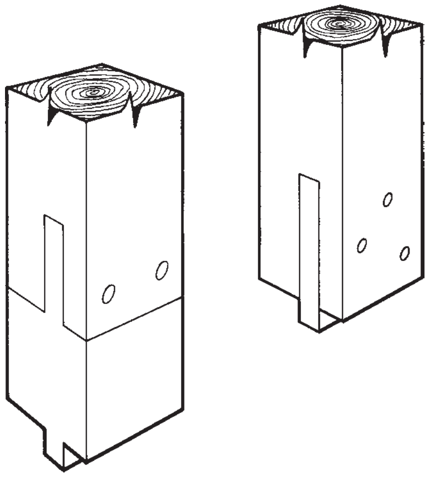


Fig. 19. A typical halved and bridled scarf. Additional pins may secure the lap.

Bridled Repair Techniques. When early carpenters encountered posts with decayed bottoms, the simplest way to replace a short section of damaged wood was with the bridle. In this position, the joint was subjected to primarily axial compression. This short, easy to fabricate joint (Fig. 20, facing page), was more than adequate. If only the tenon was decayed, it could be replaced with a *free tenon* (Fig. 20), also called a slip tenon or faux tenon. The use of a free tenon also permitted members tenoned at both ends to be inserted into an already erect frame. In a few cases where a carpenter mistakenly cut a timber off at the shoulder rather than the end of the tenon, a free tenon allowed the piece to be saved.

METHODS FOR JOINING STRUCTURES. Often enough, early builders added to existing structures or moved an existing structure and attached it to another. The frames needed to be anchored to each other to prevent displacement at the roof, walls and floors.

If both frames could stand independently of each other, then a simple free tenon was used to join adjacent posts (Fig. 21). The mortises were typically cut right through for convenience during



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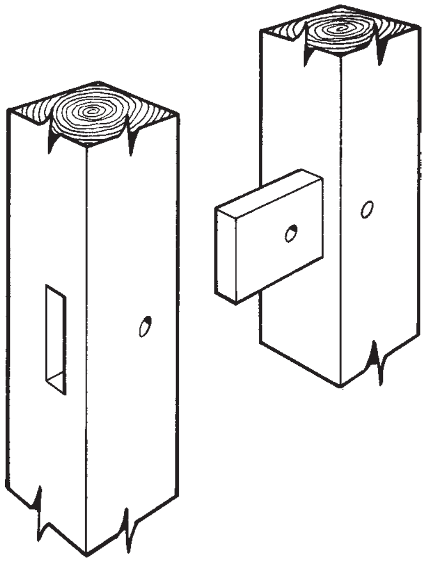

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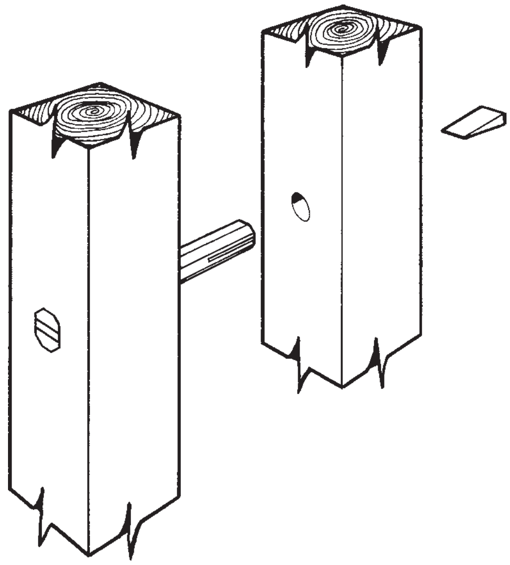

22.

Figs. 20-22. At top (20), post-bottom repairs: bridled scarf on left, free tenon on right. Middle (21), free tenon joins the posts of adjacent frames. Above (22), a stout pin kerfed and end-wedged does the same.

When the builder added to this barn in Savoy, Mass., he saved on a new 30-ft. tie beam by framing a piece into the post and pinning and nailing it to the exisitng barn's tie beam. Notice how the end is hewn down to permit better nailing.

A free tenon in the bottom of a post in this house in Windsor, Mass., may be a repair or a fix for a mistake. Shadows are cast by joists above.

This strange arrangement in a barn in Rochester, Vermont, uses the post top tenon as a sort of free tenon to join the plates, though pins are invisible. The builder must have realized the inherent weakness of the connection and added the fish plate on top, secured with two pins.

assembly and the tenons were secured by a single pin in each mortise. A simpler way to accomplish the same end was to bore 1½- or 2-in. through-holes at posts, ties and rafters, and drive large pins (Fig. 22). The pins were secured by kerfing and wedging their ends. Flaring the end of the pin acted as a sort of dovetail to hold the timbers tightly together.

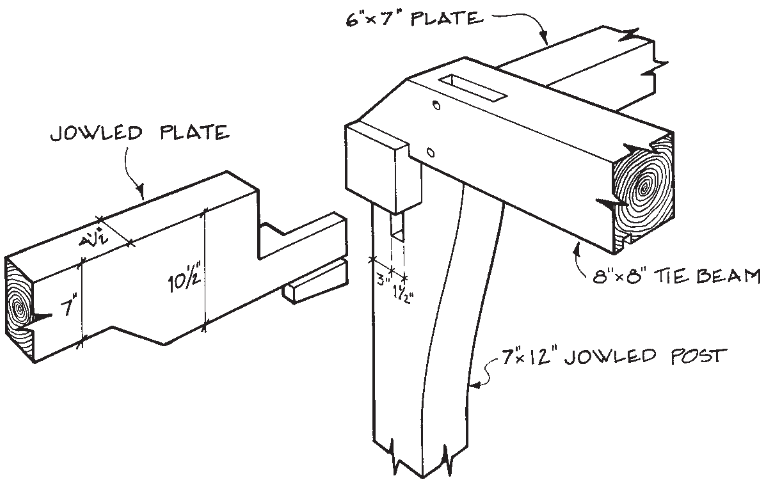

Fig. 23. Jowled plate of an early-18th-century addition to a barn in Seekonk, Mass. The mortise, offset in the post to avoid undercutting the post-to-plate tenon (hidden from view), was lengthened to allow easy insertion of the new plate tenon. The latter then was wedged up tightly under the existing plate. No pin was used.

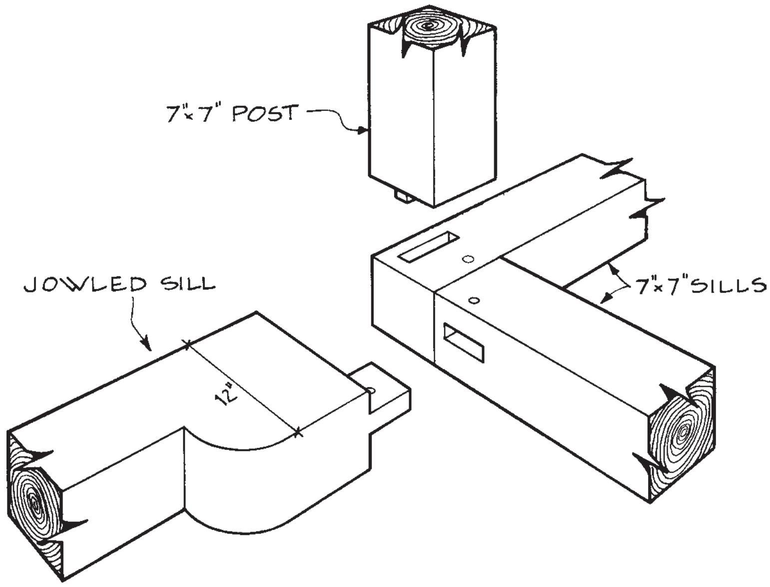

Fig. 24. In the same barn the sill was similarly jowled, but also pinned.

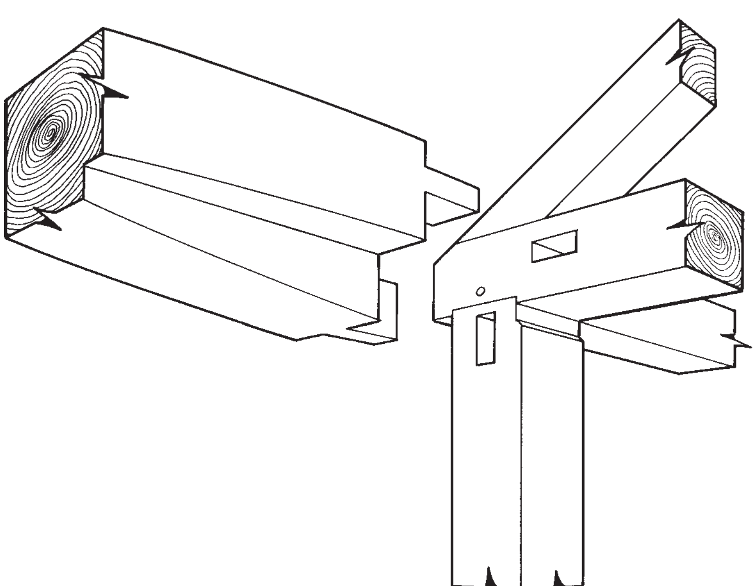

Fig. 25. A 9x9 plate, jowled in two *directions to measure 12x13, joined an 1820-1860, 16x42-ft. carriage shed to a house in Rowe, Mass. The connections were unpinned and held in place by sheathing.*

If the plates and sills of the addition could be attached to the existing frame, then the builder saved the major expense of cutting an additional cross-frame. However, scarfing onto the end of an existing plate or sill was cumbersome and might compromise the original frame. The best solution was to utilize jowled members to offset the connection to an adjacent member (Figs. 23-25). The flared butt of the tree was retained during hewing or sawing. These jowled sills, plates and purlin plates required only simple mortises in the existing timbers, easily cut in place. Ten examples of such jowled members have been found in Massachusetts, New York and Vermont, from the early 18th century to the middle of the 19th.

—Jack A. Sobon

This series of six articles (see TF 55-59) has illustrated common as well as unusual timber joinery found in old structures. The catalog necessarily remains incomplete, and the author hopes the series will inspire readers to submit additional examples that might be shown in future issues of this journal. Please address Jack A. Sobon, P.O. Box 201, Windsor, MA 01270. Some of the illustrations used in this series have appeared previously in TIMBER FRAMING, and Fig. 1 appeared in the author's Timber Frame Construction. *The author wishes to thank the following organizations and individuals who have generously supplied assistance, information or access to buildings: Hancock Shaker Village, The National Center for Preservation Technology, The National Park Service, The Timber Framers Guild, Chris Albright, Richard Babcock, Will Beemer, Leslie Bird, Rolf Briggs, Rudy Christian, Abbott Lowell Cummings, Peter Haarmann, Greg Huber, Don Johnson, David Lanoue, Jan Lewandoski, John MacFarland , Paul Oatman, Ed Ondrick, Ken Rower, Peter Sinclair, Lawrence Sorli, Arron Sturgis, Marc and Wendi Volk, Dick Warner, Rob Williams and Preston Woodburn.*

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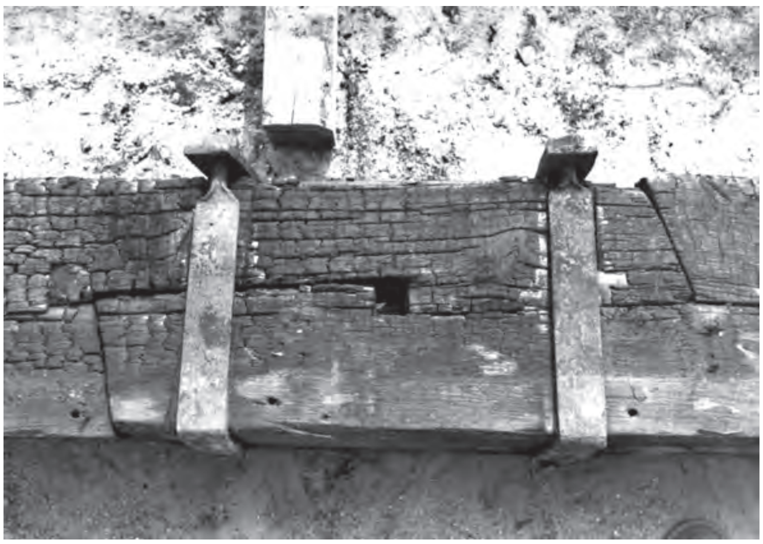
Jowled plate (one of six!) in a much-expanded 18th-century English-style barn, Huntington, Mass.

Paul Oatman



At top, bladed scarf with key, barn sill in Woodford, Calif. The sill is 8x8 Ponderosa pine, the scarf only 16 in. long. Top right, a bladed scarf used to repair a 7½ x 9½ post in a barn in Buskirk, N.Y. The tenons are 1 in. thick and 1 in. long, the scarf 23 in. long, with four pins. Above, a stop-splayed, undersquinted and tabled scarf with key used in a 6½ x 13 truss chord in the 1796 Cabildo in New Orleans (roof burned 1988, reconstructed 1992; see TF 21 and 24). There is barely a splay, and two forged iron straps still hold the joint together. At right, this unusual stop-splayed, undersquinted and tabled scarf in Pine Plains, New York, did not employ a key: the halves had to be slid together.

Southern Timber Frame Origins

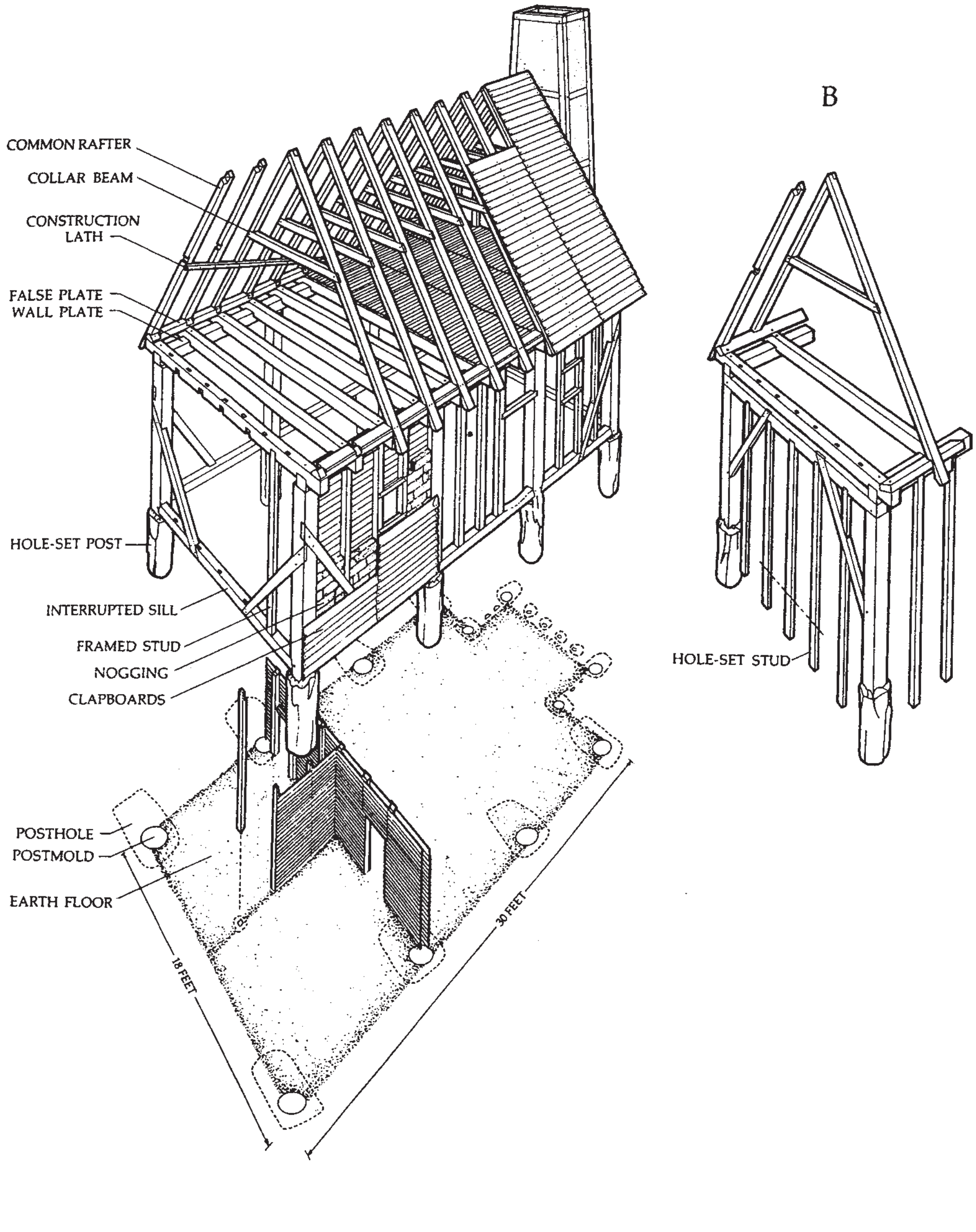
HISTORIC timber frames of the southern American states are notably different from traditional frames in other parts of the country. The southern timber frame developed in the 17th-century English tobacco settlements of the Chesapeake region (the Tidewater areas of Virginia, Maryland and northeast North Carolina), and then spread across the South and Southwest, where they became almost universal, aside from masonry and log construction, until the middle of the 19th century.

In the earliest days of settlement in Virginia and New England, the new immigrants were forced to build shelters under stressful frontier conditions. Various building styles are described in period accounts and have been recently confirmed in archeological excavation. Cellar houses were dug and lined with timber and roofed, or "puncheon" buildings were created by driving staves into the earth to make walls, then nailing boards across the outside to provide some kind of rigidity. Some buildings were raised with primary posts set deep in the earth for support; others were framed up off the ground on blocks. A 1619 structure discovered at Carter's Grove in James City County, Virginia, was framed as a gable roof with the rafters set in the earth, a "rafter house." These buildings are best described as impermanent architecture and had their design roots in ground-set, or earthfast, buildings still in use in rural England in the 17th century.

By the 1650s the second generation of New England settlers began to build fully elaborated English timber frame houses to replace the derelict and dilapidated first generation frontier houses. At the same time in the Chesapeake a distinctly new style of structure began to appear, a building that became so common it was simply called "the Virginia House." This house was an earthfast building, sheathed with split boards, designed to be constructed cheaply and to be constantly repaired until it was no longer salvageable. Remarkably, these small, simply built, perishable buildings dominated the Tidewater for a hundred more years and continued to be built as secondary structures for yet another century.

The Virginia House by definition was built in direct contact with the ground, supported by posts set several feet into the earth. The posts were hewn square and often charred in a fire to make them more durable, although in actual service this practice seems not to have made a difference. The posts were paired together front and back and positioned in bays of either 8 or 10 ft., according to the length of clapboards to be used, 4-ft. or 5-ft.

Continuous plates were run across the tops of the posts and joined by either mortise and tenon or some type of half-lap. These plates, like the posts, were hewn square. Obtaining timbers long enough to run continuously down the length of a Virginia House was no difficulty in the colonial Chesapeake. The builder could assemble the long wall of the house on the ground and raise it as one piece, in normal assembly, or with a smaller crew could opt to set the posts in the earth first and then top off the wall with the plates. (Inferring from the archaeological evidence of rectangular post holes, and assuming

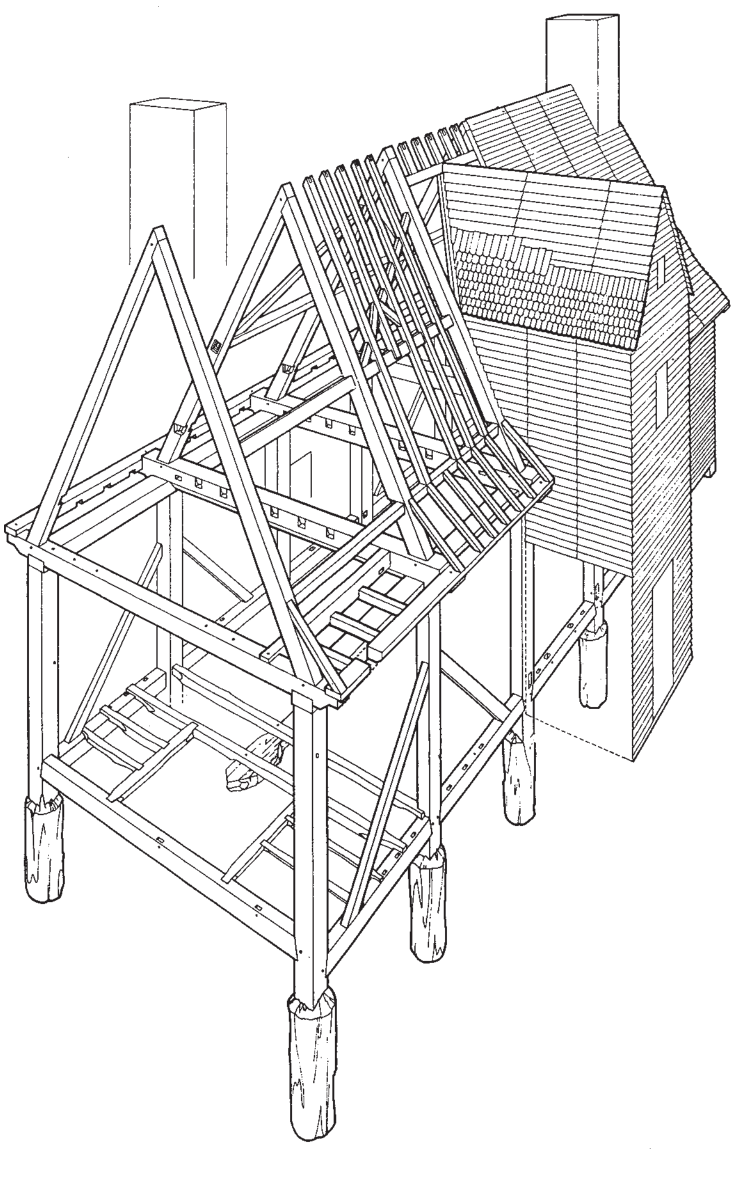


Reconstruction drawings by Cary Carson and Chinh Hoang interpreting the "ordinary beginners" house described in the 1684 pamphlet "Information and Direction to Such Persons as are inclined to America." Above left, interpretation as a conventional Chesapeake hole-set frame house, with added chimney based on archaeological evidence. At right (B), variation without sills showing hole-set studs, up braces, tilted false plates and an interpretation of the two 18-ft. spanning plates called for in the specifications. (Figures this page and facing page from Cary Carson et al, "Impermanent Architecture," Winterthur Portfolio, A Journal of American Culture, Vol. 16, 1981, published by the University of Chicago Press. Copyright University of Chicago Press, 1981. Used by permission.)

a building's ridge always runs the long way, before 1650 most structures in the Chesapeake were apparently raised in cross-frames, but this practice disappeared by mid-century.)

With the front and back walls raised, joists acting as tie beams were lapped across the plates to lock the front and the back of the house together. These were either pegged down straight through the plate or held in place by toenailing. The joists usually projected out over the long wall about a foot, forming an eave.

The frame was now ready to be stiffened by the addition of braces, of two possible types. If the house was to be better built, hewn sills would be let into the framing between the posts to support a floor system. Down-braces could then be half-lapped or dovetail-lapped into the corner posts and the interrupted sills and secured with pegs or spikes. Studs were added next and were typically lapped top and bottom into the sills and plates or end joists. The studs that intercepted the down braces were lapped at sill or plate, but butted and spiked where they intersected the brace,



Cedar Park, Anne Arundel County, Maryland, 1702. "Faire English Frame" elements include substantial principal rafter trusses, principal purlins carrying common rafters in the bays, and sophisticated bevel-shouldered, soffit-tenoned attic joists. But the English Tying Joint is nowhere to be seen, and the sills are interrupted by the posts. Common rafters come to rest on a low purlin, and the false plate is retained to carry jettied spurs. Perspective view by Cary Carson and Chinh Hoang. (Copyright 1981 University of Chicago Press. Used by permission.)

thus keeping the more-important element unweakened. If the house was cheaper and not to have a floor, then it was fitted with upbraces lapped into the posts and plates. Here the studs were lapped into the plates above but buried in the earth below, like the posts.

The box frame complete, the builder then installed structural members called "false" or "raising" plates, hewn timbers 3 to 4 in. thick and 8 to 10 in. wide. These members were pegged or nailed down across the ends of the joists projecting out over the long walls. These made the framing of the roof essentially independent of the box frame and avoided a complicated tying joint. The use of false plates became a defining characteristic of southern framing.

A PAMPHLET dated 1684 and attributed uncertainly to William Penn seems to give specifications for a settler's house that closely resembles the Virginia House. *Information and Direction to Such Persons as are Inclined to America, Most Especially Those Related to the Province of Pennsylvania* includes the following advice:

> . . . . There must be eight Trees of about sixteen Inches square and cut off to Posts of about fifteen foot long, which the House must stand upon; and four pieces, two of thirty foot long and two of eighteen foot long, for Plates, which must lie upon the top of those Posts the whole length and breadth of the House for the Gists to rest upon. There must be ten Gists of twenty foot long to bear the Loft, and two false Plates of thirty foot long to lie upon the ends of the Gists for the Rafters to be fixed upon, twelve pare of Rafters of about twenty foot to bear the Roof of the House, with several other small pieces as Wind-Beams, Braces, Studs, etc. which are made of the Waste Timber. For Covering the House, Ends and Sides and for the Loft we use Clabboards, which is Rived feather-edged, of five foot and a half long, that well Drawn lyes close and smooth. The Lodging Room may be lined with the same and filld up between [with noggin], which is very Warm. . . .

Most Virginia Houses were roofed with common rafters joined at the peak by a tongue and fork or a half-lap joint, either pegged or nailed. The feet of the rafters were simply cut off at the roof angle and pegged or toenailed to the false plate. Collar beams, also called wind beams, connected the paired rafters into simple trusses; these collars were half-lapped or dovetail-lapped into the sides of the rafters. Wind braces, riven or sawn laths or saplings cleft in two, were nailed to the insides of the rafters to stiffen the roof until the clapboard roof covering could be nailed on, and then left in place.

The studs, rafters, collars and braces were much smaller in section than the posts, plates, joists or sills. They were usually riven from straight-splitting woods like oak or chestnut, and one face was then dressed and trimmed with a hatchet. Similarly, studs and rafters were often peeled poles with the outside or reference face hewn flat. They were typically installed on either 24-in. or 30-in. centers, again according to the length of the clapboards available to cover the building.

Clapboards were another defining feature of Chesapeake building. Tobacco planters were constantly clearing new fields for the crop, and field hands were required to fell and move as much timber as possible. Oaks and chestnuts, if of sufficient quality, were sawn to 4- or 5-ft. lengths and then split into boards with wedges, beetles and froes. The clapboards were trimmed with a hatchet to remove the sapwood and straighten the lower, thicker edge. Surviving clapboards appear to have been dressed and smoothed on both sides with a drawknife, and show a chamfer laid on the outside lower edge. The boards were stacked in piles to dry. A planter could cover his own buildings with them or sell them on the open market by the hundred or thousand. Until the suitable trees ran out, this remained the cheapest building material in the Chesapeake.

Clapboards were applied on the roof, exterior and sometimes interior walls, ceilings and often the floor of a loft. They were installed thick edge down, with the chamfered side out, lapped about an inch over the board below. Where the boards met on the ends they were not butted. Instead, a feather-lap, about 3 in. long and worked with a hatchet, gave sufficient coverage. The clapboards stiffened the frame and added to the structural rigidity of the building. The nails were all left exposed to the weather and the acid in the oak began to eat into the nails after the first rainstorm. Often the buildings were treated with pine tar to preserve them, to keep the wood from drying out too quickly in the Virginia summers, to seal the smallest wormholes and cracks and to keep the nails from rusting too quickly.

The Virginia House was commonly heated with a wooden chimney. Early chimneys were post-set framed structures with wattle and daub infill; later they were more commonly built with a log base and split sticks to form the stack, with as much as a foot-thick layer of clay plastered to the inside. Some early photographs showed surviving chimneys leaning outward and propped up by poles; when the chimney caught fire, the props could be snatched away, causing the stack to collapse away from the house, saving the building!

This remarkable kind of impermanent structure was a common feature of the Chesapeake landscape for more than 200 years. From the 1650s to the 1720s, clapboard construction was used for not only the house of small planters but the houses of wealthy men as well, such as Cedar Park in Anne Arundel County, Maryland (illustrated on the previous page). County and parish records show that the Virginia House style was used everywhere for public buildings such as taverns, courthouses, jails and churches, and for glebe houses. (A glebe house was the dwelling provided, along with slaves and farm, to the priest of the local parish, to supplement his salary.) Some workmen are described in the records as "clapboard carpenters," and while that term denoted less skill than "house carpenter and joiner," a clapboard carpenter could still construct all of the buildings mentioned above and, if willing to travel, could find plenty of work in the rural Chesapeake.

Better houses at this time were described as having a "Faire English frame." These buildings were framed on continuous groundsills, themselves set on wooden blocks, stumps, brick piers or full masonry foundations. More-refined carpentry skills were required, with fully housed mortise and tenon joinery, scarf joints and sometimes principal rafter roofs if the building was especially large. Clapboards remained the most common covering in this period.

In 1981 Cary Carson and others argued in a pivotal paper ("Impermanent Architecture in the Southern American Colonies," Winterthur Portfolio, a Journal of American Culture, Vol.16, Nos. 2/3) that the prevalence of impermanent buildings can only be explained in light of the living conditions in the 17th-century southern American tobacco colonies. New planters in the Chesapeake were advised to spend most of their money on their business, investing in land and tools and labor, keeping their overhead to a minimum. Well-constructed timber frames were out of the question for most southerners. An additional problem was a chronic lack of skilled craftsmen; in a colony of farmers making money growing tobacco, most carpenters abandoned their trade and became planters themselves. Those who continued to practice their trade enjoyed inflated wages, and this high labor cost made well-built houses impossible for the typical farmer to afford. In most cases he was forced to use his own resources to provide housing for his family and labor force, often large because tobacco as a cash crop returned a profit in direct proportion to the number of hands that a planter employed. Planters worked the land and waited and hoped to become wealthy enough to finally abandon the old Virginia House and build a proper one. Most never made it to that next step.

After 1675 the price of tobacco declined and remained low for the next several decades. That forced Chesapeake planters to put off indefinitely their plans for better houses. Of more immediate effect was the staggering death rate in 17th-century Virginia and Maryland. Few immigrants lived to see their 40th birthday. (In comparison, at the same time men in New England were living into their seventies.) Very few children grew up with both of their parents. Building anything beyond minimal housing just didn't make sense to the settlers of the early Chesapeake. Carson sums up the situation thus:

> The market for tobacco went bad, fathers and mothers died, family assets were dispersed, old buildings fell hopelessly into disrepair, plantations were sold or neglected or exploited or simply minimally maintained by guardians, and years later the returning orphan sons or daughters had to begin all over again by building more temporary structures. Tenants came, built cheaply and went away again. Freeholders stayed longer, but exceedingly high building costs encouraged repairs as long as possible and discouraged genuine improvements when finally buildings had to be replaced. . . .the bay country was a perpetual frontier. Each generation was a homesteader generation: each frequently had to start from scratch.

At the end of the 17th century, the economy improved and diversified, the descendants of the original settlers became resistant to disease, or "seasoned" as they put it, and began to live longer. At last there were opportunities for the people of the Chesapeake to build better and more permanent houses. The quality of carpentry seems to have improved first in the new cities and towns being established at the end of the century. Willie Graham, architectural historian at the Colonial Williamsburg Foundation, has traced the first changes in building construction to the emerging new capitals of the Virginia and Maryland colonies, respectively, Williamsburg and Annapolis. The impermanent Virginia House now came to be of secondary importance, used for agricultural buildings and slave quarters, and as housing for folks on the fringes of society and settlement.

ONE of the primary changes in construction was a reduction in size of the timbers in the frame. Early Virginia buildings were framed with heavy posts, plates and joists, which protruded into the room, and lighter rafters and studs, which were sometimes set flatwise to the long walls of the building to minimize their projection. The new emphasis in building was to conceal the framing behind finish materials. Posts shrank to perhaps 5 in. thick while studs and braces *grew* to the same dimension, so that a flat wall of uniform thickness resulted. Clapboards (and increasingly sawn plank) were applied across the outside of the frame and lath and plaster, paneling and trim across the inside.

Structural bays had by now been eliminated from the design. Posts were located at the corners of the building and where a significant partition wall intersected an exterior wall, or where a wall was deemed too long, and at the doorways. Studs became fully load bearing, and were tenoned top and bottom to plate and sill. They were most commonly laid out on 2-ft. centers. A modular approach to framing appeared; often houses were designed in units of ten. A 1705 building regulation in Williamsburg required a minimum size of 20 by 30 ft. for a "dwelling house," with walls 10 ft. high. Sometimes a historic house frame reveals a sill where a workman was apparently instructed to start at one end and make a mortise every 24 in. until he reached the other end. Unneeded mortises were simply left empty. Williamsburg's building laws also required that houses on the "great street" be built with brick chimneys and brick cellars under the whole length of the house. It was now against the law to build a Virginia House in the new capital of Virginia.

Most of the material used to build the new style of house was sawn—produced either by slaves in the sawpits of timber yards or nearby plantations, or in one of the few water-powered gang-saw mills in the Tidewater region—and available for purchase in relatively standard sizes from timber merchants and planters. Only the largest structural timbers, the sills, summer beams and lintels, remained completely hewn. The false plate had been reduced to the size of a common floorboard.

The joinery became more sophisticated. Tusk tenons with upper beveled shoulders and housed lower square shoulders were used at the ends of summer beams and floor joists. Floor joists were often dovetailed into the sills, and bladed scarf joints appeared in plates and sills. Two of Williamsburg's early houses boasted M-shaped roofs, with internal wooden gutters. By the 1720s and 1730s, earlier experiments with spanning significant distances, like the M-roofs and principal-rafter roofs, seem to have been abandoned in favor of the textbook kingpost truss, found in every builder's book available at the time in America. Gambrel or "Dutch" roofs also become popular at mid-century.

The frame of the southern house had by now been completely concealed from view. The best houses were ornamented with shingles, beaded weatherboard, molded trim, architraves and classical cornices, and their façades were pierced by large glass windows and paneled doors. Whereas the only exotic materials in a Virginia House were the imported nails, a new-style building might boast imported window glass, oil paint, sheet lead flashing, stone steps and mantels, wallpaper and decorative hardware. But the structural elements of the frame behind the expensive finishes, except for the sills on their masonry footings, still had their origins in the framing of the old Virginia House in the previous century. Southern framing still featured as its distinguishing characteristics an independent roof assembly, typically common rafters on false plates. It still relied on sheathing to add structural rigidity to the timber frame. Down-braces were universally used and the overall joinery remained relatively simple. English tying joints were nowhere to be seen.

This new style of building, first seen in the cities and towns of the Tidewater, spread quickly to the countryside and then, after the Revolution, across the Alleghenies and throughout the Deep South and Southwest. The style becomes almost universal in the South until after the Civil War, when the southern states rejoined the Union and the nation hurtled on into industrialization. Balloon framing, steam engines, railroads, circular saws and mill shops made hand-cut timber frames obsolete and brought an end to the tradition of the southern timber frame, which had begun two centuries earlier as a planter's earthfast house alongside a tobacco field. —Garland Wood

Garland Wood (twood@cwf.org) is Master Carpenter in the Historic Trades Program at the Colonial Williamsburg Foundation. This article recapitulates his presentation at the Guild's TTRAG 2001 conference in March.

Belgian Barns I

Photos Kristen Brennan

A Flemish barn typical of the 16th to 19th centuries and similar to the one in the folktale, "The Devil's Barn of Bierbeek."

BELGIUM is a small country whose ten million people speak three official languages and share an area the size of Maryland. You can traverse the entire country in a four-hour train ride. But what Belgium may lack in physical size it makes up for in abundant history and detail. From the coast on the North Sea to the southeastern borders with Luxembourg and France in the Ardennes mountains, there's barely a stone left unturned or a building left undocumented.

A Belgian folktale, "The Devil's Barn of Bierbeek," tells of a farmer whose crops were so plentiful one season that he did not have a barn big enough to hold the harvest. No sooner had he wistfully muttered, "If I had a bigger barn, I could become a wealthy man," than the devil appeared before him.

"I can build you a bigger barn before the cock crows tomorrow morning," offered the devil. "All I need is one night and your soul when you die." The farmer, a young man with a long life ahead of him, agreed. That night in bed, he began to have second thoughts. His tossing and turning awakened his wife. When she heard the sounds of the devil and his workers hewing and sawing and mortising in the barnyard, she jumped up and ran shouting to the door. Despite the fact that it was still the depth of night, her commotion awakened the cock, which began crowing in alarm.

When the cock crowed, the sounds of building stopped. The devil abandoned the work before it was finished. The devil had not upheld his end of the contract, and the farmer's soul was saved! And because the devil works quickly, only a few rafters and the roof remained to complete the barn. The farmer eagerly set to work the next morning completing his new barn. But with each new rafter he erected, another beam elsewhere in the barn would snap. With each section of roofing he applied, a hole would appear mysteriously in the siding infill. To this day, the barn is always in need of bothersome and expensive repairs.

In this tale, which preaches against the sin of avarice, the choice of a barn as the coveted item was particularly appropriate in the pre-20th-century economy, and the condition, size and decorative detailing of a farmer's barn indicated his wealth and prosperity even well into the 20th century.

Despite its compact area, Belgium's wide variety of ecological regions required a diversity of agricultural practices and therefore of barn types. Historically, Belgian farms are roughly divisible into six regions. West and East Flanders made up a populous region practicing intensive grain and wool production on flat fertile soil. The provinces of Brabant, Limbourg and Hainaut together were dominated by large-acreage farms owned by wealthy monasteries or lords who practiced a mixed agriculture of grain and cattle raising. Third, the Campine region around Antwerp, with its poor soil, nourished subsistence farmers, and fourth, the region around Liège specialized in fruit production and mixed farming. In the Ardennes mountains, a less densely populated area with harsh, long winters, houses and barns were combined under one roof, housing the necessary sheep and the modest crops that could be grown in the region's short growing season. And finally, in the Lorraine area

A ca.-1540-style Flemish house-barn constructed after a painting by Pieter Brueghel the Elder and located at the Bokrijk Museum in Flanders. The barn window detail at right above shows typical characteristics: a tie beam's protruding through tenons fixed by outside wedges and the window's two framed openings, the upper glazed and the lower fitted with diamond bars, a light woven screen and a lockable shutter.

bordering France, farmers held collective lands and grouped their combined house-barn-stables in connected rows on the main streets of the villages.

Examples of each of these farm types can be seen at the two national open-air museums dedicated to rural life, the Bokrijk Museum in Flanders and the Museum of Rural Life in Wallonia. The houses, barns and outbuildings, dating from the 15th to the 19th centuries, were collected from around the country and carefully numbered, disassembled and reconstructed in their proper miniature regions within the museums. The Bokrijk Museum has the archeological advantage of Flemish vernacular painters who documented in great detail Flemish villages from ca. 1490 to 1700. Pieter Brueghel the Elder, David Vinckboons, Roland Savery, Hugo van der Goes and Robert Campin painted in such detail that some pictures show empty mortises or housings in odd locations, suggesting that barns even then were constructed with recycled timber.

A square mikke *barn with masonry walls, pyramidal thatched roof and central aisle entrance.*

A COMMON historical barn type in West Flanders, known as the *mikke*, is a large grain storage barn with distinctive square form and pyramidal roof. Few examples survive. The one pictured (previous page) at the Bokrijk museum dates from about 1710. The roofs were most frequently thatched, either entirely or with the lower section tiled. Like rectangular barns, they had three principal aisles, two for the stables, pigpens and storage, and a drive-through aisle for loaded hay carts. Some scholars speculate that *mikke* barns are Frisian in origin, brought from the Frisian Islands by colonizers who settled in northern Flanders at the height of Frisian oceanic prowess during the 1100s and 1200s. Frisian traders and ships were a key link between the burgeoning Flemish cities and the Scandinavian and Russian ports. Others argue that the barns developed without the Frisian influence and existed before Frisians settled the area, and that the joinery is distinct. This is a debate that may never be won because of the scarcity of surviving barns.

Agriculture in most of Flanders during the 13th through the 17th centuries was organized in a feudal structure. The Catholic Church and the landed aristocracy owned the majority of the land in large sections. The majority of the population worked as tenant farmers under a classically feudal arrangement, exchanging their labor, a yearly tithe, and often their lives in territorial wars, for the "privilege" of living on and farming the land.

The position of the monumental barn in the farmyard was often on one leg of the U that typically enclosed a courtyard. The farmstead itself was also frequently surrounded by a moat for further protection. In the wet Flemish lowlands, water provided a cheap and easy method of protection against intruders, not to mention a convenient means for extinguishing fires, an ever-present threat. The house usually occupied the bottom of the U, with the façade facing south or southeast. The outbuildings formed the legs, the biggest barn for storing grain (the "winter barn") on one side and the "spring barn" and stables or pigsties facing it across the courtyard. These buildings were all independent structures.

The protective moats underscored the social isolation of the landlords or abbeys. Abbeys were the organizing factors in community life, surrounded by their tenant farmers distributed throughout the domain. The landlords and the monks felt it necessary to protect themselves and their goods, not only from rival lords, but also from uprisings or theft by their own tenants.

Moving across the country from West to East Flanders and Flemish Brabant, styles of timbering change. The earliest form of wall timbering in the Flanders region was *regelbouwtechniek,* or half-timbering, a name reflecting the use of infill between separated timbers. This technique is thought to be a variation of the Scandinavian technique of building walls solidly of upright posts, here adapted to less-forested continental conditions. The half-timbering technique is widespread, including buildings both earthfast-posted and on groundsills, spanning a geographic area including most of England, northwestern France and Belgium, roughly the area encompassed by the Duchy of Normandy in the 11th and 12th centuries.

In Belgium, as one moves inland from the West Hoek region on the coast, the span of the infill panels gets progressively larger, from an average of 60 centimeters in West Hoek to an average of 2.3 meters in southern Brabant, and even larger in the eastern regions of Limbourg. The infill is composed of horizontal bars over which a trellis of branches is woven vertically the height of each opening.

Later barns in Flanders followed the familiar longitudinal three-aisled plan, often with a complete drive-through aisle for threshing. But as the feudal system broke down and independent farmers appeared, transverse plans occurred more frequently.

THE Campine Region was poorer than its neighbors to the west and south. In contrast to their neighbors' fortified farms comprising individual buildings around a courtyard, the *Campinois* housed everything under one roof in an arrangement typical of poorer regions in Europe. The plan was either three-aisled and divided in half across the aisles, or one room wide with a series of rooms in a long line. In both cases the façades were oriented toward the southern sun.

Because of its winter resistance, rye was the principal grain grown in the Campine region. Wealthier farmers grew some of the more vulnerable, but preferred, wheat. A crop of rye for the family's consumption for the year did not require a large grain storage area, so the principal function of *Campinois* barns was to house cattle, pigs and workhorses.

The winter food available to feed the cattle (beets for example) required cooking before the animals could consume it. Therefore the kitchens had to accommodate not only the cooking for the family and farmhands, but for the cattle as well. Each house, whether one or two rooms wide, shared its non-chimney wall with the stable. The cattle trough was located either under the shared wall as a dugout, or on the stable side of this wall, accessible by a door. Halfway across the kitchen, a *ketelgalg* (or *draaiboom)* was constructed, comprising a post carrying a large boom that held a

A barn built in **regelbouwtechniek***, or Flemish half-timbering, which appears to have evolved from Scandinavian wall construction in solid upright timbers. Above, view of barn gable end and farm gate cunningly counterweighted by the butt end, complete with roots, of a log rail.*

The **ketelgalg** *or* **draaiboom** *in a Campinois house could swing its heavy kettle all the way from the fireplace on one side of the kitchen (above at right) to the opposite wall (above left), where the boom could pass through the open doorway to the stable and enter a notch in the wall, seen at the upper right corner of the doorway, to allow the door to be shut while the cauldron was emptied into the animals' feed trough.*

cast iron pot for stewing the cattle feed. It could hang over the fire to cook and then pivot across the room to be dumped into the feeding trough without anyone having to carry the impossibly heavy cast iron pot. —Kristen Brennan

Kristen Brennan is pursuing a master's degree in historic preservation at Cornell . She has studied at the Free University of Brussels. This article is the first of a series on Belgian Barns. Research funding was provided by a US Department of State Fulbright Graduate Student Fellowship.

A typical Campine region long farmhouse. House to the left, barn to the right. Campine framing spreads the posts, adds full-height braces.

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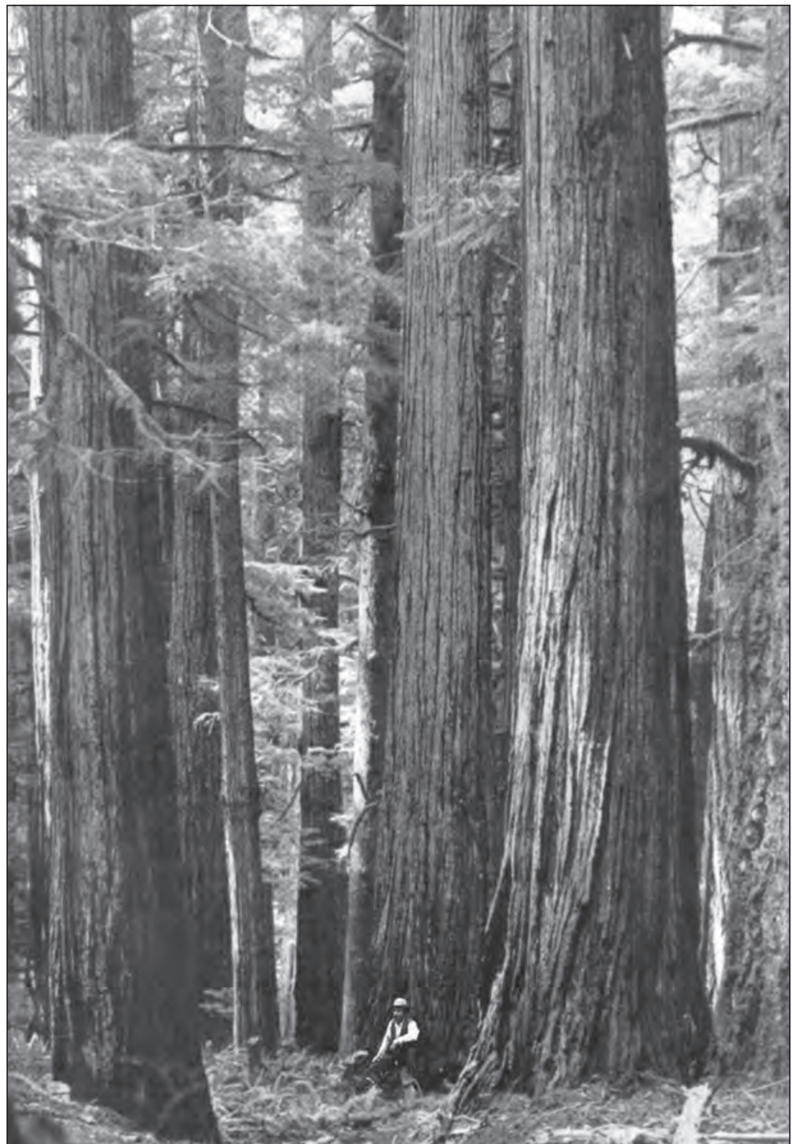
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THE People's Choice Award at the Asilomar 2001 Expo (see pages 2-5 for more on Asilomar) went to Big Timberworks of Gallatin Gateway, Montana, for a large residential project. Some of the structure stands considerably outside the timber frame (photo lower right), and the freestyle bracing (photo below), according to Big Twig's Merle Adams, "confuses the forces." Merle further reports: "In 1997, the Scherffius family commissioned us to design and build their full-time residence near Bozeman. Their design objectives were to build a place that looked like it belonged in Montana, hence the look of a 'collision of ranch buildings.' They wanted it to feel a bit 'quirky,' meaning that it would be a mixture of rustic and modern elements, as their lives are. They wanted to use as many recycled, experienced and environmentally benign materials as possible. They not only believed in conserving resources but also felt the building would be more interesting from the legacy of its materials. Near the end of the project we were approached by an old-timer from the area. He remarked, 'I'm sure glad you guys restored this old place before it went completely to hell.' We politely nodded our heads, thinking this one of the greatest compliments we had received. Afterward we wondered, 'Is this what we have to look forward to in our golden years? Or did we actually accomplish our goal of building a place that looks like it belongs?'"

Photos J.K. Lawrence