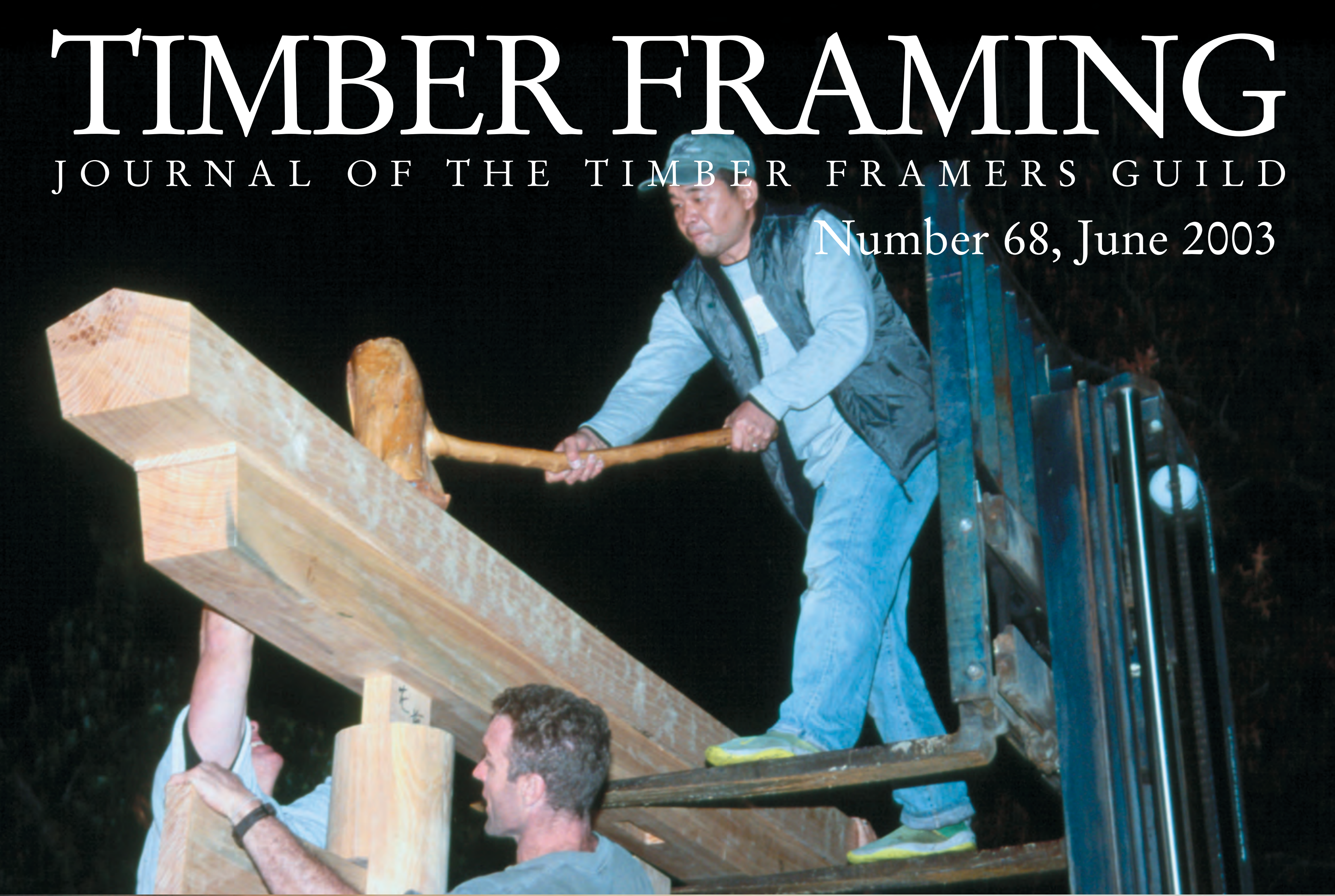
TIMBER FRAMING

JOURNAL OF THE TIMBER FRAMERS GUILD

Number 68, June 2003



Kezurou-Kai in America

TIMBER FRAMING

JOURNAL OF THE TIMBER FRAMERS GUILD

NUMBER 68 JUNE 2003

CONTENTS

On the cover at top, a Japanese carpenter makes good use of a fork lift and wields the commander to assemble the Torii gate built in a Kezurou-Kai workshop last fall at Palomar College, San Marcos, California. Photo by Norman Corwin. Below, other Kezurou-Kai members assemble the teahouse frame built at another California workshop held at the Guild's Western Conference at Asilomar in April. Kezurou-Kai, founded in 1997 by Kojiro Sugimura to preserve the art of handplaning, has 1000 members in Japan and 300 in the US, and has now made three appearances at Guild conferences, each time leaving behind a beautiful and beautifully made object and immense good will. Photo by Chris Madigan.

Editorial Correspondence
PO Box 275, Newbury, VT 05051
802-866-5684 journal@tfguild.org

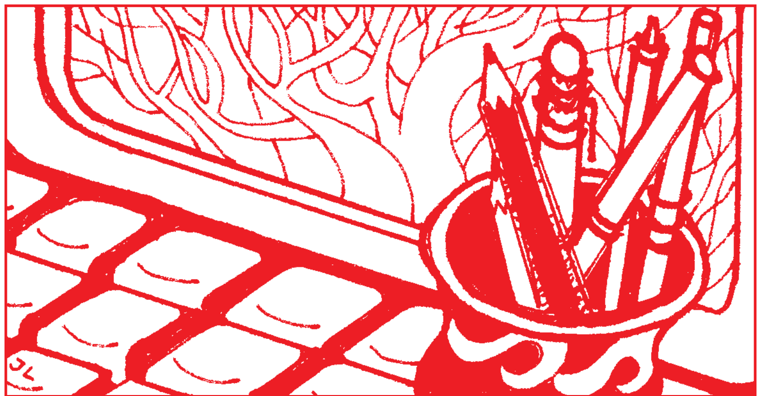
Editor Kenneth Rower

Contributing Editors
History Jack A. Sobon
Timber Frame Design Ed Levin

Published Quarterly. Subscription $25 annually or by membership in the Timber Framers Guild.
ISSN 1061-9860

TIMBER FRAMING, Journal of the Timber Framers Guild, reports on the work of the Guild and its members, and appears quarterly, in March, June, September and December. The journal is written by its readers and pays for interesting articles by experienced and novice writers alike.

1985



LETTERS

Whose Barn?

IN 1975 we began dismantling vintage barns to be restored and reassembled at new locations, at a time when new timber-framed structures were just beginning to appear in the housing market. I had always enjoyed working with antique lumber and, as a new Vermonter, I became fascinated with the old, neglected and deteriorating barns that dotted the landscape. However, I was soon to discover that their restoration was generally out of the question. The owners of the barns had little reason to have me restore them. The majority preferred that I take the barn down to lighten their tax and insurance burden, and perhaps pay them something as well. Thus began my career as a dismantler.

I learned quickly that if the wooden pegs were removed first, a barn frame could then be saved in its entirety and put back up someplace else. I then had to learn to restore deteriorated timbers and, probably most important, how to market my product. Years of trial and error, along with discovering epoxies and borates, led to an interesting, one-of-a-kind product. Visiting the barns that people call me to see is probably the best part. I only wish I'd photographed these folks or, better yet, videotaped my interviews with them. (An 80-year-old hillside farmer is the genuine article.) But I was young and had no idea yet about the study of folklore, and now I'm getting old and can't quite remember all of their names or stories. But I have at least the photographs of their barns.

Our revived barns now stand all over America, in distant places I would never have dreamed of visiting. Their frames are quite similar to the new timber frames that have become such an industry. (The advent of the structural insulated panel was a major breakthrough for our work, too.) I came to feel like a Vermont barn expert. I bounded out of bed every morning excited about my work.

Until I bought what I shall call the Wolfe Barn, in a little hamlet in New Hampshire, in late August of 2002. I had a client who required three large barns for a residential complex. I found and purchased the barns under the standard purchase agreement that I'd used a hundred times and, in turn, sold the barns to the client with the understanding that they'd be delivered, restored and reassembled by my crew, in June of 2003. I received a good deposit.

We then went off to California to complete another project. While there, I received a phone call from the seller of one of the barns informing me of an unmet requirement for a demolition permit. A recent law required a permit application followed by a 49-day delay while various committees reviewed the project. I returned from California in late November and filed the application. I thought nothing of the process. We were tired, it was cold and there was a ton of snow on the roofs of the barns. A 49-day delay was great! Not so.

The Wolfe barn had previously been for sale for eight years. It stood in a residential neighborhood, a neglected reminder of a farm that once graced the banks of the Merrimack River. When the local historical society got wind that the barn had been purchased and would be leaving, a red flag went up. For over a month I attended local meetings where the public became more and more frustrated that the permit process only required that these meetings be held. They hoped that I might be persuaded to find another barn. I explained to them repeatedly that if I had not been under contract to reassemble *that* barn elsewhere, I would certainly just ask for my money back and find another, and they could keep "their" barn. I had enjoyed an excellent professional reputation for many years in part because I did what I said I was going to do, and no less. I'd always steered clear of landmark barns that might awaken public outcry. The permit was issued.

Then along came a letter from the town's attorney announcing that the historical society had petitioned the town to take the barn by eminent domain. I attended numerous town council hearings while the councilors debated the ramifications of taking the barn from me by eminent domain, in the state whose license plate reads "Live Free or Die." At this point I hired a prominent lawyer, at my client's request, but at my expense. (A deal is a deal, after all. I owed him the barn.) The public outcry, both for and against eminent domain, was astonishing. I learned a great deal about eminent domain, historical societies, lawyers, city council systems and my rights as a property owner.

Why didn't my client just say, "Give 'em back their barn and find me another"? Perhaps because he's a fighter and a believer in property rights. Thinking it professional to do so, I'd kept his name out of the fray, which also annoyed folks because, they argued, wasn't he technically the real owner? Lawyers argued this point at length. My client and I learned that eminent domain proceedings take a minimum of one year. Meanwhile, a contractor and fairly large crew waited in the wings after having agreed to finish the barns into housing once we had reassembled the frames. The contractor had turned down work; this project was his company's 15-18 months' security. It was also a large and important project for my company.

The press was relentless. My name was in the paper twice a week as a guy who swindled barns away from little old ladies to sell to the rich and famous. I received hate mail over the Internet. And I can tell you that the letters to the editor were cruel. My legal fees were creeping up to $30,000—soon I'd be doing the project for free.

I then got a call to look at a barn almost identical in size to the Wolfe barn. It was a perfect replacement and, even if my client couldn't be persuaded to drop the fight, I bought it anyway. I sent photos to my client. He loved it and the fight could come to a halt. I was immensely relieved. This fiasco had kept me up nights—and worse—and now it was over.

Well, not really. It was another six weeks of lawyers arguing back and forth about the settlement, still at my expense. The historical society couldn't simply reimburse my money plus legal fees. There was no chance of recovering legal fees—that's the law! But might I recover the money I had spent on an architect's drawing to make the barn into a residence, again thousands of dollars? We settled, but it would be a while until the historical society could pay me.

So, I think it's over. The historical society can now deal with a lead abatement issue (painted clapboards) on their barn, and I can go on doing what I love to do, certainly poorer but perhaps a little wiser. I guess that comes with old age. As they say, live free or die.

Ken Epworth — The Barn People, Windsor, VT 05089
barnman@sover.net
April 10, 2003

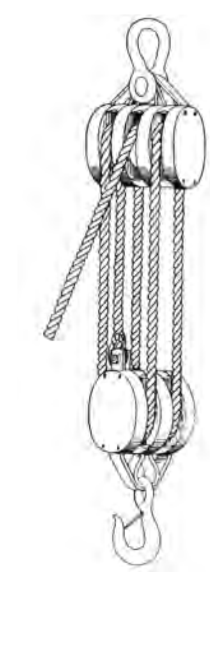
Tools for Romania

HAVING traveled to Bontida, Transylvania, with Dan Addey-Jibb, I was thrilled to read his excellent article "Restoration in Romania" in TF 66. We both felt very privileged to have been given an insight into the vernacular traditions of such an "exotic" country, but we also felt privileged to have met some great guys who work *very* hard in trying circumstances. It seems that the average daily wage for a carpenter in Romania is just a few dollars, and during the winter months many don't work at all due to the extreme cold. If a carpenter can find work, it is very common for the contractors to disappear having taken the client's money but before they have paid any wages to the tradesmen. As Dan pointed out, the Communist regime seemed to discourage the repair of many traditional buildings, particularly when they were of certain ethnic styles. That also seems to have been the case in general; much of the country is in a bad way, and corruption is rife at many levels.

We both felt very attached to our students by the end of the two weeks and, despite taking only a very limited toolkit, we gave an item to each of them as a present. It would have been more productive to have left these tools with the Transylvania Trust so that future students could have the benefit of their use but, having got to know the different carpenters, we couldn't help ourselves. The Trust is an excellent idea and it's doing great work, with the staff gradually gaining the skills to pass on to the next entrants. This will ultimately give the students the sustainability and self-sufficiency they need as the tasks ahead are, quite frankly, colossal. Some of the tools and equipment they currently have fall far short of requirements (for example, the drill that Dan mentioned), but remember that an average carpenter will never own power tools as they are simply too expensive. With this in mind, we made a point of teaching everything with a very basic toolkit. It would have been easy to revert to power tools (and when pushed for time we did) but, having taught at a basic level, we hoped to empower the craftsmen themselves in a sustainable way. I wonder if there are any companies in the US who feel they could help the Trust with hand-tool or cash donations? I think donors would find that a little help would go a long way, and that it would be very much appreciated by some truly wonderful people. Many thanks.

Rick Lewis — Traditional Oak Carpentry, Suffolk, U.K.
rick.lewis@ntlworld.com
March 12, 2000

ERRATA



THE illustration that appeared at the bottom of page 7, column 1, in the last issue (TF 67), and shown again at right, depicts a five-part block and tackle, rather than the four-part tackle indicated in the description at the bottom of column 2. The number of parts, or "falls," exclusive of the pull line, determines the designation, as well as the leverage ratio (neglecting friction) of the device. Elsewhere on page 7, but not far from the illustration, the word "and" is given as "an." On page 24, column 2, in "The Close Spacing of Trusses," a certain "Fig. 6" is mentioned, but no Fig. 6 appears in the article. The editor regrets these errors.

TTRAG Proceedings 2003

THE Guild's Traditional Timber Framing Research and Advisory Group met during a false spring March 14-16 in Shepherdstown, West Virginia, just inside the border with Western Maryland and close to famous Civil War battlefields. About 100 historic-framing specialists and enthusiasts gathered at the US Fish and Wildlife Service's National Conservation Training Center, a group of sizeable modern mill-style buildings, many faced with native stone, roofed with terneplate and trimmed inside with quartered oak, to hear presentations on historic timber framing and its repair and preservation. TTRAG symposia, beginning in 1992, have come to resemble larger Guild conferences, including bookstore, building tour, slide show and outdoor demos, but with the important exception that all sessions are plenary. The building tour visited Antietam and Monocacy battlefields to look at barns and houses as well as a historic mill and the ca.-1751 Peter Burr House near Bardane, W. Va. Presenters in addition to those given here included Jack Sobon ("Repair Techniques," see page 10), Dean Fitzgerald (covered bridge repair) and Witold Karwowski (Polish synagogues). Out of doors, John Fugelso demonstrated shingle making, and Jim Houston demonstrated hewing.

David E. Lanoue, Inc.

General Ashley House

David E. Lanoue

IN 1735, Colonel John Ashley's family was granted land and water rights along a section of the Housatonic River in Berkshire County, Massachusetts. By 1770, the colonel was able to construct a very fine 36-ft. by 46-ft. hip-roofed Georgian house for his son, General John Ashley. The Georgian hip roof was removed in the 1830s, probably because of water damage, and replaced with a gabled Greek Revival-form roof, which was then fashionable, as well as easier to build and maintain. Our primary evidence to support this hypothesis was the presence in the attic of the original scribe-rule purlin system, never moved and doing no work. This purlin system was surrounded by a later, square-rule queenpost timber frame, which supported the common-rafter roof system of the replacement roof. Rafter seats mortised into the early lapped dovetail plates on all four sides of the building left no doubt as to the original builder's intent.

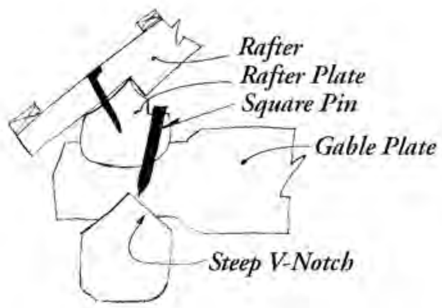
The owner turned to architect Jack Sobon to plan the reconstruction of the original hip roof system. A temporary roof was erected over the whole structure while the Greek Revival roof was removed, to ensure the protection of mostly original fabric. Extensive documentation was recorded of both the 1770 and the 1830 building systems. The project was executed using traditional hand tools and raising equipment, coupled with advanced preservation techniques, to provide continuity with the handcrafted components and conversion methods evident in the original timber frame. Like those of the original General Ashley timber frame, most of the new rafters 5x9 and smaller are pitch pine, both hewn and sawn. The new 7x12 main rafters that abut the purlin system corners are red oak, and the hips are pitch pine.

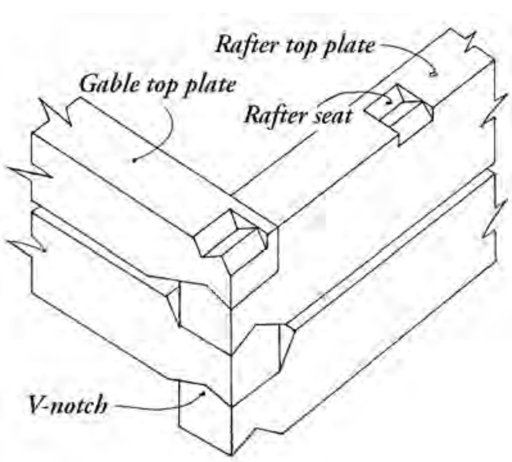
At top right, the house as modified in the 1830s, with dominant frieze added to the top of the wall and full pediments at each end of the gable roof. At right above, the reconstructed double-pitch hip roof frame, with original purlins and hip posts. At right, the house with Georgian roof complete. Under the snow, wood shingles cover the roof.

Local Rafter Plates and Notches

Douglass C. Reed

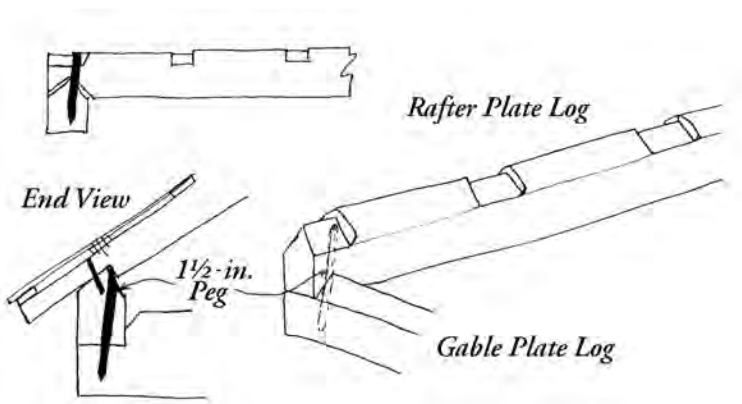
TYPICALLY in the 19th century, the last logs on the pile or crib were the gable end plates. They were often fitted with complex notches at the corners that locked in the long side rafter top plates and allowed for the uninterrupted fitting of the gable rafter sets. In the 18th century, however, it was not uncommon for some builders to make the rafter top plate the last log up on the structure. The top sides were hewn smooth and the surfaces trimmed a bit with an adze. Then birdsmouths were cut into the rafter top plates, and all the eave ends of the rafters were cut with the corresponding notch. The problem was that the rafters pushed against the top plate. If it rolled loose of its moorings, the top plate was likely to fall off the roof and allow the collapse of the entire rafter system. Even though the top plates were fastened with large 1½-in.-dia. wood pins at each end, the rafters were still capable of snapping the pins after they had aged and become brittle. By the late 18th and early 19th centuries, builders changed the manner in which the top plate was secured. The rafters still were birdsmouthed into the eave-side top plate, but the plate was captured at its two ends by the gable-end plates. The gable plates now became the topmost logs and notched over the rafter plate logs below them. No rafter top plates positioned as the top logs on a pile have been found in the area dating from the 19th century.





Above, typical early top plate construction of mid-Atlantic log house. At right, improved arrangement found beginning late in the 18th century. Below, details from the (early) Glass house in Sharpsburg, Maryland.

Douglass C. Reed



Western Log Cabin Rehab

Al Wallace

COMPARED to timber buildings in the northeastern US or in Europe, western log structures are relatively young and rustically built, such as those found on the Front Range in Colorado. The majority of these century-old structures were built during the height of the mining boom in the late 19th and early 20th centuries and reflect the requirement for quick, efficient, basic housing. The joinery was crude—full-size 300-year-old lodgepole pine logs overlapped at hog-trough corners and chinked with a cement-lime-sawdust mix. The sill logs rested directly on grade and a roof of 1x12 pine boards rested directly on the 12-in. primary purlin logs spanning 30 feet. The interiors were dark. Nature has not been kind to these structures. Repairing them to meet modern residential standards requires special skills and understanding.

Adaptive reuse prepares buildings for new uses while to some degree retaining their historic features. Since a cabin must meet the current needs of the owner, adaptive reuse is a compromise between strict historic restoration and scraping the site to build a modern structure. Using Stewart Brand's book, *How Buildings Learn: What Happens After They're Built*, as a reference text for the adaptive reuse of these structures, the remodeling contractor can evaluate a structure and its site.

Most western rustic log structures require repair to the sill logs and roof as well as remodeling of windows and upgrading or installation of modern comforts (heating, indoor plumbing and bath facilities). The optimal method when replacing rotted sill logs involves raising the cabin in place and pouring an insulated foundation underneath. Roof repairs might include installing insulation, additional structure and fire-resistant surface materials. Structural insulated panels installed over the 1x12 roof boards, then covered with cement-coated shakes, meet these requirements while revealing the roof purlins when viewed from below. Geothermal hot water (available in Colorado) supplied to a radiant floor system provides an energy-efficient, sustainable heat source, while mitigating any issues of a high water table on-site: a horizontal trench below the level of the footings tends to collect the water that might flow to the foundation. Additional site considerations in the western states include potable water quality and availability, soil consistency and stability to support the structure, the height of the water table and location of flood planes, access to the site by owners and emergency service vehicles, local zoning, building orientation and, finally, maintaining a fire-defensible zone around the structure.

The German Marking System

Rudy R. Christian

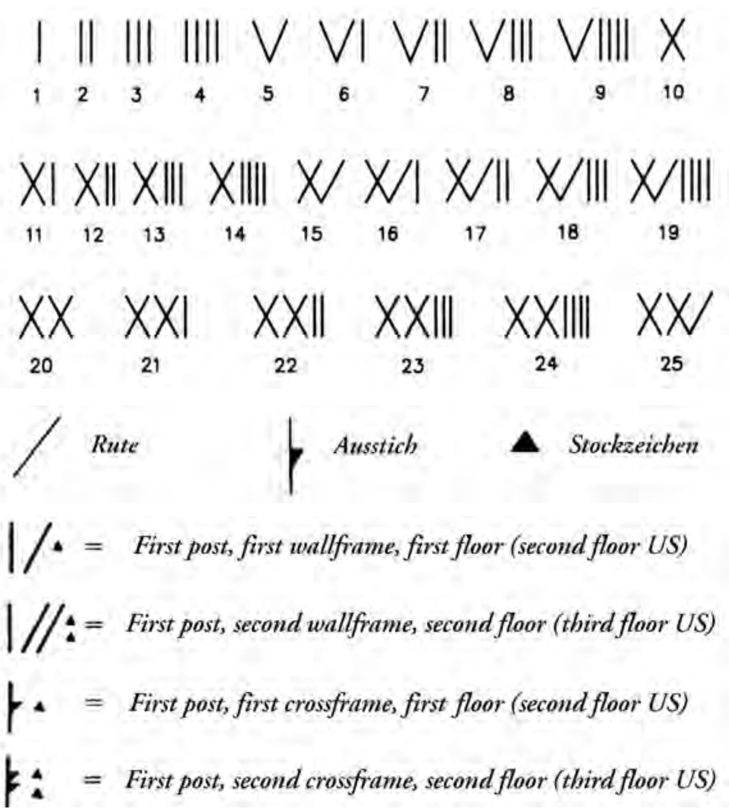
THE timber layout system used by German framers has remained relatively unchanged for centuries. Although technically not a scribe rule system, the complexity of *Fachwerk* requires carpenter's marks to identify the numerous posts, plates, studs, braces and headers assigned to wallframe and crossframe (bent) assemblies.

For a timber framer traveling through Germany, it's quite exhilarating to see these marks on the exposed framework in towns and cities from the Baltic Sea to the Black Forest. It's also very interesting to realize how similar these markings are on buildings hundreds of kilometers apart and hundreds of years apart in age. The reason is the persistence of a trades education system that has changed little since the Middle Ages.

Studying the German marking system can prove valuable in the study of timber frames in Europe, but it can be just as valuable in studying frames built by German immigrants to America. When these early builders came to the New World, they brought with them both a system of framing and a system of layout and marking. Although the framing system itself evolved rather rapidly into one that little resembled its origins, the use of the carpenter's marks continued. During the barn tour at this symposium, many in attendance were delighted to see the German marking system used on a scribe rule frame barn at the Antietam battlefield. The frame closely resembled other barn frames on the tour, with its canted queen posts and double-tied bents, but the marking system to identify the timbers was clearly German and could easily have come right out of a contemporary German trade school textbook.

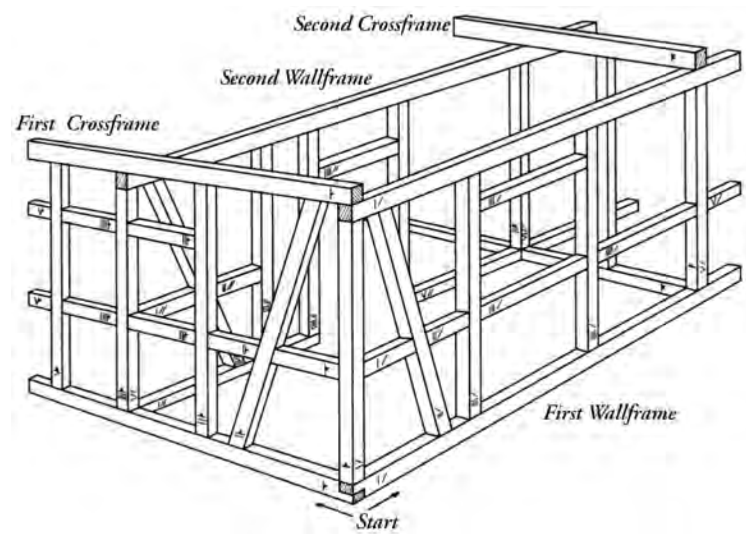
The system is quite simple to understand, which likely explains why it continued to be used in the United States until scribe rule framing was replaced by square rule. The incised numerals are Roman, except that the number four is shown as IIII rather than IV and the number nine is shown as VIIII rather than IX. These modifications allow correct reading from any viewpoint.

The numbers are augmented by incised slashes (*Ruten,* below) and flags *(Ausstiche)* to indicate, respectively, wallframe and crossframe assignments, beginning by convention at a corner such that the first crossframe is to the left of the observer and the first wall frame to the right. You are at 1 in both directions at that point.The first main wall will be indicated by one slash, the second two, and so on. The crossframe flags are attached to the last mark in the numeral and work the same way. Floor levels are indicated by an appropriate number of detached Greek deltas *(Stockzeichen)*, with the understanding that the ground floor is at zero.



Door header labeled as fitting ninth post, first wallframe, first story (second floor US). Below, second story post number 4, crossframe location indicated by just-visible single flag near center of uppermost stroke.

Rudy Christian



Isometric view of sample frame showing the German marking system. Piece numbers follow the sequence of posts (including the tilted posts that act as braces) away from the starting point. Duplicate marks indicate interchangeable pieces. Story marks are not used since this frame has no story and confusion between plates and sills is unlikely.

A Pennsylvania Barn In Central Indiana

Brian Mulcahy

THE Pennsylvania barn, which occurs in great numbers in its native state, stands out as rare in central Indiana. A small cluster of such barns occurs in Hamilton County, just north of Indianapolis. The German Baptist Gascho family, from Lancaster County, Pennsylvania, settled the area in the mid-1840s and built at least eight Pennsylvania-style barns as classified by Robert Ensminger in his book *The Pennsylvania Barn* (Johns Hopkins, 1992). All have the two-level configuration and forebay extension opposite the ramp. Central Indiana is relatively flat, and the natural hill or "bank" was not available here. All these barns were built on level ground and banks constructed around them.

We moved the barn discussed here four miles from its original location in Noblesville, Indiana, to the Conner Prairie Museum in Fishers in 2001-2002. As in most suburban areas, many original farmsteads here are being consumed by development. This barn was saved from imminent destruction by the museum, and a strip mall will soon stand in its place. Moving this 42 x 76-ft. barn (with flanking 8x14 granaries) inaugurated our timber frame restoration company, and it was the first that we had the opportunity to reconstruct. The six-bent structure has a dropped tie beam configuration with 10x10 oak and walnut framing timbers and 42-ft. flattened hickory log floor joists. The height of the barn is 34'6" from ground level to the roof peak. The all new siding is butt-jointed Eastern white pine 1x12 replacing the original tongue-and-groove softwood. Having taken down a barn a year earlier, my brother Kevin and I, along with his wife Patty, were armed with some experience, but began mostly with enthusiasm alone. (Most people thought we were a bit crazy.) My experience previously as an electrical engineer and part-time cabinetmaker provided the skills for methodically examining and documenting the entire structure before disassembly. We developed a tagging system based on geographic coordinates and sequential numbering, recorded in the drawings. During the repair and reconstruction phase, these tags proved invaluable in making sense of a parking lot full of timbers. As well, we removed all the original foundation stone and used it for the reconstruction.

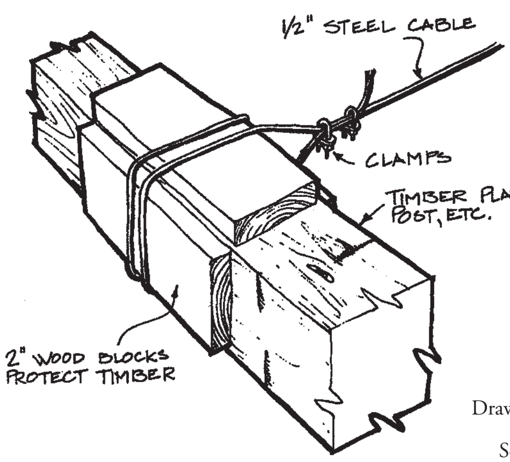
The disassembly process revealed a great deal about the history of the structure. I suspect that the frame originally stood as a ground-level, five-bent, four-bay barn with a rear shed addition. The evidence for this theory exists as legacy mortises in the bents and sill timbers reused as posts to construct the lower level. The evidence of one distinctly different bent and rafter plate extension indicates that the barn was also lengthened one bay. I suspect that, when the Gascho family moved into the area, they wanted a barn that worked in a way familiar to them, so they "recycled" a standing barn and changed its form. The barn now stands again proudly at the Conner Prairie Museum, and I am very pleased to have played a part in this third phase of its life.

Brian Mulcahy

Frame Repair Techniques

ARCHITECTS and engineers engaged in timber frame repairs, restorations and stabilizations should first familiarize themselves with early timber frame design and function. Understanding how the various loads are handled by the timber frame is crucial to designing the repairs. A good working knowledge of timber joinery is also essential both for understanding the configuration of joints *in situ* and designing the repairs. A good reference is my *Historic American Timber Joinery*, recently published by the Timber Framers Guild.*

When first introduced to a particular project, the professional should develop with the client a repair philosophy. This set of intentions is to be based on the condition and value of the structure, the client's proposed use of the building and, of course, budget. Obviously, a rough farm barn will require a repair philosophy much different from that of a museum house. All repair philosophies are valid if understood at the outset by all parties.



Drawing first published in the Dutch Barn Preservation Society Newsletter, Vol III, Issue 1, Spring 1990

Fig. 1. Many repair jobs begin with stabilization of the building. Steel cables are strong and useful, but cabled timbers must be protected by hardwood pads like those shown here.

Drawings Jack A. Sobon

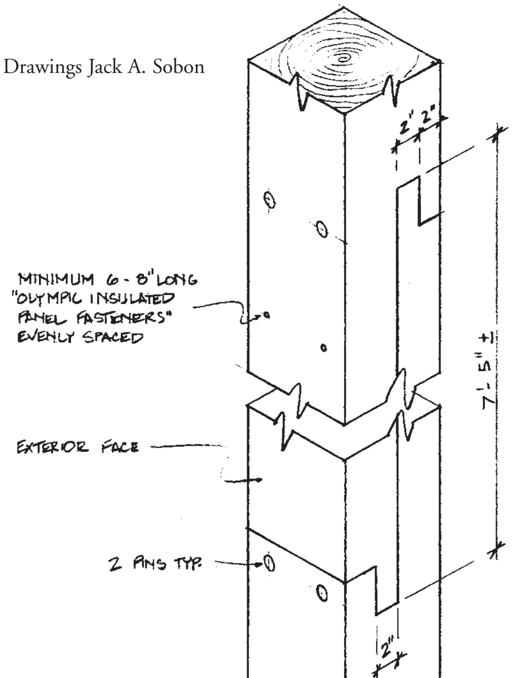


Fig. 3. Half the thickness of this post was hacked away to conceal it in a stud wall. The elongated scarf joint retains the maximum amount of the original post. The usual pins through the blades secure the joint, while slender deep-thread fasteners keep the long laps from separating in the middle.

If the entire scope of the work is beyond the budget, the structure needs first to be stabilized. The repairs can then be ranked and the client can phase the work to accommodate the budget.

For museum work, relocated structures and large projects requiring extensive repairs, full framing drawings are necessary.

**Available directly from the Guild (413-623-9926 or tfguild.org).*

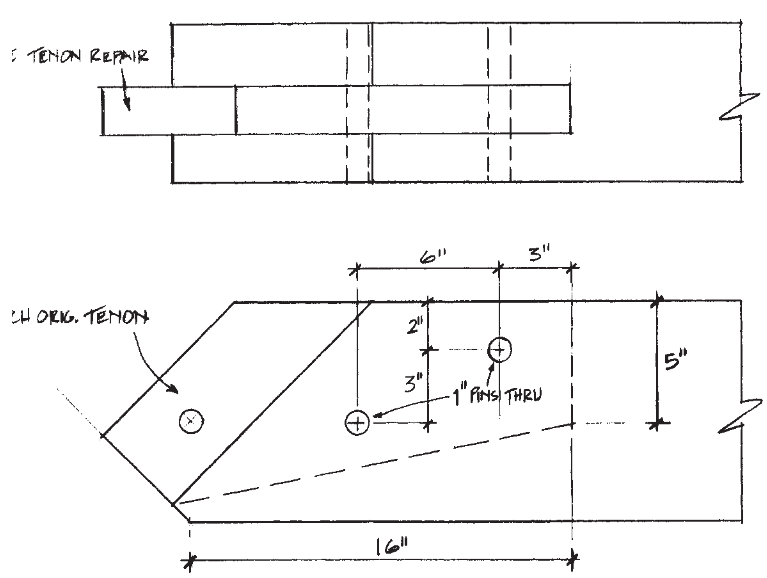


Fig. 2. Brace tenon repair to a central tenon using inserted free tenon minimizes the visibility of the repair and maintains the bearing shoulder. The repair pins may be kept blind on the visible side.

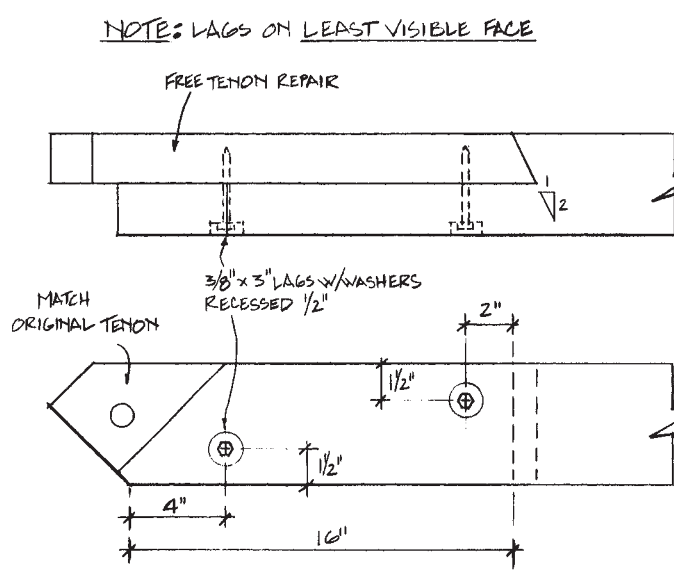


Fig. 4. Brace tenon repair to a barefaced tenon. The undersquinted lap joint is secured by a pair of lag screws from the invisible (or less visible) side of the brace.

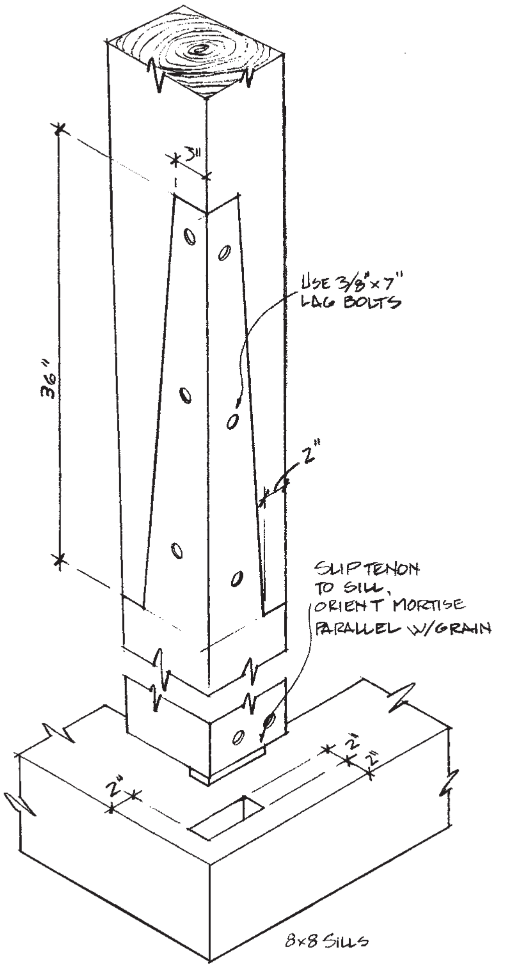
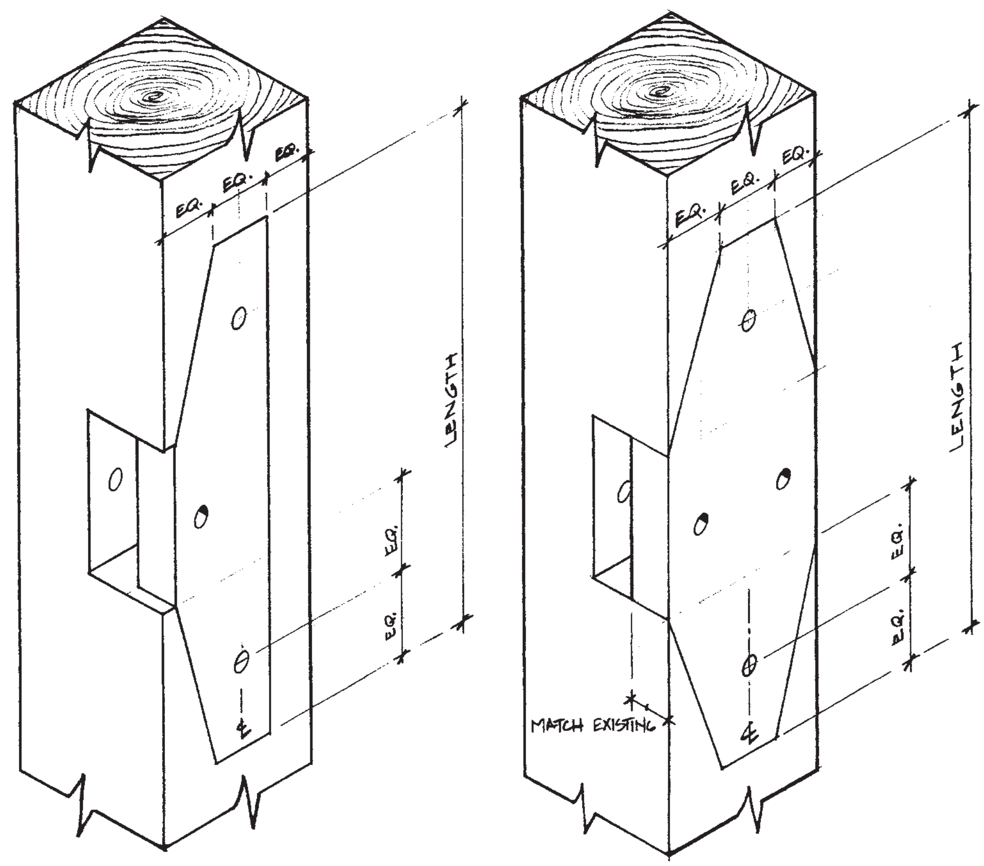


Fig. 5. This scarf configuration preserves nearly all of the original interior surfaces of a corner post substantially decayed on its outside corner. Slip (free) tenon allows reinstallation to the standing frame.



Figs. 7 and 8. Where girts or braces join posts, decay can make pin and vertical bearing surfaces ineffective. These repairs are typically made to an outside (and thus invisible) face. Holes for the fastening pins are bored at opposing angles to secure the patch.

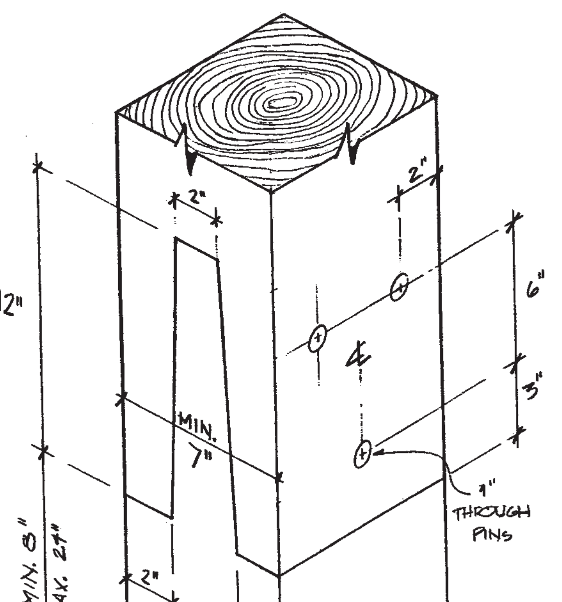
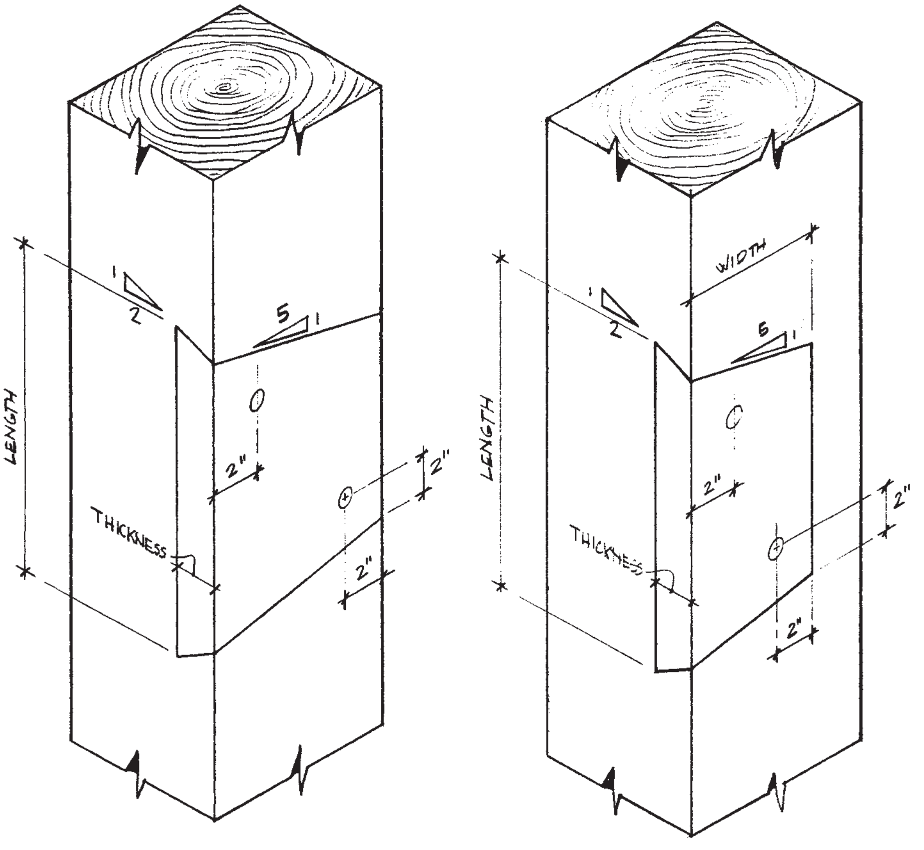


Fig. 6. When just the bottom of a post is decayed, this conservative repair is relatively inexpensive to cut. But the post should be at least 7 in. thick.



Figs. 9 and 10. When just the surface is decayed (e.g., where a rafter bears on a plate or a stud on a sill), a tapered undersquinted patch can be slid into place until snug. In the figures, the length component is specified by the engineer or architect.

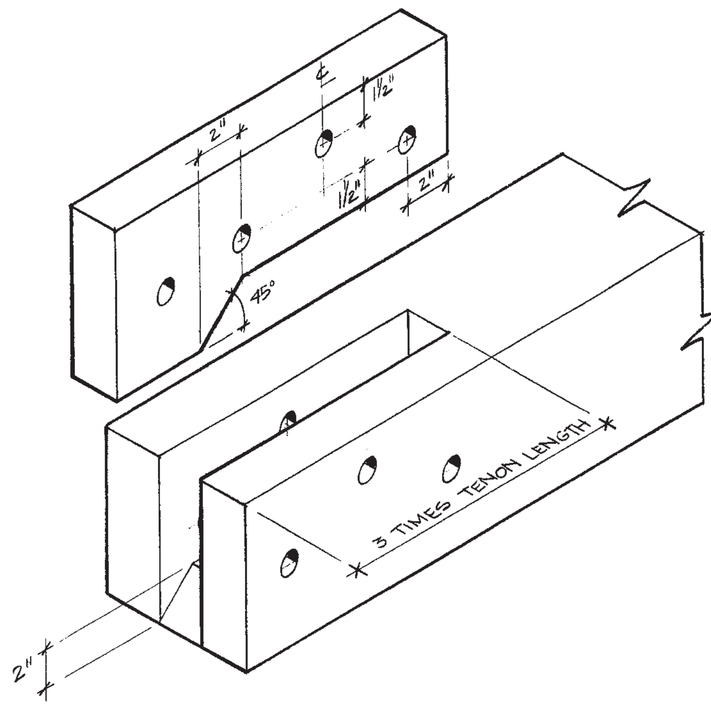


Fig. 11. Concealed free tenon repair for the end of a timber. The pins may be blind on the visible side.

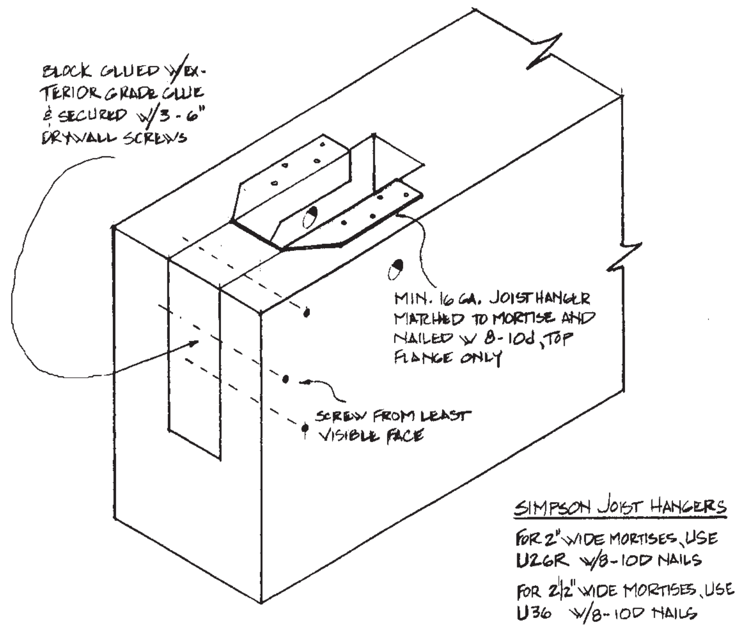


Fig. 13. The relish of mortises at the end of a timber such as a plate or sill often pops out under load. In addition to new relish carefully fitted, glued and screwed in place, this repair uses an off-the-shelf joist hanger (available in the common mortise widths) that reinforces the joint and ultimately will be concealed.

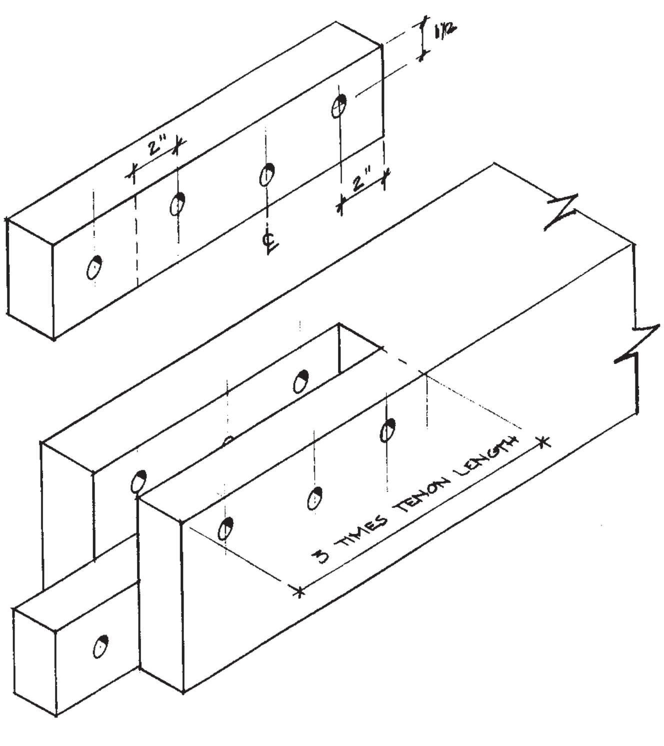


Fig. 12. When only a portion of the tenon is broken or decayed, only that portion need be replaced, with a partial free tenon. Pins can be kept blind on one side.

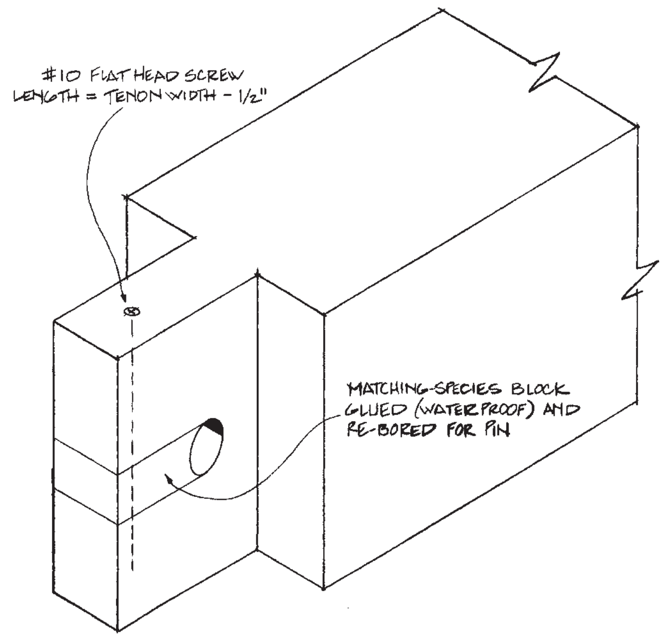


Fig. 14. When the pin hole relish is missing but the tenon is otherwise sound, a new section is carefully fitted, glued and screwed, then rebored with the original offset. Though unable to handle large tensile loads, it can draw the joint up tight.

They are a great aid to the design professionals (engineer and architect), the building officials, ancillary trades, the contractors and the owner. For simpler projects with minimal budgets, quick field sketches may suffice. Though they may be done quickly, they should specify all materials and joinery, and copies should be in the hands of the owner, the professionals and the contractors. Drawings are essential for communication and estimating.

The actual repairs should be designed with these criteria:

1. Repairs using traditional carpentry techniques are preferable to modern solutions (e.g., steel, epoxy, engineered wood, etc.). This criterion helps to keep the timber framing craft alive.

2. Materials should match the original work if possible in species and surface (hand hewn, sawn, hand forged, and the like).

3. Structural integrity, ease of execution and insertion, and ultimate durability should determine the choice of repair technique.

4. Minimal disturbance should be made to the building's fabric, and minimal visibility should characterize the repair.

The figures, a sampling of repair drawings from actual jobs, give some idea of the possibilities, which are extensive. Most show somewhat typical repairs; Figs. 3, 16 and 18 were specific to their projects. All proposed repairs should be checked by a design professional for the specific situation at hand. —Jack A. Sobon

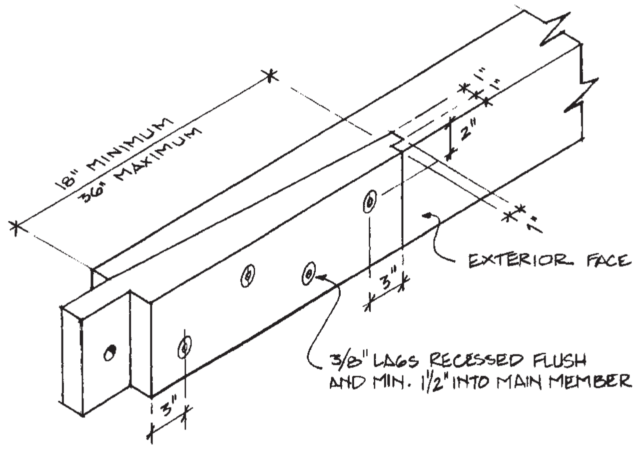


Fig. 15. When more than the tenon is decayed, this timber end repair can be used, secured by mechanical fasteners from the least visible face.

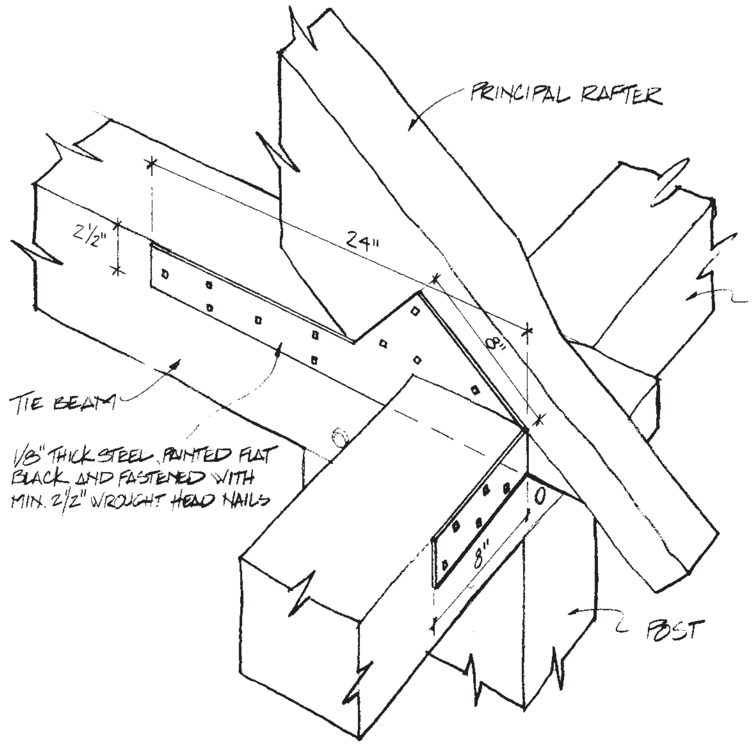


Fig. 18. Later carpentry compromised both the tie beam's lap dovetail joint at the plate and the relish of the principal rafter mortise in this 1770s tying joint. A low-profile, custom-fabricated steel gusset was the best solution here.

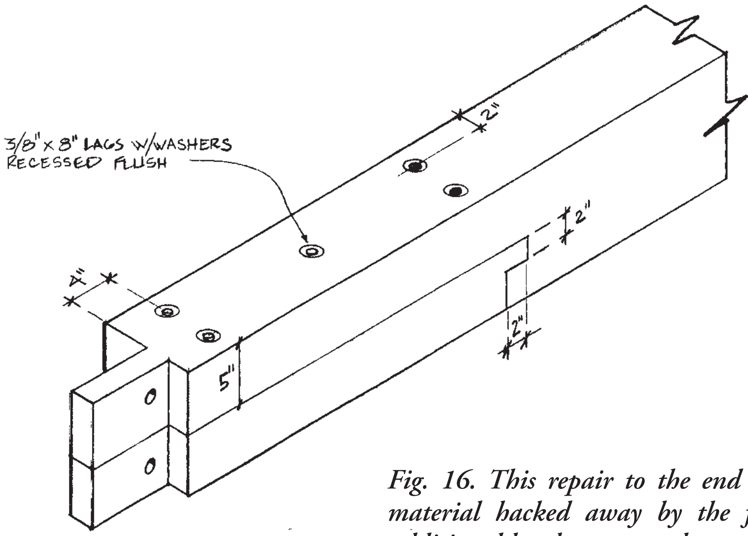


Fig. 16. This repair to the end of a girt replaced material hacked away by the farmer to provide additional headroom at a doorway. Lag screws from the unseen upper face secure the bladed lap .

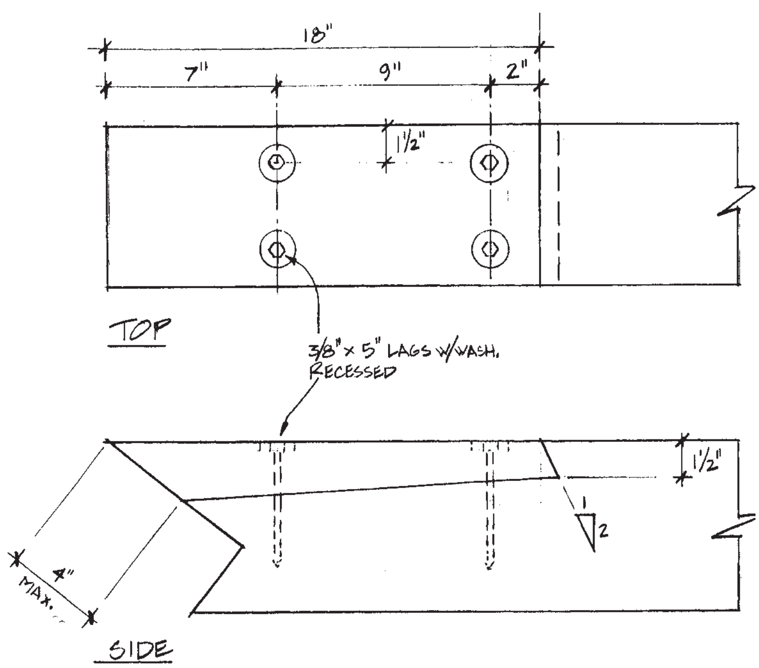


Fig. 17. This undersquinted lap repair was specified for the butts of Duch barn rafters approximately 7 in. square at their bearing ends. Original wood keeps the birdsmouth functional.

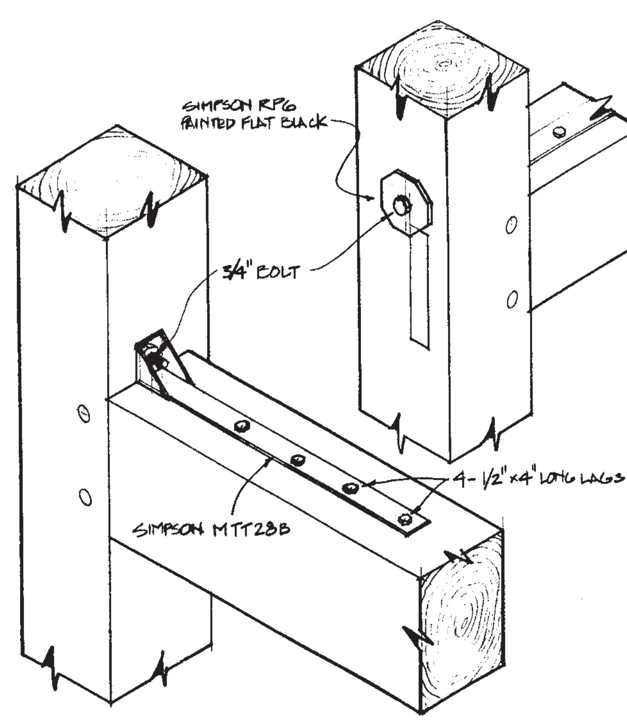


Fig. 19. Off-the-shelf components reinforce a tying joint in place. Allowable component loads are listed by the manufacturer.

TIMBER FRAMING FOR BEGINNERS

VI. A Glossary of Terms

ABUTMENT. In joinery, the end of one timber touching another. See also BUTT JOINT.
ADZE. A handled edge tool (various patterns) with its edge at a right angle to the handle, used to shape or dress timbers.
AISLE. Lengthwise space (parallel to the roof ridge) in a building divided into several such spaces, usually three. Cf. BAY.
ANCHOR BEAM. Major tie beam joined to H-bent posts, generally with shouldered, outside-wedged through-tenons.
ARCH BRACE. 1. Curved brace. 2. Brace rising from bridge abutment to support lower chord of truss.
ARRIS. The edge along which two adjacent surfaces meet.
ASHLAR PIECE. Short vertical strut near the foot of a rafter, joining it to a sole piece at the top of a masonry wall.
AUGER. A handled edge tool for boring holes in wood.
BACKING. Top surface of a hip or valley rafter, beveled to follow the slopes of adjacent roof surfaces. The hip backing is thus convex, the valley backing concave.
BAREFACED DOVETAIL. A dovetail (see) flared only on one side and thus suitable for mortising as well as housing. Also *half-dovetail.*
BAREFACED TENON. A tenon flanked by only one shoulder.
BARGE BOARD. The board covering the ends of purlins at the gable end of a roof. Also RAKE.
BASE CRUCK. Cruck with blades starting as posts and curving upward to end at the collar beam. Cf. CRUCK FRAME.
BAY. The volume between two bents or crossframes. Cf. AISLE.
BEAM. Any substantial horizontal member in a building's frame.
BEETLE. A large wooden mallet typically weighing 15 to 30 lbs. Also COMMANDER, PERSUADER.
BENDING. Deviation from straight resulting from the application of force. In a bent member, the concave surface is compressed, the convex surface is tensioned and the neutral axis is unaffected.
BENT. 1. An assemblage of timbers perpendicular to the ridge, usually the crossframe of a building, sometimes including rafters, assembled on the ground and then reared up into position. 2. One of the supporting frames of a railroad trestle.
BEST EDGE. On a timber to be laid out, the secondary reference surface adjacent to the best face.
BEST FACE. On a timber to be laid out, the primary reference surface, which will typically receive flooring or wall and roof sheathing. Not an appearance term.
BEVEL. Any non-orthogonal angle taken through the breadth or depth of the material; the tool to measure or lay out such angles.
BINDING JOIST. Transverse floor timber (runs perpendicular to the ridge) connecting posts and carrying common joists. Cf. BRIDGING JOIST.
BIRDSMOUTH. A 90-degree notch cut into the seat of a rafter to fit the corner of the plate or a step in it.
BLADE. 1. In a scarf joint, the termination of one half of the joint so as to lap under the beginning of the other half. 2. In a cruck frame, one half of the cruck.
BOLT-O'-LIGHTNING. Scarf form with many abutments, whose jagged interface line resembles its eponym; used in heavy work.
BORING MACHINE. A hand-cranked device with gears that drive an auger bit, used to bore large holes, as in roughing out a mortise.
BOW. Deviation from straight in the length of a timber. Also SWEEP. See also CROOK and CROWN .
BOXED HEART TIMBER. Timber whose section includes the heart of the tree. Since checks will not cross the heart, such a timber can never split completely. Cf. FOHC.
BOX FRAME. Construction in which roof trusses are carried by a self-supporting structure of posts, tie beams and wall plates. Cf. CRUCK FRAME.
BRACE. Any diagonal timber (permanent or temporary) that resists distortion of a frame. See also KNEE BRACE.
BRACKET. Block tenoned or pegged to one timber to support another. Also *cleat.*
BREADTH. See WIDTH.
BRIDGING JOIST. Intermediate floor beam connecting one crossframe to another and carrying the inner ends of common joists. See also SUMMER BEAM. Cf. BINDING JOIST.
BRIDLE. 1. An open mortise and tenon end joint, such as at a rafter peak or sill corner, with one end of the mortise open (see TONGUE AND FORK). 2. An open mortise and tenon joint between the top of a post (the bridle) and a passing beam reduced in section to form the tenon.
BROADAXE. Wide-bladed axe with its edge usually beveled only on one side, and fitted with an offset handle for knuckle clearance. Used to hew timbers from logs or for similar shaping work.
BUCKLING. Irreversible bending of a timber as a result of a compressive force along its axis.
BUILDER'S LEVEL. A rotating telescope set on a tripod and used for leveling a foundation or sill timbers.
BUTT. 1. The end of a log that in the living tree stood at the ground; generally, the larger end. 2. The end of a timber cut at right angles to its length.
BUTT JOINT. An abutment (see) of two timbers without penetration, kept in place by gravity or other timbers, or ironwork.
BUTTRESS. A reinforcing mass, typically masonry, built against a wall to counteract the thrust of an arch.
CAMBER. Hewn, sawn, natural or deliberately bent upward sweep in a beam or in its top surface, often incorporated into the lower chords of timber trusses, to increase stiffness (especially in bridges) or to obtain aesthetic effects in the space below. See also CRANK.
CANTILEVER BEAM. A projecting timber unsupported at one end.
CARRYING STICKS. Sticks placed under a timber to provide easy handholds for carrying.
CHAIN MORTISER. Jigged power tool with chain-mounted cutters that plunge into the face of a timber to cut a mortise, fitted with a depth stop and other controls.
CHAMFER. A bevel cut at the long arris of a timber, which may be run right through or decoratively stopped before the ends; a bevel at the leading arrises of a tenon, to ease assembly.

CHASE MORTISE. 1. A lengthened mortise for swing-insertion of a tenoned member otherwise impossible to insert in an existing assembly, such as a brace or a joist added after assembly of main members. See also PULLEY MORTISE. 2. A mortise with one end angled to follow the slope of a member such as a brace.
CHECK. Separation of wood fibers along the rays, caused by the tension of differential radial and tangential shrinkage or by surface fibers of a timber drying first and attempting to shrink around an incompressible, still-wet center.
CHECK BRACE. A short, low-angle brace fitted behind a principal post in a bridge truss as reinforcement. It tranfers back to a housing in the chord the horizontal component of the main brace load arriving on the front of the post. Also *kicker* (M. Graton, 1972).
CHEEK. The broad surface of a tenon; the corresponding surface of a mortise. The tenon shoulder is usually square to its cheek.
CHORD. In a truss, the major uppermost member (*top chord*) or lowermost member (*bottom chord*). In a roof truss, the principal rafters serve as top chords, the tie beam as bottom chord.
CLASPED PURLIN. A purlin fitted under the common rafters (the principal rafter is reduced to match) and over the collar beam.
COG. Recess in one timber to accept full cross-section of the end of another timber; notch. See also HOUSING.
COLLAR BEAM. Horizontal member fitted between a pair of opposed rafters, used, depending upon position, to prevent sagging or spreading of the rafters. Often improperly called *collar tie.*
COLLAR PURLIN. In a roof frame, the central longitudinal beam running under the collar beams and usually supported by crown posts.
COMMANDER. See BEETLE.
COMMON PURLIN. In a roof frame, lengthwise member, regularly spaced in sets, connecting principal rafters and carrying the roof sheathing. See also PRINCIPAL PURLIN.
COMMON RAFTER. Inclined member, regularly spaced in sets, that supports the roof sheathing. See also PRINCIPAL RAFTER.
COMPOUND JOINERY. A connection whose timbers are cut at non-orthogonal angles on both face and edge, typically found in hip and valley roofs.
COMPOUND ROOF. Hips (outside corners) or valleys (inside corners) formed where two adjacent roofs join at an angle.
COMPRESSION. The state of stress in which particles of material tend to be pushed together.
CORBEL. A block protruding from a wall to support the springing point of a masonry arch or a roof or floor member.
CORNER CHISEL. A chisel with two equal cutting edges forged at 90 degrees, struck with a mallet to clean out the corners of a mortise.
CRAB. In steeple work, an eight-armed flat roof frame that sits upon the octagon stage of a steeple, supporting the next octagon.
CRANK. A sharp change of angle in a timber, usually in a collar or tie beam higher at the center than at the ends on both upper and lower surfaces. See also CAMBER.
CRIBBING. Stack of crisscrossed short timbers used for temporary support of a structure or timbers being worked on.
CROOK. Deviation from straight in the length of a timber. In a plank, *crook* is curvature of the width, *bow* (see) is curvature of the thickness; in a squarish timber, the two are indeterminate.
CROSSCUT SAW. Saw whose teeth are sharpened to a point and set outward to cut across the wood fibers by severing to left and right, so that the waste between falls out as dust. Cf. RIP SAW.
CROSSFRAME. See BENT. However, traditional crossframes do not include rafters.
CROSSGRAIN. Grain not parallel to the long axis of a timber. The ultimate strength of a timber is greatly dependent on the slope of its grain. Also DIAGONAL GRAIN.
CROWN. Curvature in a timber's length placed upward in spanning members where the load will tend to straighten it.
CROWN POST. Central post of a roof truss that connects the tie beam to the collar or to the collar purlin.
CRUCK FRAME. Early timber frame type with each crossframe made up of two opposed and collared timbers, usually curved, set up as an arch or A-frame that rises from the ground or a short foundation. Each half of a cruck is called a *blade*, and a matched pair of blades is often cut from the same tree. Cf. BOX FRAME.
CRUSHING. Permanent deformation resulting from compression.
DAP. To house in (usually) a beam; the housing (see) itself.
DEAD LOAD. Weight of building (roof, floors, walls, etc.).
DEFLECTION. Movement of structure under load.
DEPTH. 1. The vertical dimension of a beam or rafter. 2. The sectional dimension of a post measured perpendicular to the wall; otherwise, the larger dimension of a post.
DIAGONAL GRAIN. Also *sloped grain.* See CROSSGRAIN.
DIMENSION LUMBER. Planed timber sold according to its nominal size, usually less than 6 in. thick.
DORMER. Aperture or window of variable shape rising upright from the surface of a roof and having its own roof. According to its extent and form, a dormer may be termed *eyebrow, doghouse, roundhead, shed* or *running.*
DOUBLE TENON. Two tenons cut in line on the end of a wide or deep member. A triple tenon is possible. Cf. TWIN TENON.
DOVETAIL. A central or lap tenon shaped like a dove's spread tail to fit a corresponding notch. See also BAREFACED DOVETAIL.
DRAGON BEAM. A horizontal timber bisecting the angle formed by two wall plates and used to carry the foot of a hip rafter or the inner ends of joists from the adjacent walls, or both.
DRAWBORE. Traditional fastening technique in which the peg hole in the tenon is deliberately offset from the peg hole in the mortise to draw a joint tight when assembled and fastened with a tapered pin. The proper offset varies with species and scale.
DRAWKNIFE. A large knife blade with bent tanged handles at each end so that the knife can be pulled with both hands toward the user; for chamfering, shaving pegs and shingles and general trimming.
DRIFT PIN. Tapered iron pin with enlarged head used to bring joints home and hold them temporarily during assembly, to be removed and replaced by a permanent wooden pin. Also *hook pin.*
DROP. In general, any ornamental pendant; in particular, the square-turned or carved termination to the lower end of a second-story post in a framed floor overhang.
EAVE, EAVES. The drip edge of a roof, often overhanging the wall.
EDGE-HALVED. A lengthwise timber joint divided through its thickness; a class of scarf joints. Cf. FACE-HALVED.
EXTREME FIBER STRESS. Maximum compression in the concave edge and tension in the convex edge of a member in bending without failure.
FASCIA. Generally, a face board to cover the exposed ends of joists or rafters. In neo-Classical trim, the horizontal band in the cornice assembly, set plumb to cover the edge of the soffit.
FACE-HALVED. A lengthwise timber joint divided through its width; a class of scarf joints. Cf. EDGE-HALVED.
FISH, FISHPLATE. Reinforcing member applied over a break in a timber or an end joint between two timbers; usually applied in pairs and bolted right through.
FLYING PLATE. In a framed overhang, a beam set outside the wall plane and forming a solid base for the cornice elements and sometimes for the feet of common rafters; it can be continuous or interrupted (by tie beams) according to the framing system. Cf. PLATE.
FOHC. Free of heart center. Timber sawn to exclude the heart can in theory be seasoned without checking.
FOOTING. Sub-foundation.
FRAMING CHISEL (US). A long, rectangular-section heavy-duty socket-chisel typically 1½ in. or 2 in. wide, handled for striking.

FRAMING SQUARE. L-shaped metal graduated measuring tool with legs fixed at 90 degrees, used for layout and checking of angular lines. Most framing squares have a *body* 24 in. long by 2 in. wide and a *tongue* 16 in. long by 1½ in. wide. Also STEEL SQUARE, RAFTER SQUARE.
FREE TENON. A tenon cut as a separate piece and used, via appropriate mortises, to join two timbers face to face, end to end or end to face. See also SPLINE.
FROE. A stout, flat-bladed, handled tool for cleaving pegstock as well as shingles, clapboards or sections for furniture.
GABLE ROOF. A double-sloping roof that forms an inverted V.
GAIN. Sizing (see) reduction at timber surface in joinery area; any shallow housing, as for a hinge. Cf. HOUSING.
GAMBREL ROOF. A double-pitched, double-sloping roof with the lower slopes steeper than the upper slopes; resembles the gable roof but with each leg of the inverted V broken into two pitches.
GIN POLE. A lifting device composed of a single pole, stayed by guy lines, from which lifting tackle is hung.
GIRDER. Major timber spanning between sills to carry floor joists.
GIRDING BEAM. See BINDING JOIST.
GIRT. Horizontal timber joining wall posts at a level somewhere between sill and plate. A *wall girt* runs parallel to the ridge, a *bent girt* perpendicular; either can support the edge of a floor frame.
GRAIN. The pattern of growth rings, rays and other structural elements in wood made visible by conversion from the tree.
GREEN WOOD. Wood freshly cut, not dried or seasoned.
GROUNDSILL. Sill, originally laid directly on the ground.
GUNSTOCK POST. A post deeper at the top to provide more wood for intersecting joinery, and usually obtained by inverting the timber from its grown position to take advantage of butt taper or swell. Cf. JOWL.
HALF DOVETAIL. See BAREFACED DOVETAIL.
HALF LAP. An end joint or a crossing (the latter called a *halving)*, in which two timbers are let in to each other to half their depths.
HALF-TIMBERED. 1. An evolved building type in which wall timbers are spaced out (cf. STAVE CONSTRUCTION), to be filled in with other materials. 2. Closely studded or otherwise elaborated versions of the type. See NOGGING and WATTLE AND DAUB.
HALVING. See HALF LAP.
HAMMER BEAM. A roof bracket consisting of an interrupted tie beam projecting from the top of a wall and supporting a roof truss. A complete hammer beam roof frame permits a large roof span made of relatively short timbers.
HARDWOOD. Wood of certain deciduous trees, e.g., oak, beech, ash and the like. Cf. SOFTWOOD.
HAUNCH, HAUNCHED TENON. On a tenon, the part—square or diminished in outline—that would otherwise be removed to preserve the relish of a mortise cut quite near the end of a timber. The haunch helps preserve alignment of the members without unduly weakening the end of the mortise.
H-BENT. Crossframe made up of floor-to-roof posts connected by a heavy, braced tie beam, usually enclosing the taller central aisle of a Dutch or other three-aisle barn.
HEADER. 1. Floor member running across the joists at an opening, as for a staircase, and supporting the ends of cut joists. 2. Wall member bridging the opening for a door or window and carrying any cut studs. 3. Roof member bridging the opening for a chimney, dormer or skylight and carrying any cut rafters.
HEARTWOOD. The inner, nonliving part of the tree, as a rule the more durable portion.
HEW. Shape wood with an axe, usually to convert a log to a timber.
HIP RAFTER. In a roof frame, the rafter that follows the line of the hip, typically backed to follow the slopes of the adjacent roofs.
HIP ROOF. A compound roof occurring where two roof slopes meet over an outside corner. Cf. VALLEY ROOF.
HOG. Lengthwise deformation of a timber supported in the middle and (over)loaded at its ends. Cf. SAG.
HOLLOW CHISEL MORTISER. Jigged power tool with auger bit fitted inside a square hollow chisel that plunges into the face of a timber to cut a mortise, fitted with depth stop and other controls.
HORIZONTAL SHEAR. Shear along the grain resulting when a beam is loaded in bending.
HOUSING. A shallow mortise or cavity to receive the full section of a timber end for load bearing. Often but not always combined with a standard mortise to add bearing area and secure the connection via the tenon. Cf. GAIN. See also COG and DAP.
HUNDEGGER. Proprietary name for computer-controlled industrial joinery machine designed to handle large timbers.
INFILL. 1. Insulation placed inside timber-framed walls (see NOGGING and WATTLE AND DAUB). 2. Studding placed between major posts to support interior and exterior finish.
JACK RAFTER. A roof framing member that lies in the common pitch and terminates at the hip or valley rafter. In a valley system, the jack runs from the ridge down to the valley; in a hip system, it runs from the eave up to the hip. In general, any rafter shortened from its full run between ridge and plate.
JAMB. Side of any opening such as a door or window.
JETTY. Cantilevered overhang of an upper story.
JOINERY. The work of connecting timbers using woodwork joints; the joints themselves.
JOINT. The connection of two or more timbers; to make one (UK).
JOIST. Relatively small timber, usually spaced regularly in sets to support a floor or ceiling.
JOWL. Local step or flare near end of post or beam to accommodate joinery. Cf. GUNSTOCK POST.
JUGGLING. In hewing, striking a log crosswise at wide intervals and then splitting off the chunks in between, to remove the bulk of the waste before broadaxe work. Also SCORING.
KERF. The space left by the passage of a saw blade.
KERFING. 1. Making a series of shallow sawcuts to hasten the removal of a section of wood. 2. Sawing along the abutments of an assembled joint to improve the fit.
KEY. Small element, usually wedge shaped, used to lock a joint or, if a shear key, to prevent sliding of one member over another.
KINGPOST. In a truss, the central, vertical member extending from the tie beam (or *lower chord*) to the peak and receiving the upper ends of the rafters (or *upper chords*). Cf. QUEENPOST.
KNEE. Alternative term for brace, but often implying a naturally curved piece, usually taken from the base-swell of certain trees, that presents long grain to both timbers being braced. Knees are termed *hanging* (if beneath the beam), *standing* (if above the beam) and *lodging* or *lying* (if bracing beam to beam).
KNEE BRACE. A relatively small, short timber framed diagonally between two members at right angles to stiffen their connection.
LAP JOINT. Similar to the half-lap joint, but the parts are not necessarily housed to half their depths.
LAYOUT. The drawing of a joint on a timber before it is cut; the arrangement of timbers into a predetermined pattern for marking.
LEAN-TO. A shed-roofed section of a building, often an addition, joined into the main frame. See also OUTSHOT.
LEDGE OR LEDGER. Band of timber fastened to or let into the face of studs or posts to support the outer ends of floor joists. Also RIBBAND.
LINTEL. Horizontal beam over a door or window opening. Also HEADER.
LIVE LOAD. All load other than the permanent weight of a structure including people, furnishings, snow, wind, earthquake, etc. (Cf. DEAD LOAD.)
LOAD. Force imposed on a structure.
MALLET. A hammer of wood, rawhide, steel or synthetic materi-

al, weighing generally between 24 and 40 oz., and used to drive a framing chisel.
MARRIAGE MARKS. Marks incised in a timber to indicate its proper placement in the frame when matched to identical marks on an adjoining timber. By extension, any marking system to aid assembly or reassembly of individually fitted joints.
MAST. In framed spires, a central timber that anchors the spire rafters at their apices and moves the center of gravity of the spire inward and down. Masts often exceed 45 ft. and may be pendant, compressing the rafters, or clasped by partner timbers (nautical tradition) to stiffen the spire.
MITER. Equal division of the angle formed by two intersecting members.
MODULUS OF ELASTICITY. A measure of stiffness of a material. The ratio of stress (force per unit area) to strain (deformation).
MOMENT. A load that imparts torque or rotation, quantified as the product of a force times the distance over which it acts.
MOMENT OF INERTIA. A measure of the resistance of a body to angular acceleration about a given axis. Moment of inertia is the section property used to gauge the stiffness of a beam in bending. For rectangular members of breadth *b* and depth *d*, the moment of inertia taken through the centroid (center of mass) of the section is quantified by the formula $I = bd^3 \div 12$.
MORTISE. In general, a rectangular cavity into which a tenon (or another object such as a lock) may be inserted.
MORTISE AND TENON JOINT. The end of one timber, usually reduced in section to form the *tenon*, inserted into a corresponding cavity, the *mortise*, in the face of another timber, and most often pinned across, though sometimes otherwise secured.
MUD AND STUD (UK). 1. Late framing method using relatively few and light framing members infilled with wattle and daub. 2. Notorious timber framers' pub in the East Midlands.
MULLION. Vertical division in window opening.
NOGGING. Infill in early framed walls, often brick. See also WATTLE AND DAUB and HALF-TIMBERED.
NOMINAL SIZE. Sawn or hewn timber dimensions before *sizing*; actual dimensions may be larger or smaller than nominal.
NOTCHED LAP JOINT. Lap joint with interference surface cut to prevent withdrawal of the tenon, found in very early braces.
OUTSHOT. Lean-to (see) area added to a building, usually an aisle.
OVERHANG. Projection of second story beyond the first, or projection of roof over wall.
PACKING PIECE. 1. Short piece of material used to fill the empty space in a mortise previously elongated to allow insertion of a tenoned member into an existing assembly. 2. In cruck framing, the cleat set on the back of a cruck blade to carry a purlin.
PARGETING. External plastering.
PASSING BRACE. A long brace half-lapped over other timbers, sometimes running from plate to sill (Cecil Hewett, 1962).
PEAVEY. A pointed tool with long stout handle and forged side hook, used to roll logs or heavy timbers.
PEG. A wooden pin typically ¾-in. dia. and larger, usually of oak or other tough hardwood, formerly riven and shaved, now usually turned, and used to fasten timber joints, particularly the mortise and tenon joint. Bridge builders distinguish tapered *pegs* from cylindrical *pins*: the latter are used particularly at connections stressed in shear (see PIN 2).
PENTICE. Narrow roof projecting from a wall over a door or window to protect it from the effects of the weather.
PERSUADER. See BEETLE.
PIKE POLE. A long pole, pointed with a sharpened spike, used to raise frames. These tools were known as early as the 15th century, when they were called *butters*.
PIN. 1. A short shaft of tough hardwood, often tapered, used to draw together and fasten the traditional mortise and tenon joint in timber framing. See PEG. 2. A pin of uniform diameter, usually 1 or 2 in., used to transfix timber, join members or resist flexure when the goal is to maximize the uniform bearing area between timber and fastener, notably in bridge lattice-truss work.
PLATE (US). In normal position, the most important longitudinal timber in a frame. It ties the bents together at their tops and simultaneously stiffens and connects the wall and roof planes while providing a base for the rafters. Also *top plate, wall plate*. Cf. FLYING PLATE.
PLATE (UK). The sill or the subsill; the sole plate.
PLUMB. Vertical; perpendicular to the ground.
POST. Vertical or upright supporting timber. See STORY POST and PRICK POST. Cf. BEAM.
POST AND BEAM. 1. Any structural system made up primarily of vertical and horizontal members. 2. Such a system in which floor and roof loads are carried by principal timbers butted together and fastened with structural hardware. 3. A structural system of heavy timbers connected by woodwork joints. See TIMBER FRAME.
PRICK POST. A post of single-story height.
PRINCIPAL PURLIN. In a roof frame, lengthwise timber connecting principal rafters and carrying common rafters. See also CLASPED PURLIN, COMMON PURLIN, PURLIN and RIDGE PURLIN.
PRINCIPAL RAFTER. In a roof frame, a large inclined timber carrying a substructure of purlins and common rafters, usually but not always placed over a principal post.
PULLEY MORTISE. 1. Long mortise found at the lower edges of the lower chords of roof trusses, where ceiling joists were evidently swung in after erection of the trusses. See CHASE MORTISE.
PURLIN. Any longitudinal member in a roof frame lying in or parallel to the roof plane.
PURLIN PLATE. In a roof frame, a longitudinal continuous timber used to support common rafters near the center of their span and itself supported by posts or struts.
PYTHAGOREAN THEOREM. In a right triangle, the theorem that the sum of the squares of the sides is equal to the square of the hypotenuse ($a^2 + b^2 = c^2$). Used to calculate rafter, knee-brace and other lengths.
QUEENPOST. In a truss, one of a symmetrically placed pair of vertical members standing on the tie beam or lower chord and separated at their upper ends by a straining beam. In a barn, queenposts may be full height and connect to rafters, the collar beam or purlin plates. Cf. KINGPOST.
RABBET. An open (one-sided) groove cut at an arris.
RABBET PLANE. A handplane with cutting edge exposed completely across the sole, and thus able to cut up to an inside corner; used to trim tenon cheeks and shoulders, to level material across the grain and to form or trim rabbets.
RACK. The action of straining or winching a framework to bring it into square or plumb; the opposite action by a force of nature.
RAFTER. In a roof frame, any inclined member spanning any part of the distance from eave to peak. See COMMON RAFTER, PRINCIPAL RAFTER and JACK RAFTER.
RAFTER FOOT. The lower end of a rafter, usually framed into a plate or a tie beam, rarely into a post.
RAFTER PEAK. The point where the tops of opposed rafters would meet if mitred (see). A series of such points forms a *ridge*.
RAFTER SQUARE. See FRAMING SQUARE.
RAISING (A FRAME). Erecting the bents, roof trusses and other subassemblies of a frame and fastening them. Also REARING.
RAKE. In a gable or gambrel roof, the edge of the roof as seen at the gable end. Also BARGE BOARD.
RAKING STRUT. In a roof truss, an inclined member fitted between the tie beam and the principal rafter.
REACTION. A force pushing back in response to a load.
REARING (A FRAME). UK term equivalent to RAISING.

RELISH. 1. In the case of a mortise cut quite near the end of a timber, material the width and depth of the mortise remaining between the mortise-end and the end of the timber; in a tenon, material between the peg hole and the end of the tenon, equal in cross-section to the path of the peg through the tenon.
REVERSED ASSEMBLY (UK). For a timber frame with continuous top plate, raising procedure in which the crossframes or bents including tie beams are raised first and the top plates are laid last. Traditional assembly first raises the sidewalls including the plates and lays the tie beams over the plates, as for the English tying joint (Cecil Hewett, 1962). American frames with dropped tie beams are raised by "reversed assembly."
RIBBAND. See LEDGE.
RIDGE (RIDGE PIECE, RIDGE TREE). In a roof frame, the continuous longitudinal timber at the peak of the roof to which the rafters and sometimes wind braces are attached; ridges are often five-sided or otherwise non-orthogonal in section to allow square connections to the rafter ends when the roof peak is not square.
RIDGE PURLIN. In a roof frame, a ridge member, continuous or interrupted by rafter apices, lying in notches or trenches on one side of the roof; if continuous, sometimes itself trenched where it crosses a principal rafter.
RIP SAW. Saw whose teeth are designed to cut parallel to the wood fibers, each tooth a small chisel to shave off lengthwise a short bundle of fibers that falls out as stringy waste; the teeth are set left and right merely for clearance. Cf. CROSSCUT SAW.
RIVE. To split wood along the grain, thus avoiding any slope of grain, for maximum strength in a given cross-section; pegs, ladder rungs and chair parts were formerly riven and shaved.
ROOF PITCH. Inclination of a roof to the horizontal, usually given as inches of rise per foot of run. For example, a roof inclined at 45 degrees has 12 inches of rise for each foot of run and is therefore called a "twelve-pitch" roof.
ROOF TRUSS. See TRUSS.
ROUTER. A hand or power tool designed to produce or to level grooves and housings along and across the grain; the power tool can also be used as a molding plane.
SAG. Lengthwise deformation of a timber supported at its ends and (over) loaded at its middle. Cf. HOG.
SALLY. Pointed end of a scarf-half.
SCANTLING. 1. The cross-section of a timber, as found in a table of scantlings, together with length. 2. Any small piece of wood.
SCARF. To join two equal-section timbers in their length to make a longer beam; the joint so used. There are many variations in the form of scarf joints, such as *bladed, bridled,* or *stop-splayed.*
SCHNAFF. Slang for an inch and a half.
SCORING. See JUGGLING.
SCRIBE. In general, to mark a timber by scratching a line with a sharp instrument; specifically, to use dividers to transfer a profile to be cut—often enough irregular—from one surface to another.
SCRIBE RULE. General term for layout systems where each timber is custom-mated to its neighbors. The process requires setting out all the timbers for a given assembly in a framing yard or on a floor, positioned relatively as they will ultimately rest in the building. Cf. SQUARE RULE.
SEASONED WOOD. Wood dried over time to equilibrium moisture content with its atmosphere.
SECTION MODULUS. The section property used to quantify the strength of a beam in bending; for rectangular sections, given as $S = bd^2 \div 6$.
SHAKE. Separation of the growth rings in a timber, a structural defect normally developed during the growth of the tree.
SHEAR. State of stress wherein particles of material tend to slide relative to each other; the force inducing such stress. Vertical (cross-grain) shear loads also impart horizontal (long-grain) shear stress.
SHEAR BLOCK. Wood block dapped (let in) partially to adjoining parallel laminae in a built-up chord, designed to resist shear between the two members or to transfer load around a discontinuity such as a scarf, and properly oriented parallel to the grain, so that shear block end grain bears upon chord end grain.
SHEAR KEY. Wood block oriented perpendicular to (across) the grain. Easier to assemble, and tightenable if wedge-shaped, but not so resistant to compression as a shear block.
SHEATHING. A covering of rough boards or sheet goods on exterior walls or roofs, usually itself covered by an additional weatherproof layer of material.
SHED ROOF. A monoplanar roof sloping in one direction.
SHOULDER. In a mortise and tenon joint, the element of the tenoned member perpendicular to the tenon cheek, and which lies against the face of the mortised member; there can be as few as one and as many as four shoulders on the tenoned member.
SHRINKAGE. Reduction in section and length of a timber as it dries. Sectional shrinkage is analyzed into *tangential* (shortening along the rings) and *radial* (shortening along the rays).
SILL. Horizontal timber that rests upon the foundation and links the posts in a frame; usually fastened to the foundation.
SIZING. Planing hewn or roughsawn timber to uniform section, by hand locally at the joints, or by machine for the whole timber.
SLICK. A large, long, heavy chisel with a blade as much as 4 in. wide, fitted with a handle meant to be gripped with both hands, used for trimming and surfacing of all kinds.
SOFFIT. 1. In general, the underside. 2. In neo-Classical trim, the cornice element set level and joined to the fascia to form a band under the edge of the eaves. 3. The trim piece covering the undersides of overhanging rafters for a roof without cornice.
SOFFIT TENON. A horizontal tenon with lower cheek coplanar with the lower surface of its beam.
SOFTWOOD. The wood of conifers or evergreens, e.g. pine, spruce, Douglas fir and the like. Cf. HARDWOOD.
SOLE PIECE. Short beam at top of masonry wall to carry the foot of the rafter and the ashlar piece; a sort of interrupted tie-beam for intermediate roof crossframes.
SOLE PLATE (UK). Sill.
SPAN. In a roof frame, the horizontal distance covered by a rafter; in a beam, the unsupported distance from support to support.
SPANDREL. The triangular space between a knee brace or arch brace and its adjoining members.
SPIRAL GRAIN. In the log, the disposition of the fibers twisted like a corkscrew around the pith of the tree (and normally visible in the bark); in the timber, distinctly sloped grain as displayed by the direction of the rays. Such timbers tend to twist as they dry and are weaker in ultimate bending than straight-grained examples.
SPLAY. 1. In a vertical member, divergence from upright. 2. In a scarf joint, a cut through the depth or breadth of the timber not parallel to the original surface.
SPLINE. 1. A relatively thin piece of material fitted to full-length grooves in the edges of planks, used for alignment and load sharing; a feather. 2. A stout piece of material, comparable in section to a tenon, used particularly to join beams to posts in three-way and four-way joints where individual mortises cut for each entering tenon would weaken the post fatally. See also FREE TENON.
SPLIT. Complete separation of wood fibers, normally on a ray plane. See also CHECK.
SPOKESHAVE. An extremely short plane with wing handles in line with the edge of the blade. Pushed or pulled, it is used for forming and finishing curved surfaces.
SPUR. 1. The short tie that connects a cruck blade to the outside wall post or plate. See CRUCK FRAME.
SQUARE. At an angle of 90 degrees; a measuring tool so angled.

SQUARE RULE. Layout system in which a smaller, perfect timber is envisioned within a rough outer timber; joints are cut to this inner timber. Many timbers in a square rule frame are interchangeable.
SQUARING OFF. Cutting off one end of a timber so that the cut gives a plane surface perpendicular to the length; helpful for layout.
SQUINT. In a scarf joint, an abutment angled at other than square.
STAVE CONSTRUCTION. Ancient wall method of solid posts.
STEEL SQUARE. See FRAMING SQUARE.
STICKER. Spacer used between stacked timbers or boards to provide air circulation and between stacked bents for strap clearance.
STOP. See CHAMFER.
STORY POLE. A slender stick marked with important intervals, for repeated transfer in frame, finish or individual timber layout.
STORY POST. A wall post that rises through more than one story.
STRAINING BEAM. The topmost horizontal timber joining the upper ends of queen posts in a truss or in a roof frame.
STRESS-SKIN PANEL. A sandwich of two layers of sheet goods enclosing and bonded to a core of framing lumber.
STRUCTURAL INSULATED PANEL. A sandwich of two layers of sheet goods enclosing and bonded to a core of thermal insulation.
STRUT. An axially loaded minor member in a truss or frame.
STUB TENON. Abbreviated tenon designed for location only.
STUD. Subsidiary vertical member in a framed wall or partition.
SUMMER BEAM. Major timber spanning between other floor timbers to support common joists. See BRIDGING JOIST.
SWEEP. See BOW.
TABLE. 1. In a scarf joint, the raised portion of each scarf-half, designed to interfere once assembled and so prevent withdrawal in the length. 2. The broad surface of a vertical housing.
TEAZLE TENON. In the English tying joint, the tenon cut at the top of the post that engages the underside of the tie beam.
TELESCOPING FRAMING. Steeple framing, concealed from the outside, that lodges the bottom timbers of any given stage several feet within the frame of the stage below, contributing stability.
TEMPLATE. A full-size pattern of thin material, used for laying out and checking joints and other purposes.
TENON. The end of a timber, reduced in section and flanked by one or more resulting shoulders.
TENSION. The state of stress in which particles of material tend to be pulled apart.
THICKNESS. See DEPTH.
THROUGH TENON. A tenon that passes right through the timber it joins; it may be cut off flush or it may extend past the outside face of the mortised member to be wedged or locked in place by one of several means.
TIE BEAM. An important horizontal transverse frame member that resists the tendency of the roof to spread the walls. The tie beam may be found at the top of the walls, where it is able to receive the thrust of the rafters directly, or it may be found as much as several feet lower down the walls, where it joins principal posts in tension connections.
TIMBER. A large squared or dressed piece of wood ready for fashioning as one member of a structure.
TIMBER FRAME. A frame of large timbers connected by structural woodwork joints and supporting small timbers to which roof, walls, and floors are fastened. Sometimes called a *braced frame*. Cf. POST AND BEAM 2.
TONGUE AND FORK. An end joint in which one timber has the shape of a two-tine fork and the other a central tongue that fits between the tines; usually found at rafter peaks. See also BRIDLE.
TRAIT DE JUPITER. See BOLT-O'-LIGHTNING.
TRENCH. Crossgrain open housing cut less than half the depth of the timber, to receive any crossing lapped timber.
TRIMMER. Floor member running with the joists at an opening, as for a staircase, and carrying the end of the header (see).
TRUNNEL. A peg. Sometimes refers to an extra-large peg.
TRUSS. A network of timbers forming a rigid support structure; ideally, all members of the truss behave in either compression or tension, none in bending. Trusses are used to span distances impractical for solid members, or to support unusual loads.
TUSK TENON. 1. Horizontal through-tenon with outside-wedge (the tusk) applied vertically (Hewett, 1980). 2. Horizontal blind tenon with square buttress (the tusk) between lower cheek and shoulder (Newlands, 1854; Alcock, 1996). 3. Horizontal blind tenon with diminished buttress (the tusk) between upper cheek and shoulder (Moxon, 1680), called by Hewett and Alcock (1996) a *diminished shoulder* tenon, and by Levin (1980) an *entrant shoulder* tenon. This buttress is sometimes called a diminished haunch because of its resemblance in profile to that of a diminished-haunch tenon. However, the latter tenon is used to make a corner joint, whereas the tusk tenon is used to connect the end of one beam to the face of another.
TWIN TENON. Paired tenons cut side by side and used to strengthen connections in large timbers. Cf. DOUBLE TENON.
TWIST. Deviation from plane in the surface of a timber. The bane of the woodworker. If the twist is the result of released growth stresses in the tree (see SPIRAL GRAIN), rather than poor conversion, all surfaces of the timber will be twisted. Also WIND.
UPPER FACE (UK). Best face, used for marking out.
VALLEY ROOF. A compound roof occurring where two roof slopes meet over an inside corner. Cf. HIP ROOF.
VERNACULAR. Local, as applied to building style, method and materials; vernacular styles are directly influenced by immediately surrounding culture, conditions and climate.
WALKING BEAMS. Two parallel beams laid on the ground upon which timbers may be moved with a pivoting action.
WANE. Nature's chamfer; the rounded edges of a timber squared from an undersized log. Adjective *waney*.
WARP. Deviation from flatness across the grain. If concave, also called *cup*. Timber surfaces typically warp as if to return to the log.
WATTLE AND DAUB. A framework of woven withes covered by layers of daub mixed of clay, lime, horsehair and cow dung, used to fill openings between studs in early timber frames.
WIDTH. The horizontal dimension of a beam as viewed in place; breadth. Cf. DEPTH. Indeterminate for interior posts.
WIND BRACE. A brace lying in the plane of the roof, usually running from a principal rafter to a ridge or purlin.
WIND, WINDING. See TWIST.
WINDING STICKS. Matched pair of perfectly straight sticks laid across a timber at some interval (usually the full length) and sighted over their top edges to reveal twist in the timber surface. If the sticks are parallel, the surface is free of twist.

—WILL BEEMER AND KEN ROWER

Published sources consulted for this beginner's glossary include *Recording Timber-Framed Buildings* (Nat Alcock), *Building the Timber Frame House* (Tedd Benson), *Build a Classic Timber Frame House* (Jack A. Sobon), *The Timber Framer's Workshop* (Steve Chappell), *The Framed Houses of Massachusetts Bay* (Abbott Cummings), *English Historic Carpentry* (Cecil Hewett), *Discovering Timber-Framed Buildings* (Richard Harris), *Mechanick Exercises* (Joseph Moxon) and *The Carpenters Assistant* (James Newlands). Ed Levin (engineering terms), Jan Lewandoski (bridge and steeple builders' terms), Chris Madigan, Jack A. Sobon and Peter Wechsler contributed additional entries or emendations. Many of the joinery terms in this glossary are illustrated in *Historic American Timber Joinery, A Graphic Guide* (Sobon), recently published by the Guild and available at www.tfguild.org or 413-623-9926. For historic English carpentry, Alcock, Harris and Hewett all offer excellent drawings. For illustrations of first-period New England work, Cummings is probably alone except for J. Frederick Kelly's *Early Domestic Architecture of Connecticut.*

Ropes and Knots

ROPE and knot work is often regarded as some sort of black art. Climbing and arborist catalogs list all sorts of exotic (and expensive) ropes. Knot books with their endless variety of knots leave one in despair as to which knot to use. How can you select or remember the right knots or rope for a timber framing application? Like much of life, once you get past the clutter, a small group of simple things learned and done well will cover almost any situation. Most human-scale frame rigging can be done with readily available Manila or polyester rope. And six different knots will handle any timber frame rigging job.

Rope in all its forms is a collection of small fibers bound or wound together to allow the fibers to grip each other and withstand tension. All that transmits a pull from one end of a 120-ft. rope to the other is the friction between the individual short fibers. Rope works only by pulling (tension) in a straight line. You cannot push on a rope. Anything that causes a rope to deviate from a straight line (such as a knot) decreases the strength of the rope. For negotiating turns, manufacturers specify minimum acceptable ratios of pulley diameter to rope diameter according to the type of rope.

Natural rope. Plant fibers have been twisted into rope since before recorded history. Individual fibers can be up to 10 or 12 ft. long. Natural rope is probably the most easily obtainable, but it suffers the limitations of an organic material.

Sisal rope is normally a three-strand rope twisted from the henequen fibers of the agave plant, with a whitish color and a rather coarse feel. Sisal is low in price but not durable. It is susceptible to decay from weather and should be examined often for signs of deterioration. Because it degrades rapidly, sisal is not recommended for loading. This is the stuff found in small coils at the local hardware store, fine for tying bundles but not for lifting bents.

Manila rope is made from the fiber of the abaca plant, which grows in the Philippines. Much of this golden brown rope is shipped from the port of Manila, explaining the name. Manila rope is flexible and strong and stands up well to wear and weather. Number 1 Manila rope is suitable for most rigging applications and readily available in the US.

Hemp rope is made from the fibers of the hemp plant. Hemp is generally light gray in color and has a soft feel, with strength similar to Manila's, but it's much more flexible. Hemp generally is used in small sizes, for detail work (rope ladders, bell pulls, floor mats) and for rat and service lines (parts of the rigging on a traditional sailing ship), but not for main lifting tackle. Hemp rope is not readily available in the US. There is political resistance to the cultivation of the plant as well as confusion about its uses.

All of the natural fiber ropes are most readily available as standard, three-strand twisted rope. Manila can also be found in an eight-strand braided configuration.

Synthetic rope is made up of individual fibers that can run the entire length of a piece of line. The longer fibers give the rope greater strength for a given size than rope of vegetable fiber. As synthetic materials, these ropes are also impervious to rot and mildew. They also tend to be more resistant to wear and abrasion. However, it's worth noting that they do soften at high temperature.

Nylon rope has a chalky white color, with a soft feel and over twice the strength of Manila. It is available in both three-strand and braided construction. Nylon is highly elastic and can absorb shock. As it wears, its outer surface becomes fuzzy, protecting the rope from further abrasion. It is resistant to alkalis but weakened by acid. Also, nylon does absorb water and loses about 10 percent of its strength when wet. Because of its elasticity, nylon rope can snap back dangerously if it breaks under load.

Polyester (Dacron) rope is slightly heavier than nylon, and with slightly lower strength. Its abrasion and chemical resistance are similar to nylon's, and it too is available in both three-strand and braided construction. Polyester rope does not absorb water and therefore loses no strength when wet. Its shock-absorbing capacity is about two-thirds that of nylon. Polyester rope is often tinted brown to look like Manila for historic rigging purposes.

Polypropylene rope is weaker than both nylon and polyester. It stretches about the same amount as nylon, and has similar chemical and abrasion resistance. Polypropylene rope is lighter than nylon and floats in water. It is unaffected by wetting. Perhaps the most recognizable use of polypropylene rope is as water-ski tow rope.

Exotics. Development of special fiber such as Kevlar has led to the production of high-strength, lightweight (and expensive) ropes such as Spectra, Technora and Vectran. These ropes are commonly composed of a core of parallel high-strength fibers protected by a braided cover of an abrasion-resistant material such as polyester. (Vectran is also available without a cover.) The core does the work while the cover serves to protect the core. Such ropes have more use in sailboat and specialty rigging than in timber frame raisings.

The table below gives the relative strengths and costs of the ropes discussed. Cost data are from McMaster-Carr (www.mcmaster.com), a principal supplier.

Most normal timber framing raising loads can be safely handled with one or more sets of block and tackle threaded with ½-in. to 1-in. Manila or polyester. (Nylon's stretch is a problem for lifting applications.) If larger forces or more complex problems are involved, don't be bashful about asking rope suppliers or manufacturers for help. They can and will provide extensive technical help in choosing and using their products correctly. An Internet search will quickly turn up a number of rope suppliers.

Rope Type	½-inch Diameter Breaking Strength (lb)	½-inch Diameter Weight 100ft (lb)	½-inch Diameter Cost 100ft (*$*)	1-in. Diameter Breaking Strength (lb)	1-in. Diameter Weight 100ft (lb)	1-in. Diameter Cost 100ft (*$*)
Sisal, 3-strand	2120	7.5	*13*	7200	27.0	*48*
Manila, 3-strand	2380	7.5	*17*	8100	27.0	*60*
Nylon, 3-strand	5670	6.3	*38*	22,230	25.3	*125*
Nylon, double-braid	8500	6.3	*56*	34,000	25.4	*198*
Polyester, 3-strand	5750	8.0	*61*	19,800	30.4	*160*
Polyester, double-braid	8200	8.0	*92*	38,000	33.0	*243*
Polypropylene, 3-strand	3780	4.7	*14*	12,600	18.0	*54*
Spectra, double-braid	16,984	7.2	*403*	70,000	31.0	*1530*
100% Vectran, braided	18,400	8.1	*483*	71,000	32.0	*1835*

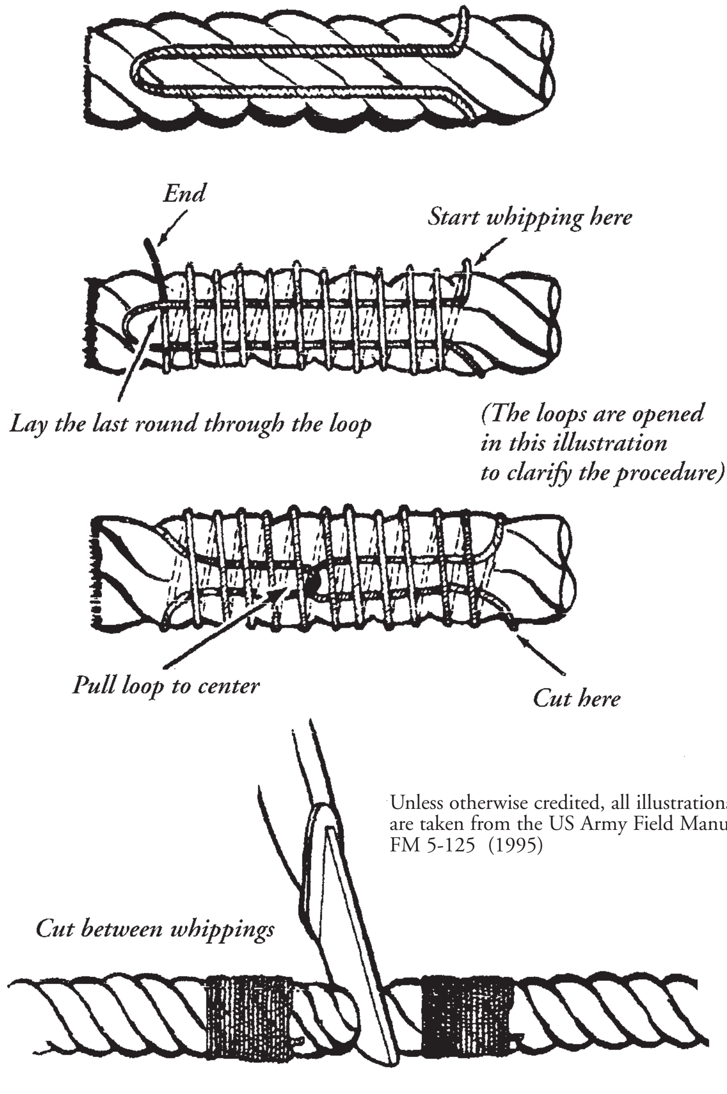
TABLE 1. COMPARISON OF ROPE STRENGTH, WEIGHT AND COST.

Care and handling of rope. The strength of rope relies on the individual fibers remaining intact and retaining their full strength. Each fiber of the rope has to carry its appropriate portion of the total load for the rope to reach maximum strength. Any action that damages the individual fibers of the rope or creates an uneven distribution of load within the rope decreases its strength. Dirt in the rope can cut individual fibers, weakening the rope. Kinks in a rope concentrate the load in the fibers at the outside of the kink, overloading and breaking them.

The first step in putting a rope into service is to uncoil it in a smooth line without developing any kinks. Assuming coiled, three-strand rope, the bundle is placed on the floor with the inside rope end at the bottom. Reach into the coil, grab the end and begin to pull the rope out through the middle. It should uncoil smoothly in a counterclockwise direction. Carefully straighten out any kinks that may develop.

When a rope is not in use, it should be coiled up and stored properly. Recoil in a clockwise direction. As each loop is added to the coil, give the rope a clockwise half-twist to make it coil smoothly without kinking. An alternate method is to coil the rope purposely in a figure-eight configuration. The half-twist that makes each figure untwists as the rope is paid out, preventing kinking.

Whenever a rope is cut, the ends must somehow be tied off to prevent the rope from unraveling. With three-strand rope, the fibers untwist, rendering the rope progressively shorter and less useful. With double-braided rope, failure to secure the ends can cause the braids to slip in relation to each other, causing part of the rope to carry more than its share of the load.



Unless otherwise credited, all illustrations are taken from the US Army Field Manual FM 5-125 (1995)

Fig. 1. Whipping the ends before cutting the rope.

The cut end of a rope can be quickly secured using twine and a constrictor knot. A more durable solution is to wind a *whipping* on the end of the rope (Fig. 1). For three-strand rope it's also possible to make a *backsplice* (Fig. 2) to prevent the end of the rope from fraying. An inelegant but effective solution for synthetic ropes is to melt the end of the rope together with a cigarette lighter (the rigging author Brion Toss calls this procedure the Butane Backsplice).

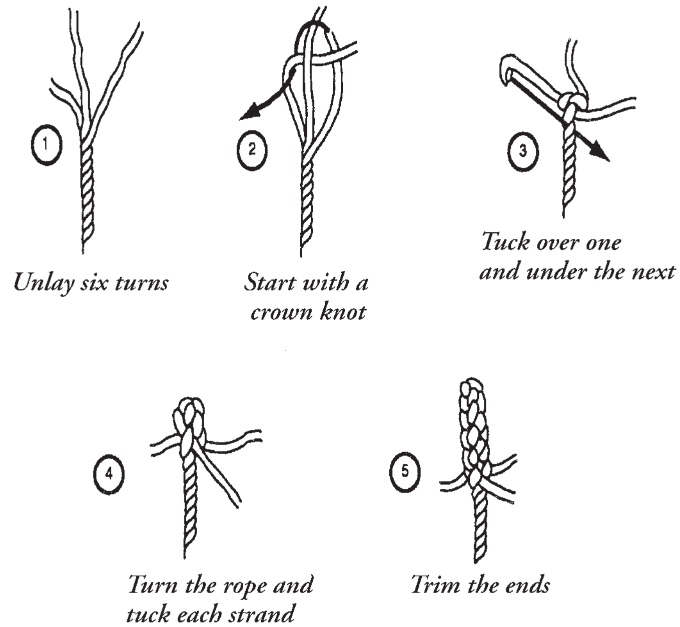


Fig. 2. Backsplice for three-strand rope.

The following information on the proper use and care of rope is taken from www.manilacordage.com, the web site for The Manila Cordage Company. This information can be found elsewhere, but it's stated succinctly and particularly well here:

> *Select the best rope for the job. Economy as well as service depend on the right size and quality for the work. Allow a safety factor of at least five to one to determine the safe working load for new rope. As rope ages, the safety factor should be increased.*
>
> *Store the rope properly. Rope should always be dry before storing. Storing wet rope causes mildew and rot. A cool, dry room with free air circulation makes ideal storage. If necessary to store on metal or concrete floors, protect the rope with planking to prevent contact with the floor.*
>
> *Reverse the ends of the rope. Changing ends of the rope regularly when used in tackle permits even wearing and assures longer useful life. If a short section shows undue wear or damage, cut out the worn section and splice the rope for best service. Then make sure the cause of the excess wear is corrected.*
>
> *Keep rope clean. Dragging rope on the ground or over rough, gritty surfaces allows abrasive particles to work into the rope and weaken fibers. If rope becomes muddy or dirty, it should be washed and dried thoroughly before storing.*
>
> *Kinks cause rope failure. Prevent kinks which cause permanent damage and weakening of the rope. If kinks should form, or if the rope is continually twisted in one direction, as over a winch, remove kinks or restore balance in the rope by throwing in twist in the opposite direction.*
>
> *Protect rope from chemicals. Acids and their fumes, alkalis, oils, paints, and barnyard mud are injurious to vegetable fibers and will quickly damage rope.*
>
> *Avoid sudden strains. Jerking or sudden strain may cause failure of a rope normally strong enough to handle the load safely. A steady, even pull will assure full strength from rope.*

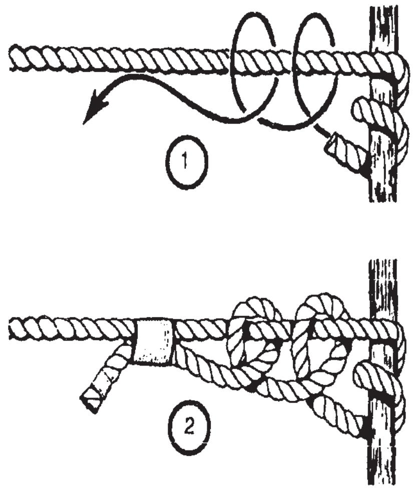


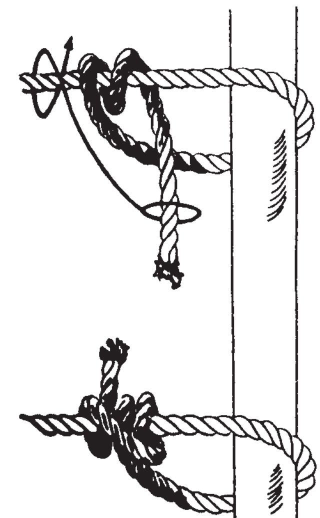
Fig. 3. A Round Turn and two Half-hitches.

Knots, bends and hitches are just fancy names for some method of attaching a rope either to an object, to itself or to another rope. Books the size of unabridged dictionaries have been written on the subject of knotting. But most timber frame rigging applications can be safely handled with the six (well, seven) knots described below.

A *round turn and two half-hitches* (Fig. 3) are used to secure a rope to a fixed object. This knot is particularly useful for tying off the end of a guy line that will not need to be adjusted for length. It works well around an object such as a tree trunk, telephone pole or trailer hitch ball. The rope wraps smoothly around the anchor, gradually distributing the tension in the rope to the anchor. Without major kinks, the knot reduces the strength of the rope only slightly.

The *clove hitch* (Fig. 4) is another knot used to tie a rope to a fixed object. But it has additional uses as the starting knot for various seizings and lashings. It can also be modified slightly to form a constrictor knot to prevent the unraveling of the cut end of a rope. Like the round turn and two half-hitches, the clove hitch provides a smooth transition of load to the anchor, thereby preserving much of the strength of the rope.

The *tautline* or *rolling hitch* (Fig. 5) is excellent for making an adjustable loop. The primary use in timber framing is for securing guy lines that may need to be adjusted for length. The knot can be tied fairly easily in a rope under load. Also, the length of a guy tied with a tautline hitch can be adjusted under load.



Robert Shetterly, in *The Complete Rigger's Apprentice*

Fig. 5. The Tautline or Rolling Hitch.

The *bowline* (Fig. 6) creates a loop that will not slip. It's particularly useful for attaching guys at the top of gin poles or shear legs and safety ropes for hand raisings. Another use is to attach a rope to the *becket* (the tieoff point on the outside of a block) in a set of block and tackle.

The *sheet bend* (Fig. 7) and *double sheet bend* (Fig. 8) are secure knots for joining two ropes together. The arrangement of ropes in the sheet bend is identical to the bowline, except that the two ropes are joined end to end instead of forming a loop in one rope. The knot works equally well with ropes of equal or different sizes. It can be used also to join a rope to a sling. The double sheet bend is just a more secure version of the single.

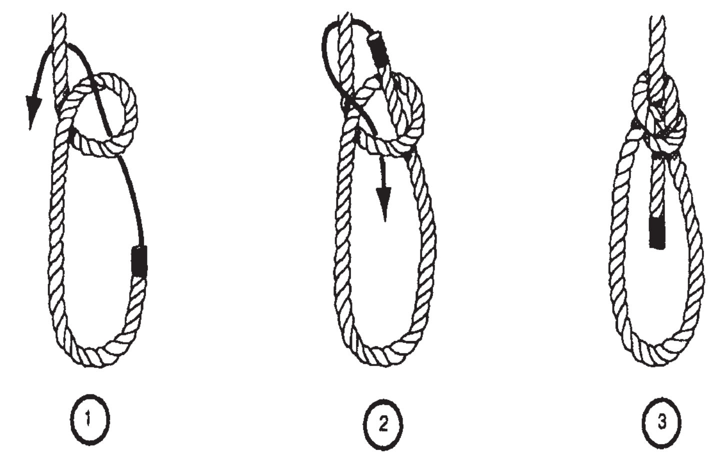


Fig. 6. The Bowline.

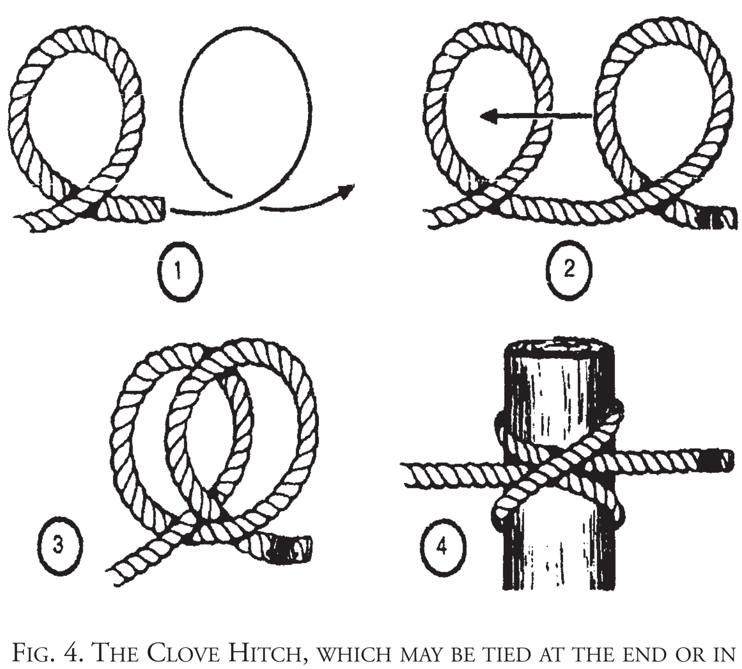


Fig. 4. The Clove Hitch, which may be tied at the end or in the middle of the line.

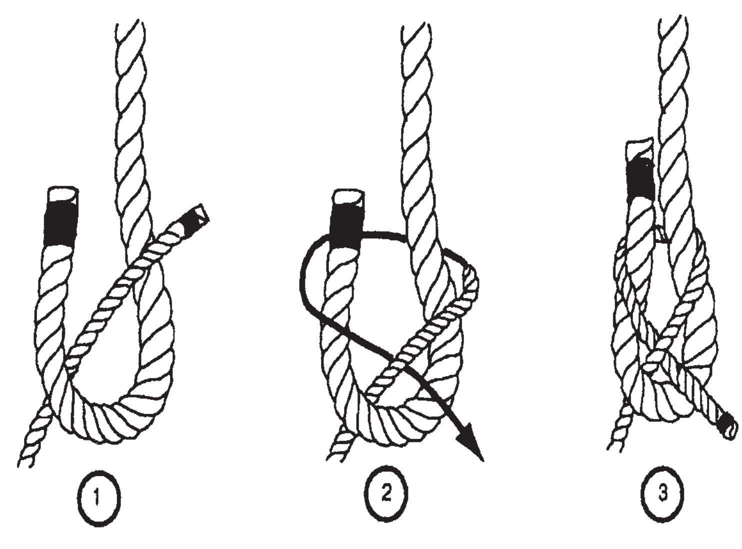


Fig. 7. The Sheet Bend.

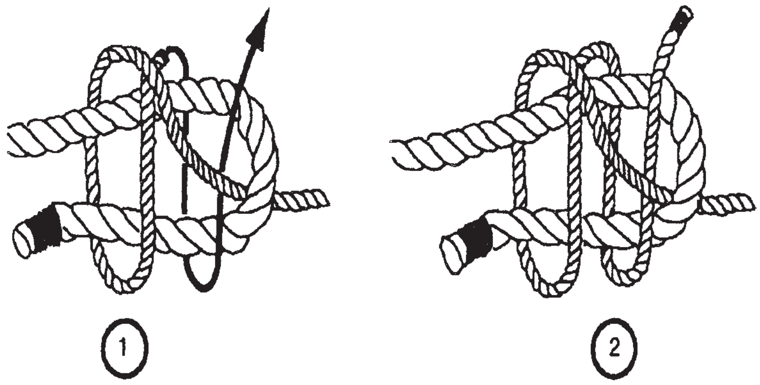


Fig. 8. The Double Sheet Bend.

The Boy Scouts were wrong. The *square knot* is not a good bend for joining two ropes. The ends can snag on an object and cause the knot to untie. The square knot will also come loose quickly with repeated cycles of load or vibration. The sheet bend and double sheet bend are much more secure methods of joining two ropes. Avoid the square knot.

The *trucker's knot* or *Baker bowline* (Fig. 9) is used to form a non-slip loop in the middle of a rope. By passing the running end of the rope around an attachment and back through the loop, it's possible to gain a 2-to-1 mechanical advantage. Truckers use the knot to securely tie down loads. It can shake loose in a slack rope but can be secured by inserting a peg through the knot.

Seizing. Most knots, particularly those used to form a loop or to join two ropes, can be made more secure by a process called *seizing.* Seizing prevents the knot from untying, making a safer and more nearly permanent fastening. The bitter (free) end of the rope is secured to the standing (continuous) part of the rope by wrapping both together with small twine. An example is seen in Fig. 3-2.

Start a seizing by tying a clove hitch around one of the parts of the rope. Then tightly wrap the twine around both parts of the rope for a distance of about two rope diameters (*seizing turns*). Next, reverse direction and cover the seizing turns with another layer of twine (*riding turns).* Finally, pass the twine between the two ropes and wrap perpendicularly around the middle of the seizing and riding turns. Tie off the ends of the twine and you're done.

I have found seizing particularly useful as a safety measure when attaching a line to a set of blocks. Once the blocks and tackle are in place for a large lift, it's very difficult to get to the top block to ensure all is well. A seizing on the bowline around the becket at the bottom of the block is cheap peace of mind. —Grigg Mullen

Grigg Mullen teaches engineering at the Virginia Military Institute. This article is second in a series on timber frame rigging, which began in TF 67 with "Raising Calculations and Prep" and will conclude with an article on the use of gin pole, shear legs and derrick.

References:

The Complete Rigger's Apprentice, by Brion Toss, illustrated by Robert Shetterly (International Marine/Ragged Mountain Press, Camden, 1998). I highly recommend that any student of rope work obtain this work. Its wit, wisdom, information, advice and humor will last a lifetime. Also useful from a more technical standpoint:

Handbook of Rigging for Construction and Industrial Operations, 4th Edition, by W. E. Rosnagel, Lindley R. Higgins and Joseph A. McDonald (McGraw-Hill, New York, 1988).

Rigging Techniques, Procedures, and Applications, US Army Field Manual FM 5-125 (Headquarters, Department of the Army, Washington, DC, 1995), approved for public release. Also at www.adtdl.army.mil/cgi-bin/atdl.dll/fm/5-125/fm5-125.htm.

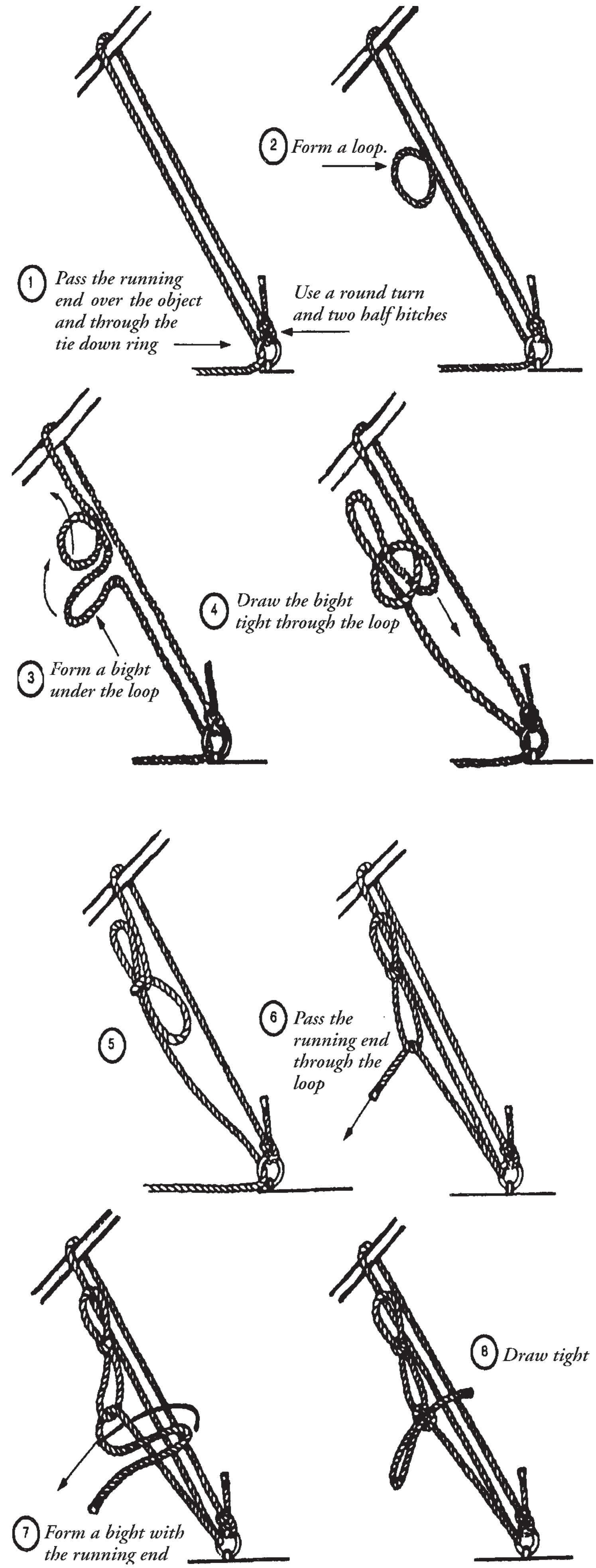
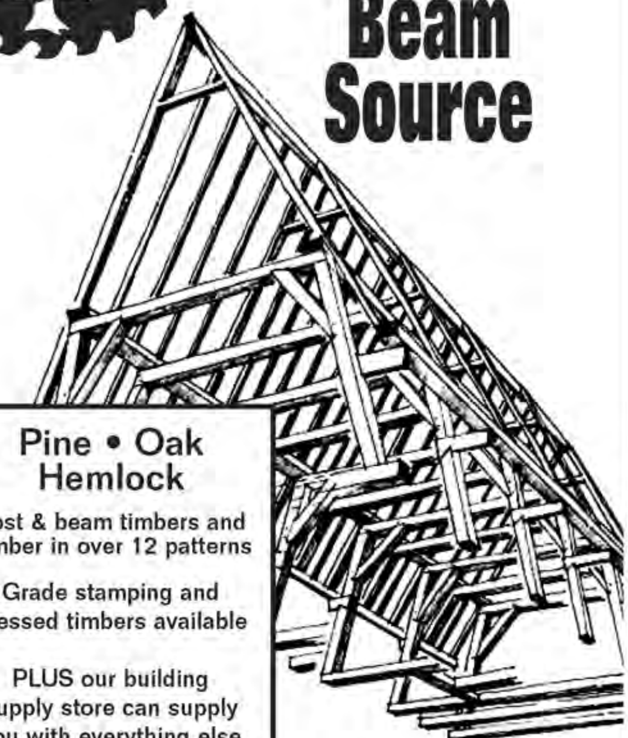


Fig. 9. The Baker bowline or Trucker's Knot.



Burlington '02 and Asilomar '03

DESIGN EXPOS and slide shows at the Guild's 18th Eastern Conference at Burlington, Vt., last November and its 18th Western Conference at Asilomar (Monterey), Calif., in April showed an eye-catching range of structures. Both conferences hosted Kezurou-Kai, a Japanese carpenters group who built objects later sold at auction: at Burlington, a temple door (prehung!) in white pine (seen under construction overleaf) and, at Asilomar, with the help of a workshop group, a teahouse frame (shown on the cover).

Steve Amstutz

Boathouse 28 ft. sq. at Lake Placid, N.Y., designed by Will Forester and framed by Amstutz Woodworking of Upper Jay in Douglas fir. The double-pitched hip roof includes a kingpost truss turned to follow the hips. The frame was raised by a barge-mounted crane.

David Gentry

Above, art studio roof 18x28 ft. near Philadelphia, with faux trusses in hard pine designed by Ed Levin of Hanover, N.H., in the style of Mackintosh's Glasgow School of Art and built by Jack Witherington and Tim Whitehouse of Methods and Materials, Gilbertsville, Pa.

At right, indoor tennis court 122x88 ft. framed in Douglas fir by Timmerhus of Boulder, Col., with architectural design by KH Webb, Architects, and structural design by Ed Levin and Ed Shure. Eyebrow dormer, 72 ft. long, uses naturally curved solid timber. Principal rafters were cut from 16x32x50 recycled timbers; design snow load is 120 psf.

Marcus Brandt

Pedestrian (and oxen) canal bridge, 40-ft. span, at Jhinze, China, 60 miles from Shanghai, built for the PBS series "Secrets of Lost Empires." Below, workman mops tung oil onto Chinese larch logs and timbers lashed together under sawn, curved Eastern hemlock deck timbers imported from the US. A Song Dynasty (960-1279) scroll painting guided the construction. Marcus Brandt Restorations, Allentown, Pennsylvania, provided the "Western carpenter of record."

Egils Artmanis

Todd Powers

Fancy-framed porch in Douglas fir added to kitchen wall of former camp on Lake Groton in northern Vermont. The camp was transformed throughout in the same style, with design and construction by Nathan Puffer of Groton Timberworks of Vermont.

John Seyfreid

Cherry arch framing a passage-to-be in an 1850 sq. ft. house in Ohio framed by David Yasenchack Timberframers of Kingsville, who were "entrusted with the client's dreamy woodlot." Cantilevered joists are ash, walnut and butternut.

Roger Wade

"Four Suns," 20,000 sq. ft., Orland Park, Illinois, designed by Robert Flubacker, Architect, and built by Herb Nadelhoffer (who found the tree for the entry porch), with oak frame by Riverbend Timber Framing of Blissfield, Michigan.

Photos Lancaster County Timber Frames

Above, below and bottom, winner of the People's Choice award in the Burlington Design Expo, this 3800 sq. ft. house (Joshua Coleman, designer) was built by Lancaster County Timber Frames in Lititz, Pa.

Lancaster's Anthony Zaya reported: "This client came to us with photos and postcards of lighthouses from shore points on both coasts. The structure was to be a vacation and weekend home, and he wanted to satisfy his long held fantasy of living in a lighthouse. We were happy to indulge him."

Chris Madigan

Above, at the Asilomar teahouse workshop, Kezurou-Kai member Nishiyama-san, room key unloseable, patiently marks out a timber with sashigane (the flexible square), bamboo brush and inkpot. Below, constructing the temple door at Burlington. Square stock with mitred twin tenon corners will make up the frame, to be rabbeted later. The door, two wide planks slot-dovetail-keyed together (under test assembly here), will hang from pintles integral with hinge edge (one seen here on the lower plank). Planks will be restrained by mitred and tenoned bolsters, not shown.

Ken Rower

Photos Norman Corwin

Detail of Torii gate at Palomar College, People's Choice Award winner at the Asilomar '03 Design Expo, built by Kezurou-Kai and workshop helpers. The wood came from a salvage Torrey Pine (no relation) offered to the College's urban forestry program. (See also construction photo on cover.) Below, finish planing one of the gate posts. At bottom, an off-duty carpenter tests a Bailey pattern smooth plane using a Japanese grip.

PUBLISHED BY
THE TIMBER FRAMERS GUILD
PO BOX 60, BECKET, MA 01223

NON-PROFIT ORG.
U.S. POSTAGE
PAID
EAST BARRE, VT
PERMIT NO. 2

THE Phillip Pry house and barn at Antietam Battlefield, Keedysville, Maryland, visited during the Guild's 2003 TTRAG symposium in April at Shepherdstown, West Virginia. The National Park Service dates both structures at 1844. The house (which sits on a bluff on the east side of Antietam Creek) and property were used as General George McClellan's field headquarters during the Battle of Antietam, also known as the Battle of Sharpsburg, fought during one long day September 17, 1862. Union generals Joseph Hooker and Israel B. "Fighting Dick" Richardson, wounded in battle, received medical treatment here, and Richardson died in the house six weeks later. The Battle of Antietam engaged about 130,000 troops on both sides, of whom 22,000 were killed and wounded. TTRAG Proceedings, page 4.

Chris Madigan