TIMBER FRAMING

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On the cover, skillful integration of old and new work at the Nicol barn, Newton, New Hampshire, shown by Arron Sturgis and Preservation Timber Framing at the Traditional Timber Framing Research and Advisory Group's 2006 Symposium. Symposium Proceedings begin on page 16. Photo by John Butler.

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1985

BOOKS

Modern UK Framing

Oak-Framed Buildings, by Rupert Newman. Lewes, East Sussex, UK, The Guild of Master Craftsmen Publications, 2005. 10x10 in., 192 pages, copiously illustrated. Paper (Smythe sewn), $24.95.

WE here in the UK have been awaiting a book like this for a long time. There is a wealth of books—some good, some very good—on the history of timber-framed buildings in the UK but, until the publication of Rupert Newman's, there was nothing specifically focused on the subject of timber frame building as carried out today. Before I dive into a description of what's on offer here, I should say that I have known the author for many years; indeed, I was fortunate enough to work with him in the late 1980s. I have tried to give an unbiased assessment of the content with particular emphasis on what might be relevant to Guild members.

The book, well laid out in currently fashionable square format and loaded with good photos, drawings and diagrams, includes helpful translations for some (but not all!) key words that might differ in common usage between our two countries. For example, in the UK you build on a plot, not a lot (possibly because a plot isn't a lot in the UK, but a lot is often quite a lot in the US). So if we are two cultures separated by a common language, as Mr. Wilde pointed out long ago, the misunderstandings will be minimized.

Immediately you get past the first page of the introduction, you dive into the big issue—"What Is Green Oak Framing?" To the intense disgust of a small but vocal minority in the UK, timber framing here is practiced using unseasoned or green oak. Of the total number of new frames built in the UK each year, only about one percent is built of anything other than green oak, and our industry is based upon that fact. It's telling that most (if not quite all) of the companies in the UK have the word "oak" in their names, which reflects the predominance of oak as the material of choice when building traditional timber frames. The English are fond of the oak tree, and there is a long historical affection based on its association with strength and durability, for example in the phrase "hearts of oak" (possessed by English sailors, along with their bellies of brass) and in the popular pub name Royal Oak. The oak is embedded deep into our national psyche.

The companies who started the UK timber framing revival back in the 1980s built traditional half-timbered (or "black and white") houses or houses based on examples of existing barns. For these companies, some of whom were founded in the repair or conser-

Erratum

The Benson Woodworking Co., placed in Keene, N.H., on page 2 of TF 80, in fact stands in Walpole. The editor regrets the error.

vation of old timber-framed houses, it was a natural step to begin to replicate the style of the vernacular buildings they knew. It was also a natural step to use the same material, especially where the finished houses featured a frame exposed both outside and inside and expected to give a 400-year service life in the damp climate of the British Isles. Oak's strength and natural durability, coupled with years of custom and practice, made it the obvious choice.

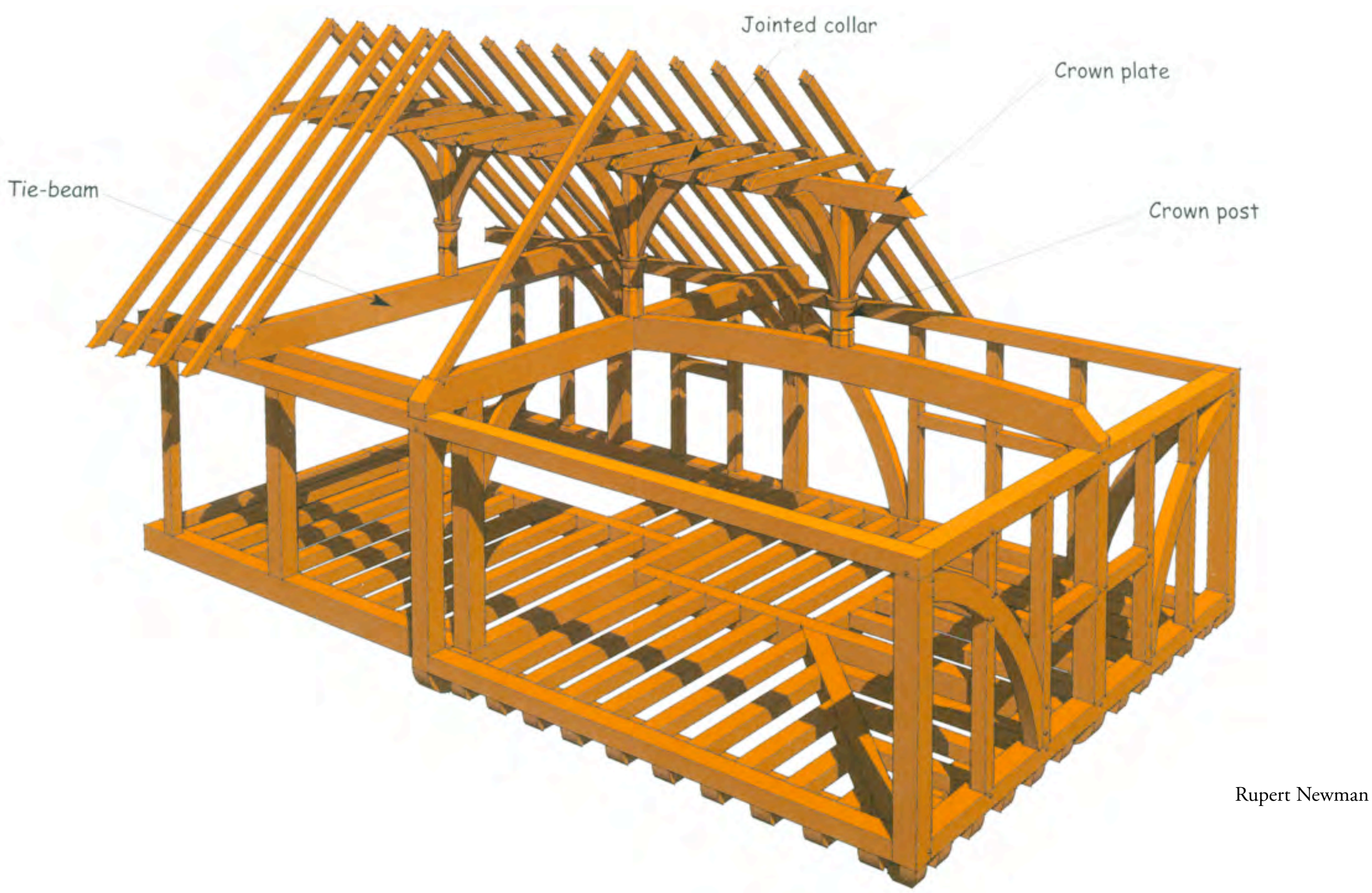
Back in the late '80s and early '90s, dry oak in large sections wasn't readily available and, if you could get it, cost about eight times the price of green. This pretty much sent everybody down the green route, and we came to love working green timber and learned to love (perversely, some would say) what it does as it dries out. This bending, twisting, distorting movement, all restrained by the joints in the frame, has become known as *the subtle undulation of line and level.*

Rupert Newman's first chapter deals with the history of framing and, bearing in mind the foregoing, suffices to put today's oak framing into context. After that, he has organized the book for the convenience of the prospective timber frame owner as well as the practitioner, interweaving case studies (four) for illustration. Thus we early on arrive at that most important issue, the budget, followed by a discussion of the usual problem for those of us who want to live on this small and overcrowded island: finding the land. The biggest obstacle to building a new house in the UK is finding somewhere where permission to build can be obtained. (Over the last 20 years this has become predominantly a case of buying a plot and demolishing an existing building.) We go on to look at the design process, planning (zoning) issues, siting the building on the plot and—very important—how structure affects design, a discussion that includes the very necessary appeal to allow the natural divisions of the frame to set the locations of internal partitions. (The paragraph titled "Add-ons and extras" on page 62 will draw a few wry smiles, especially the bit about being asked to remove strategic posts after the design has been finalized.)

A chapter on frame design looks at types of frame construction, truss types, loads and stresses, crucks and jetties (Fig. 1). This includes a comprehensive trip through the various truss and cross-frame types, their pros and cons and typical applications. The author goes on (pages 57 and 80) to explain a mystery of oak frame building, why oak rafters and joists are laid flatwise. The practice descends from the time when such secondary members were obtained by halving fairly small trees and laying the trued split surface in the plane of the roof or floor. In the frequent case of curved logs, the cleft would naturally be made on the axis of symmetry and any curvature put to the sides.

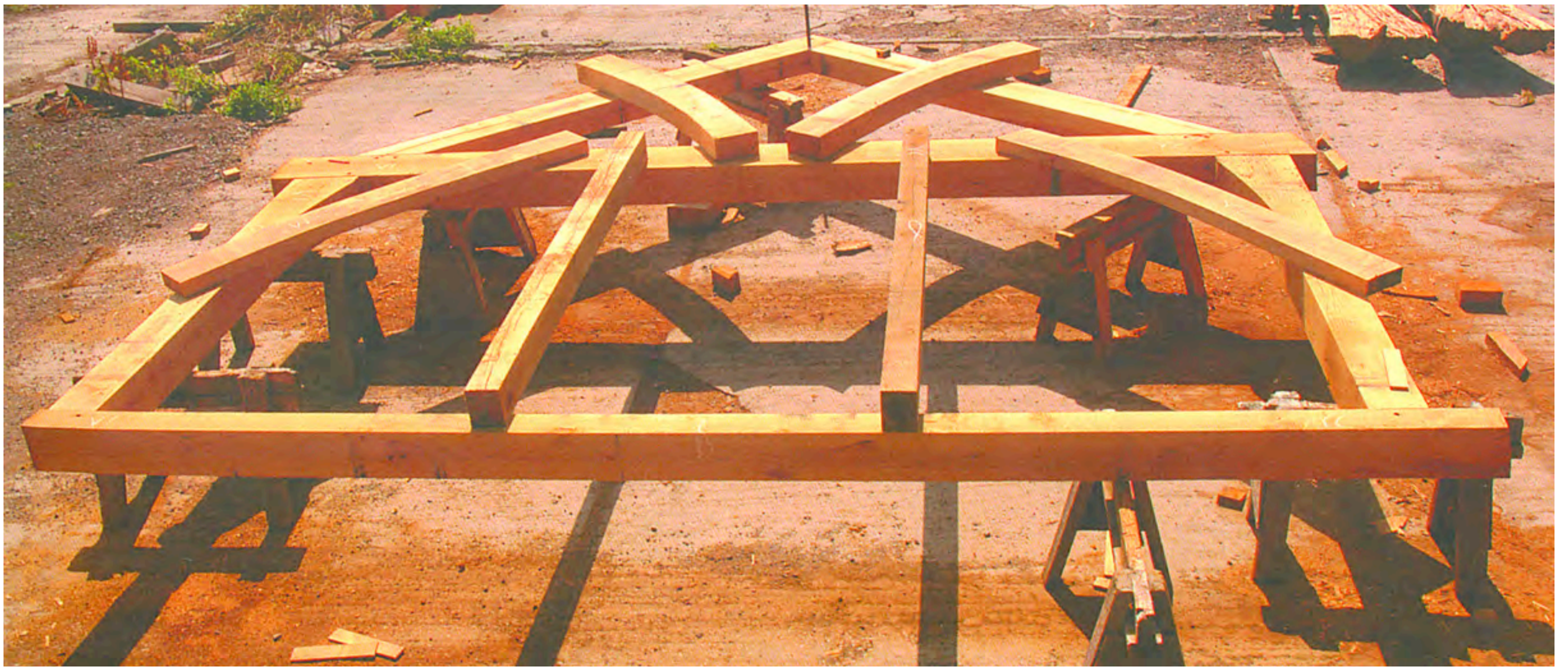
While structural qualities of oak, environmental issues, grading and conversion, shrinkage and fire considerations, and so on, make for interesting discussions, the chapter "Making the Frame" grabs the attention, with lots of pictures of thumpers, podgers (you'll have to get the book!), axes and mortisers, and then climbs higher to examine various layout methods, orientation of timbers, layup, lofting and scribing. Being able to scribe (and this could mean being competent at or even being allowed to) is perceived as a key part of being a British oak framer. Scribing one member to another is a basic skill for anyone who works in timber, whether fitting molded skirting boards together or joining large pieces of oak. The sheer scale of the oak timbers, the frequent use of curved members, the fact that British timbers are supplied band-sawn, not planed, and the necessity to scribe (accurately) both ends of the timber simultaneously—all these conditions, coupled with the rituals and devices of the scriber, have resulted in a mystique developing around the process of joining one timber to another. There's no doubt that scribing is an essential skill, and joining two uneven faces together neatly is extremely rewarding.

But in the 21st century, when timber comes in from the mill dimensionally accurate and very close to square, you could be forgiven for thinking that not every piece needs to be subjected to the scribe ritual. Yet managers, foremen and company owners are



Rupert Newman

Fig. 1. Upper level of jettied frame showing dragon beam in floor, curved full wall braces and crown post roof frame.



Rupert Newman

Fig. 2. Layup of secondary members after main members have been scribed and assembled.

regularly faced with the declaration, "I'm an oak framer—I scribe!" and have to watch two almost perfectly square pieces of timber laboriously scribed together rather than marked up immediately, taking advantage of their regular geometry. At any rate, Rupert makes a fine job of explaining his method of plumb-bob scribing (Fig. 2), the method that has evolved in many framing shops in the UK, and then goes on to examine joints, draw-pegging, traditional carpenter's marks, curved timber and peg-making.

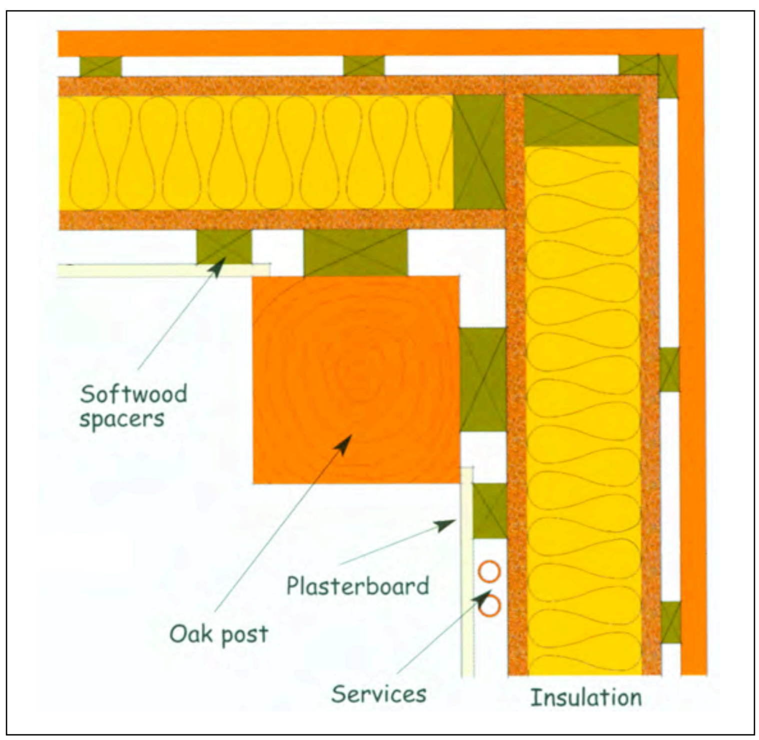
A frame rearing (raising) in England, especially for barns, generally puts up the long walls first and bridges them with the roof trusses or crossframes (bents). House procedures vary according to their design. In jettied designs, frames often are erected as walls up to joist level, joisted and then the upper wall frames erected up to top plate, with the roof trusses and purlins lifted on last.

The building envelope is a current concern, and Rupert gives today's ideas a good exercising, looking at the environmental issues and most insulation types, missing only the wood fiber and hemp products currently coming into vogue in Europe. Mineral wools and petroleum-derived insulation products are examined, and their various properties stated in an evenhanded manner without too much emphasis on the environmental downsides. (It's appealing that the author assumes no prior knowledge but does not treat his readers as if we were idiots.) Structural insulated panels, so popular in the US, warrant little mention, as they have not taken hold in Europe, but the book offers an application detail that will be new to most North American readers (Fig. 3).

Multifoil quilts (multiple layers of reflective foil wadding and foam 25mm thick) get a paragraph. For many of us, the jury is still out on these quilts. They are not made from "green" materials and, while slim in themselves, require a correctly installed airspace (correctly being the operative word here) on both sides, which bulks up the total thickness. These foils as yet do not have full acceptance in the UK. Recycled newsprint (warmcell), sheep's wool and straw bale are mentioned without any particular recommendations.

North American readers will be interested in the face-glazing systems, developed and refined in the UK over the last 20 years to deal with traditional frames exposed both inside and out, but also to show the frame in what many consider its most pleasing state—without infill, behind glass, as seen in parts of Fig. 4. Initially, infilled oak frames were glazed by inserting subframes or casements within the thickness of the timber wall. This method is still used for smaller windows in traditional half-timbered houses but, given the inevitable shrinkage and movement, this isn't ideal where large expanses of glass are required, and people began fitting sealed double-glazing units between studs. While that was better, it wasn't long before designers hit on the idea of putting the sealed glass units on the outside face of the frame, and subsequent refinement has made this fairly foolproof. The book has 12 pages on glazing, including working drawings and details showing how it can be done (Fig. 5).

We find a significant divergence between British and North American practice in the matter of cleanup and finish. Whereas Americans frequently go to great lengths to put an oil or even a shiny finish over a smooth-planed surface, Rupert offers a comprehensive section on the British practice of sandblasting and leaving the wood bare.



Rupert Newman

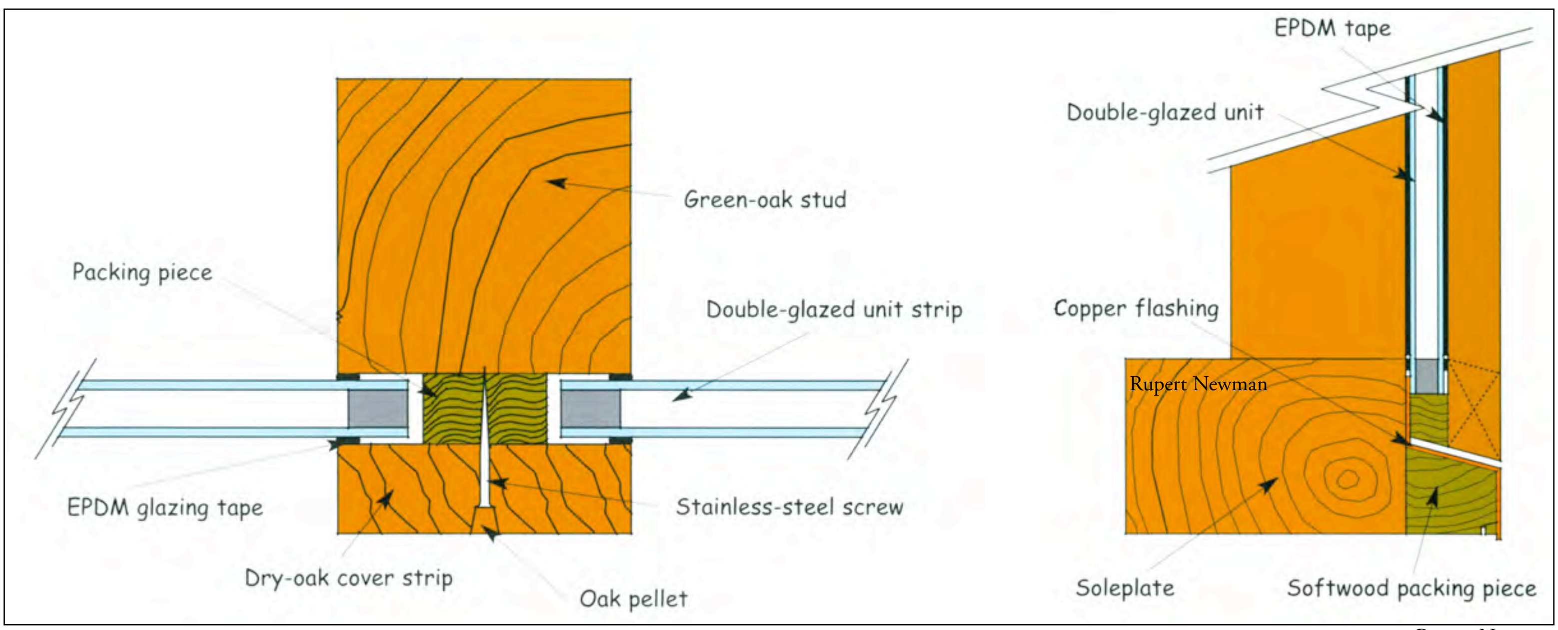
Fig. 3. Structural insulated panel application detail.

Bob Atherton

Fig. 4. Raised house for site prone to occasional flooding, designed by Wilfred Burton, a bold combination of traditional framing with modern fenestration and an open plan.

The book is furnished with some helpful appendices—an illustrated glossary running to two pages, a fairly curtailed list of books suggested for further reading (which misses a few of the old favorites), the names of useful contacts, places to visit and, last but not least, tool distributors. Many people have asked me what I think of this book. It has rightfully caused a stir here in the UK (being the first on the block). I can say, all modesty aside, that having done oak framing for nearly 20 years, I found little I didn't already know but much I'd forgotten. But it's superb to see it all finally written down, drawn together and laid out logically, and with good illustrations. The book did, as promised in the introduction, provide me with interest and inspiration (and most people here haven't been framing for 20 years). I dearly wish that all the clients and professionals I have ever dealt with had read this book, because it answers a wealth of questions. In fact, I'm going to give every new client of ours a free copy (after I've banked their deposit check, of course). —Bill Keir

Bill Keir (bill@oakwrights.co.uk) is general manager and head of design at Oakwrights Ltd., timber framers at Swainhill, Hereford, UK, as well as a board member of the Carpenters Fellowship (UK). He is a frequent visitor to the US and lives, he reports, at the top of a hill with one wife, two daughters and numerous Land-Rovers.



Rupert Newman

Fig. 5. Glazing details allowing the appearance of an exposed frame to the exterior while providing a good weather seal little affected by timber shrinkage. EPDM is ethylene propylene diene monomer, a rubber roofing material in use since the 1960s.

The English Barn in America

II. The Timber Frame

TO the layperson, and probably to most timber framers, the construction of the scribe rule English barn appears at once archaic and primitive, with its hewn and rough-sawn components of varying sizes, often tapered or flared, and its unnecessarily complicated tying joints. The structure may be archaic, but it is far from primitive. In fact, it is the result of a long-established craft tradition that made efficient use of local timber to create an economical and enduring frame. When closely examined, these barns, built typically for yeomen, are found to consume no more than what is necessary to function.

The appearance of their carpentry is the result of their fabrication process. Before the early 19th century, these barns would have been laid out by the scribe rule. Sections of framing timbers—floors, walls, roof—would be set out square and level, with joints uncut. Timbers would be carefully positioned so mating parts could be scribed to one another and fitted. The parts, because they were noninterchangeable, would then be numbered for future reassembly. The scribe rule system developed over centuries to make use of less-than-perfect timber resources and was brought to America by English settlers. Though by today's standards scribing seems more labor-intensive than necessary, it was appropriate and economical given the timber available.

At the outset of the 19th century (Delaware County, New York, has a known instance dated 1805), the square rule layout method was introduced. Though its provenance is unknown, likely it was an American innovation. The first building in a town framed by the square rule is occasionally noted in town histories as an important event (e.g., Goshen, Massachusetts, 1812 and Milford, Pennsylvania, 1835). According to the square rule, within every actual rough timber there exists a smaller, geometrically perfect timber to which all joints can be faced. Because square rule did not require the preassembly and trial fitting of the older scribe rule, the new method entailed about half the labor (my estimate). Distinct scribe rule and square rule terminologies appear at the time of the square rule introduction, whereas no special terminology is in use before then. After the square rule was introduced, the older scribe rule system was referred to in derogatory fashion as "the try rule" or "cut and try."

In late 18th-century New England, the scribe rule English barn type was quite common, with towns conceivably averaging 60 barns each, judging by the Federal tax census of 1798 (Garrison 122–125). If we multiply this average by the 352 cities and towns in Massachusetts, we get a remarkable 21,120. Today, however, scribe rule English barns are quite rare. For example, in my town in Massachusetts (Windsor), none survives, and each of three neighboring towns has only four. Because of a two-century hiatus in its use, knowledge of this English scribe method, which does not employ the plumb bob as does the better known French scribe, has virtually been lost. All that survives of the system are a few written descriptions and the buildings themselves. With the building of my own barn, I had hoped to ferret out the missing portions of the story. In scribing the barn, I discovered that a complete structure can be laid out using only the two techniques described by Edward Shaw in 1836 in *Civil Architecture:* tumbling and the double cut.

I made some minor modifications of the traditional plan to accommodate my uses, but none affected the scribing process. The barn is authentic in that it rests on a dry stone foundation, it's made of local timber both hewn and sawn and, not least, I cut the joints using hand tools. I did use a boring machine, a tool developed about 1840, to rough out the mortises.

BEFORE discussing the actual scribing process, it is worth mentioning a few salient points of this English-American scribing process. The first is how to get started.

The floor frame, a full-size draft. In Europe, timber-framed buildings were often framed in shops or framing yards off site, carted to the site and assembled. In America, they were most likely framed on site using timber provided by the owner. Remember that in the 1700s land was still being cleared in most of New England to build these barns. A farmer with the wherewithal to clear land could easily hew timbers and draw logs to the sawmill. The builder traveled to the job with his crew and tools. In my area, framing styles are localized and often change as one crosses a town line. In European scribe, a full-size draft of the building's plan, cross-section and longitudinal wall is created on a carpenter's shop floor using chalk lines. Here in New England, I believe the building's floor frame served as the full-size draft. Once cut and assembled on the foundation, it offered a level and square base with pertinent bay divisions located.

This may seem odd to our English timber framers, as the ground floor of a building is usually just that, and intermediate cross sills are uncommon. But, in timber-abundant New England, framed floors are typical. Though the side bay floors in our English barns are often earthen, the threshing (central) bay floor is always framed. The top side of the floor framing is, of course, the reference face, assumed to be flat and level. Any tenons entering this top face are cut square. There is no evidence of post bottoms being scribed to the tops of sills. Even if a building was to be framed off site, as perhaps for urban work, the floor frame set on blocking could still serve the same purpose.

Lining the timber. We know from Shaw that square rule timbers are lined. More recent old square rule frames are occasionally found with timbers lined with red chalk. Unlike white chalk, red is permanent, not obliterated by rain. This was perhaps unsightly to the client but fortunate for us timber frame detectives. Each face of a post, for example, would have two lines. One represents the edge of the mortises or tenons, usually either 1½ in. or 2 in. off the face. The other represents the ideal timber within to which the joints are faced. A 10-in. timber might have a line at 9 in. off the face. Shaw only mentions the second chalk line: "All the timber should be lined to its proper size, and the mortices faced to the same." This implies that the first line for the joinery was already customary from the scribe rule. Original intact white chalk lines are occasionally found in scribe rule buildings, for example St. John's Church, Portsmouth, New Hampshire, 1807, where some rafters still show the layout lines for purlin mortises. It seems obvious that to end up with flat floor, wall, and roof planes, some sort of reference line is required on hewn pieces or warped sawn ones. It is only necessary to sight down an old plate, post, or tie to see that all the mortises are in line.

The English tying joint. Flared, tapered, or gunstock wall and corner posts are synonymous with English framing. They are wider

Fig. 1. English tying joint in author's barn. Post jowl, center, is joined to tie beam via teazle tenon; post is tenoned separately to continuous plate, left, which also passes under tie while capturing it in a shallow dovetail housing, unseen. Rafters are tenoned into tie for base-tied truss.

All photos Jack A. Sobon

Fig. 2. Shared mortise in barn in Plainfield, Massachusetts. A scribe line seen crossing the V mark shows the brace mortise layout; the girt's underside has been reduced to fit the mortise, which has been precut to a standard length.

at the top to accommodate tenons into both the plate and tie beam. The junction of these three, and usually the rafter as well, comprises the English tying joint, developed in the 13th century (Fig. 1). It persisted in New England until the appearance of the square rule. Though it had structural advantages, the most likely reason for the persistence of the English tying joint was that it facilitated the scribing process. Being able to assemble an eaves-level plan, a full longitudinal wall and a complete cross-section is advantageous for scribing. One can assemble the cross-sections with rafters but without the wall plate and, separately, the eaves level plan with the tie beams and plates. This isn't possible with a dropped tie arrangement. When the square rule became the norm, the use of the complicated English tying joint was no longer justified, and dropped ties became the norm.

Mortises first. If one takes a ruler to an old scribe rule frame, one will find standard length mortises, regardless of the exact size of the piece accommodated. For instance, post mortises might be all 8 in. though post size might vary from 7½ in. to 8½ in. A post wider than 8 in. would have its tenon reduced in width. A post narrower than 8 in. would have a visible gap in the mortise on the non-face side of the post. It thus appears that the mortises were made and pinholes bored before setting up timbers for scribing. Shaw mentions this for at least one part of the scribing process: "First, the mortices are made and the faces got out of wind." This operation saved time and labor.

Shared mortises. In many but not all scribe rule barns, braces will share a long mortise with a girt or another brace (Fig. 2). With two fewer ends to square up, a shared mortise certainly saved some labor, but in time it made for less effective braces: as the other member shrank in width, a gap would form at the bearing end of the brace, and the pin would take the load. We will see that the shared mortise's ultimate purpose was to save setup time during the scribing process.

Craftsmanship. The level of craftsmanship in these old scribe rule barns is often not very high. Though the master builder's influence on the design and setting out shows a high level of thought, the actual cutting of joints often seems careless. Two factors must be taken into consideration. These structures were utilitarian, often the first permanent building erected on a farm, and they needed to be put up quickly and economically. Function, not fine workmanship, was primary. Also, though the master builder was trained in a long and ancient tradition of carpentry, his apprentices, young and fresh, executed the joinery. Even so, as many barns have lasted 200 years and more, we see that sound structural design and a forgiving building method can determine a building's longevity. Mortise and tenon construction is durable even when imprecisely done.

THE SCRIBING PROCESS. A probable scribing sequence would start with the floor frame (sills, joists), then proceed to the eaves plan frame (plates and ties), then the longitudinal frames (side walls) followed by the crossframes (section framing) and finish with the roof framing (rafters and purlins). The roof framing could also be done after the eaves plan. Different roof systems might require different sequences.

Lining the timber. With hewn or twisted timbers, the timber must first be lined to describe the joinery plane. The most direct method needs two people, each holding a framing square against the ends. (The reference face of the timber is up.) Using either the 2-in. blade or 1½-in. tongue of the square, depending on the joinery layout, sight across the top of the square, moving it up or down until it's both flush with the high spots of the surface and in parallel with the square at the opposite end (Fig. 3 overleaf). When the square is positioned correctly, scratch a line on the end grain along the *bottom* of the square's blade or tongue. If working alone, use a level at each end to establish the parallel scratched lines.

Fig. 3. Sighting across the top of the blade of a square to make it flush with the high spots on a hewn sill. A line is then drawn along the underside of the blade to describe the 2-in. joinery line.

Then, successively turning the timber onto its sides, snap lines from end to end to connect the scratched lines. Occasionally, hewn surfaces need to be corrected somewhat to have a reasonably flat, uniform surface. Old timbers sometimes show evidence of having been rehewn. Generally, scribe rule buildings have smoother hewn surfaces than square rule ones.

With longer, more flexible members such as plates, it may be necessary to have one or two intermediate points, because when turned on its side the timber may spring into a bow. Then the lines are snapped in shorter segments to better follow the member. The intermediate points are chosen first, making sure they represent the general plane of the timber's face. The surface is then leveled with a plane until the edge of the square touches across the beam's width without rocking. This exact spot is scribed with a level mark: three intersecting lines, the center perpendicular to the timber (Fig. 4).

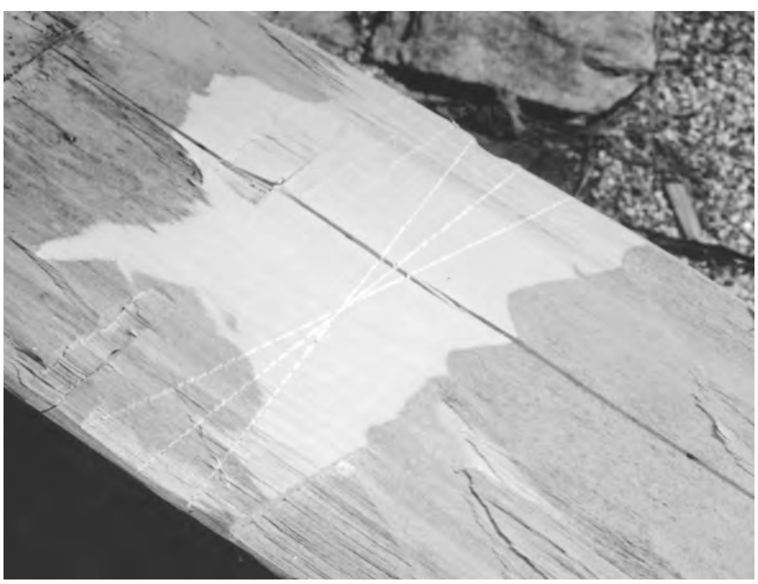


Fig. 4. Level mark on a hewn timber. Freshly planed wood is the paler. This mark graphically represents taking out the winding.

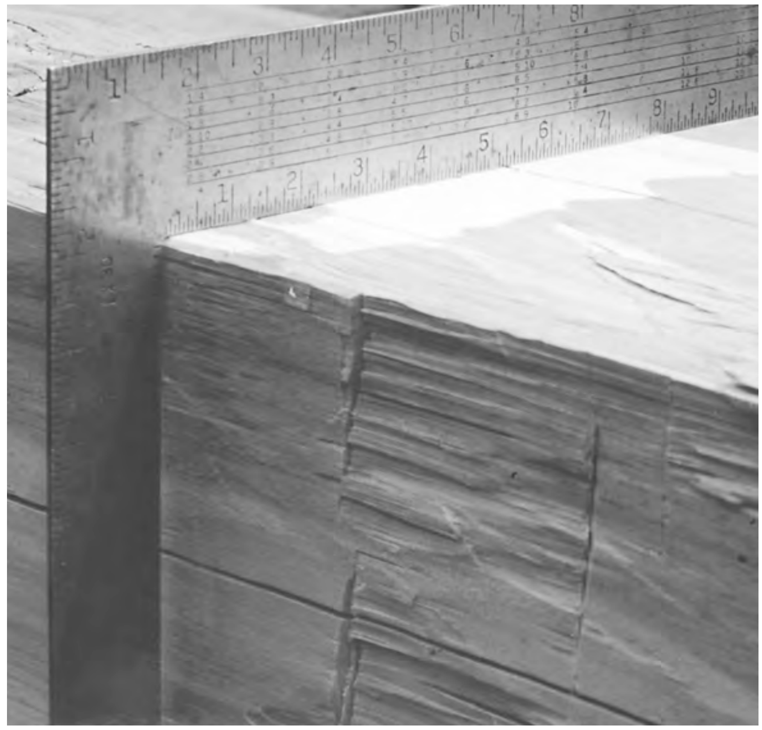


Fig. 5. For longer, flexible members, the square can be applied at intermediate points and the joinery mark ticked off on the tongue of the square.

With the tongue of the square hanging down the vertical face, put a prick mark at 1½ in. or 2 in. for the joinery plane. Repeat on the opposite vertical face. With one square set on this level mark, repeat this procedure at another interval with a second square, sighting across to the first for parallel. If the ends of the timber are not sawn square but axe cut, this procedure is repeated a few inches in from each end (Fig. 5). For sawn members free of twist, joinery can be laid out from an edge rather than a line.

Scribing the sills. Position the two longitudinal sills side by side with the faces up, best edges out. Measure out the bay divisions on one sill. In English barns, measurements are to a face of a post, not to centerline. On the end posts, the face is of course to the outside. On the two intermediate posts, the face is toward the center bay (threshing floor). Scratch a line across the upper face and down the best edge (outside face) of one sill. Position the other sill next to it to make the best use of it, and continue the lines across and down the outside of the second one. Now you have marked all the longitudinal dimensions that you need for the barn.

Lay out and cut the mortises for the cross sills. My barn sills are 10 in. wide (as is typical) and the mortises are framed 2 in. down and 2 in. wide ("two-two"), and 5 in. deep. End mortises have 2 in. of relish. (It's advantageous not to cut the longitudinal sills to length until the siding is to be applied. The extra length keeps the relish from breaking out during construction.) After the mortise is made, recheck the face of the mortise to see if it is a flat plane. For tumbling, it is important that this mortise face is free of wind. If not, fix it with a plane and perhaps hollow it out a bit. Bore the pin holes. These can either be laid out or just eyeballed. I have found evidence of both.

Separate out the two longitudinal sills on level cribbing, about a foot off the ground, parallel and the proper distance apart. If they are bowed, space the ends the proper distance apart and don't worry about the center. This can be adjusted during the tumbling process. The sills should be leveled across their width (top face) as well as in length. If they have a level mark, level that point. In lieu of a level, a square can be placed on the level mark, tongue hanging down (or, if a sawn piece, anywhere on the surface), and sighted along the bottom edge of its blade to the opposite sill to see if the latter is in plane.

Place the two end sills over their respective mortises and square the entire assembly by checking the diagonals or by measuring a multiple of 3-4-5 at one corner. Don't be fussy at this point. An inch or two off on the diagonal of a floor 25 ft. 6 in. x 34 ft. will not measurably affect the fit of a 10-in.-wide sill joint. The two interior cross sills can be positioned. Now we are ready for tumbling the four cross sills.

Tumbling. Roll the cross sill 90 degrees (hence the name tumbling) until its best edge touches the longitudinal sill on the face side of the mortises. Put a scratch mark on the edge exactly to the face of the mortise at each end of the cross sill. Roll the sill back until it is again face up and positioned directly over the mortises. We have the shoulder-to-shoulder length at the upper face; next, we need the profile of the face of the mortise. Place the square (or a straightedge) alongside the cross sill and tight against the face of the mortise. Slide the cross sill by tapping its end (a second person is useful here) until the edge of the square aligns with the scratch mark. Draw a line along the square through the scratch mark. Without moving the timber, apply the square on the other side and draw a similar line. I like to connect these lines across the face while all is still in position. I can sight down the edge of the square to see if it is parallel with the face of the mortise below. The line is connected across the underside when flipped over for cutting. Repeat this procedure at the other end of the sill (Fig. 6).

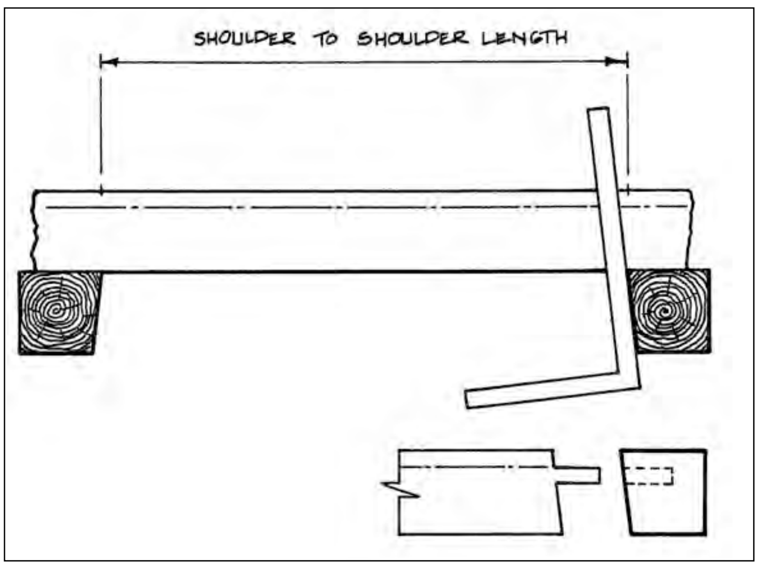


Fig. 6. After marking shoulder length on the face, timber is rotated back up. With square applied to face of mortise, tenoned member is tapped until mark aligns with edge of square. Shoulder cut will then conform to face of mortise.

If the long sills are bowed, the intermediate sills cannot be tumbled quite as above. Instead, mark out the width of the building on the face of the cross sill. Roll the cross sill 90 degrees until the best edge touches the long sill on the face side of the mortises as above. Now, slide the cross sill until the building-width mark lines up with the outside of the long sill. Apply the square as above and draw lines on both sides. Repeat at the opposite end. When assembled, the long sills will be forced straight.

Next, lay out and cut the sill tenons (Fig. 7). Note that in old work, the shoulders of tenons were often undercut to allow for distortion of the mortise face as it dried since, in boxed heart timber, mortise faces tend to crown up in the middle.

Once the sill tenons are cut, the floor frame can be assembled and the joints drawbored. With a joint reasonably tight, prick through the existing mortise pinhole to mark the tenon with the

Fig. 7. Laying out a sill tenon. On lined timber, the square is set flush to the chalk line and a line scratched on both sides.

point of the auger bit. If a cross sill is less than 10 in. wide and the tenon doesn't fill the width of the mortise, tap it tight to the layout face end of the mortise before pricking through the pinholes. Later, the pins will keep it in position.

The tenon is then withdrawn enough to see the mark, relocate it slightly and bore the hole. The hole in the tenon is offset *toward the shoulder* about an eighth of an inch (plus the amount of gap if the joint wasn't tight). As the reign of the scribe rule only overlaps the use of the Scotch-pattern auger with its screw point by a few years, early scribe rule builders probably traced the hole either with a point of their dividers or with the same gouge that was used to start holes for the shell augers (or spoon bits) then in use (Fig. 8).

Fig. 8. Drawboring the mortise and tenon joint. After using the drill-bit to prick through the pinholes in the mortise with the joint closed, the tenon is withdrawn far enough to offset the marks toward the shoulder and bore the holes.

Fig. 9. Sill joint assembled and held temporarily with a tapered drift or hookpin, which can be levered out. Pins that can be conveniently turned while being withdrawn are easier to use.

Fig. 10. Hewing the notches in the sleeper to allow it to come flush with the bottoms of the joists, which are 2 in. shallower than the intermediate sills. Notches also locate and stabilize the latter.

Assemble the sill framing; pin, level and square it. For holding framing together temporarily, the preferred method is iron drifts or hookpins, which can be made by a blacksmith (Fig. 9). Wood pins can be difficult to remove, especially after a good rain. For 13⁄16-in. pinholes, I use ¾-in. pins to prevent binding.

The threshing bay. The threshing bay in the center often had the only framed floor in these barns. Because of its importance in holding the grain crop as well as loaded wagons, the builder took extra care in both the framing and the flooring. To keep the floor from sagging or spreading, the joists ran full length across the barn's width and were supported midway by a timber called a sleeper. Joists continuous over two spans, though no stronger, are more than twice as stiff as two single-span joists over the same total distance. This arrangement was thus superior to running the joists the short way between the intermediate sills, a configuration never seen in English barns. It also provided good support for wagons driven into the central bay, with the wagon wheels running across floorboards directly supported by heavy joists rather than along single floor boards spanning joists. The sleeper placed at midspan served an additional function of tying the two intermediate sill girders.

In my own barn, I used Eastern white pine, red spruce, and red maple joists, sawn top and bottom, 6 in. thick, and peeled of bark. Because the sleeper sits closer to the earth, for durability I chose the only rot-resistant species from my forest, black cherry. The sills are all pine.

To scribe the sleeper to the timbers above, I simply positioned it under the two cross sills, blocking it up tight, and projected the sides of the cross sill onto the sleeper. The sleeper was then notched out 2 in. to bring its top surface up to the joist bottoms (Fig. 10).

The three floor joists are reduced to 4-in.-thick tenons where they bear in the sill pockets. In width, however, they are sized to the individual piece, from 6 in. to 8 in. In old work, one finds both consistently sized ends and random ones. The joists are first cut to length in position but on blocks (Fig. 11). Next snap centerlines down the joist and lay out the end tenons parallel to these lines. Then trim the sides of the tenons to width.

To do so for my barn frame, I chopped the sides with an axe and finished with an adze or slick. Then, with the joist in its proper position, I marked the lines for the pocket (Fig. 12). The lines on the vertical face of the sill can be laid out either off the top edge (if the sill is sawn) or the joinery chalk line (if hewn).

Fig. 11. The threshing-floor joists are positioned on blocking, ready to have their end tenons cut. Note sleeper beneath.

When the pockets are cut, drop the joist in upside down. The portion of the tenon rising above the surface of the sill can be hewn off flush, the surface acting as a guide and the pocket firmly holding the joist in place while it is worked (Figs. 13, 14). When both ends are done, turn the joist back right-side up.

Numbering. Before taking a finished assembly apart, the individual components must be marked. The use of Roman numerals is standard, cut with either a chisel or a race knife (timber scribe). Additionally, a tag may be added to the number to differentiate one side of the building from the other, or crossframes from longi-

Fig. 12. Joist end reduced in width and projected on sill preparatory to cutting pocket. This work is all done to centerlines.

Fig. 13. Joist is inserted upside down and tenon shaped with axe and adze until flush with top of sill.

Fig. 14. Work is checked with a square for flush. Joist is then inverted.

tudinal ones. Roman numerals found in old frames differ from those we are familiar with on the clock face. Because they might create confusion when seen upside down, subtractive numbers are avoided. There is never a I before a V or X to indicate 4, 9, 14, 19, etc. A four is shown as IIII, a nine as VIIII. (A special symbol, a I inside a V and touching its point, can also indicate nine.)

A race knife has a hooked blade that, when drawn across timber, scoops out a narrow trough that remains quite visible even after hundreds of years. It is often combined with a compass point to swing circles and arcs, usually about 1½-in. diameter (Fig. 15). Circles, half-circles and, rarely, quarter-circles added to the number distinguish different portions of the frame and serve to keep the numbers low.

Fig. 15. Race knives. From top, 20th-century fixed-blade style, 19th-century folding model and 18th-century folder with fixed compass point.

Numbering schemes varied with the builder and the tool used. Here is the common system I used for my barn. Starting at the northwest corner, I numbered with a race knife from left to right, I-IIII. Moving around to the opposite side, I numbered again from left to right V-VIII. The joists are numbered I-III, also from left to right. For the floor frame, I made a single set of numbers across the joint creating true marriage marks (Fig. 16). In later framing, I switched over to two sets because the numbers became too long to fit conveniently across the joints.

Fig. 16. True marriage marks indicating joint number 2.

At this point (to free up my driveway), I moved and assembled the floor structure on its foundation, where the remainder of the scribing and framing took place. Though it's likely that a typical barn was framed on site, it's difficult to determine if it was framed on its foundation. Doing so, however, didn't present any problems. Because of the weight of the floor timbers, knocking timbers about during the rest of the framing had no effect on the dry-laid stone work.

The foundation. Though it would have been easier to purchase a couple of truckloads of flat stone blasted out of a nearby quarry, I chose to use the fieldstone gleaned on site. The mix of colors and textures, the weathering and lichen, made the whole more attractive and sympathetic to the landscape. The foundation area was first stripped of organic material, which tends to settle over time. I set up four level string lines to define the perimeter. The largest stones, 3 ft. to 5 ft. overall, were dragged into position with their best faces (not necessarily the widest) to a line. Filling in between and above these are stones manageable by a single person (Fig. 17).

The wall is faced only on the exterior and slightly battered. Because of the ground slope, it ranges from 1 ft. to 2 ft. high. When the top of the wall was roughly to the line, the sills were placed, leveled and squared. Then the gaps in the wall were filled with thin shim stones. The topmost stones do not protrude past the sills, to allow the boarding to lap down for a drip.

How were barns leveled in Colonial times? Certainly there were transits in use then for surveying, but were barn builders using them? A framing square can be used as a sort of transit level by letting the tongue hang down and holding a plumb line near it. When the tongue is parallel to the string, you can sight level along the blade. Though not comparable in accuracy to a transit, it would have been satisfactory for a barn.

With our floor framed, set on the foundation, level, and square, we have our full-size drawing and working platform on which to scribe the remainder of the structure (Fig. 18). —Jack A. Sobon

Fig. 17. The stonework is faced only on the outside. Note the large cornerstone, original batter board and stretched level lines.

This article is second in a series describing the contemporary construction of an English barn in Massachusetts using traditional techniques. The next article will continue the scribing of the timber frame.

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Fig. 18. Stone foundation with square and level floor frame makes an excellent platform on which to scribe the rest of the frame.

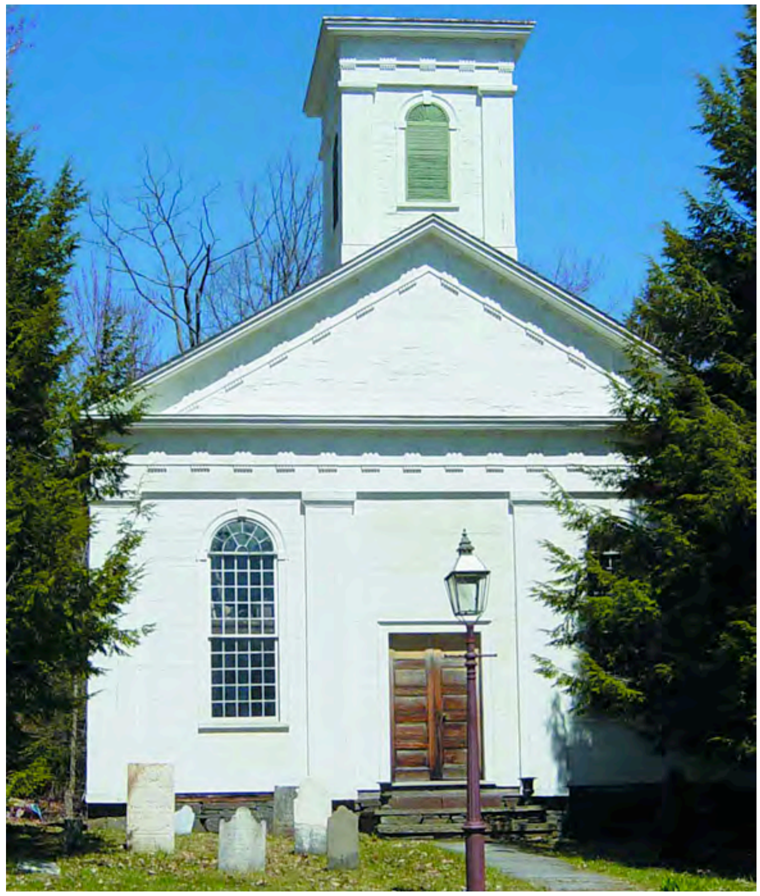
Moving the First Universalist Church of Duanesburg (1838)

THE First Universalist Society of Duanesburg, Schenectady County, New York, the first Universalist congregation in the Capital District of New York State, was formed in 1831 by very well-off farmers who embraced this new and optimistic religion in the small village of Braman's Corners. The land for the church was donated by the great benefactor of the community, Dr. Joseph Braman. In the beginning, the parishioners held their services in the County Line Meeting House on the boundary between Schenectady and Montgomery Counties. After several attempts to purchase the existing meetinghouse were rebuffed by the County Line congregation, the new society decided to build their own edifice. The initial design called for a large rectangular structure with multilight windows with arched tops, keystones and impost blocks, as well as a horizontal, flush-boarded façade embellished with pilasters and a grand Greek pediment including guttae and triglyphs. Six months after construction had commenced by the contractor, William Kellogg, the congregation "was desirous of having a belfry on the new church now erecting in Braman's Corners" and sent out a subscription that raised $133 to build it. The total cost of the structure was $1381. The Duanesburg church was a very expensive structure, especially considering that it was built during the Great Depression of 1837—a time, however, for religions to flourish.

The congregation had several periods of expansion in the first half of the 19th century, and a small rebirth in 1875 when the building was rededicated as The Church of the Redeemer, but by 1900 the congregation was dwindling. By the late 1930s, a local entrepreneur, Leroy Smith, rented the structure from the classis in Utica to use as a warehouse for his many small business ventures, which included selling maple syrup and job printing. In 1940, Smith and his family were forced to vacate the house they had been living in and, having little money and nowhere to live, purchased the church and moved in. They lived and worked there for the next 16 years while raising their four children. To live and work in the church, Smith was forced to remove all of the box pews and dismantle the low paneled balcony walls. He also built a floor across the opened section of the main room and created five rooms on the first floor and seven rooms upstairs. This work included removing the columns on the north side that supported the balcony. The good news is that Smith was also a compulsive saver and filled the attic with everything that he removed from the structure, nails and chips included! Unfortunately he also saved every tea bag pouch, cereal box, tissue box and every other container he ever bought for the contents, filling the 14-ft. high attic to the roof boards.

I stumbled across the building in 1978 while looking for antique printing equipment listed in an auction ad in the local paper. I was very interested by the structure housing the printing equipment and actually bought all of the beautifully grained doors, four columns, several lard-burning solar lamps and the 1843 replacement pulpit desk, which cost $1. That same day, a large pile of boards that Mr. Smith had carefully stored in the attic was sold for $75. I was the underbidder at $65, and a broken spring on my truck kept me from bidding further. I eventually found out just how valuable that pile of boards was.

At that point in the building's history, the windows were almost



Photos and digital imagery Don Carpentier

The Duanesburg Church today, relocated to East Nassau, New York.

completely intact with their original glass, but the building was abandoned, filled with trash and beginning to decay. Impressed and excited by the church, I returned the next day and asked the gentleman in charge of the sale if I could buy the salvage of the architectural elements in the building. He commented that the owner was hoping to find someone to buy and remove the whole structure and that they thought they had found someone. Over the next few years I traveled by the church several times and was surprised to see that it was still there.

It was four years before I again had thoughts about purchasing the building. This time it was to add it to the collection of historic buildings that I was moving to Eastfield, my home in East Nassau (Rensselaer County), New York. I had begun a series of historic preservation workshops in 1977 and was quickly outgrowing the copy of a meetinghouse that I had built in 1973. I needed space to expand the classes, and the church seemed like the perfect solution. I was able to buy the building for $1000, a large sum for me in 1982. The owner, Eugenia Smith, originally wanted $1200, but she kindly sold it to me for the lower price because she felt that I was the "right" person. (Or the craziest, I thought.)

The interior was filled with accumulations and debris of all kinds, which had to be carefully looked through because there were many parts of the building in among the junk. Since I had no money to move the building, my crew included my brother Jim, a

Raising the first wall of the relocated church at Eastfield on Guy Fawkes Day, 1982.

group of very dedicated volunteers such as Bill McMillen of Staten Island and a collection of eager friends. It took a full week just to clean out the junk, creating a pile about one-third the size of the building. We did find an important collection of church parts during the process, including some patented 1843 chandeliers (under the south staircase), most of the original railings to the 1836 pulpit, the ends to most of the original box pews and many balcony parts. Once the church was cleaned out, it took five weeks to dismantle and move the building to Eastfield. My brother Jim and I would leave about 6 AM every day, work all day at the site, then load the truck in the evening and make the hourlong drive home. We then had to unload the truck, eat and go to bed, usually by 10 PM. And then do it again the next day and every day for those five weeks. Jim took all of one weekend off.

Every inch of the building was measured and recorded using photographs and drawings—all 5000-plus parts. The slate roof installed in 1869 over the original sawn pine shingles was saved carefully for reinstallation at the new site. Any ornamental architectural elements were removed intact when possible, except the Federal-style staircases that we kept in two large sections each.

Most of the materials came home in my beat-up 1968 Ford F-150 pickup with a 6-ft. box. There sure were a lot of things hanging over the end of that tailgate every day. The large timbers were brought home by a good friend from Hoags Corners, Jim Hankle, who had a logging truck. He didn't lose or damage anything and used great dexterity picking up and moving every piece with the log arm on the truck.

Except for the kingposts in the roof trusses, the entire frame of the church was hemlock. The inner 6 in. of each of the 12x12 corner posts were cut away to make plaster corners, in Greek Revival fashion. Girts connected the 6-in. wall posts all the way around the building except at the window openings. The kingposts in the main trusses were hard maple with wedged half-dovetailed tenons at the bottoms. The tie beams were 12x14s, 39 ft. long. A pair of 44-ft. carrying timbers ran front to back, bolted directly under the tie beams. The bottoms of these timbers were hewn to the curvature of the vaulted ceiling and to follow the 99 curved ribs joined to them. An additional bent had been added to the roof frame to accommodate the belfry, with a queenpost truss that formed the rear wall of the tower, its tie beam merely half-lapped into the main plates.

The last of the church parts were on their new site at Eastfield by mid-August. It took until November 4th to clear the site, build a massive foundation, obtain necessary timbers and commence the repairs. On that day we had the first of three long-weekend gatherings to raise the church. The first day we put together the underpinnings and prepared to raise the rear bent the next day. So, November 5th, Guy Fawkes Day, saw the beginning of the vertical timber work.

The rear wall bent, at 39 ft. wide and 22 ft. high, was no lightweight, and we raised it all by hand. With braced blocking at the base of every post and blocks and tackle on each corner, as well as 16 people with pike poles, we struggled and struggled and miraculously raised the wall, much to our surprise. Bill McMillen and I admitted years later that the night before we both had dreams about the bent coming down and killing us. The first bent raising was a great moment, but it was just the beginning, as we had three more bents and five trusses as well to raise.

It took two three-day weekends to raise the frame up to the level of the plates. Every week after the volunteer crew left, I had to set to work as fast as possible to make the needed repairs and parts for the next work-party to raise the next weekend. The hardest part was yet to come, the raising of the belfry and roof framing. You need to understand that working in high places has always made me very uncomfortable. The distance from the top of the foundation to the top of the belfry was 50 ft., and there was darned little beneath me a lot of the time. I did make sure that anywhere other people were working was always covered in planking and safe, but I'm the one who had to get the planks there in the first place. I was also extremely lucky to have a friend and his family who came up faithfully to help. Don De Fillo comes as close to a human fly as anyone I have ever met. I believe he had worked on high steel projects in his younger years, and to him the church was just another fun challenge.

We did use a rather sad excuse for a crane to help raise some of the materials to the level of the plates and help pull up the parts of the belfry. We assembled the front truss with the front wall framing of the belfry lashed to it. We then assembled the rest of the belfry and used the tie beam at the base of the supplemental queenpost truss as a pivot to raise it in one piece. It took serious work because the crane didn't have the power to pull the back section of the belfry up on its own, so we had to pull as much as we could with the crane and then take our pikes and lift as far as we could. Then we would prop it up and repeat the process.

Since we were coming up on an angle, and the length of the tenons brought the joints up in a higher position than wanted, we had to put a block and tackle between the front and rear sections and tie back the rear of the belfry to rock it enough to get the joints together. It worked, but it was very nerve-wracking to say the least. The last really difficult item was putting the plates on the top of the belfry. Two of them dropped straight down on the tenons of the posts, but the other two needed to be slid onto the ends of the first plates. That meant that Don and I had to put down a pair of planks across the top girts of the belfry and hang out over the edge holding the 6x8 plates and slide them over the horizontal tenons, 50 ft. in the air. After that I worked alone to complete installation of all of the common rafters, cripple studs, curved ceiling joists, balcony framing and floor joists. The frame was completed by December 31.

The exterior trim and roofing went on in the spring of 1983 and the siding and windows by that August. Bill McMillen and I installed a flat-seamed, soldered, lead-coated copper roof on the belfry.

All this work really made me wonder whatever had happened to all of the wood that was sold from the attic at the auction in 1978. I asked everyone I knew, and several articles on the project appeared in the Albany newspapers carrying pleas for anyone with information to please contact me. They produced no results. Then, in October of 1983, a fellow was sent up from Litchfield, Connecticut, to dismantle my first meetinghouse and move it to a site in Litchfield. He had heard about a nearby town called Rensselaerville in Albany County and expressed an interest in seeing it really soon. We decided that November 5th would be a good day. I needed to go out anyway and pick up my girlfriend in Cooperstown. So it all would work out perfectly. After we toured Rensselaerville, I had planned on heading north to Cooperstown, but the man from Litchfield kept asking about a house-parts dealer in the vicinity. I finally agreed to go look for the dealer, even though I'd never heard of him.

We went south for several miles to the antique shop of a friend, Ruth Anne Kees, where I asked if she had ever heard of this man. She immediately pointed to the fellow helping her load her van in the driveway. It turns out he had a lot of house parts stored in a two-story chicken coop just up the street, so we went to see what was there. The upstairs of the building was divided by a chicken wire wall, and nothing on the far side was for sale. I saw nothing that interested me and became bored, so I went back to examine a pile of old bed rails leaning against the wire wall. There I noticed a pair of long, narrow paneled boards lying on the floor on the other side of the wire. Remarkably, they looked just like the two pieces I was missing for the girt supporting the balcony inside the church. In fact, the really large pile of boards next to them had the same graining and the same red rails and were identical to the few pieces of the pews that had survived from the church. The more I looked, the more I realized that they were the missing pieces of the church! I got very excited and asked who owned the boards. The answer came back—*Ruth Anne Kees*. I tore down the road to talk with her, and it turned out it was her father who had outbid me at the church auction and then given her the boards to make a kitchen floor.

Fortunately they hadn't gotten around to doing it, and I was able to take the boards home that day. I traded Ruth a load of beautiful new wide boards for her floor. All this happened exactly one year to the day after the raising of the frame. Needless to say, my girlfriend didn't get a ride back from Cooperstown that day.

The church has been restored to its original appearance and even the solar chandeliers are now restored and usable. It has new plaster over new, vertically sawn accordion lath, and the interior was painted using the colors applied during the summer of 1869.

I have since found the records of the church in the New York State Library in Albany, and we have added considerably more to its history. The church has been used for the programs at Eastfield since the summer of 1983, as well as for services of local Unitarian-Universalist congregations. Many friends and relatives have been married there, and another good friend is buried at the site. My wife and I were married in the church in 1987, and our children were baptized in it as well. It has a new life. —Don Carpentier

Don Carpentier (dcsapottery1@taconic.net) built and operates Eastfield Village, a collection of historic buildings he dismantled, moved and rebuilt in East Nassau, N.Y.

The church after use as a dwelling and decades of neglect.

Dismantling the kingpost truss roof frame, as seen from the steeple. Steeple truss was queenposted.

The building mostly stripped and rafters coming down in 1982, faithful Ford F-150 at the ready.

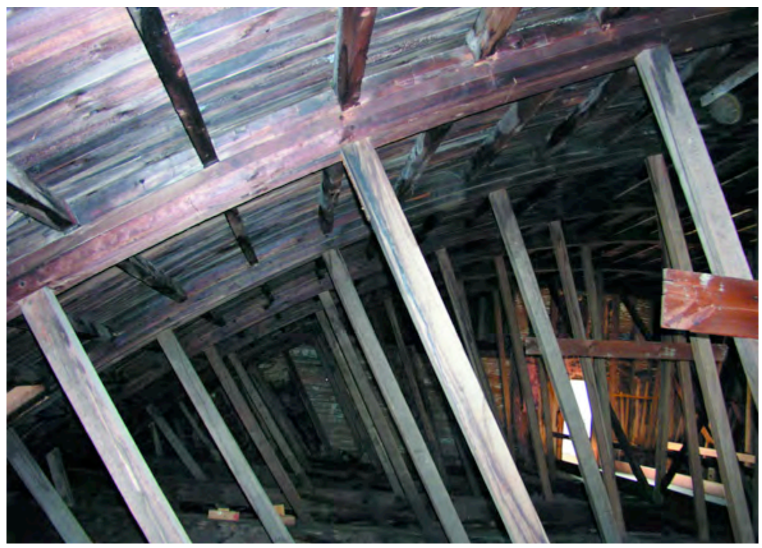
TTRAG Proceedings 2006

THE Guild's Traditional Timber Frame Research and Advisory Council held its 15th public symposium in May with a gathering at Eastover in Lenox, Massachusetts. Some 135 participants fitted in visits to two nearby Shaker villages, one at Hancock and the other just over the New York border at Mount Lebanon, to view the buildings and speculate on their framing. The roof framing shown here, of the 1824 meetinghouse at Mount Lebanon (now the Darrow School library), was of the greatest interest. At the symposium itself, over the course of two evenings and two mornings, ten scheduled presenters and a few opportunists ranged over stone, iron, timber, dendrochronology, plank framing and barn repair. Two TTRAG 2006 presentations appear in this issue not as proceedings but as articles on their own. The second installment of Jack Sobon's series on building an English barn in Massachusetts appears on page 6, and Don Carpentier's authentic history of dismantling, moving and rebuilding a deconsecrated, partly deconstructed and somewhat scattered 1838 Greek Revival church appears on page 13.

Photos Rudy Christian

Barrel-roofed meetinghouse 65x80 ft. without annex at Mt. Lebanon Shaker Village. The building is now a library for a preparatory school.

Two-part 12x12 tie beam, a 65-ft. hewn pine log sawn in two, passes over jowled post and clasps large post tenon, the connection clamped by a bolt. Knee brace is doubled. Arch rafter to tie connection is minimal.



Struts, deeply mortised at the rafters and bolted at the ties, descend from segmented, laminated 10x10 rafters. Top laminae of rafter is thickest of three, to house purlins. Method of forming arch is unrecorded.

Tie beams, firmly braced in the plane of the attic floor, clasp the radial struts supporting rafters above and the domed plaster ceiling below.

Last strut nearest wall breaks radial pattern to form much steeper angle with tie, suggesting an intention to restrain the arch end.

A Timber Frame Victim of Katrina

Rudy R. Christian

THE photo below shows a stretch of North Beach Boulevard in Bay St. Louis, Mississippi, after a direct hit by hurricane Katrina at the end of August last year. On one lot, a jumble of debris and uprooted tree limbs concealed a brick chimney and a length of interior wall exposed by the hurricane, as well as various pieces of building fabric and the interface of an early structure and a later addition, including evidence of traditional mortise and tenon timber framing.

Sifting through the rubble inside the collapsed structure, known as the Hecker cottage, we found wide yellow pine ceiling boards with beaded tongue and groove edges worked with hand planes. We also found that the lathing applied to the walls for the lime plaster work appeared to be riven rather than sawn and applied with forged nails to the wall framing.

The storm ripped away large amounts of the interior and exterior fabric, revealing hewn timber frame members, including the top plate and two wall studs. The top plate carried scratched layout lines indicating the use of scribe rule, the layout method used in Europe during the settlement of the New World and practiced by carpenters here until roughly 1800, when a new system called square rule evolved. Square rule layout simplified the work and was quickly adopted by American timber framers, effectively replacing scribe rule in most places early in the 19th century.

Katrina's victim, the Hecker cottage, in an old photo.

Remnants of lapped exterior siding boards revealed a beaded lower edge, again worked by hand plane. The hand-tooled building elements, the use of scribe rule in layout and the fact that all of the timbers were hand hewn (rather than sawn) would indicate this building is very likely first period for its area. Conversations with local historians and the state historic preservation officer suggest a date ca. 1780. The building has been dismantled and is in storage awaiting plans for reconstruction as a local history museum.

Photos Rudy Christian

Above, shards of roadway. Below, frame of wall at right above.

Above, standing remains of eaves wall. Below, fallen wall section.

Dendrochronology for Timber Frame Dating in the Northeast

William Flynt
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DENDROCHRONOLOGY, or the study of tree-ring growth patterns over time, is becoming a more frequently used analytical tool for dating the felling year of historic building timbers. While dendrochronology has been used successfully in other regions of the United States and in Europe, it has only been put to the test in the Northeast since the late 1990s.

The Society for the Preservation of New England Antiquities, and Anne Grady in particular, arranged for dendrochronologists Paul Krusic and Ed Cook to conduct a pilot project in early 2000 on oak building timbers in eastern Massachusetts. In 1997, an old-growth stand of oak had been discovered on Mount Wachusett in central Massachusetts, and we hoped that historic timber tree-ring patterns could be linked to the living tree data. The results were positive, revealing that current computer-aided dendrochronology techniques could provide accurate results. Subsequent sampling of historic oak timbers over a wide geographic expanse of eastern New England led to many buildings in the region being tested and conclusively dated.

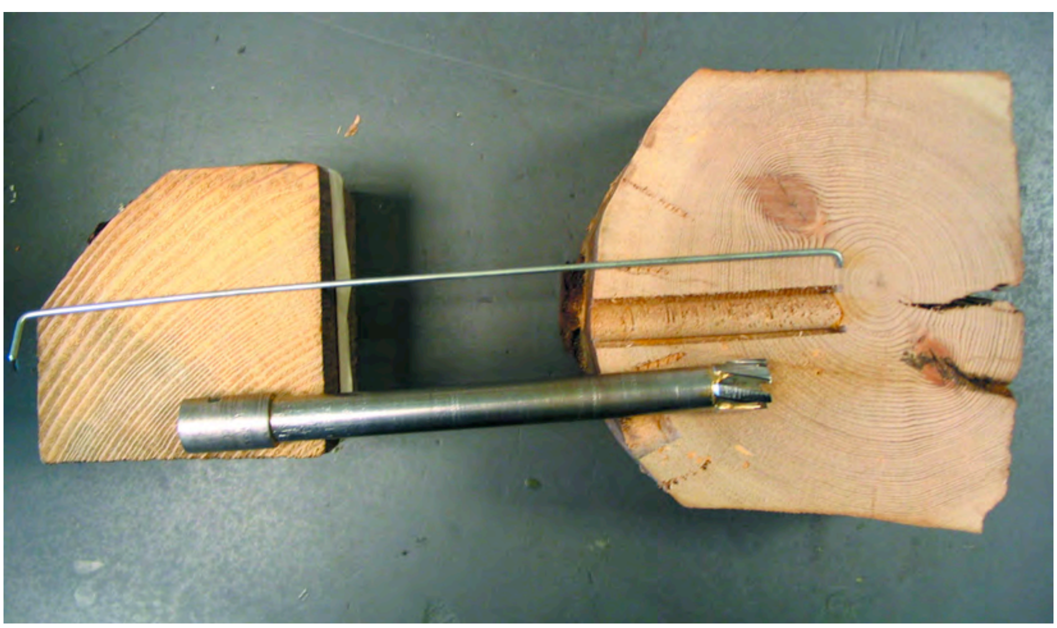
In early 2001, Historic Deerfield began using dendrochronology to help solidify dates on buildings in the Connecticut River Valley and Deerfield in particular. Pitch pine, one of the dominant species used in late 17th- through early 19th-century valley structures, was selected for study. Dendrochronologist Krusic was able to ascertain that historic samples could be accurately aligned with each other. Over a period of several years, Krusic analyzed additional samples and generously offered to teach the author the rudiments of coring timbers, preparing the samples and conducting the dendrochronological analyses. With this new knowledge in hand, continued studies of select Deerfield houses as well as structures in other valley towns proceeded at a quickened pace and provided the data needed to compile a dated pitch-pine master chronology composed of over 150 samples spanning the years 1569–1846. Along the way, the historic chronology was tied to both a living pitch-pine chronology developed by Krusic and Cook, located in New Paltz, New York, as well as to one closer to Deerfield in Montague, Massachusetts, compiled by Annie Hagar.

While pitch pine was the initial species studied in the valley, subsequent work with oak and hemlock (and, to a certain extent, chestnut) has led to development of dated masters for these species as well. Though they do not have sample depths comparable to the pitch pine, they are proving to be valuable and usable tools in dating timbers of these species.

For a given timber to be suitable for dating it must possess several attributes. First, it needs to be a species for which there is a dated master chronology (developed within a reasonable distance geographically) that includes the suspected time period of the timber's growth and felling. Second, it needs to have a sufficient ring count (60 years minimum) to provide meaningful results. Third, it must have a waney, or bark, edge to provide the last year of growth through which the sample must be taken. Fourth, bug or decay damage cannot be so excessive as to allow the outer portion of a sample to fall apart as coring commences. If timbers in a structure meet these criteria, then a study is possible. Ten or more samples from each distinct building episode usually supply enough information to obtain meaningful correlations to a master, though by no means can a dendrochronologist guarantee that any samples will date. About 80 percent of the studies have provided meaningful results. With time, some of the inconclusive analyses will invariably come into line as more successful studies are added to the ever-increasing data bank of site and regional masters.

Over the last few years, dendrochronology research in New England has successfully dated about 100 structures. Out of this work have come results that forced architectural historians to rethink some assumptions. In Deerfield, for instance, several historic houses have had their interpretations modified. The history of the Sheldon house had to be revamped when the dendrochronology study confirmed a reanalysis of the architectural and documentary evidence of its evolution. The previously accepted "pre-1743, likely 1735" construction date for the main edifice, derived from documentary records, was reassigned to an earlier structure (no longer standing) onto which the two-story, five-bay edifice had been added beginning in 1754. The latest date for felling of the timbers sampled in the main house frame correlated with 1753, in line with the current research.

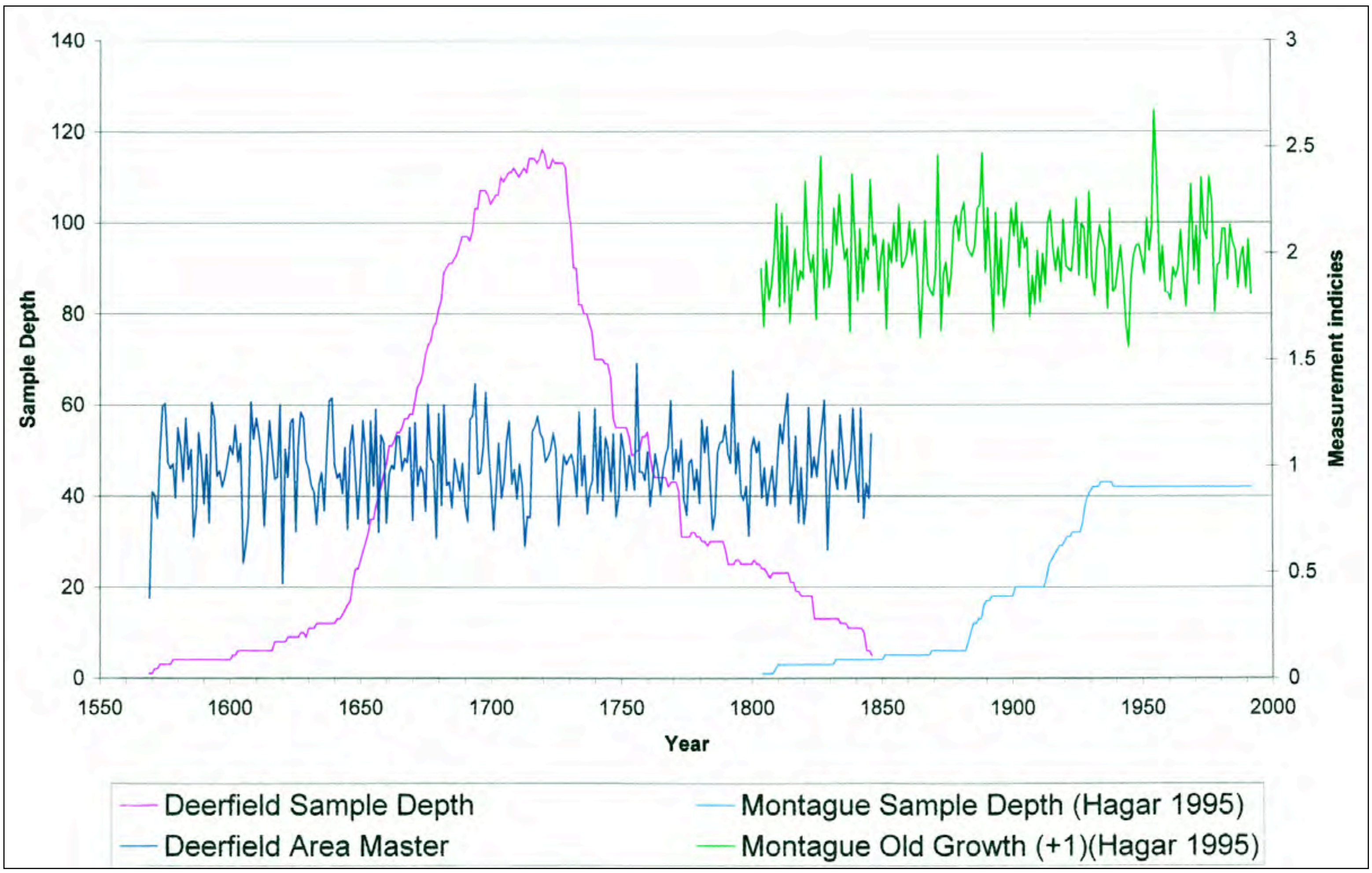
At the neighboring Reverend Jonathan Ashley house, while the long-held conclusion of a mid-1730s construction date appears to be confirmed by the dendro data, the 1750s date associated with the addition of an imposing gambrel roof has had to be rescinded. Ashley account book records do indicate significant work was carried out in the 1750s that likely included the removal of a central chimney in favor of a center hall plan and the addition of significant decorative details both inside and out. While the roof change had been assumed to have been part of this work, coring of the framing revealed the four purlin tie beams to have been felled in the fall of 1780. A review of Reverend Ashley's son's medical account book revealed an October 1780 entry "to paying Chapman for two days work carting timber for the roof of my house with a yoke of oxen." This entry was followed by a series of debts to various workmen for work on the house. In one case, the daybook for the workman revealed that he was shingling the house. Reverend Ashley died in August of 1780 and his son inherited the homestead.



Historic Deerfield

Cross section of cored hemlock with coring bit and core extractor.

Above, Sheldon house, Deerfield. Main house (front) redated from 1735 to 1755 with confirmation of dendro. Above right, Bill Flynt coring chimney girt in the 1735 Col. Ashley house, Ashley Falls, Massachusetts. In the latter house, dendro confirmed documentary date.



Deerfield pitch pine master summary. Sample Depth (magenta and light blue lines) is the number of samples in a given year that make up the measurement indicie average for that year. Measurement indicies (green and dark blue lines) are measures of the growing conditions on a year-by-year basis. A measurement indicie of 1 is average. Measurement indicies above 1 reveal years of better than average growth; conversely, measurements below 1 signal years of weak growth. In the case of researcher Hagar's data on living pitch pine trees from Montague, Massachusetts, +1 was added to her measurement indicies to physically separate the graph from that of the Deerfield data. Thus, for the Montague data, 2 equals the average growth measurement indicie. All lines relate to the year dates on the bottom of the graph.

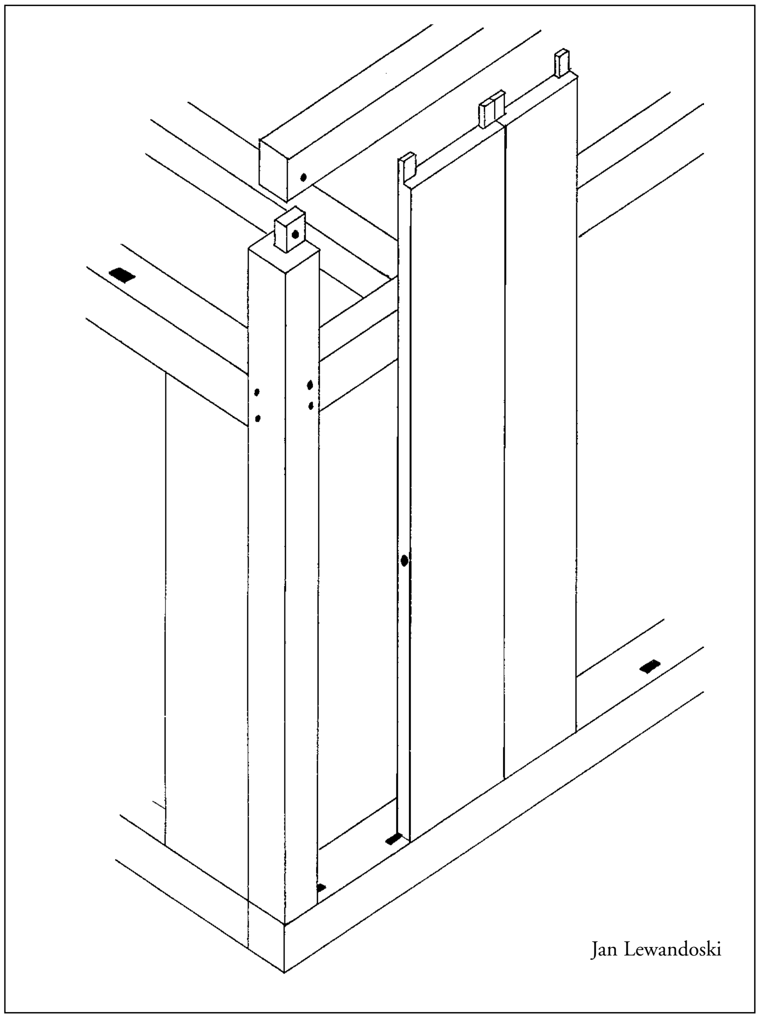
Plank Framing

Jan Lewandoski

THE use of vertical planks as partial, principal or sole elements in wall framing has a long history, most of which is unknown because the planks are concealed under finished surfaces. At least two examples ca. 13th-century are known in England, one suggesting an evolution from earth-fast palisade walling to squared material rising vertically from a sill.

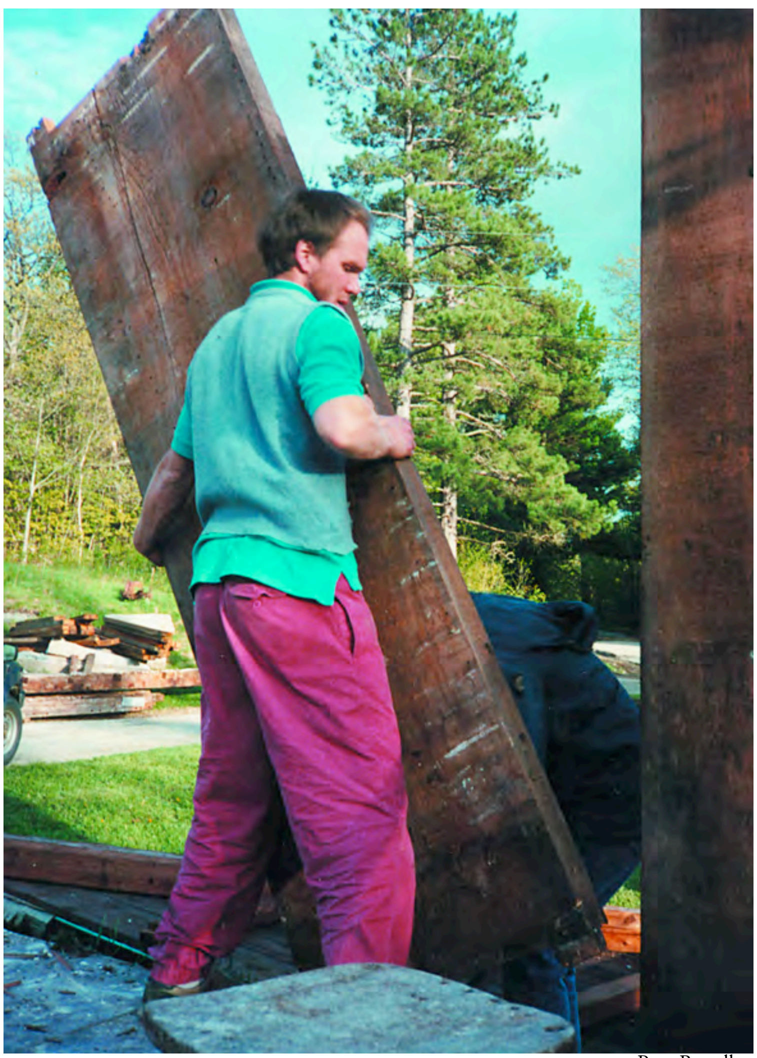
In North America in the 17th and 18th centuries, vertical planks spiked or pinned to the exterior of a timber frame were common. In such cases, the planks took the place of studs, diagonal braces and sheathing boards. At some point in the late 18th century, probably in the interior of New England, some framer decided to eliminate the wall posts as well and let vertical planks form the entire wall frame, often tenoned top and bottom and laterally pinned to each other. The planks varied in thickness from 4 in. down to 1½ in. and were often quite wide—12 to 30 in. across. Their use is always associated with an area rich in timber although, with the development of railroads by the 1850s, plank houses were being fabricated in upstate New York and shipped to the treeless prairies.

In the period 1800 to 1880, plank framing, usually without posts, became a substantial minority style in interior New England, upstate New York, Quebec, Ontario and in numerous other states and Canadian provinces all the way west to California and British Columbia. In time, the thickness of the plank and the use of traditional joinery declined, leading to so-called "box houses," where wide, thin planks were spiked to the exterior of sill and plate. This evolution reflects less a shortage of wood than the modern tendency to build quickly and lightly, with a minimum of skilled labor. Much of the popularity of plank framing throughout the earlier 19th century had to do with the ease with which the frame could be concealed while still being traditionally joined. As such, plank framing can be seen as one of timber framing's responses to the falling out of style of the exposed, decorated frame.



Jan Lewandoski

Best plank-frame method exploited the joiner's art, obviated bracing.



Pam Broadley

Dismantling 1840s plank frame in Enfield, N.H. Plank edgings supplied studding for interior walls. No alignment pins used at joints.

koby van beest

Enfield roof was raised in 1905 and light-frame second story added. Second story was removed in 1990 and plank frame entirely rebuilt.

Paul Oatman

Palmer-Barber Bruns barn, Diamond Valley, California, about 1860. Apparently Dutch influences include tapered rafters and through tenons, though ethnicity of builders is unknown.

Timber Frames of Nevada and California

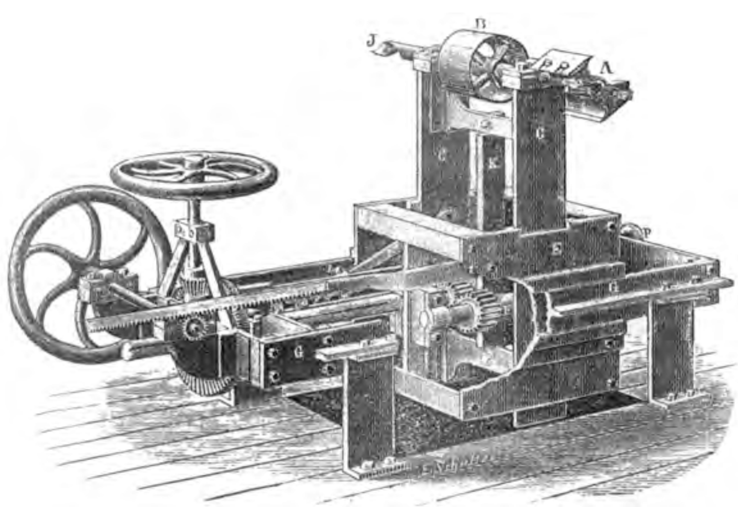
Paul Oatman

FROM 1850 to the First World War, hundreds of timber frame structures were erected in the valleys of the Sierra Nevada Mountains, which lie in both California and Nevada. In 2000, I toured the state of Nevada for the Nevada Humanities Committee under the Barn Again banner in search of how far from the Sierras these structures were built. Not far, it turns out. First came the miners by land and sea. They concocted sourdough bread and they wanted beef. Then came the ranchers. Then came the carpenters, who built the barns and mine buildings and then opera houses and churches. It was almost 70 years of nonstop building—a carpenter's heaven. Mass production machines were invented to cut tenons and mortises for square-set timbering.

The timber-framed barns of this region have a number of common features. All have square rule layout, dropped tie beams, common rafter roof systems and a mechanical hayfork that runs the ridge from gable to gable. And they all lock together with softwood pins. The mother lode of barns is Carson Valley. It caught the miners coming to the California gold rush and back again for the Comstock silver lode of Virginia City, Nevada. On the western side of the Sierra Nevada, the gold rush towns of the foothills are also speckled with barns. Although black oak is prevalent there, the barn builders still used pine pins.

North of Carson Valley lies Sierra Valley, the largest alpine valley in the Lower 48. While Carson Valley has many beautiful barns, the ranches today are shrinking as development of trophy homes eats up the land. Not so in Sierra Valley. Little has changed in 150 years, and many of the original ranches are still in family hands. The population of Sierra County in 1850 was 3741; in 2002 it was 3557. North of Sierra Valley is Quincy, which is thick with barns, and farther north is Cedarville, uncharted territory where, I hear, the barns are made of cedar.

The majority of these barns are still in use, but the hayfork was abandoned in the 1920s and tractors then carried the hay into the main aisle. This development caused some structural changes, like taking chainsaws to the gable sills and cutting large doors in the gable ends. One notable exception is the Scossa barn in Carson Valley, pictured below. The grandmother still holds the reins and the grandsons still stack the hay by fork, and they hate it.



Timber cutting machine built by Isaac Lepley of Amador City, California, patented 1882. On a common shaft driven by overhead belt, two-knife cutterhead at A makes tenons, auger at J makes mortises. Timber (not shown) is held on a separate carriage. Head can be positioned and repositioned vertically and horizontally for successive cuts.

Scossa barn, Minden, Nevada, 1908, a good example of Carson Valley barns, in original condition and equipped with Jackson hayfork. Note unhappy grandsons. The softwood frame has three bays 18 ft. on center and measures 60 ft. wide by 54 ft. long. Central aisle appears full of hay.

Pilton Barn Reconstruction

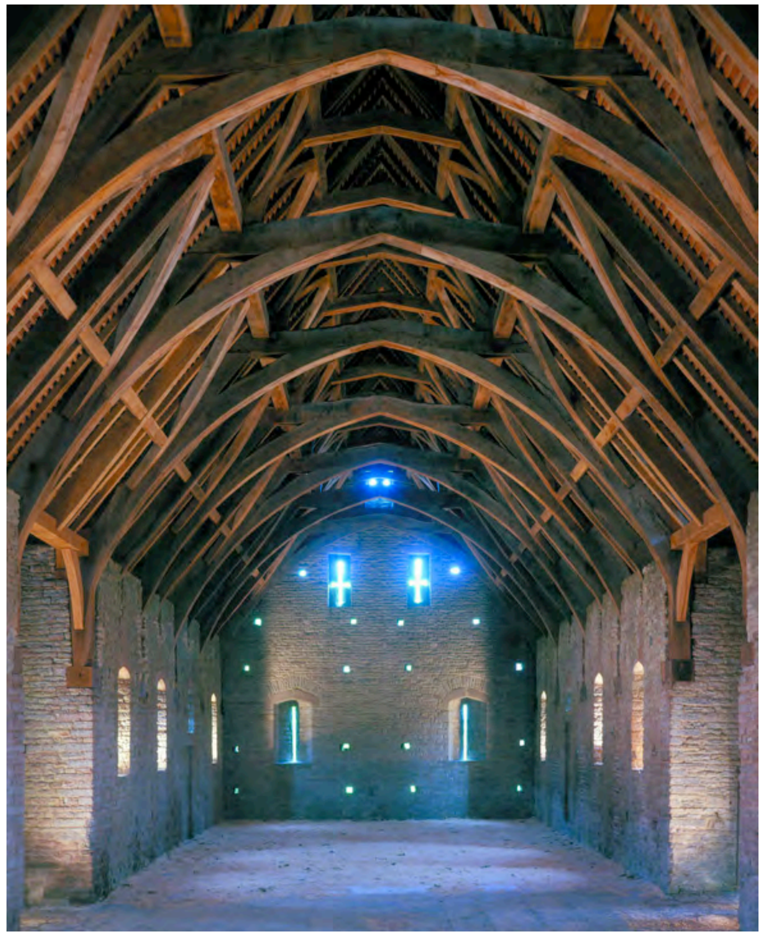
Peter McCurdy

THE medieval barn at Pilton, Somerset (UK), is the largest of four extant barns built by Glastonbury Abbey around 1300. In 1963, Pilton barn was struck by lightning, and the huge oak roof structure was completely destroyed by fire. In 1996, the Pilton Barn Trust was established to undertake the restoration of the barn. Apart from the evidence in the surviving stone walls, the main record of the roof was a single photograph of the interior. We carried out a detailed study of the abbey barns and other precedents and made discoveries regarding how the trees had originally been used and the method and sequence of fabrication and erection.

The main features of the Pilton roof are the large raised base cruck frames with their curving arch braces. As a two-tier cruck roof, above each cambered main collar there is a smaller upper cruck frame. Along the length of the roof at both upper and lower levels are more than a hundred curved wind braces. The very large number of selected curved and shaped timbers is a major characteristic of the building.

All the timber used on Pilton barn (including the doors) is English oak. In some cases, working closely with Somerscales, the timber suppliers, we selected standing trees to achieve the particular shapes required. We made full-scale templates for each type of shaped timber, which Somerscales then used to select appropriate trees or logs.

The different crucks generally use a fork in the tree to achieve the shape needed. The main base crucks are from the trunk of the tree and part of the first major fork, to create the angle formed by the wall and the roof. These timbers are inverted in the building, with the long length of the trunk forming the main rafter up to the collar. An important part of the selection process was specification of the appropriate quality and character of the English oak. Reflecting the historic methods and the character of the original building, the trees and logs used were as small as possible, often including sapwood and sometimes bark. This efficient use of the tree is consistent with historic practice and differs from the tendency in conservation to overspecify timber to too high a grade.



Photos Jamie Woodley

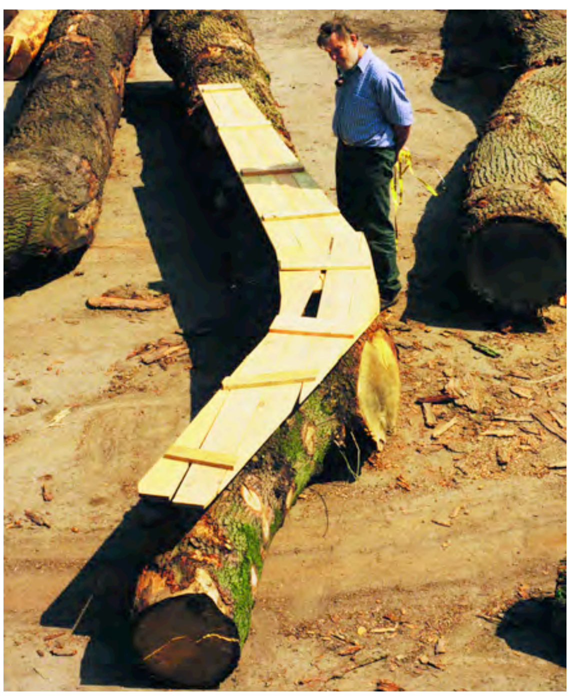
View of about half of Pilton barn roof frame. A small forest of English oak was necessary to produce the hundreds of necessary pieces, of which 250 are curved. Barn has nine bays including the entry bay. Lower crucks were individually sized to fit existing pockets in the stone walls, reversing the original construction procedure.

The stone walls were originally built around each individual cruck foot. In the reconstruction, each cruck was converted as boxed heart or halved to follow the original conversion and sized

Entry porch required its own cruck framing, though considerably reduced in scale. Uncorrected repair to stonework at upper right.

Above, upper cruck roof frame fully assembled in the workshop. At top, frame in place over Pilton barn, with one side lathed and tiled over.

to follow the individual pocket details. Following the evidence for sawing on halved historic crucks, the halved pairs of crucks and braces in the east gable cruck frame were pitsawn using the seesaw method over a single trestle. The cruck frames were fabricated in the workshop using the English scribe method based on the joining methods and details recorded in the research.



Above, templates were essential to choosing sawlogs for lower crucks. Above right, lower crucks sawn out and under preparation in the workshop.

Repairs and Rigging Checklist for Large Timber Frames

Arron Sturgis and Peter Rudd

1. ***Conditions Assessment.*** Thorough existing-conditions documentation: building location, type, basic dimensions, photos. Building history: family history, previous repairs, current and past use of building. Initial survey and thoughts on nature of damage and structural issues.

2. ***Initial plan of action.*** List of materials and equipment needed for stabilization and further assessment. Cost estimates based on in-depth discussion with client about scope of work and budget.

3. ***Organize.*** Plan appropriate flow of repairs so that equipment and personnel are most efficiently used.

4. ***Work Documentation.*** Maintain constant written documentation: drawings and photographs of completed work and conditions discovery. Include system of measuring and drawing bents, walls, roof, undercarriage, etc., to develop clearer understanding of building's existing geometric shape and how the building should be changed (or not) to insure most effective and appropriate repairs.

5. ***Communication.*** Maintain open dialogue with client to insure appropriate budgetary and repair decisions while new discoveries of building conditions are made and change orders issued.

6. ***Rigging Plan.*** Establish rigging plan and materials needed to ensure effective and safe moving or racking of building. Determine control points to be used for measurements and monitoring progress.

7. ***Rigging Targets.*** Establish targets on current drawings for final desired post/bent elevations and positions. Establish post/bent targets for final desired post foot/sill locations.

8. ***Establish Conventions.*** Continue open discussion with crew and client of joinery conventions, layout method and changes from use of original joinery if needed so that client and all workers understand reasons and methods for repairs. Determine historical significance of building, its current and future use and structural needs. Decide on criteria for replacement of entire frame members vs. repair of partial members, as well as use of sawn vs. hewn log conversion, if appropriate.

9. ***Weather.*** Work smart: determine how weather affects building and crew. Establish plan for temporary covers to protect building and crew.

10. ***Execute Work.*** Rigging to enhance not hinder repair process. Perform traditional timber repairs with great craft. Complete repairs in timely fashion. Document repair process. Involve client.

Rigging Tools. Haven Grips, lever hoist, AC-powered winch, swager, cable cutter, pulleys, rope slings, ascender, carabiners, loadbinders, steel plates and rollers, timber arch.

Rigging Hardware. Cable, aluminum oval sleeve, thimble eyebolt, nut eyebolt, forged cable clamps, rapid links, turnbuckle.

Resources.
Cable and Tools: www.e-rigging.com, www.fehr.com
AC winch: www.gowarn.com/warn-works-winches.asp, www.superwinch.com/pages/ac/sac1000.html
Haven Grips: www.mytoolstore.com/klein/1604-10.html
Timber Arch: www.novajack.com/en/0101_06.htm, www.futureforestry.com/arborists/index.html
Pulleys: www.cmi-gear.com

John Butler

Repairs to Nicol barn, Newton, New Hampshire.

Timber and Stone

Allen Williams

THE combination of timber and stone is logical, based on the natural properties of the two materials and on historic precedent. Both materials were abundantly available to the early New England settlers. In converting forest to farmland, settlers needed to fell the trees and remove the fieldstone to create pasture. Timber with its high strength-to-weight ratio and stone with its high compression strength and low moisture absorption rate offered a perfect combination of materials to build a barn. The barn was of vital importance and often its building preceded the farmhouse in the struggle to gain a foothold and face the grim New England winter.

Consider the basic format of the New England barn. Whenever possible, the structure was built into a hillside to create upper level access for hay storage. If no grade difference was possible, a ramp was built to reach the upper level. Dry-laid stone was the ideal material for this ramp and retaining wall. Within the barn, stone footings would often be used on the lower level to support the timber frame and prevent rising damp. In the foundation walls, stone lintels and sills were used to create ventilation openings. Overhanging shed roofs would often rest on pillars of stone. Lower level floors were often paved with random flat stones to create a cleaner, drier storage area.

In our current work of repairing or replicating old barns, or in using timber frame structures as living spaces, all these historic uses of stone can be employed to great advantage. In the restoration of the round barn at Hancock Shaker Village here in Massachusetts, we used lintels and sills of rough-split granite, closely matched in color and grain, to replicate the original limestone that was no longer quarried. The critical point here was to keep the rough rock-pitched faces and slightly uneven top and bottom arrises of the original work (Fig. 1). A contemporary use of the same elements would be in my own timber-framed home, where I used granite as a veneer but kept the look of a full masonry wall by using heavy rock-pitched faces, L-quoins, and deep window openings (Fig. 2).

Pillars of stone can be a practical means of taking the vertical elements of the timber frame outside the protective skin of the building. At Hancock Shaker Village, our granite pillars are used in several of the entry areas (Fig. 3 overleaf). Note the batter of the pillar, which replicates the natural taper of a tree, thus giving the sense of a grounded and stable component.

Plinths of granite bring timber posts out of the floor with a real sense of stability and add visual interest. Fig. 4 overleaf shows an axed chamfer with rock sides on a plinth emerging from a stone floor reminiscent of an old farmhouse. With the use of radiant heat, a stone floor is now practical for the home environment. Stone easily transfers heat into the room and has good thermal inertia—holding a constant temperature in winter, cooling the room in summer months.

Of all the ways stone can enhance a timber structure, the simplest is to use a perimeter course at grade. In new work this can be done using a standard brick shelf in the foundation pour and placing full-height split-face stone around the foundation. This gives a look of quality and permanence and serves the practical function of protecting the area most affected by weather. Using L-quoins at the corners and pitching back the perimeter of each piece gives the foundation a sense of mass.

There are two common mistakes I see in architectural stonework today. The first is in not trusting the material. Often, stone will be specified with undercuts to receive structural steel or anchors to attach to redundant backup work. Used properly, stone can serve better than almost any other material in compression.

Fig. 1. Lintels on round barn at Hancock Shaker Village.

Photos Allen Williams

Fig. 2. Heavy rock-pitched faces and substantial lintels in stone veneer on a timber-framed house in western Massachusetts.

Fig. 3. Granite pillars at Hancock Shaker Village.

When stone is used as a lintel, its grain must run lengthwise and the section dimension should be in scale to the opening. The second mistake I often see is the use of stone that is too clean and straight to achieve the look of old work. I deliberately keep the faces rough and slightly uneven. I often flame the outer edges to give a flaked, rounded look.

Fig. 4. Impermeable stone plinths raise posts out of ground and block rising damp. Paving with stone keeps storage areas drier.

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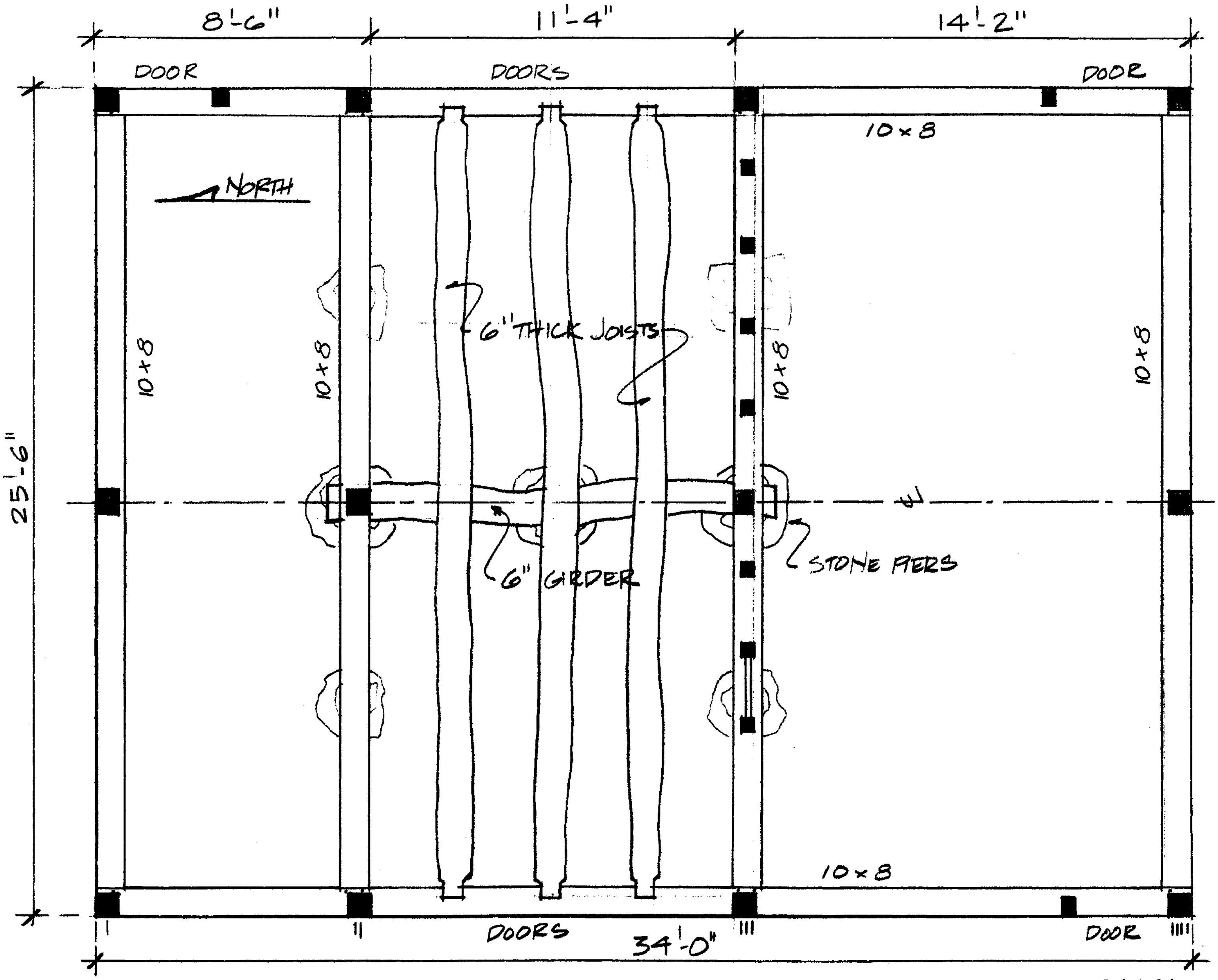

Jack A. Sobon

Builder's floor frame drawing for traditional English barn built in Massachusetts. Story page 6.