TIMBER FRAMING

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CONTENTS

TOPICS: Attack of the Green Gizmos 2
Lisa Sasser

THE SHAPE OF STRUCTURE 4
David Leviatin

THE WOOD LATTICE BRIDGES AT SNEEK 8
Thomas Allocca

KITCHEN-SINK SCRIBE: LIVE-EDGE TIMBER LAYOUT FOR EVERYONE 10
Sarah K. Highland

FREIGHT MANAGEMENT AND STORAGE OF ARCHITECTURAL TIMBERS 14
Bruce Lindsay

TYING JOINT ADDENDUM 22
Jack A. Sobon

On the front cover, well-packaged West Coast hemlock awaits export in Vancouver, British Columbia. Attached dunnage 3 in. thick for good fork clearance. Breathable burlap protects top and ends from sun and dirt. Each package is numbered and bar-coded for computer inventory control and invoicing. On the back cover, well-packed timber truck in Missoula, Montana. Ponderosa pine 10x12 waney cants on bottom for log building, boxed-heart 12x12 and smaller timber on top. Packages 20 ft. long should have additional steel bands. Photos Bruce Lindsay.

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TIMBER FRAMING, Journal of the Timber Framers Guild, appears 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

Attack of the Green Gizmos

THERE'S no question that LEED, or Leadership in Energy and Environmental Design, the green building rating system developed and administered by the U. S. Green Building Council (USGBC), has emerged in the last 12 years as the dominant standard for environmentally sustainable construction. LEED certification provides independent, third-party verification that a building has been designed and built using tactics aimed at achieving high performance in key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. More than 40,000 commercial and industrial projects have gone through or are in the process of LEED certification, representing 7.9 billion square feet of construction space in 50 states and 117 countries.

Still, LEED is not without its critics. While most credit the undeniable impact of the program in creating a massive shift of focus by architects, builders, government agencies and the public toward the recognition that building sustainably is ultimately not an option, many cite the point-based system as promoting excessive reliance on new technologies at the expense of sound design fundamentals. Toronto architect, developer and teacher Lloyd Alter gives as an example Canada's first LEED Platinum house:

> It has ground source heat pumps, lots of insulation and a pile of other tricks that are good for LEED points. It also has a black asphalt roof, double car garage, no shading of its windows and an impermeable driveway. In short, it has almost none of the features that we know can make a better, more energy efficient house.

British energy and building expert Roderic Bunn (Building Services Research and Information Association) is also skeptical about the use of complex systems such as photovoltaics and wind turbines whose maintenance needs are rarely taken into account. "We have been seduced by the often false promises of new technologies," he says. "We tend to glue these things on to the outside of [the] building before we have actually reduced the loads of the building as far as we can go."

To its credit, USGBC recognizes that the indiscriminate propagation of "green gizmos" undermines the credibility of the program. Scot Horst, LEED senior vice president, says, "We know you can do a LEED building without doing the process the right way. The question is: can we write credits that will encourage people to consider an integrative design process in a better way so that they see that green features don't work when they're just additives?"

This is emphatically not to say that there's anything wrong with using new technology. Wind turbines, photovoltaics and other new and emerging technologies only merit being dismissed as green gizmos when their adoption is predicated mainly by the lure of innovation and the idea that the newest technology must be radically better than what preceded it. Donovan Rypkema of PlaceEconomics and New Urbanist Steve Mouzon on Original Green are among those most eloquently making the case that people have known for thousands of years how to create buildings that adapt to climate in ways that are durable, flexible, frugal and local.

As pervasive as the LEED standard is, it's by no means the only framework for creating environmentally responsive and responsible infrastructure. The National Association of Home Builders (NAHB) offers the ICC 700 National Green Building Standard for single-family and multifamily homes, residential remodeling projects, and site development projects. Originally applied to energy-efficient consumer products, the U. S. Environmental Protection Agency's Energy Star rating is now available for homes and commercial and industrial buildings.

The Passive House Standard originally developed in Germany as *PassivHaus* is primarily known and well respected for cutting the heating energy consumption of buildings by up to 90 percent through high levels of insulation and other efficiency measures. While not a building standard per se, Resilient City, a nonprofit organization working to develop strategies to prepare for societal shocks associated with climate change, energy scarcity and global population growth, proposes a statement of building design principles that emphasize design for durability and robustness, and use of building systems that can be serviced and maintained with local materials, parts and labor. Taking this concept to the next level, the Architecture Foundation of British Columbia is currently sponsoring a competition to design a 100-Mile House where participants are challenged to demonstrate the integration of local social, technological, economic and aesthetic sustainability while sourcing all materials within 100 miles of the city of Vancouver.

The wide diversity of approaches, expectations and philosophies expressed in these standards illustrates just how difficult it is to come to grips with the manifold political, social, economic and scientific challenges posed by climate change and peak energy. With some variations, high performance, durable and maintainable buildings can be created under any of these standards. More problematic is making sense of the torrent of data, claims, products and requirements needed to support design and decision making. It's not unlike drinking from a fire hose, but the real challenge lies less in coping with the volume of data than developing the judgment to extract the useful parts and employ them meaningfully.

I FOUND a surprisingly useful set of tools for thinking about and evaluating the process of sustainable building in an unexpected place. Howard Rheingold is a critic, writer and teacher specializing in the cultural, social and political implications of the Internet and other rapidly evolving communications media. He is credited with inventing the term *virtual communities* as a result of his early work with personal computers and Web-conferencing groups like The WELL. In his latest book *Net Smart* he identifies five key "literacies" for informed, effective and, above all, mindful participation in a massively networked online world. He cites "attention, participation, collaboration, the critical consumption of information (aka *crap detection*), and network smarts" as the core tools to improve the quality and utility of the digital commons. While Rheingold's book is specifically about best practices and protocols for successfully engaging in the digital world, it seems to me that anyone concerned with the increasingly fragile and threatened condition of our analog world would do well to embrace similar practices for informing our contributions to the built environment.

Rheingold uses the term *attention* as a means of pointing to the need for working actively to achieve concentration, maintain focus and cultivate awareness in spite of the distractions of ubiquitous and unfiltered access to information. Intention drives attention and provides a basis for metacognition (thinking about thinking) as a way of evaluating and revising one's own thinking processes and products.

People who work with their hands have an especially rich relationship with the concept of attention. The saying that "the hand teaches the eye" references the particular form of attention required in learning to use tools and shape materials and the resulting combination of skill, judgment and dexterity that long-term, focused concentration, awareness and practice confer. These skills, once acquired, tend to transfer to deeper understanding of how the built environment performs and functions at all levels.

Participating in the creation of things fundamentally changes how we understand and experience them. This is also true in how we perceive and interact with the built environment. Critiques of architectural education routinely include the lament that students are rarely exposed to the actual process of construction. (One such report in *Progressive Architecture* was memorably titled "Why Can't Johnny Size a Beam?") While participation produces an "amplification of personal capabilities," collaboration amplifies collective action and contributes new knowledge in new ways.

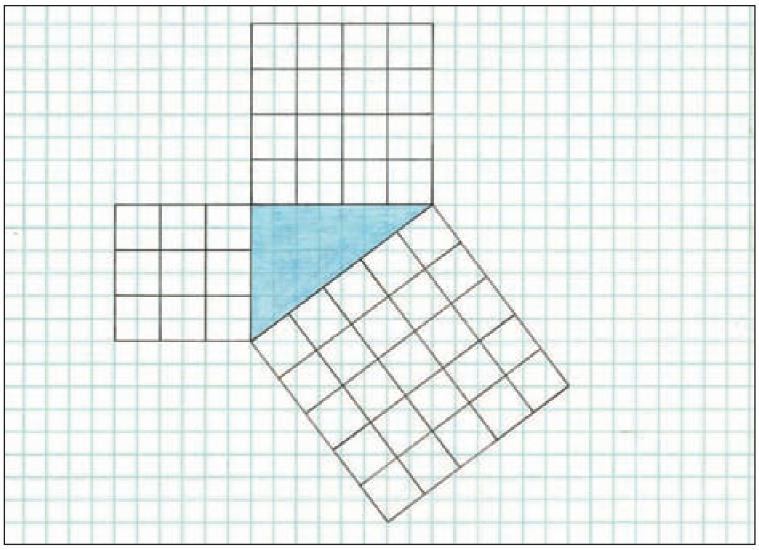
A well-honed critical consumption faculty is undoubtedly a critical part of this tool kit. Rheingold describes *crap* as "information tainted by ignorance, inept communication or deliberate deception." Greenwashing can be as banal as describing paper plates as "eco-friendly biodegradable tableware." For the perversely inclined it's possible to earn a free Continuing Education unit by completing a webinar entitled Building Green with Vinyl Siding from—who else?—the Vinyl Siding Institute, which breezily touts the potential of their product to contribute to LEED points for being "local, recycled and energy efficient." No mention is made of the fact that the production of PVC results in the release of hundreds of thousands of pounds of toxic chemicals into the atmosphere each year. Some suspect claims for building products are far more subtle and require an advanced set of filters for attributes like durability, maintainability and social good.

Anyone who's posted in the Timber Frame Forums or attended a Guild event knows that timber framers have always been a highly networked group. Hardly a day goes by without some familiar Guild faces showing up on my Facebook, Twitter, Google+ or RSS stream. These small digital snapshots of work and life are both welcome and revealing. For one thing, Guild members seem to waste a lot less time on *FarmVille* and *Mafia Wars* than the rest of the random aggregate of friends and acquaintances that populate my online world. More significant, the photos, comments and links shared reveal an extraordinary level of conscious engagement with the practice of environmental responsibility as a basic and fundamental aspect of civic, community and family life. What I see are people who are actively involved in smart networks of participation and collaboration that reflect a shared commitment to creating (and conserving) rather than passively consuming, at both small and large scales of environmental effect.

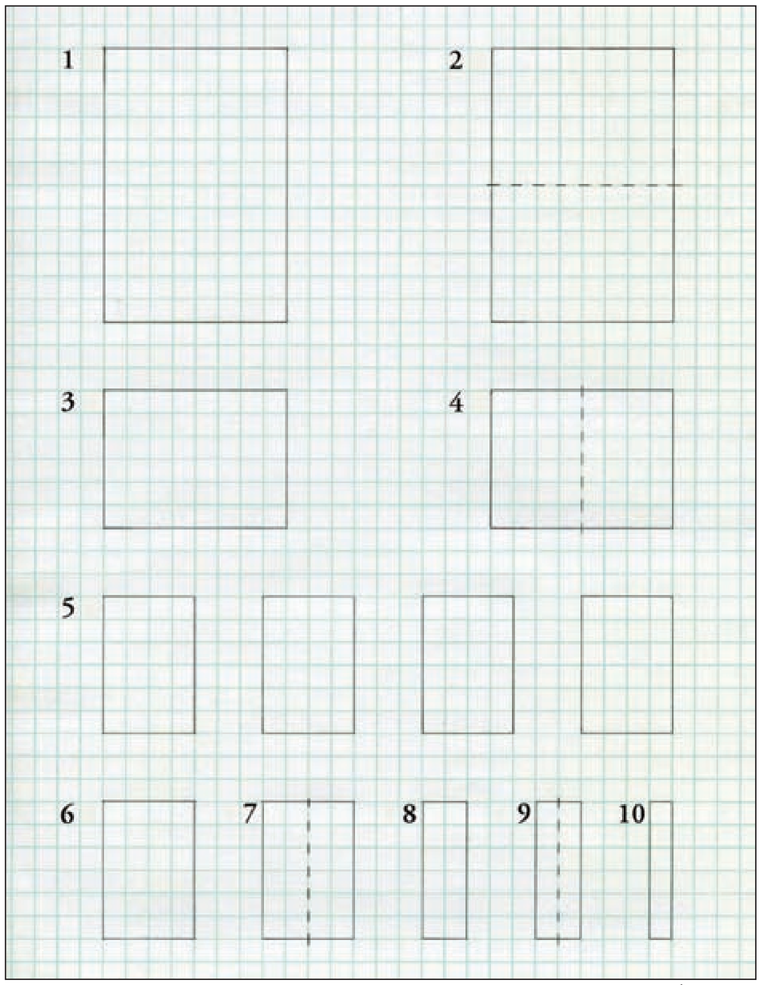
The proliferation of green building standards has been remarkably swift and pervasive, although the standards themselves vary widely in scope and application and are constantly evolving. One of the most important strengths that timber framers bring to the dialogue on environmentally responsive building practices is the understanding that just as buildings have embodied energy, they also have embodied knowledge. Knowledge founded in hundreds of years of traditional building skills, augmented by research and adaptation of new materials and methods, is one of the best defenses against the green-gizmo approach to sustainability. Guild members also have the tools of participation, collaboration and smart networking to continue to advance this knowledge in the broader sustainability dialogue. —Lisa Sasser

Lisa Sasser (lisa@quid-tum.com), AIA and LEED Green Associate, is president of the Timber Framers Guild.

The Shape of Structure



1 The 3,4,5 triangle and the relation of the squares of its sides.



Diagrams David Leviatin

2 Successive foldings of sheet of paper.

AS curious craftsmen, a few of us may be familiar with the practice of using squares and equilateral triangles (respectively *ad quadratum* and *ad triangulum*) to design buildings. As practical carpenters, however, we are all familiar with the 3,4,5 triangle—the most famous of the many Pythagorean triples arising from the theorem that the sum of the squares of the sides of every right triangle equals the square of the hypotenuse, graphically represented in Fig. 1.

In attempting to discern the underlying lines and logic of medieval cathedrals, Chartres and Milan in particular, architectural historians have tried to show how *ad quadratum* and *ad triangulum* may have been used as complete systems of design relied upon by master masons and carpenters to generate the harmony and integrity of entire structures.

While the 3,4,5 triangle, the on-site standard for squaring up used thousands of years ago in Egypt by rope stretchers setting out the pyramids (see Paul Calter, *Squaring the Circle: Geometry in Art and Architecture,* 2008) and by builders today looking for a right angle, is considered more a tool for construction than the critical piece of a design system, it can also be used like *ad quadratum* and *ad triangulum* to generate the design of entire buildings. Developed from the relationship of the area of three squares of different sizes ($a^2 + b^2 = c^2$), the 3,4,5 system—call it *ad 3,4,5um* if you like—is easy to construct, grasp and practice.

The accompanying drawings show how easy and natural it is to make a 3,4,5 triangle and then to use the triangle to design and set out an entire building. The process unfolds organically, resulting in a pure geometric design to which dimensions can then be applied.

IMAGINE that you have been asked to design and build a traditional frame with broad central aisle and narrower flanking aisles.

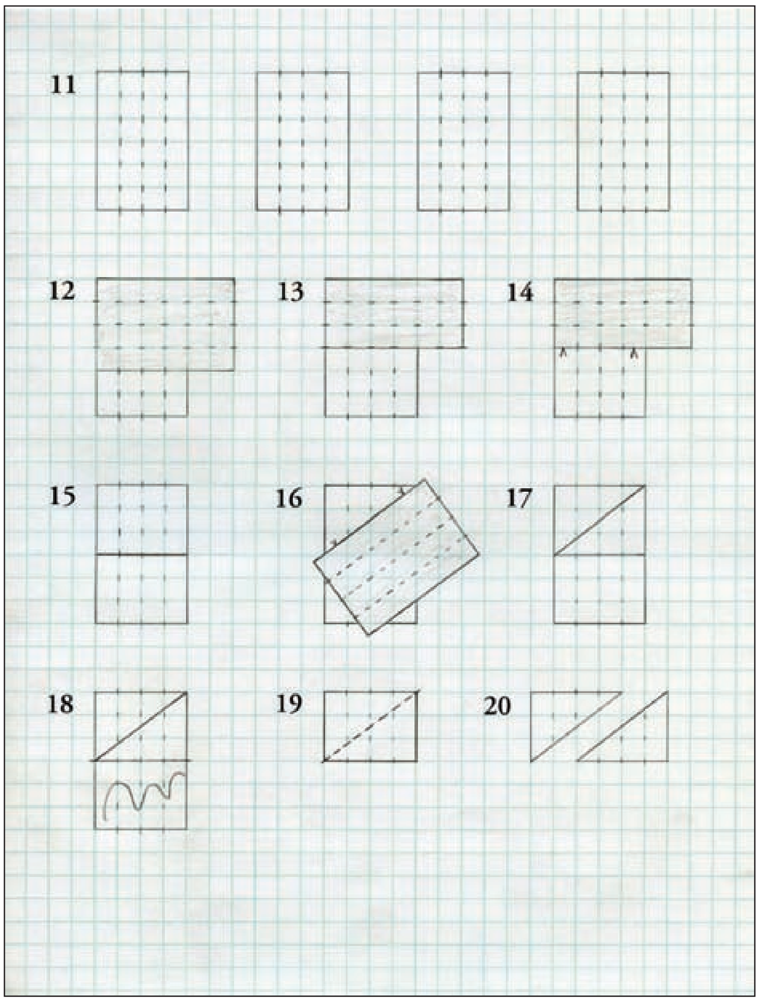
Making the shape (Figs. 2 and 3)

While the following exercise works with most sheets including American letter size (8½x11 in.), as a UK resident I naturally use our standard A4 sheet (8.27x11.69 in.), which has the same aspect ratio as the side and diagonal of a square ($1{:}\sqrt{2}$). Usually encountered in the form of the $1,1,\sqrt{2}$ right triangle, or half of a square, this is a familiar ratio to a builder. A-series sheets (beginning with A0, area 1 sq. m) have the interesting property of maintaining their aspect ratio when bisected the short way.

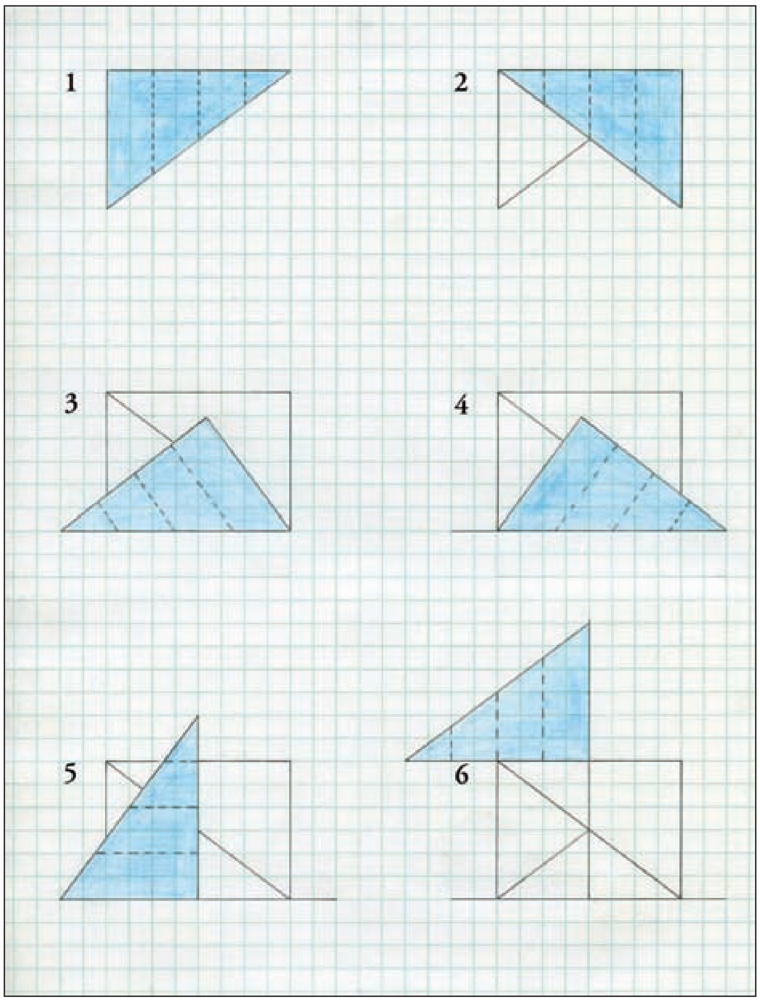
1. Start with a letter size or A4 sheet.
2. Fold the sheet in half crosswise.
3–4. Fold it in half again.
5. Open the entire sheet and tear along the folds into four separate sheets.
6–10. Fold each of the four sheets as shown.
11. You now have four sheets with folds dividing each sheet into four equal sections.
12. Take one of these sheets and place it over another so that the folds of the top sheet are running horizontally and the folds of the bottom sheet vertically.
13. Turn up the bottom fold of the top sheet.
14–15. Mark points as shown and draw a line.
16–17. Mark points and draw the diagonal.
18. Tear off the bottom half.
19. Fold on the diagonal.
20. Tear along the fold. You now have two 3,4,5 triangles.

Drawing the structure in section (Figs. 4, 5, 6)

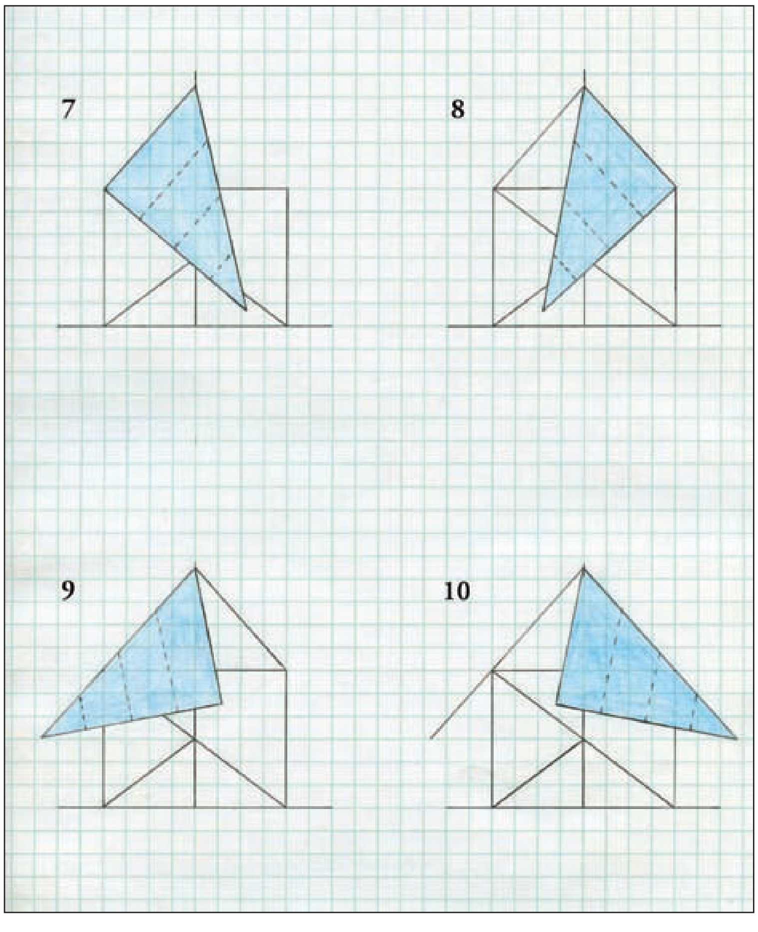
1. Place the triangle on a piece of paper and draw around it.
2. Flip the triangle and draw around it.
3. Drop the triangle and strike a line along the 5 side.
4. Flip and drop the triangle and strike a line along the 5 side.
5–6. Establish and extend the centerline.
7–8. Use the 3 side to draw the rafters.
9–10. Use the 5 side to run the rafters long.
11–14. Square off the wall posts to position the wall ties.



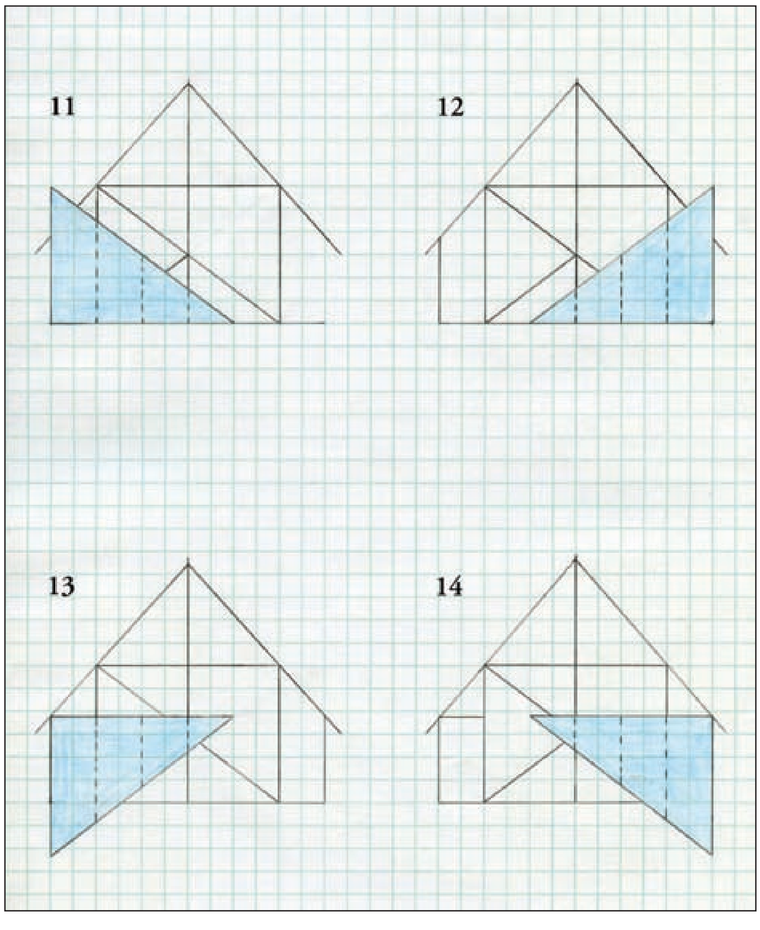
3 Folding and drawing to obtain 3,4,5 triangles.



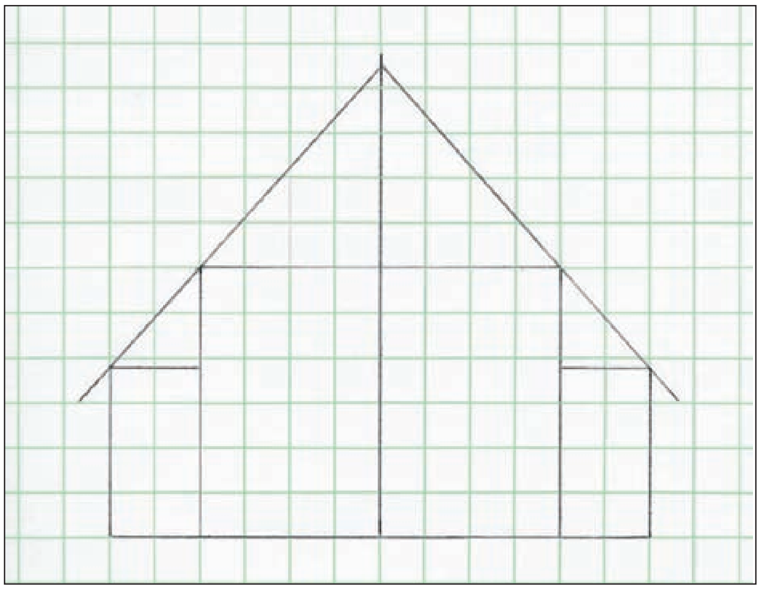
4 Beginning front elevation with the triangle.



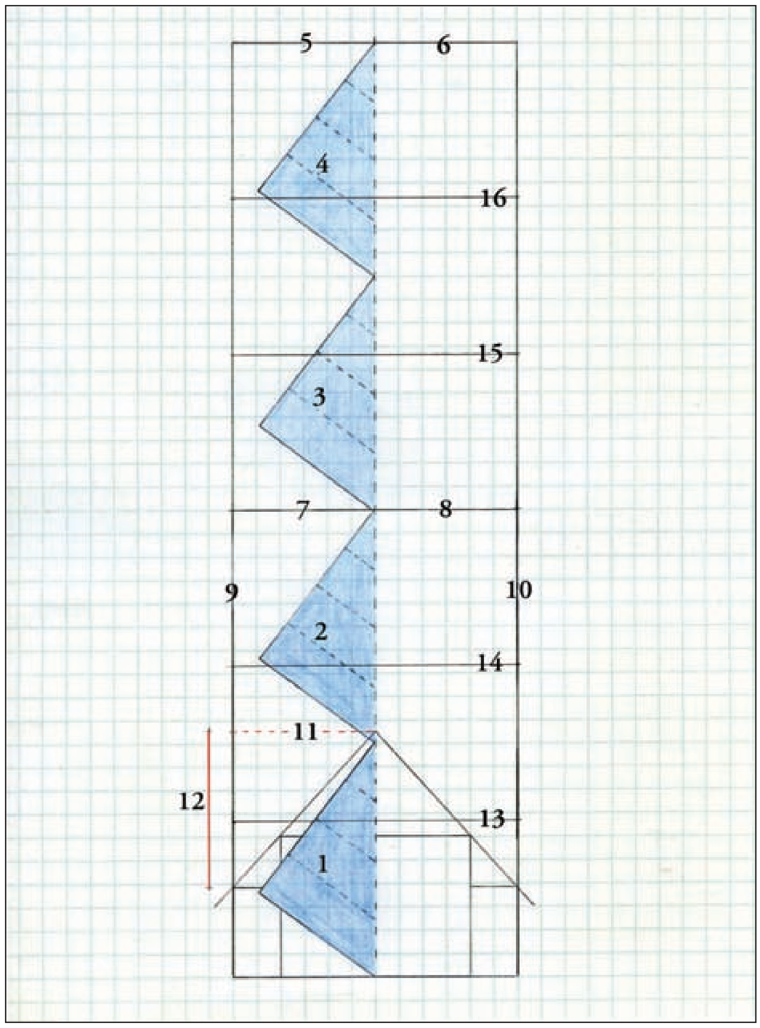
5 Drawing rafters.



6 Drawing wall posts and ties, completing front elevation.



7 Framing elevation schematic of barn complete, enlarged for clarity.



8 Step off length of building and subdivide into equal bays.

Having created the frame of the building's section or face (Fig. 7), you can now move on and draw the outline of its plan or body.

Drawing the structure in plan (Figs. 8 and 9)

1–4. To extend the harmonic proportion of the building's section, use the 5 side of the triangle to set and step off its length. Your client wants a large building, so step off 4 units of the triangle's 5 side.

5–6. Square off the building's length.

7–8. Square off the building's center.

9–10. Draw in the building's outside walls.

11–12. Determine the bay division by using the section rise.

13–16. Step off the building into six equal bays.

17–18. Draw in the arcade plates. The intersection of these lines with the bay division lines gives you the arcade post positions.

19. To further refine your drawing, the 5 side of the triangle can be extended, as the line numbered 19 shows, to generate an isometric view.

The frame, unfolding naturally from a well-defined shape, now needs dimensions. Since tie beams required to span the central aisle are members of large section and long length, and thus the most difficult timbers to acquire, even for timber framers now, aisled medieval buildings were dimensioned using the width of the central aisle as one of the building's fundamental measures. We know that medieval craftsmen used the rod of 16 ft. 6 in., a unit measure for land surveying, also as a standard with which to dimension their buildings. Aware of all this, if we make the 4 side of our triangle 22 ft. in length, everything falls into place.

Fig. 10 shows the frame's dimensions with 22 ft. used as the 4 unit; it also shows a larger 3,4,5 triangle, the diagonal of which is half the building's length.

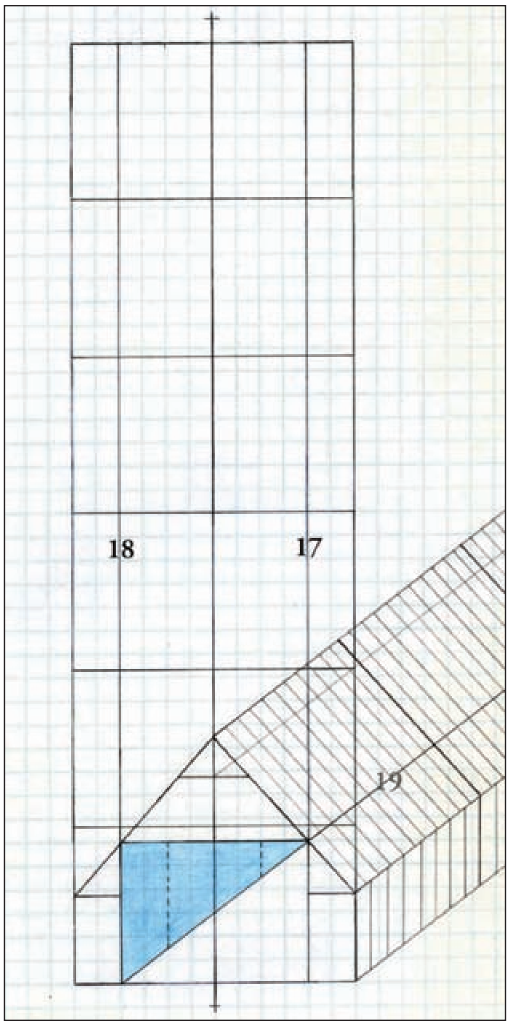
Setting out the building full-scale in the workshop and on site also makes use of a 3,4,5 triangle. The Egyptian rope stretchers mentioned earlier knew how to lay out a 3,4,5 triangle and to form an accurate right angle by using just three pegs and a length of rope with 12 equally spaced knots tied along its length. A similar method can be used to set out and square up our timber frame building. A 66-ft. string (4 rods) with knots tied every 66 in. (one-third of a rod) is all you need. Fig. 11 shows the string first being used to lay out the central aisle (string 1) and then to square up a corner of the entire frame (strings 2,3,4).

Readers familiar with my earlier article "The Lordship Barn and Regulating Line Technique" (TF 101), may recognize the building laid out here as the Lordship Barn. In addition to the use of a regulating line as described in that article, and a 3,4,5 triangle as described here, to design and lay out the barn, Fig. 12 shows how the 33x110-ft. barn, when centered within the width of a medieval English acre, 66 ft. wide by 660 ft. long (drawn to scale in the figures at full width and one-sixth of its length), could also have been derived by generating a lattice or grid of equilateral triangles, the method known as *ad triangulum*.

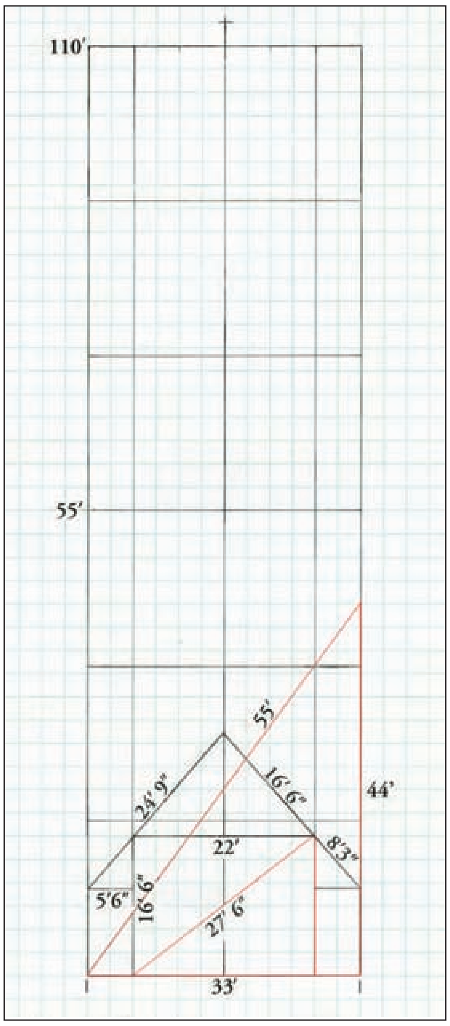
Fig. 13 shows further how the barn could have been designed by compass geometry related to *ad triangulum*, in which a series of daisy wheels generate the design.

Left with only the barn's frame as evidence, we can no more than speculate about the methods that may have been used to design it and then set it out in the shop and on site. Was the process primarily geometric, the shape-related technique associated with the "Gothic" period, or was it metrical, the dimension-based system associated with the Renaissance? Or is the barn, built in the second half of the 15th century during the beginning of the English Renaissance, a result of some combination of both geometric and metrical systems? —David Leviatin

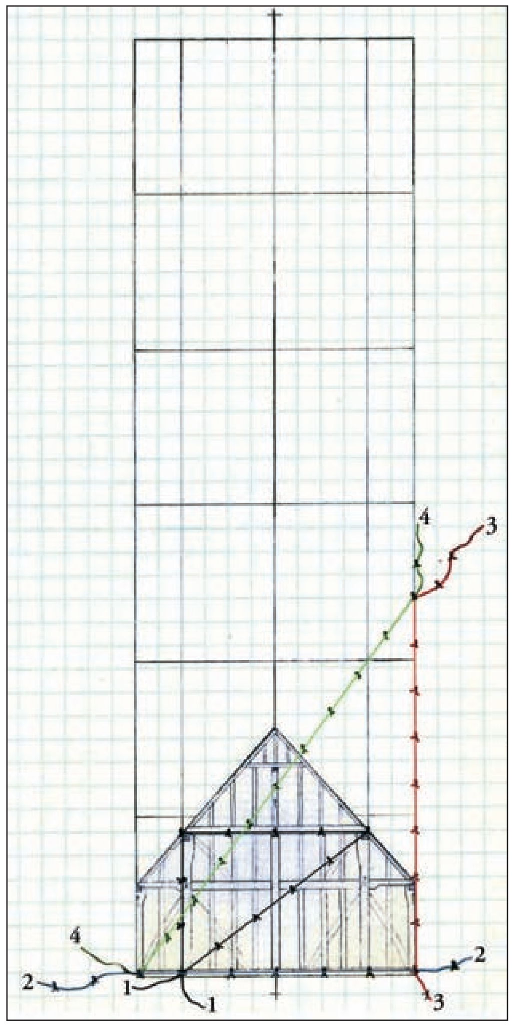
David Leviatin (dleviatin@yahoo.com) operates Boxed Heart Timber Frame (boxedheart.com) in London and Essex, UK, and is the new editor of The Mortice and Tenon, *the quarterly journal of the Carpenters' Fellowship (UK).*



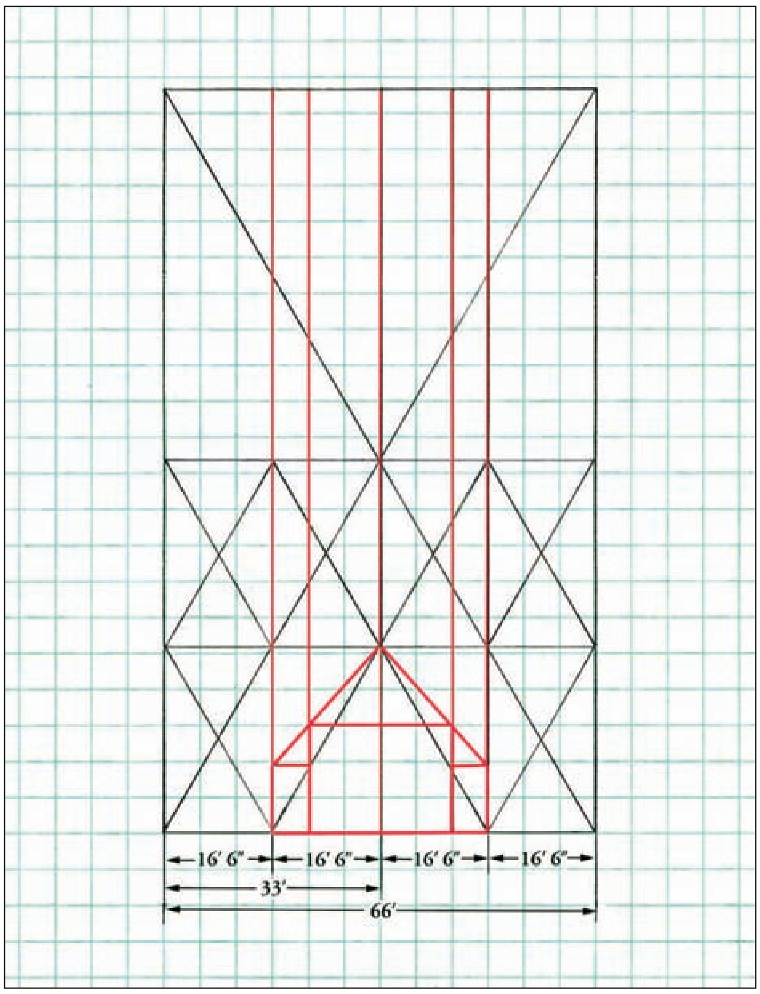
9 Add arcade plates and draw isometric view.



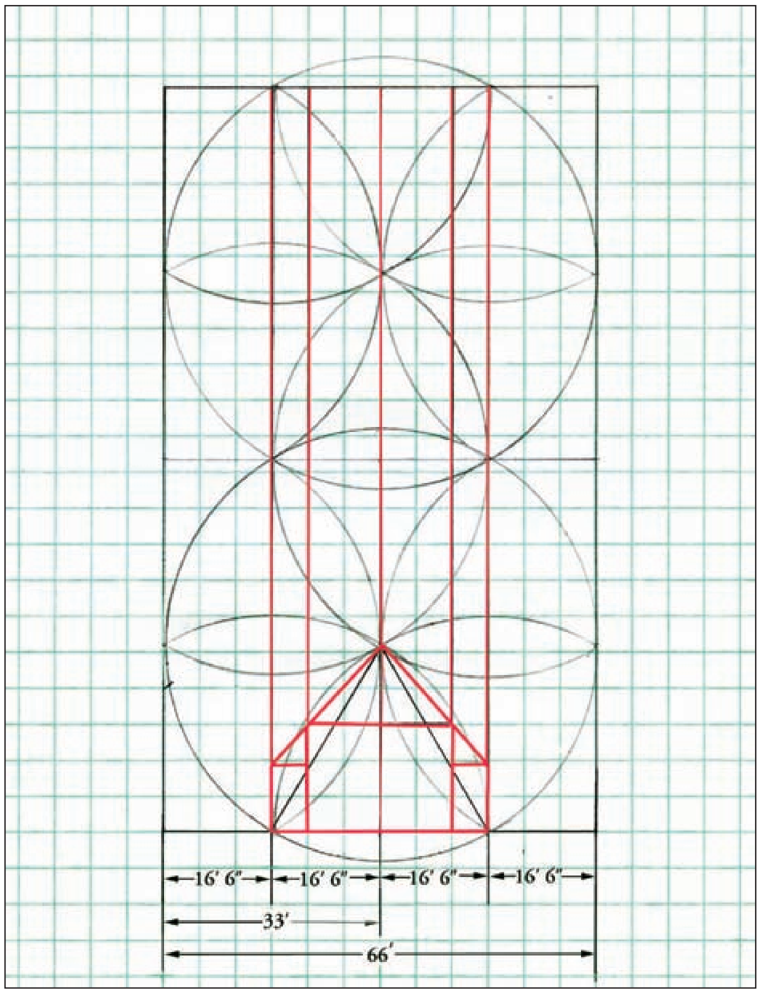
10 Dimension building by base unit.



11 Set out building plan at full scale.



12 Alternate design method for same plan, *ad triangulum.*



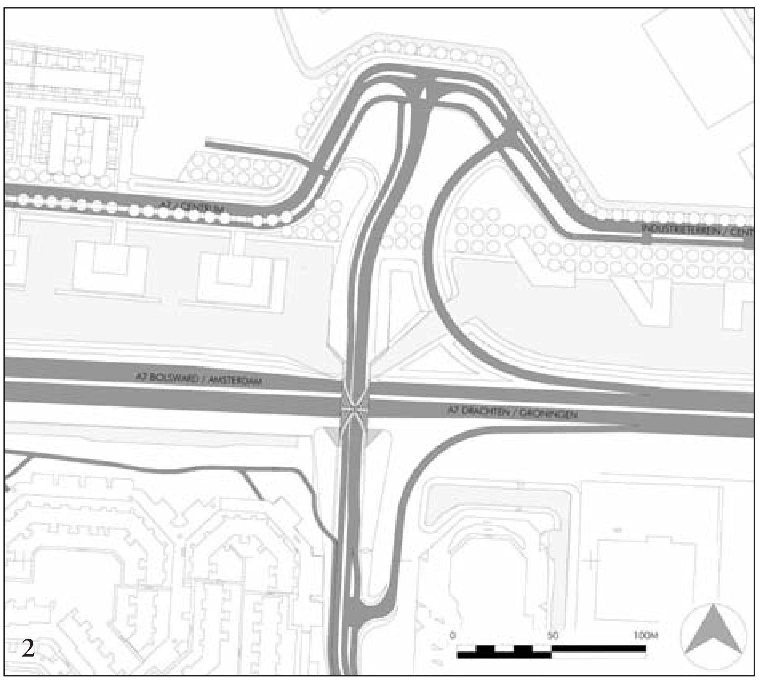
13 Second alternate design method, by compass geometry.

The Wood Lattice Bridges at Sneek

1

Photos and drawing OAK

IN the pack of tarot cards, the bridge symbol can have multiple meanings, representing not only the passage from one state to another but also the whole journey where an obstacle is not able to interrupt the way. A real bridge that makes it possible to pass over from one way to another can be much more interesting when so interpreted, not as an external element of two different paths but as part of the path and the history of the journey. This is what can happen when a municipality invests in a bridge not alone as an engineering work but as architecture, where the aesthetic plays a dominant role. Bridges, instruments of transportation, strongly reflect society's use of highways to unite people. The 2008 and 2010 wooden bridges at Sneek, commissioned by the Province of Friesland in the Netherlands and designed by the associated firms Onix Architects and Achterbosch Architectuur under the collective name OAK, connect two districts of Sneek separated by the Amsterdam-Groningen A7 motorway and cost about €4.5 million. The bridges are 105 ft. long, respectively 26 and 39 ft. wide and 52 ft. high. Each weighs more than 400 tons and has a load capacity of 60 tons.



2

3

The lattice bridges were designed to be city markers along a motorway for local people and to encourage tourism, the second most important source of income for the province after agriculture. The Rijkswaterstaat asked for a design in wood, so the project team conceived a large bent lattice truss, somewhat recalling the idea of Sneek's famous watergate, interpreted in a modern design.

According to the designers, the construction evokes buildings still abundantly present in the old city, as the wooden beams reflect the shipbuilding industry that once made the city of Sneek one of the most important of northern Europe (for images, see 360cities.net/image/watergate-of-sneek). Like the pedestrian bridge based on Leonardo's unrealized masonry design for the Golden Horn in Istanbul and realized, scaled down, in wood at Ås in Norway in 2001 (see nextwd.com/the-most-unusual-bridges-in-the-world), the design of the Sneek bridges arises in the past, but in this case in the more recent past, especially in the 19th-century covered bridges of North America.

The design appears here uncovered and chemically treated for an expected service life of 80 years. Built of resorcinol-glue-laminated Accoya® wood (acetylated *Pinus radiata* from New Zealand), relatively durable in the Netherlands' climate, cold and under salty winds, the bridge shown in the photos (the wider of the two) has two trusses developed into a twisted lattice pattern, with major beam sections about 3 ft. 3 in. by nearly 4 ft. The lattice crossings, requiring fasteners some 7 ft. long, are connected by bonded threaded rods nearly 2 in. dia. The arched form, according to Onix Architects, "performs greatly both statically and architecturally, endowing the triangular design of the framework with surprising visual perspectives both longitudinally and transversally." Crossing the motorway on this bridge, one passes through a vaulted space while keeping in contact with the sky—and perhaps with the wind, to recall another element of the genius loci, Holland's windmills. —Thomas Allocca

Thomas Allocca (www.wooden-architecture.org) is a journalist and architectural designer in wood in Frosinone (Lazio), Italy. In his personal e-publication, Wooden Architecture Magazine*, he has written about the Wooden Bridge at Ås, and in* Mondo Legno *No. 142 he wrote on the covered bridges of Maine.*

1 Lattice truss road bridge at Sneek, Friesland, one of two, span 105 ft.

2 Road plan of immediate vicinity of bridge, which crosses an expressway to relink severed city districts.

3 View from interior of bridge. Largest glulam lattice sections are 3 ft. 3 in. by nearly 4 ft. and fabricated by Schaffitzel Holzindustrie in Schwäbisch Hall, Germany.

4 View of bridge showing steel deck substructure. Arrays of steel tensile rods provided by DSI Netherlands are concealed in the arch-to-chord connections. Note pedestrian just entering bridge from left.

5 Interior of bridge with two-lane roadway, wide side-lane for pedestrians and cyclists, and doubled guard rails between.

Kitchen-Sink Scribe: Live-Edge Timber Layout for Everyone

1

2

3

4

Photos Sarah K. Highland

MY clients tend to like buildings that use space and resources efficiently, for both environmental and economic reasons. The designs we create together have sheltering ceilings and full second floors rather than spectacular trusses and tall living rooms. The spice we add to these designs comes in the form of live-edge timber, added sparingly amid foursquare posts and beams. Sometimes the budget allows for just a couple of featured posts, sawn on two faces to let the shape of the tree enrich the living space.

Given the problem of setting a layout square directly on a live edge, there are alternative ways to lay out a live-edge post or beam to make tenon shoulders square to the sawn faces of the timber. What follows is a method I have found to be simple and flexible, for both straight and very bumpy or wiggly timbers. It can be done in the yard with tools that every carpenter has. I call this system *kitchen-sink scribe* because it combines cheap and motley tools with the wisdom of several traditions and teachers.

Kitchen-sink scribe combines readily with square rule and mapping. I generally do not cut housings in the bottoms of beams receiving live-edge posts. Instead, using a plane I reduce the bottom of the beam to a standard size at each post location (square rule) or else I measure the depth of the beam at the location of each post and adjust the length of the post to put its shoulder at the height of the beam bottom (mapping). These methods give clean-looking results with no scribing. If I am using a live-edge beam to connect two posts, I like the look of a housing into each post, though it runs the risk of shrinking away from the scribed edges. The depth of the housing is still laid out using square rule, but it requires prefitting the beam to trace its curving profile onto the post at the ends of the housing.

The beauty of this system is the variety of forms that can be created without fancy bubble scribers, layout floor or specialized plumb bobs. It can be done in relatively little time with minimal moving and fitting of timber. While it requires timber sawn on two or more faces to join with fully square timber, I find these understated combinations to be elegant, with the flat planes calling greater attention to the beauty of the biomorphic curves, and plenty of lovely grain showing as counterpoint to the unpatterned rounded sapwood surfaces (Figs. 1–4).

1 Live-edge beam housed in posts of same thickness.

2 Live-edge posts meet underside of rafter cleanly.

3 Blind-housed live-edge cherry beam joins thicker posts.

4 Wild-edged timbers present no special problem with the given layout method.

5 With reference face chosen, level timber lengthwise and crosswise with sticks and wedges.

6 Plumb chalked centerline down ends of timber.

7 Register framing square, knife shoulder line and pencil in end line.

8 Tack plywood straightedge at shoulder line, hang plumb weights.

9 Close one eye, carefully sight across strings and mark lower extremity of timber; repeat from other side.

WE will look first at how to lay out tenon shoulders and cheeks on live-edge timber, then at how to house live edges in square timber and square timber into live edges.

Choose one of the sawn faces to be a reference plane of your timber. For this kind of layout, there will be only one visible reference plane; the other will be perpendicular to it and indicated by a chalk centerline snapped on the reference face and (with the timber leveled on horses) extended plumb down the ends of the timber. When the post is installed in the frame, this centerline will be plumb (and the centerline of a beam will be level).

After snapping the centerline, level the post lengthwise and crosswise by means of wedges and a stick. The shoulder-to-shoulder length of the post can be marked as two points on the centerline (Fig. 5).

Extend the centerline plumb down the ends of the post, thus determining the secondary reference plane slicing invisibly down the middle of the timber (Fig. 6).

Mark the tenon end and shoulder square to the centerline. I like to mark shoulders with a knife line and tenon ends with a pencil line. Fig. 7 shows shoulder and end lines for a stub tenon at the bottom of a post.

In the case of a post meeting a sloping roof pitch, such as seen in Fig. 2, the framing square can also be used to lay out the pitched shoulder from the centerline. Set the square on the centerline so that the tongue (short arm) graduation marks the roof rise and the blade graduation marks the run, then slide the square to meet the shoulder mark on the centerline and trace the shoulder line along the tongue.

Next, to obtain shoulder lines on the live edges, tack a plywood straightedge against the shoulder line on the reference face. Hang two plumb bobs (or anything small and heavy) from the straightedge, one on either side of the timber (Fig. 8).

Two points determine a line: close one eye and shift your head to align the two strings. Put a pencil mark at the lower extremity of the timber edge in line with the near string. Repeat the process looking from the other edge of the timber. The two marks will determine the shoulder cut line on the sawn face of the timber opposite the reference face (Fig. 9).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10 Timber inverted, join the marks just made to define the shoulder line this side.

11 Sight across square and plywood edge and carefully mark points in that plane. Knife a line through the marks. Shoulder plane is now fully outlined.

12 Lay out cheek lines for tenon on timber end, transfer defining point at shoulder line with jig to accommodate curved surface.

13 Cut shoulders and full-width cheeks of tenon. Recover centerline and mark for tenon edges (one already cut here).

14 Mortise and housing depth by square rule, live edges scribed by trial fitting.

15 Reduction by kerfing and chopping.

16 Joint ready to make up.

17 Proof of the pudding.

18 Author roughs out mortise using ratcheting T-auger.

Gently roll the timber over, leaving the straightedge tacked to the reference face. Use the framing square to connect the two marks just made and define the shoulder on the new face. Keeping the square in place, close one eye and line up the edge of the framing square with the edge of the plywood straightedge (Fig. 10). Carefully mark a series of points along the curving sides of the timber. These lines complete the tenon shoulder plane, which slices through the post perpendicular to its sawn faces (Fig. 11). Connect the dots, preferably with a knife line, the knife run ideally against a thin, flexible steel ruler that conforms to the live edge.

Cheek lines Given the shoulder lines, lay out the cheek lines of the tenon on the timber end, parallel to the reference face, and bring the lines around on the live edges to meet the shoulder lines. In this case, a tie beam to be housed on edge into two posts, the tenon cheeks are respectively 1½ in. and 3 in. from the reference face (upper surface in the photo). A framing square and combination square clamped together can assist in transferring points on curved surfaces (Fig. 12).

Cut the cheeks the full width of the timber first, then recover the centerline on the cheeks and use it to lay out the ends, in this case 5 in. above the centerline (already cut in photo) and 2 in. below (Fig. 13).

Mortise layout When laying out the accompanying mortise, the the reference for the mortised timber is again the centerline of the tenoned timber. Find the position on the face of the receiving timber where this line will meet it and mark a square line across the face, then mark the ends of the mortise outward from this reference line. Lay out mortise width and offset by square rule (Fig. 14).

Housings This tie beam is housed into the posts that support it. The depth of the housing and the beam length are laid out by square rule. The mortise made first and the joint assembled, the profile of the beam end has been traced onto the post beyond the sawcuts made to housing depth for rough removal of material (Fig. 14).

The lower edge of the housing has been shaped and the upper edge is in progress in Fig. 15. The completed joint ready to make up is shown in Fig. 16.


12

Fig. 17 shows the beam in place, as well as a pair of short posts housed into the top of the beam by square rule and mapping. The bottom shoulders of the posts are flat, though angled to follow the direction of the curve of the arch at the point of intersection.

The housings are laid out by measuring from the chalked reference line earlier used to lay out the tenon (seen in Fig. 13), since in the raised frame this line will be level and thus parallel to the beam above. Rather than create level housings, however, I like to angle them to follow somewhat the curve of the beam, though the mortises are excavated parallel and plumb to the reference planes (Fig. 18). To obtain planar housings, the distances from the right and left corners of each housing to the reference line are transferred as well from a corresponding chalkline on the opposite face. These distances also are required to map the differing lengths of the left and right sides of each post. —Sarah K. Highland

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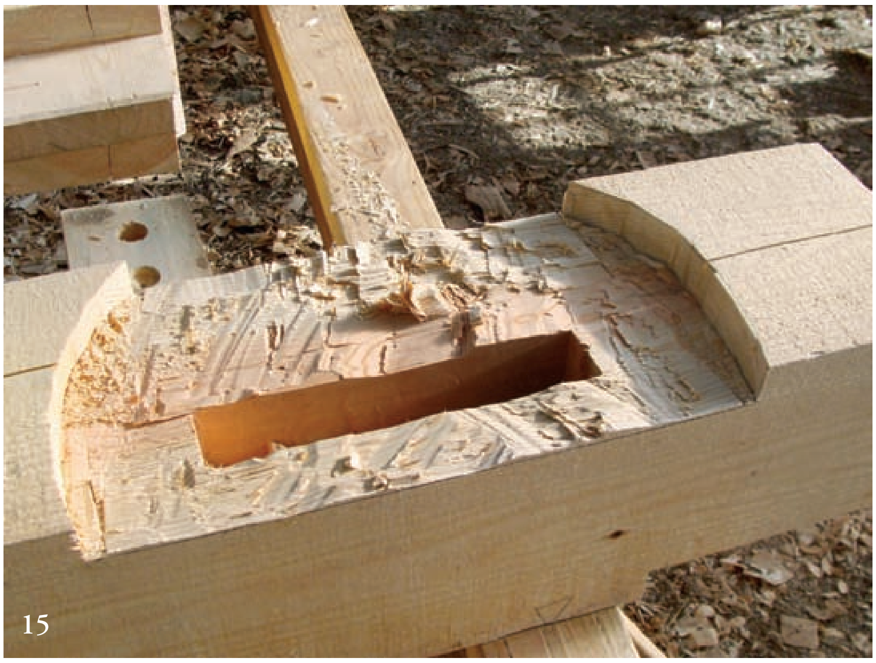
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Freight Management and Storage of Architectural Timbers

ONE of the foundations of good timber framing is clean, well-presented raw material. Careless timber handling and storage practices cost the industry thousands of dollars in damage, degrade and lost time. A damaged custom-sawn timber becomes two or more shorter timbers and in some cases nothing more than expensive firewood. Claims and complaints between mills and customers arising from damaged timbers can strain relationships. Careful material management is one of the easier ways to reduce expenses and help the timber framing job run smoothly.

There are important questions to ask. What are the tricks, tips and quick fixes to package, ship and handle timber to make sure it retains its value and arrives at the jobsite looking beautiful? Lurking in the shadows are multiple gremlins that conspire to cost money by poor storage and drying. Timber poorly piled, dirty, improperly packaged or carelessly handled is like throwing money on the ground.

They say you can tell a good farmer by how his front gate hangs, and perhaps you can tell a good framer by how his timber is stacked. A customer seeing dirty, poorly stored timber (Fig. 1) might well ask, "If you can't do a simple task like taking care of timber, how will you be able to deal with the complex task of making a great timber frame?" Timber properly packaged and stored in a clean yard with good material management saves money and impresses customers (Fig. 2).

Ordering and shipping Let's begin at the beginning, before your timber order is cut at the sawmill. As in any other job, if you give good instructions, you will get good results. The-confirmation-of-sale document between the supplier and customer should include detailed instructions for packing, wrapping and timber handling as part of the order. Proper timber care starts at the mill and continues all the way through the supply chain.

The mill should have the space, equipment and manpower to antistain, stack in units and wrap a full truckload of timbers. A trailerload of custom-cut high-value timbers, especially if kiln-dried and surfaced four sides (S4S), cannot easily be replaced. Everything the mill does to make the timber bulletproof for loading, securing and handling is low-cost insurance. Here is an ideal checklist of 12 items to specify as part of the purchase order:

¶ Stack and band in packages about 2 ft. high x 4 ft. wide.

¶ Put similar lengths together, no more than three lengths per pack.

¶ Use plywood, chipboard or low-grade lumber bottom, top and two sides to protect against forklifts.

¶ Affix tally tags on end of each pack.

¶ Band with minimum of three bands per pack on units longer than 10 ft.

¶ Protect with cardboard corners under bands (missing in Fig. 3).

¶ Protect packages with waterproof paper wrap top, sides and ends (leave bottom open).

¶ Staple only on ends.

¶ Use dunnage (bunks) minimum 3 in. thick under and between timber packages.

¶ Driver to use corner protectors under binding straps or chains.

¶ Driver to tarp load fully down to deck in the millyard before receiving bill of lading (B/L).

Standardized package heights fit efficiently onto trucks and result in a fuller load whose top is even from front to back of the trailer (Fig. 4 almost makes it). A flat-topped load without voids is easiest to tarp, which means your timber will arrive clean. Though in timber framing we are unlikely to be dealing with standard *units* of lumber, we might still strive for standard packages about 2 ft. high by 4 ft. wide, with similar lengths together. Ragged Random Length (RRL) packages (multiple lengths from 6 ft. to 20 ft. or longer) or jags should be avoided because they are cumbersome, spill easily and expose the longest lengths to breakage (Fig. 5). In addition to handling damage, when left outside in rain and sun, even for a few days, random-length packs suffer sunburn, water stain and splits in the exposed longer ends. The benefits of standard packages are ease of maneuvering and loading. (Single length packages, the ideal, are also easier to tally.) Finally, standardized packages allow more timber to be loaded on a truck or stored in a shed. For the longest pieces, however, up to 30 ft. and 40 ft. for western timbers, smaller packages are often unavoidable.

Ask for packages no heavier than the maximum lifting capacity of your forklift. (Don't ask me how I found this out.)

The most frequent cause of timber damage, dirt or stain is the forklift. The forks are about ½ in. thick at the tip and increase to 2 in. thick at the back. Single 2x4 dunnage obviously does not allow enough room under the package for the length of the forks, which will need to be inserted fully for heavy loads. Squeezing steel forks under timber does a great job of cleaning the forks and marking the surface of the timbers (Fig. 6). In addition, to force the forks under the load, the operator needs to apply extra power and then the lift often unexpectedly jumps ahead and stabs the timbers in adjacent packages.

For sufficient clearance, specify 4x4s under each package (or, at a minimum, two stacked 2x4s). Any tactic to make it easier for the forklift to move the timbers will result in less timber damage and faster truck loading.

Checking for damage The timber is loaded on the truck at the mill and has made it across country to your shop or the jobsite. Prior to delivery have your camera charged up, storage space cleared in your yard and clean, thick dunnage ready. Before you take custody of the timber, check to make sure that the load has not been damaged in the millyard or in transit. If the unit tally, tarp (or lack thereof), packaging or condition of the timber concerns you, then immediately take photos. If the truck is in your yard, make a brief note on the trucker's bill of lading, have the trucker sign it and then release the truck. Damage, shortage or grade claims are resolved easily provided that you immediately—not merely that day but that hour—put the shipper on notice (a formal step) of a possible discrepancy. If it turns out that the problem was minor, then contact the other party with the good news. Most common problems are fixed at the mill when you make it known in advance to the shipper that your receiving procedure is to scrutinize the timber on arrival. Generally, discrepancies that do slip through are made good quickly when documented promptly.

Yard location, housekeeping and storage plan Your storage yard or warehouse space should be level, clean, well drained and free from debris. Yard cleanup should be part of a regular maintenance

Photos Bruce Lindsay

1 Messy yard, messy workers?

2 Careful timber piles may suggest good workmanship.

3 Unprotected corners suffer when banded. Protective sticker has shifted.

4 Even-height bundles separated by adequate dunnage make for efficiencies. Two more bundles lengthwise and this trailer will be easy to tarp.

5 Packages with great length differences waste space and risk breakage. This particular load also may have inadequate fork space between the bundles.

6 Fork stain on Douglas fir timbers in foreground and fork damage to corners on upper left (though dunnage in view looks adequate). Bundle was correctly banded with corner protectors, however.

program. Steel, timber and loose dunnage scattered on the roadways are tripping hazards for workers and forklifts alike. The primary piling surface should be concrete, asphalt or well-packed smooth gravel to prevent uneven settling of the timber piles. Tilted piles are unstable and present a safety hazard. They can fall over easily, often without warning. A dirty yard means grass, mud and gravel can get onto forklift forks, which in turn mark and gouge the timbers.

The risk of damage occurs every time the forklift shifts timber. Therefore, placement of each package should be sequential whenever possible, based on when the timbers will be needed in the shop. A good storage plan in a clean environment with minimal shifting of the inventory reduces downgrade and trim loss.

Green timber short-term storage Let it breathe. Green timber can be stored with no paper wrap outside in cool weather for short periods. Depending on the species and time of the year, rain-wet timber for immediate use should shed surface moisture after a few days of sunshine or covered storage, with no harm done. In the case of green timber in paper-wrapped packs, water vapor in the air will condense and become trapped inside the wrap. There can be the equivalent of a mini-greenhouse under the paper. Mold and fungus will develop into stain and eventually develop rot. Paper wraps, of both kiln-dried and green timber, should be opened on the ends to let moisture escape and the timber breathe. Keep the top, sides and ends loosely covered and, when stored outside, the sides protected from rain. The idea is to protect the timber from handling damage and keep it dry and clean, but to let it breathe (Fig. 7).

Air drying Whole books have been written and workshops and month-long courses given about timber drying. What follows here are options, observations and solutions for small-volume, occasional air drying of timbers in shops or small timber yards, distant from a high-production environment, with piling instructions (Figs. 8, 9).

Green timbers when stored for long periods should be stickered to avoid mold or stain. This is critical in warm months of the year. As it dries, wood checks and shrinks unevenly, usually out of square. After drying, timbers usually require surface planing or resawing to bring them into square and to remove surface drying defects, including sticker stain. As a result, some framers specify timbers sawn oversize to account for the expected reduction in section, or they use American Lumber Standard (ALS) dry sizes (e.g. 7½ in. for a nominal 8-in. green timber) when designing and engineering a frame. But note that nominal 8-, 10- and 12-in. timbers sawn to ALS *green* sizes are only ¼ in. over ALS dry sizes. When well-dried and planed on all four sides to the latter sizes, they often show rough patches of hit-or-miss dressing.

Considerations in efficient air drying include yard location and surface, pile spacing and orientation, and foundation blocking. First of all, choose a yard location favorable to sunlight and prevailing winds. A windy site on a bluff or crest of a hill is ideal. The surface should have a slight slope to drain rainwater and prevent pooling under the packages. Nearby trees and buildings, while generally to be avoided, can sometimes be useful by providing shade in the summer and protection from wind-driven rain. A ventilated warehouse, open-sided shed or overhang on the north side of a building out of the (summer) sun might all be workable locations depending on the time of the year.

Cooler times of the year take longer to air dry timber. This is good because slow drying results in fewer drying defects like surface splits and checked knots. Drying in hot months needs to be slowed down lest splits, checks and cracks be more severe. Timber can be heard snapping, popping and splitting as one walks by the pile in July. (Timbers dried too quickly sometimes make good curved stairway rails or airplane propellers.) With green timber, slow loss of moisture at the surface of the wood is critical. If the timber surface dries too soon before the core, then resulting surface stress splits, surface-checks and often twists the timber.

Slow the rate of drying by putting stickered timber in the shade (Fig. 10), and gently moisten the stacks to keep surfaces damp while the inherent moisture moves out of the core of the timber. To further slow drying in hot climates, bring stacks closer together, perhaps as close as 9 in. to 12 in. apart. For faster air drying, improve airflow and expose more of the stack to sunlight by increasing the space to 48 in. or more between neighboring stacks.

Piles exposed to full sun should be oriented east–west. Piles oriented north–south present exposed timber ends all day to the south, with the risk of excessive end splits, while the ends to the north remain in shadow. Oriented east–west, however, one side of a pile will then be in full sun and therefore the stacks should be turned end for end (180 degrees) periodically. This will ensure even drying on the sides and provide an opportunity to clean underneath the stacks.

If there is no other option than piling over grass or dirt, then first put down a tarp or 6mm black polyethylene underneath the stack. This will keep ground moisture, bugs and dirt away from the timber, with the penalty that it may pond rainwater that finds its way through or under the stack. Dirt, grass, overhanging trees or nearby bushes retain water, insects, leaves and mold spores that will get into the pile. Check the area regularly for bugs. Spray pesticide in any brushy or grassy storage area.

Foundation blocking The first layer of dunnage laid on the yard surface is called the foundation blocks. Clean, solid blocks keep the bottom timber of the stack clean. Old timber, scrap or reclaimed timbers transfer rot, paint and residual dirt to timbers. Avoid old railroad ties unless creosote stains, distress, and character timbers are desired features of the project. Strong, level blocks will avoid slumping, subsiding or silent shifting of the stack (fatally dangerous) when melting snow or ice accumulates between the timbers and the blocks. The width of your forklift and its ground clearance determine the size and placement of the foundation blocking. Concrete piles or cement blocks that drain freely are ideal. Where possible, foundation blocks should be at least 12 in. high to permit good airflow and ease of handling by the forklift. Good height allows moist cool air flowing down through the stacks to move away quickly, thus speeding drying. Foundation blocking less than 6 in. high allows accumulation of dirt and water and provides a haven for critters who can make their way up into the timber stacks.

Rain caps Rain caps cover the top of the timber stacks stored outside and protect from rain and direct sunlight (Figs. 9, 10). Rain caps can be made from plywood, corrugated plastic or wide boards, but avoid corrugated iron sheeting as it may cause metal stains. Use stickers to space the cap off the top layer of timber. Slope the cap by propping up one end a few inches so the rain runs off. Cinder blocks exactly over the stickers keep the cap in place. Overhang the sides and ends of the piles by several inches. Shade boards propped against the piles will also stop wind-driven rain from blowing into the piles.

Stickers To air dry the timber or store it for an extended period, separators called stickers are placed between each layer of timber in the package to allow airflow across the horizontal surfaces. Dry 1x3s or 1x4s slightly longer than the stack is wide are ideal for lighter timbers that can be managed by hand. Thicker stickers, 3 or 4 in., are necessary for heavy pieces to be handled by forklift.

Air circulation helps prevent mold and stain. Stickers should be placed at a consistent distance apart along each layer, usually 2 to 4 ft. according to the thickness of the drying material, and must be aligned vertically from the foundation block at the bottom of the

7 Paper-cap top and ends on yellow cedar timbers lets wood breathe, sheds water and keeps dirt off. Stickers promote air drying and are essential for piling green timber for any but briefest intervals.

8 Scheme for air drying stacks of green timber. Careful alignment of stickers and blocks is essential and provision for airflow through middle of stack both crosswise and lengthwise helpful to timely, even drying. Regional timber grading authorities such as WWPA (Western Wood Products Association) and NELMA (Northeastern Lumber Manufacturers Association) offer online publications, brochures and tips for proper storage.

9 Thick larch planks stickered properly to very ends, with weighty timber across top giving pitch to rain cap. Good alignment of sticker and foundation blocks, the latter shimmed to level the stack.

10 Stacks of larch air drying in mixed sun and shade along woods road, set on bank for good drainage, and built by an Austrian timber framer and cabinetmaker now retired in British Columbia.


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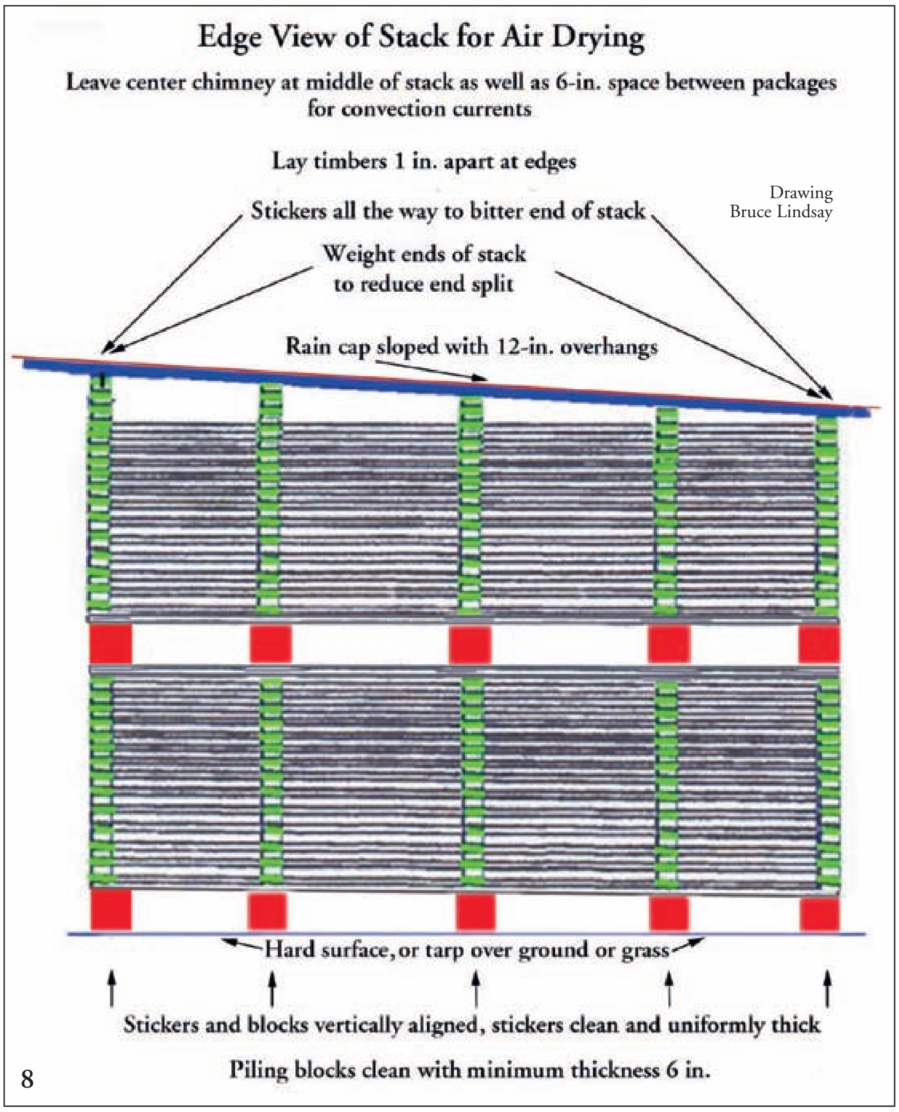

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stack to the top. (A story pole or jig applied horizontally is useful here.) The load from above should be carried solidly to the ground via proper alignment of the stickers. Randomly placed stickers may bow your timbers (and worse).

As stickered timber dries, even dry stickers usually leave sticker stain, light discoloration caused by uneven moisture loss where the sticker sat on the surface of the timber during drying. Sticker stain usually is not deep and disappears during final finishing, though it can be persistent in timbers stored a long time without rain protection. Thicker stickers not only provide clearance for the forks when lifting large timbers, but also provide better support and allow a skilled forklift operator to de-sticker or split stacks without damaging the wood. Thicker stickers also provide sturdier support at the extreme ends of the stacks.

Here at the ends of the stack one critical mistake frequently made is not going right to the ends of the timbers (assuming uniform lengths) to align the last sticker. This rule is often ignored, by putting the sticker 2 or 3 in. inboard from the end. Placing stickers at the bitter or absolute end of the timbers slows the drying on the ends, somewhat countering the tendency of wood to dry much faster through its end grain than through other surfaces, and thus reduces end splits and consequent trim loss from each piece of timber (Fig. 11). End splits, checking and twisting are more severe in boxed-heart (BH) than free-of-heart-center (FOHC) timbers. Thus if you are drying a load of second-growth boxed-heart timbers, then pay particular attention to the ends (Fig. 12).

End seals End- sealing with products like beeswax, commercial liquid plastics and paint is another control on end-splitting. (Land Ark liquid wax I consider one of the best because it is natural and nonstaining.) For the budget solution, try the mis-tinted shelf at the paint store. Coat with roller or brush. In the hands of inexperienced operators, spray guns on a windy day can result in overspray onto adjoining faces of the timber, so caution is advised. But any end-sealing is better than none. The final step to control the rate of drying would be to prop up some shade boards, mesh, burlap or plywood on the ends and sides of the timber pile to keep direct sun off the timbers.

Air drying times and monitoring moisture content (MC) First of all, buy a moisture meter. A good one costs less than $200. This is a handy tool that should be in every shop. The choice of meters is open to debate. Surface meters are okay for hobbyists or quick moisture-checking. My preference is for a pin-type meter, but any moisture meter, properly used, is helpful.

Leave one or two scant (thinner) pieces loose in the middle of the timber stack as test pieces so you can withdraw them at regular intervals. Note the moisture content of the test pieces at the start and then remove them every week to check drying progress, keeping a logbook. When you get close to the end of the drying schedule, cut a test piece in half to check for the core moisture content. When the MC is unchanged over three subsequent checks, then the stack can be considered as dry as it is likely to get. This is known as equilibrium moisture content (EMC) for that drying environment. The wood is neither taking on nor giving up moisture. For softwoods after a couple of months under ideal conditions, this frequently averages 16–22 percent.

When the wood is dry, de-sticker the piles for storage or immediate use in the shop. Store in a dry shed out of the weather, covered to keep footprints, bird droppings and dust off the timber. For outside storage, cover the stack to allow good ventilation of the timber and protection from the weather.

Kiln-dried timber storage Kiln-dried timbers should not get wet. Over the course of loading, trucking and unloading, waterproof paper wrap often gets torn, so it is wise to store kiln-dried wood under cover. Dry timber does not need to be stickered but ideally it should be stored in or under a protective structure. Not everyone has inside storage, so for outside storage loose-fitting tarps that keep water out but let air in are a good solution (Figs. 13, 14). In the case of a large order of dry timber, contact a local warehouse or timber yard to arrange to store the bulk of the timber there. Inspect the timbers going in, and draw out what you need on a weekly basis. Open the ends of the paper wrap to get rid of any condensed moisture trapped inside. Wood is hygroscopic and will attract moisture and sweat underneath the paper wrap if left (inside or outside) for extended periods.

Notwithstanding all of the above, if dry timbers do sustain a brief rain shower, with torn paper wrap or none at all, then prompt action will reduce damage. A light rain shower produces just surface water that generally does not penetrate the core of the timber. The fix is to quickly get the timbers under cover and individually exposed to the air. Depending on species, weather and other variables, surface water may evaporate in a couple of days with no harm done. Immersion of timber for several days in heavy rain will require longer drying, and damage can result (Fig. 15). The worst-case scenario of timber soaked through may require, as a last resort, air- or kiln drying, followed by resurfacing to get rid of twist and drying checks. This can end up costing in the range of $500 for a thousand board feet of timber or around $7,000 for a full truckload. (Don't ask how I know these numbers.) In addition to the costs of redrying the timbers, time will be lost and the job disrupted. A few hundred dollars of active care and on-site protection, built into the job price, are a good investment.

Fixes for dirt, oil, mold and rust stain When things go off the rails there are quick fixes. *Quick* is the operative word. Despite the best efforts of many players in the supply chain, timbers do get dirty. It only takes a forklift operator to set his forks down in a dirty mud puddle or a truck driver to spill fuel that gets onto the timbers via oily boots. A leaky hydraulic cylinder can spray a fine, barely noticeable mist of oil onto rollers, forks or dunnage, which then is unknowingly transferred to the timbers. When the paper wrap is removed in the customer's yard, the results are evident and prompt action at all levels is required.

Marinating is good for steaks, not for timbers. Whatever you do, do not delay or procrastinate cleaning the timber. Responsible suppliers will pay the cost to correct a problem that is clearly their fault. However, a supplier could be justified in ascribing some or all of the liability to others if you delay and prompt action could have kept remedial costs down. Despite the fact that damage was caused at the mill or during transit, do not leave oil, mold or rust stain to soak in deeper, multiply (in the case of mold) and become heavily ingrained deep in the wood fibers. The longer it is left, the worse it gets. Oil, stain, mold and dirt on timbers, like dead fish, do not get better with age.

Use test sections of the timber to apply any chemical cleaning solution. When you get the mixture right, then do all the stained pieces. For mold, spray diluted ammonia or bleach onto the test section, leave it for varying lengths of time and then power-wash. Table A on page 20 lists remedies for common problems.

Oxalic acid ($H_2C_2O_4$), 10 percent solution Oxalic acid is used to clean metal stains that come from steel decks, forklifts and rollers. Generally available as a powder from paint stores, it's also known as wood bleach. Read the manufacturer's instructions and adjust the proportions for the size of your rust-removal job. Oxalic acid powder must be mixed with *hot water* to be used on wood. Oxalic acid will react with metal, so mix the solution in a plastic container.

11 Stickers at "bitter end" of flitch-cut pile of yellow cedar boards help retard rapid end drying and consequent end checking. Large gaps between boards and bundles promote airflow and permit moist air to exit the stack.

12 Douglas fir 9x13x30 timbers kiln-dried without end restraint or proper piling. Boxed heart examples characteristically react worse to kiln drying, though free-of-heart-center example on far left has not done much better.

13 Loose-fitting tarps over kiln-dried yellow cedar timbers. Attached dunnage makes for quick unloading. Despite some air circulation under tarps, condensation is still possible and tarps should be removed periodically to allow evaporation.

14 Stacks of Douglas fir 4x12x24 nicely paper wrapped if just a little short on the sides. Ends easy to lift on arrival for release of trapped moisture.

15 Stacks of deadpiled timber packages that have been soaked and begun to stain. Remedy if applied promptly can be as simple as repiling well spaced on stickers. Thin dunnage between upper two packages will lead to fork stains if top package is not first lifted gently by fork tips from one end for insertion of thicker dunnage.

Table A Easily available cleaners for dirty timbers

Oxalic acid	Rust, metal stain.
Marine bilge cleaner	Oil, grease, dirt
Boat deck cleaner	Oil, grease, dirt, sunburn
Bleach	Mold
Borax	Mold (inhibitor), insects, fungi
Trisodium phosphate	General dirt

For large areas (Figs. 16, 17), apply the solution with a stiff brush over the complete face of the timber to avoid splotchy light patches. If the rust stain is a small one, use a thin brush to apply the oxalic acid and leave the timber overnight. To avoid a blotchy appearance, then treat the whole surface completely from end to end. For a severe rust problem, you may have to reapply the solution two or three times. Let it dry each time.

The final step is to neutralize the acid to stop its corrosive action. Make an alkaline solution by mixing 2 tbs. of baking soda with 1 qt. of water. Use this solution to wash the wood, let it dry, and then a final power-wash should clean the timber.

Desirable tools for cleaning timber include the power washer (3000 psi), a hot-water pressure washer, a steam cleaner, a stiff-bristled deck brush and a stainless steel or brass brush for rotary drill or angle grinder.

At the sawmill, antistain solutions are applied to control mold, stain and rust as an integrated part of the production line. Commercial antistain solutions contain bleach, borate and oxalic acid, among other things, a preventive cure for most timber stain problems before the timber is packaged. During an 8-hour shift it is possible to treat 10 to 20 truckloads of timber through commercial antistain machines, dip tanks and spray tunnels. For small-volume, occasional stain control in a timber framer's yard, antistain solution can easily be applied with a watering can or garden sprayer. But time is of the essence. Commercial antistain brand names and suppliers are listed in Table B.

PROPER timber storage concerns timber protection, moisture control, packaging, shipping protocol and active material management (Fig. 18–20). In business, it's not about doing five things 50 percent better, it's all about doing 50 things 5 percent better. Proper timber storage practices should be in everyone's toolbox.

Table B Chemicals used to prevent mold and stain on freshly sawn timber in the Pacific Northwest

Trade name	Supplier	Active ingredient
Premier	ISK	3-iodo-2-propynyl butyl carbamate and propiconazole
Orange Shield	Diacon	propiconazole
Anti Blu XL	Arch	propiconazole, tebuconazole, iodo propynyl butyl carbamate
Britewood PF-1	Contechem	propynyl butyl carbamate
Britewood Z	Contechem	propiconazole
Britewood XL	Contechem	propiconazole and didecyl dimethyl ammonium chloride
Bazooka	Kop-Coat	diiodomethyl p-tolyl sulfone-propynyl butyl carbamate and propiconazole
LTC – 3	Kop-Coat	3-iodo-2-propynyl butyl carbamate

(From Schauwecker, Christoph J. and Jeffrey J. Morrell, "Use of antistain chemicals by softwood timber producers in the western United States during 2006—a survey," *Forest Products Journal*, Vol. 58, No. 10, October 2008.)

Many companies in the supply chain operate at a reserved pace today. The mills are open to new suggestions that will improve the perceived value equation for their customers. When mills are busy and can sell every stick they make, you will have no chance of getting them to adopt any new quality-control program for packaging or timber handling. When things are slow is the best time for timber framers to learn new programs and new skills and to upgrade timber storage and handling. —Bruce Lindsay

Bruce Lindsay (brucelindsay@shaw.ca) runs Evergreen Specialties Ltd., a timber brokerage, in North Vancouver, British Columbia.

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GLOSSARY

ALS American Lumber Standard, designated PS 20-70 (product standard issued 1970), specifies dimensions for various timber products, sizes for dry and green timber, grading and technical requirements.
BH Boxed heart, a timber in which the heart, or pith, is enclosed within the four sides of the piece by a minimum number of rings.
B/L Bill of lading, a shipping document issued by the shipper to the trucker acknowledging receipt of the goods and serving as a contract for the shipment, and which should list the total number of packages loaded on the truck.
Check Lengthwise separation of wood.
Confirmation Written verification of an order issued by the purchaser, listing the details of the transaction.
Dunnage Four-ft. lengths of timber used to separate timber packages from each other or a truck bed.
EMC Equilibrium moisture content.
FOB Free on board. Delivery point at which the buyer takes possession of the timber and is responsible for costs beyond that point. as in FOB mill, FOB jobsite.
FOHC Free of heart center. Timber sawn to exclude the pith, or heart center of the tree.
Jags Odds and ends left in inventory, quantities too small to make up a full unit.
MC Moisture content.
Package Pile of timber, also unit, stack, pack.
Paper wrap Reinforced plastic used to cover units of timber.
RRL Ragged random lengths (multiple lengths from 6 ft. to 20 ft. or longer).
S4S Surfaced four sides, planed smooth.
Seasoning Process of evaporation and extraction of moisture from green or partially dried wood.
Stack Timber piled in an orderly manner (see also *Package*), usually with stickers between each layer for seasoning.
Standard unit A securely banded package containing a specified number of pieces and generally 24 in. high x 48 in. wide +/-. Surfaced 2x4, 208 pieces (16 high x 13 wide); 2x6, 128 pieces. Rough 2x4, 144 pieces (12 high x 12 wide); 2x6, 96 pieces.
Stickers Four-ft.-long sticks or narrow boards placed at right angles between each layer of timber in a stack to allow air circulation and drying of the timber.

16 Mold growing on Douglas fir. Bleach may be remedy.

17 Rust, water, black mold and sap stain on Douglas fir. Remedies are oxalic acid for the rust, bleach for the black mold.

18 Western red cedar 4x8s and 6x6s air-drying in fabric-covered shed, correctly stickered and banded (though dunnage at bottom is too-thin single 2x4s). Stack could be improved by adding piling blocks at bottom and chimney at middle for moisture egress.

19 Ideal lumber racks, fully lined with nonreactive plastic to avoid staining timber.

20 Ideal storage (or combination workspace and storage) for dry timber.


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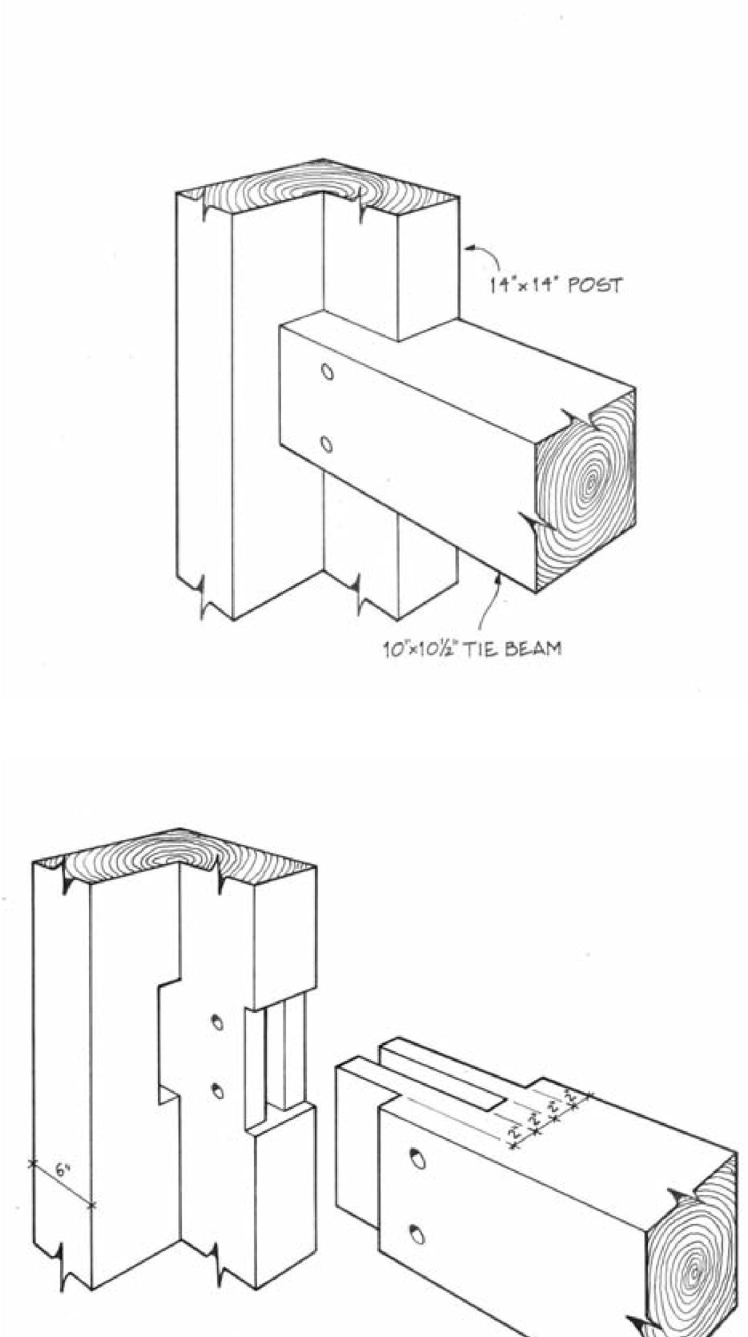
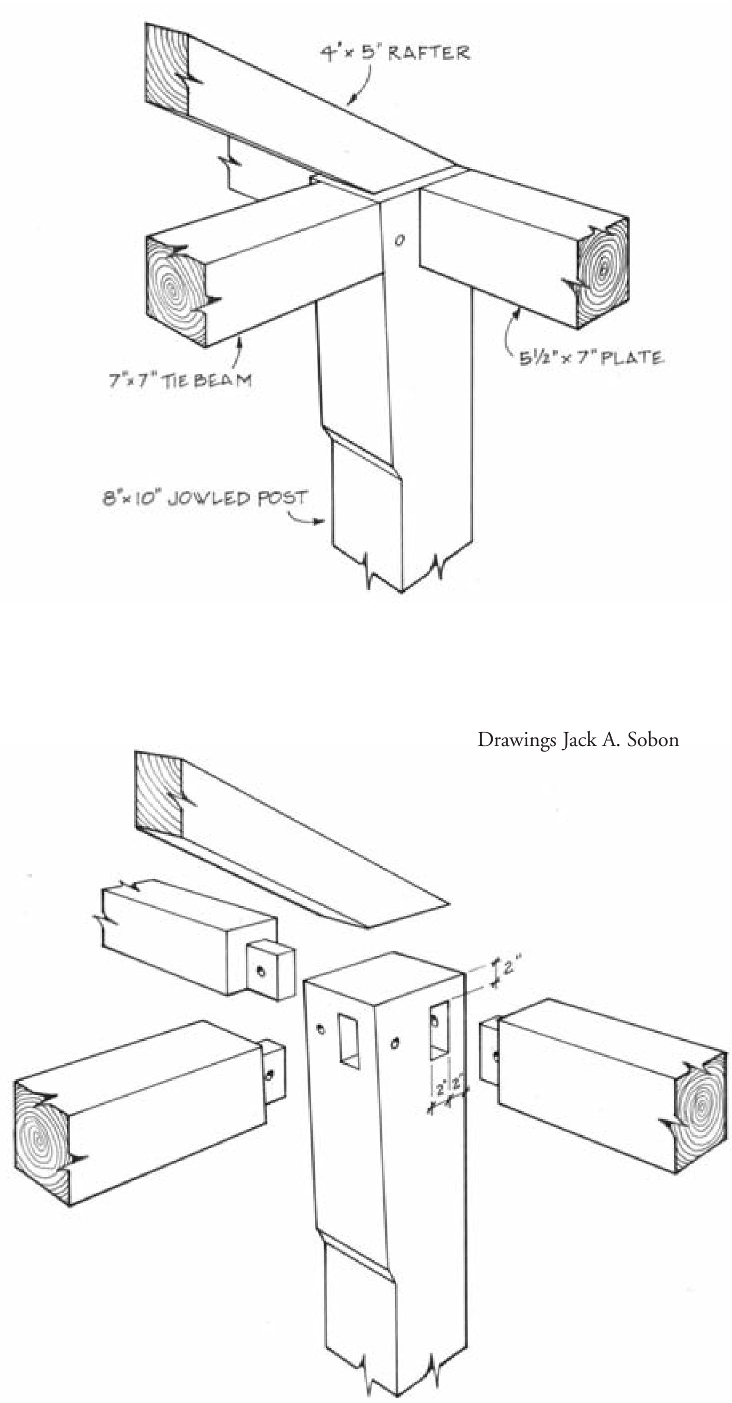
Tying Joint Addendum

SINCE Guild publication of *Historic American Timber Joinery: A Graphic Guide* in 2002, additional timber joinery examples continue to surface. Herewith five new tying joints. (See also "Scarf Joint Addendum" in TF 99.) —Jack A. Sobon

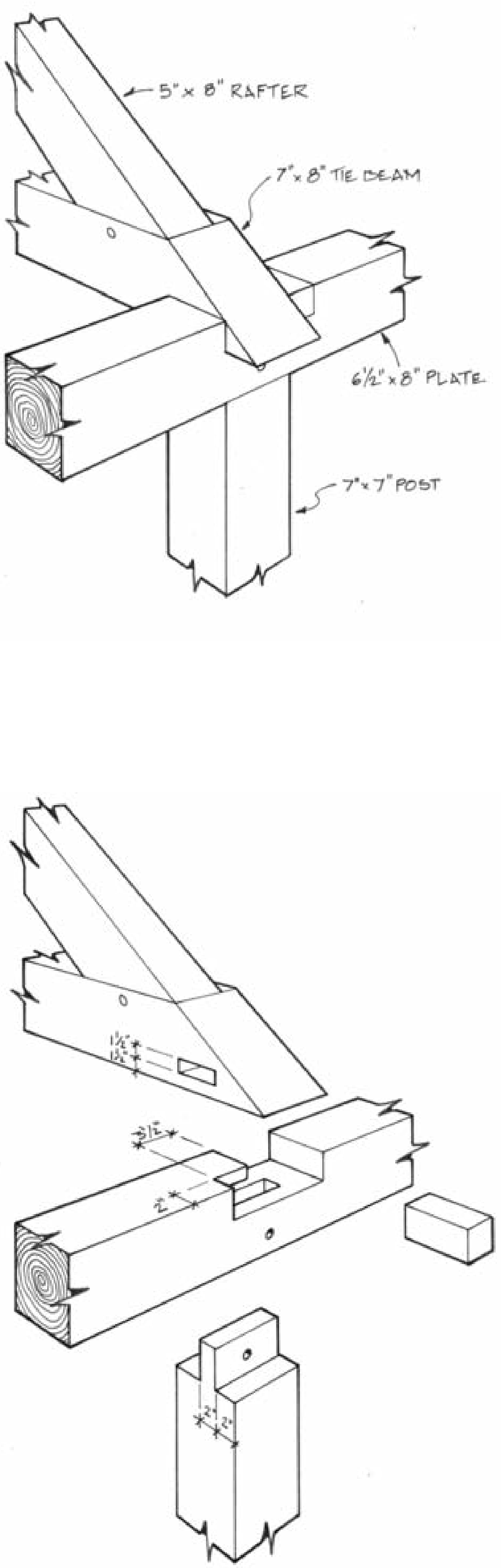


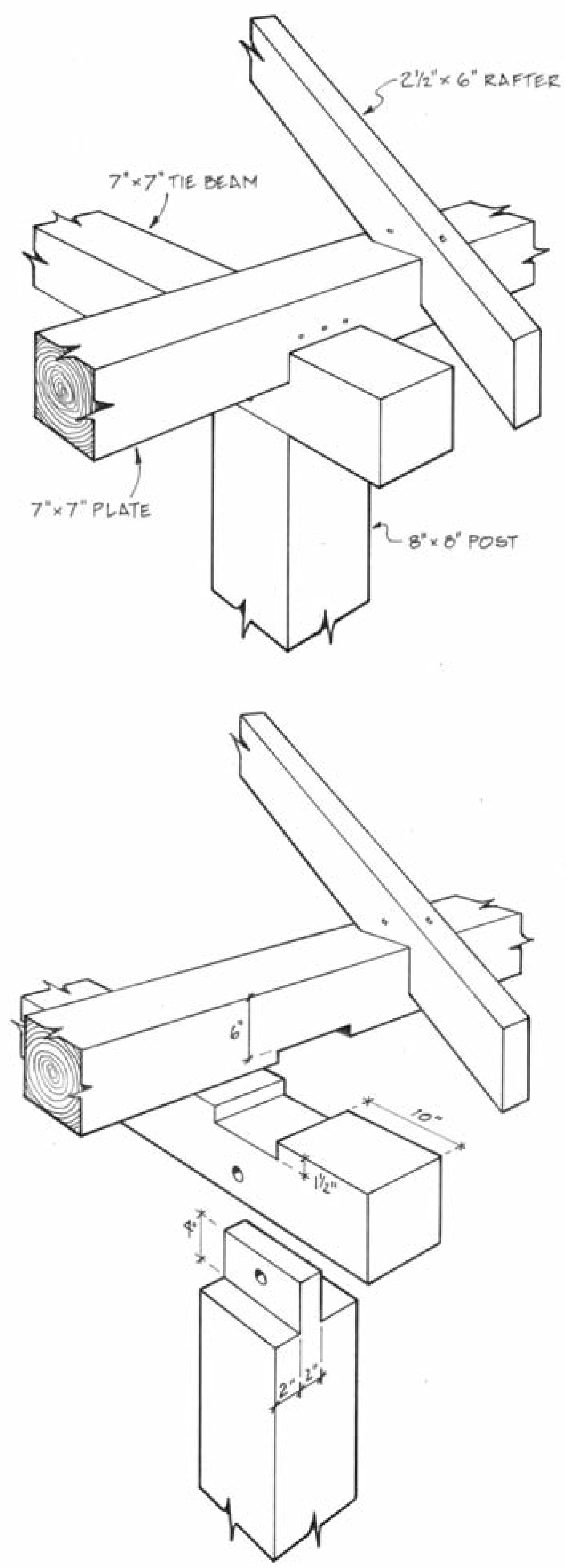
1 **Twin-tenoned, dropped tie beam in the 32x42-ft. Duanesburgh, New York, Christ Church Episcopal, constructed in 1793. To keep the wall framing invisible on the interior of the church, the 14x14 oak corner posts are hewn down on two faces to the 6-in. depth of the wall studding, providing a flush surface for interior finish. The white pine end tie beams, 10 in. broad, then meet the L-shaped corner posts with unequal shoulders on the tenons. While two sizable pins are visible, additional blind pins may help secure the joint.**



Drawings Jack A. Sobon

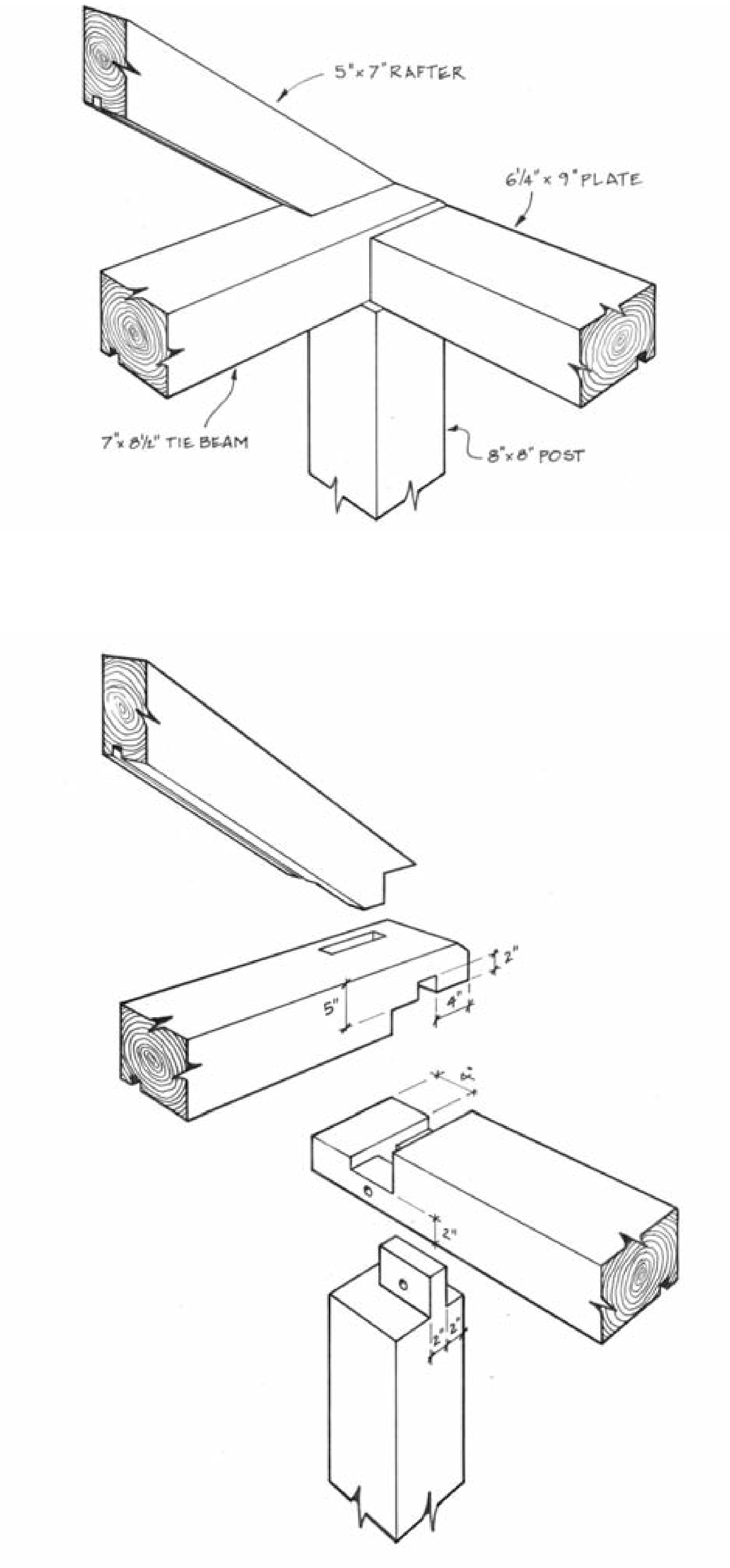
2 **Pseudo-English tying joint in three-bay, scribe rule 15x33-ft. carriage barn in Ashfield, Massachusetts, built before 1798, with mixed softwood story-and-a-half frame and wall plates 4 ft. above the loft floor. Though it has the jowled (gunstock) posts of a typical 18th-century English frame, the similarities end there. Plates are interrupted, their tenons bear the roof weight, and rafters are merely nailed to the top of the post. There is insufficient relish beyond pin holes to afford any tensile capacity for the tie beam, and one plate pin actually runs into the tie mortise. A short tenon secured by a single ⅞-in. pin has obvious shortcomings structurally in a tying joint; steel tie rods have been added over the years. Other than the use of short stock for the plates, the only imaginable advantage of this arrangement would be during the scribing process. The carpenter wouldn't have to scribe the plan layup of ties and plates.**



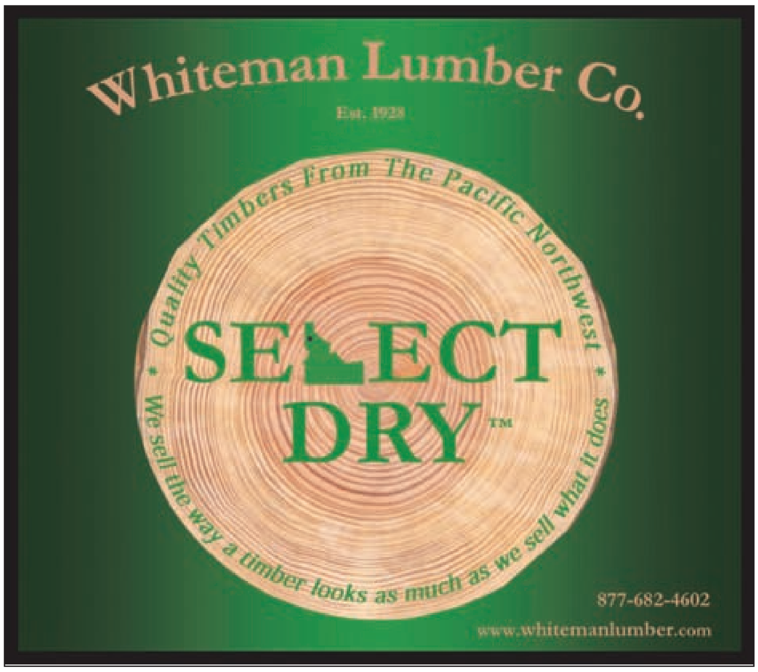


3 Unusual tenoning arrangement for intermediate ties in a three-bay scribe rule English barn, date unknown, in Lincolnville, Maine. A number of barns have been found where gable tie beams slide horizontally onto plate end tenons, but in these cases intermediate ties are lapped over the plate or a dropped tie is used. In this barn, framed of spruce, the intermediate ties also slide onto plate tenons. The extra wood removed to enable this is replaced with a filler block. The end joints are secured from sliding off by a pin. A square-rule four-bay Maine barn with similar joints, presumably of later date, was found farther inland by Brad Morse in the town of Wayne.

4 Simple, effective tying joint found in mid-19th-century 38x60-ft. barn in Kittery Point, Maine. A boxed-in cornice conceals the tie beam to project beyond the building far enough to make a secure lap joint with the plate, effective in resisting roof thrust as well as improving the bracing effect from post to tie beam. The plate is simply toe-nailed to the tie beam. If there is a weakness, it is resistance to uplift in the lap. Racking of the frame longitudinally from the wind would cause the plate braces to lift the plate up. The many vertical siding boards nailed to the face of the plate and the weight of the roof have resisted this force. Posts are hemlock, ties and plates white pine.



5 Corner tying joint in a much-altered scribe rule English barn, orginally 30x40 ft., now 46x80 ft., in Kent's Corners, Vermont. Post tenon, protruding above lap in plate, acts as cog to resist thrust of common rafters on plate. Despite the fact that both tie and plate are reduced substantially at the joint, both have full bearing over the post. Plate and tie beam are both shifted 2 in. to the exterior to allow for sheathing board channels on their undersides, as seen in the drawings. End rafters are further offset and likewise have a board channel, an unusual detail. Pin diameter is ⅞ in. and the timbers are spruce. Intermediate tying joints are lap dovetails with a shear pin. (Thanks to Seth Kelley for this discovery.)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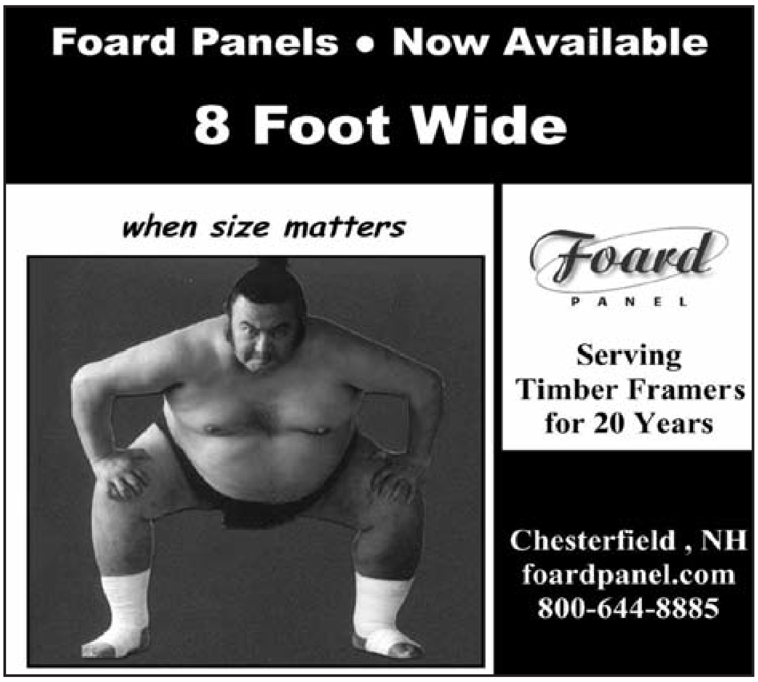
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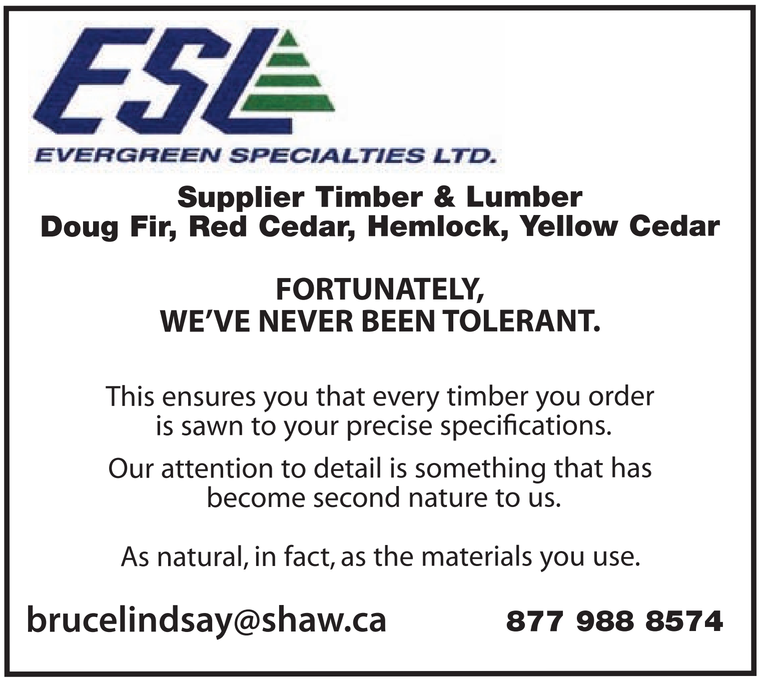
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