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INCORPORATING TIMBER FRAMERS NEWS

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BOOKS

Seeing and Designing

The Old Way of Seeing, by Jonathan Hale. Houghton Mifflin Company, Boston and New York, 1994. 7 in. x 9.5 in., 241 pages, illustrated. Hardbound, $24.95.

WRITTEN by a Massachusetts architect, this book argues that until 1830 there was an "intuitive" way of designing buildings in America that gave them beauty and harmony. According to the author, this broke down about 165 years ago with the rise of the Greek Revival style. Using examples drawn from Massachusetts towns, Jonathan Hale examines a number of Federal and Georgian buildings, finding order and balance in their primary facades, and argues that with the advent of the Greek Revival, design changed from an unconscious method expressing visual pattern to one of self-conscious symbolism. For example, Hale observes that the columns of Greek Revival "end houses" were supposed to symbolize purity and power, and laments the loss of a simpler, more harmonious design aesthetic.

Hale also spends a lot of time with what he calls "regulating lines," diagonals drawn against photographs of buildings' primary facades, that seem to show a definite order and relationship among windows, doors, roofs and chimney tops. He is very careful, however, to point out that these lines are not to be used for designing, but instead illustrate, after the fact, the kind of order that characterized Georgian and early Federal building.

While the concept of regulating lines is interesting, the author does not discuss two important conditions of early American architecture. First, buildings could present a simpler appearance because the functions they housed were not so specific as those in modern buildings. No window needed be 42 in. off the floor, and especially wide, to clear the kitchen sink; no window needed be especially small and high to give privacy to the bathroom. Second, builders' and architects' routine use of plane geometry and traditional drawing instruments certainly influenced the way buildings were designed.

Just as Gothic buildings, designed with full-scale mockups and models, were very spatial in effect, later buildings, designed using by-now ubiquitous and less-expensive paper, tended to be flat and two-dimensional. During the 18th century an architect's drawing tools consisted of brass and steel ruling pens, dividers and compasses, held in a sharkskin-covered case, together with wooden scales. These drawing instruments led naturally to regular divisions and sub-divisions, facades inscribed in circles and to a shape the author finds particularly exciting, the *vesica piscis* (intersecting arcs to form a cat-eye or, if they pass, a fish). Today, with the rise of CAD, a false sense of accuracy and the opportunity to repeat existing elements tempt designers with the lure of endless and easy repetition.

One of the intriguing aspects of Hale's approach is that he shamelessly anthropomorphizes architecture and interjects his own preferences. The work of Henry Hobson Richardson is "hard to look at," the Shingle Style is acceptable, but the International Style is criticized for its self-conscious use of elemental forms. He also finds Harvard's Memorial Hall "scary on the outside," though the picture illustrating it is an old one including the original bell tower roof, now gone. In fact, Memorial Hall, which has just been renovated on the inside as a dining hall, its initial function, and restored on the outside, is a striking example of Ruskinian Gothic. Built as a memorial to Harvard College's Civil War dead, it also contains the small, charming Sanders Theater. When it was built in 1869, surrounded by brick and wooden Georgian buildings that followed Hale's regulating lines theory, Memorial Hall was considered the most beautiful building in Cambridge.

HALE gives a brief synopsis of the outstanding modern masters, including Frank Lloyd Wright, whose Zimmerman House (Manchester, New Hampshire) is examined in some detail. This is a fascinating house, built in 1951 to the clients' demands that it accord to the much earlier Usonian model. While praising Wright's masterful use of space, which is extraordinary, he fails to make one interesting point: the Zimmermans were short, musical people who had no children or pets. Their house, with its private street facade, open garden room, small kitchen, "dining room" for two and simple master bedroom, fitted them like a custom suit. There is no basement, nor attic for storage. The furnishings, as well as the landscaping and even the mail box, were all designed by Wright. The most remarkable feature is the garden room's plate glass south wall, with planters inside and out all filled with the same plants. As a result, the rear wall seems to disappear, and the garden room, used for musical soirées, becomes

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one with the private back yard.

I remember thinking, when I had the opportunity to meet Mrs. Zimmerman and tour the house in 1971, that in order to sell the house one would have to find an identical pair of people with the same interests and passions. Today the house has been restored and belongs to the Currier Gallery of Art.

Hale contends that seeing is the problem, and that is why modern houses are so ugly. But John Ruskin, who single-handedly invented art criticism, could really see (and draw). He struggled with the ugliness of industrial England, whose buildings were full of regulated design, and loved the complexity and surprise of Gothic buildings. Why he found some buildings attractive and others not is not a simple matter. For Ruskin, the Gothic style, and especially Italian Gothic, had a purity and spirituality not found in contemporary English Victorian architecture.

Jonathan Hale

Two houses on the same street in Belmont, Massachusetts. Above, the genuine article from 1775, below left, a "Colonial" from the 1920s.

Later, during the International Style of the 1920s, intentionally designed "for the masses" with an absence of decoration, the intent was to free design from the fussiness and expense of Victorian excesses. Le Corbusier's dream of the house as a machine excited the designers of the time; they so firmly believed in architecture as a means of social good that it imbued their work. Forty years on, Post-Moderns such as Robert Venturi rejected the extremes of the Moderns and their International Style, and instead of stressing form, used symbols and decorative elements as reminders of other architectural styles.

But the simple fact is that each and every age was once "modern." The first brick and glass-filled Georgian buildings were "modern" compared to the previous Tudor examples. Greek Revival, which represented the new American republic and celebrated the Greeks' war for independence from the Ottomans, demonstrated the wealth and power of the age and was itself the latest fashion from about 1830 to 1850. During the Victorian era, a panoply of new materials and wealth opened up new possibilities to play with all the traditional styles. Much later in the 19th century, after the Philadelphia Exposition of 1876, the Colonial Revival and Shingle Style were attempts to reinvent the "traditional" American Colonial styles, and indirectly celebrated the owners' lineage.

And so the latest fashion or style moves on. Each style has its own social agenda and appeals to people for a variety of reasons. The Georgian style, derived from the Dutch by way of England, was the dominant way of building when America was British. Limited by the locally available materials, Americans built according to pattern books and tradition.

The designs were symmetrical and the exterior appearance was more important than interior function. There was no attempt to have interior spaces "show through" to the outside; most Georgian buildings are boxes because of the natural lengths and spans of the post and beam framing. In Colonial Williamsburg as in the other colonies, a "house kit" consisted of a tool chest of woodworking tools, window glass in standard sizes (either 6x8 or, later, 7x9), kegs of wrought iron nails, hinges, locks and pigment for paint. All of these were imported from England. Everything else was produced locally: boards and timbers from local woods, bricks and mortar from local brickyards. Plaster was made from local sand and lime, and the paint was mixed with linseed or fish oil.

So a certain similarity was inevitable due to the available materials. The other major factor was that rooms were multi-purpose, and those for special uses such as privies were outside the building. The "necessaries" and outside kitchens at Williamsburg allowed the buildings, and their plans, to be much simpler. Finally, and this has more of an impact today than many realize, there were no building codes. The modern "Colonial" house inevitably looks out of proportion, for the simple reason that its second-floor windows, though they may be the traditional double-hung sash, are sized not according to a standard pane of glass but in order to meet egress requirements. This means the second-floor windows are both wider and deeper than they would have been in their original period.

Another difference is that most of today's buildings are much flatter and have less of what Michael Graves called "the architectural in and out." Standard trim depths and stock windows and doors lack both the richness and depth of period ones. This means fewer shadow lines, and, ultimately, a bare, stage-front appearance for most houses. Such flatness (some colonial-style houses today have less than 2 in. of projection anywhere on their front facade) may be unrelieved by ornament or detail. Older houses were intended to be seen, and admired, on foot; today people often view houses from a car. The difference in speed and viewing distance means that only big architectural items are seen, much less appreciated. In a period house, the hand-wrought hinges, box locks, moldings and other hand-wrought details bring the building alive in a way not matched by gypsum board and latex paint.

Ultimately, *The Old Way of Seeing* is enjoyable, and gives many insights into a variety of modern architectural styles. But for all it does to examine and celebrate fine architecture, it does not present a systematic approach that would help one design better. Good design ability is both innate and learned, and the first step, helped by books such as this one, is to learn how to really see. Even then, we may appreciate, but are unlikely to match, the spatial and visual virtuosity of a Frank Lloyd Wright.

—JONATHAN S. VINCENT, AIA

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Timber Frame Design Standards

HEAVY timber (post and beam) construction is used in a broad range of structures including buildings, bridges and towers. The timber members in these structures are usually connected with the aid of steel bolts and metal fastening hardware such as plates and hangers. Design procedures for this *conventional* approach to heavy timber construction have a sound technical basis in comprehensive past research. Likewise, specialty products for fastening and a modern design standard, the *National Design Specification for Wood Construction* (or NDS, published by the American Forest and Paper Association), which recognizes the use of metallic fasteners, aid the engineer in producing safe, serviceable structures.

By contrast, builders of *traditional* timber frames eschew the use of metal to make connections. In a traditional timber frame, the timber members are attached with pegged mortise-and-tenon joints, dovetails, scarfs and many variations of these basic carpenter-style joints. This approach to construction with heavy timber is termed traditional because it dates back to colonial times in North America, when craftsmen of the day used the joinery skills and techniques that they brought with them from Europe to fashion all-wood connections.

The last quarter-century has witnessed a rebirth of traditional timber framing. Designers and builders with an interest in historic preservation restore and rebuild priceless historic structures (mills, barns, bridges, churches). Others design and build new timber frame structures, such as homes and public facilities, using traditional methods of joinery. Unfortunately, modern building codes and design specifications evolved after timber framing gave way in the last century to conventional light-frame construction techniques. Accordingly, today's codes contain no provisions for the particular details unique to traditional methods. Architects, engineers and contractors are constrained in their use of timber-framing techniques because of the lack of both design provisions and knowledge regarding structural behavior. Likewise, building inspectors and code officials (especially in geographic regions where timber-framing was not historically practiced) may be reluctant to approve these construction methods. Modern building materials and the limitations of current building codes have stimulated development of a variety of hybrid timber frame systems. These include the use of enclosure systems or conventionally framed, interior stud walls for lateral load resistance and the use of concealed metallic fasteners in tension joints. Nevertheless, the fundamental problems associated with timber frame design remain.

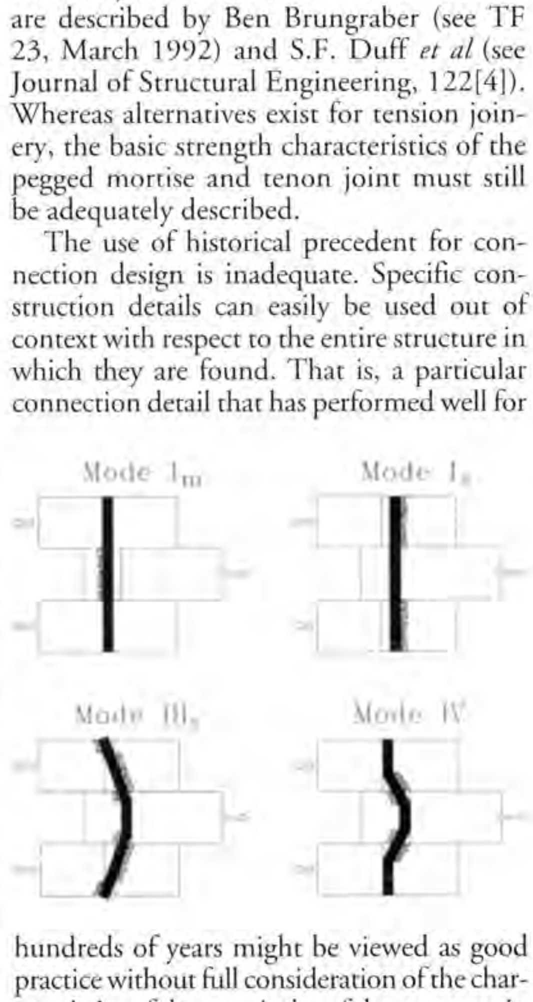
The technical problems associated with the design of a timber frame lie not in the behavior of the members themselves, but with the joints. Current practice, which is guided in part by the NDS, is adequate to predict the structural performance of the members themselves. Likewise, certain joint design considerations, such as those involving load transfer through bearing, are treated satisfactorily in the NDS. The difficulty arises when carpenter-style joints such as the pegged mortise-and-tenon are used to transfer tension loads. In this case, the shear, bending and dowel bearing strengths of the wooden peg are critical to the integrity of the joint. Also, since the full-strength requirements of the NDS for peg-hole end distances (in the tenon) and edge distances (in the mortised member) are difficult to satisfy, joint failures due to cross-grain tension at the mortise or splitting in the end of the tenon are design concerns. Designers are confronted with the problem of how to detail such a joint (or an alternative) to resist tension forces due to wind and seismic loads, with little guidance from the NDS.

WITH the 1991 release of the NDS, connection design is based on yield models developed in Europe and recently adapted to U.S. practice. With suitable extension, the yield model approach could be applied to the design of timber frame tension joints. In the yield model approach, connection strength is governed by the dowel bearing strength (crushing strength) of the wood members being joined and the bending strength of the fastener (presumed to be a metal bolt, screw or nail). Certain combinations of wood crushing and fastener bending are evaluated to find the one with the lowest strength. That limiting strength defines the capacity of the connection. The double-shear splice connection shown in the figure at right can be viewed as a reasonable approximation of a mortise-and-tenon joint subjected to tension. The main (middle) member represents the tenon and the side members represent the mortise cheeks.

Mode I_m is a crushing failure of the wood in the main member and Mode I_s demonstrates crushing of the side member. In both cases, the metal fastener is undamaged. Modes III_s and IV illustrate a combined failure involving wood crushing and fastener bending. Failures similar to Mode IV have been observed in experimental tests of mortise and tenon joints. Thus, design of these joints with wood pegs requires no new engineering theory, just modifications and extensions to one that is already accepted by the technical community.

Design procedures for timber frame structures in the U. S. have evolved from historical precedent. The timber frame revival began with restoration and reconstruction of existing structures. Craftsmen studied these structures and the writings of their builders to learn how they were made. New buildings were designed following the lead of their ancestral models. When structural design of a timber frame is performed today, engineers often look for alternatives to the traditional pegged mortise and tenon joint to resist tension forces. One attractive alternative inspired by practice in Japan uses a spline that typically extends through the post and into housed, square-ended beams on each side. NDS end distance requirements are easily satisfied and satisfactory tension capacity of the joint can usually be obtained. When a spline cannot be extended through the post at a side wall or corner, hidden metal fasteners can be used to secure the joint. These and other alternatives are described by Ben Brungraber (see TF 23, March 1992) and S.F. Duff *et al* (see Journal of Structural Engineering, 122[4]). Whereas alternatives exist for tension joinery, the basic strength characteristics of the pegged mortise and tenon joint must still be adequately described.

The use of historical precedent for connection design is inadequate. Specific construction details can easily be used out of context with respect to the entire structure in which they are found. That is, a particular connection detail that has performed well for



hundreds of years might be viewed as good practice without full consideration of the characteristics of the remainder of the structure in which that detail is found. Since many new timber frames are built in forms (and sometimes for uses) that differ markedly from their historical predecessors, it is unwise to assume that historical practice is always applicable.

Traditional timber frame construction has a longer history of success than does conventional heavy timber framing. Yet current design specifications and building codes do not include explicit provisions for this construction technique. Use of hybrid systems and hidden metal fasteners provide alternatives to the design of all-wood joinery. However, these alternatives are not acceptable to traditionalists and those who practice historic preservation. Hence, rational design guidelines for wood joinery, in the form of industry-wide standards, are needed.

IN the last issue of this journal, Kevin Ireton offered a thoughtful view of the elements of a fine home. These elements include good craftsmanship and good design, which are quite independent. There is yet another element to a fine home (or any fine structure) that cannot be omitted: good engineering. Whereas good craftsmanship and good design appeal primarily to the aesthetic sense, good engineering is needed to assure the safety and serviceability of the structure. Safety, the most important of these objectives, is usually achieved through detailed engineering analysis and design to assure that the structure has adequate strength.

So, how do we achieve good engineering in timber frame design? Many engineers (even good ones) are unfamiliar with the basic structural system and the details that make it work. Even with the available training, comprehensive guidelines for joint design are not available. Hence, some designers cannot see farther than the nearest steel bolt when it comes to joining two pieces of timber. Nevertheless, capable engineers are doing the job now. But, without commonly accepted design standards, designers must act conservatively. As Ben Brungraber put it (TF 23, March 1992): "I simply have no testing or analytical leg to stand on . . . in accepting the standard connection methods simply because a great number of buildings have grown quite old with these joints." The professional engineer must regard his duty to the public welfare as paramount. Historical success stories are not sufficient guidelines for the designer. The saying "We've always done it that way" is not good enough.

To trim the fat (and the steel) from our designs without compromising the safety of our clients, the Guild must foster the development of design standards for timber frames. These design standards will serve as the fundamental guidelines for designers (including architects and engineers) to assure good engineering in their structures.

The definition and adoption of standards in the timber framing industry is a passionate issue for Guild members, perhaps because it is surrounded by confusion and misunderstanding regarding the intent and scope of design standards. To clarify this issue, several questions should be posed:

- Just what are *design standards*?
- Who will set these standards?
- Who will be required to meet them?
- Who will enforce them?
- Will they limit creativity and stifle innovation?
- Can't we just get by without them?

Just what are design standards? Who will set these standards? From the perspective of structural engineering, a design standard is a set of rules that defines minimum acceptable criteria and procedures to assure that a structure will safely serve its intended function. As practice in a profession develops and matures, the lessons learned are compiled in a unified form. In essence, a standard is a representation of the accumulated knowledge of the profession. When we use a design standard we demonstrate that we have used, in distilled form, the large body of expertise available to us. Alternative names for a standard include *code* and *specification.* Usually, a design standard is written by a committee of professionals who have achieved the highest level of distinction in their profession.

By way of contrast, let's switch the word order and consider a *standard design.* A standard design is a design that is developed out of experience, without consideration of the needs or interests of one specific customer. Standard designs are established primarily for economy. With experience, we tend to develop routines that are efficient and predictable. A standard design is simply an expression of that routine. Your favorite method for joining a floor joist to a summer beam can be regarded as a standard design. Standard designs are developed, not by a committee of experts, but by the builder himself.

Who will be required to meet them? Who will enforce them? When a design standard is established, we are all obligated to abide by it. This is true even when the standard does not meet all of our expectations, such as the design values for Oak (see TF 6, November 1987). The obligation might be a legal one, through inclusion of the design standard in the local building code or in a contract with the client. However, we also have an ethical obligation to follow the design standard, since it is the accepted representation of a body of knowledge.

If we don't like a standard, we can have it changed. If we know that the provisions of a standard are overly burdensome or conservative, then we must work to improve the standard. Design standards are never static. For example, the most applicable design standard for timber framers, the NDS, is in its 11th incarnation and another major revision is nearing release.

To change a design standard, we document what we have learned by objective experimental methods or theory, cast the results in a form that can be interpreted and applied by practitioners, and then submit the changes to the appropriate standard-writing body.

Enforcement of design standards is handled in two ways. First, local building officials (inspectors) are responsible for interpreting the building code and assuring that a particular structure satisfies the code. If the inspector doesn't like what he sees, he can intervene in your work for a few weeks or months until the problem is resolved. The second enforcement method is through the court system. In this context, suffice it to say that, if an applicable design standard exists, you had best follow it.

Will they limit creativity and stifle innovation? Can't we just get by without them? Design standards do not specify how a particular structure must be built. They are not so specific as to require what joint type must be used in each situation. Design standards don't specify standard designs. Instead, the design standard defines the allowable load for a particular type of joint, based on the associated material and geometric characteristics. The designer's task is to adjust materials, geometry, loads, etc. so that the allowable load is not exceeded by the actual loads from building self-weight, wind, snow and occupancy.

What is implied by the absence of a design standard? Does it suggest that there is no knowledge held within the profession that can guide design of safe structures? If the Guild does not act to develop a design standard for all-wood joinery that is in the best interests of the industry, it is possible that existing standards, for lack of better evidence, will prohibit certain practices that are now common. That situation might already exist. The Uniform Building Code classifies structures into certain categories of Structural Systems (Table 16-N of the UBC). A stand-alone timber frame with knee braces does not fit into any of the current definitions and should fall into the final category of Undefined Systems. Without sophisticated dynamic analysis and experimental tests, Undefined Systems cannot be built in regions of the country with high seismicity. Hence, stand-alone traditional timber frames could be excluded from much of the western U.S. and parts of the Midwest. The "escape clause" is to design interior partitions or the enclosure system to resist lateral loads due to earthquakes. Do we really want to tell a client that these marvelous frames can endure for centuries, yet we must rely on supplementary structural systems to meet the codes? —DICK SCHMIDT

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Round Post, Square Beam Joinery

DREW and Lynn Thorburn were sure their home was to be timber framed. Drew is a Guild member who got hooked while working on the Guelph bridge. Lynn's childhood home in England was a 14th-century timber frame. And they wanted something out of the ordinary for their new house at Isabella Point on the southern tip of British Columbia's Saltspring Island.

Photos Jeff Arvin

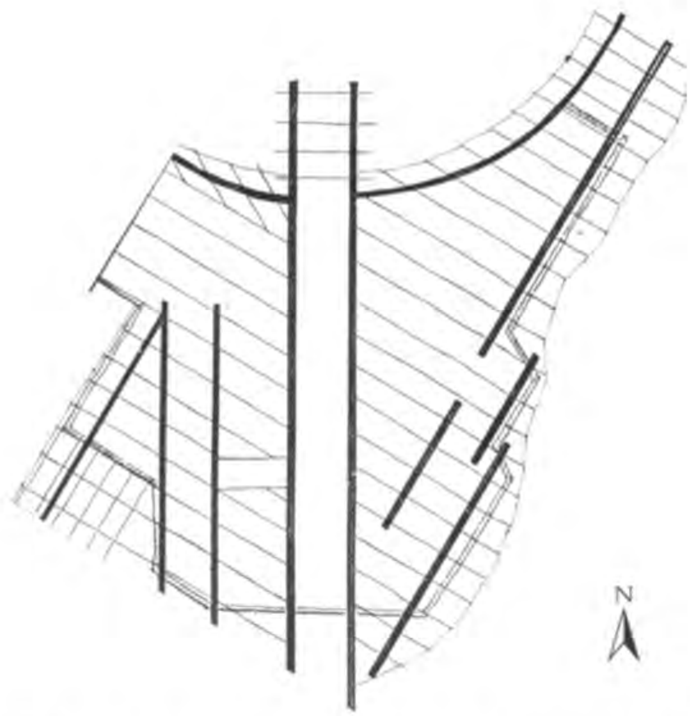
The first quick look at schematic drawings for the Thorburn residence showed that, indeed, this project wouldn't be business as usual. Architect Michael McNamara of Blue Sky Design on Hornby Island had cooked up a building, which, while it fit snugly into the spectacular site, departed from mainstream timber framing in several ways. The plates weren't level, rafters intersected plates at angles other than 90° and the eave line actually undulated (though in straight sections). Log columns supported sawn beams and only in a few places did the columns come in contact with the exterior skin of the building.

The existing house on the property was built by Hawaiian whalers who came to B.C. in the late 19th century. But Isabella Point is the site of centuries of successive human settlement. So while not directly derivative of native buildings, the new house's round columns, square beams and low-pitched roof show the influence of place.

On paper, the roof plan resembles the skeleton of a ray (or a frog, depending on the viewer) so it's appropriate that the plan is based on a central "spine" or colonnade, 78 ft. long by 8 ft. wide, that runs the length of the building from front to rear, stepping down four times on the way. Common rafters intersect the plates on either side of the spine at a 60° deck angle. Additional mid-span plates lie on gridlines at 60° and 90° to the commons. Interior partitions and the exterior skin don't follow the gridlines of the framing. Lateral loads are handled by interior shear walls, leaving the frame responsible for gravity loads only.

We faced two technical challenges: joining the square beams to the round columns and producing rafters for the undulating roof.

The first challenge was to arrive at a mathematical description of an undulating roof. Rise and run coordinates for each intersection of plate and rafter were easily found, since we had each column location in plan and each plate height in elevation at that point (and finding 50 different ones did not completely exhaust us). The difficult task was finding the angle, sometimes called the top cut, at which the rafter crosses the plate—the angle to strike on the top or bottom edge of a rafter. Recall that we had plates rising and falling and rafters crossing the plates at 60° angles.



With trigonometry, the top cut angle can be found through the known rafter pitch and deck angle: the tangent of the top cut angle is the tangent of the deck angle multiplied by the cosine of the rafter pitch. In our case, the reciprocal of the tangent of the desired angle was obtained by taking the square root of the sum of the rise squared and the run squared, then dividing it by the run times the square root of three. (Root three is the tangent of 60°.) With this angle we were able to locate the plumb cut lines for the compoundangled notches in the undersides of the 6x10 rafters. The correct depth of the notch on each side of a rafter we found by adopting a standard height-above-plate for the rafter-top and measuring down the plumb-cut line at its intersection with the outside of the plate. These measurements differ since the plate is changing height over a distance equal to the thickness of the rafter adjusted for the deck angle.

Again, where the rafters cross the plate at other than 90° and the plate is not level, the adjacent surface of the notch, which we called the seat cut, is bordered by non-level lines on the side of the rafter. Their angles can be obtained by adding to the rafter pitch the angle whose tangent is the cosine of the deck angle multiplied by the tangent of the plate slope.

To cut a notch in an inverted rafter, after making the plumb cut with a Skilsaw set to the right bevel and only as deep as the shallowest part, we screwed guide boards to the sides of the rafters, parallel to the seat lines and a fixed distance above them, to carry a router across the timber to mill the seat cut. An extended base for the router and a top-bearing bit made the work practical and fairly swift.

TO cut accurate rectangular beam housings in the log columns, we used a two-piece box jig that slipped over the end of the timber and aligned with horizontal and vertical center lines. On the top of the box jig was a 7½-in.-square hole (lined with aluminum against wear) that served as a router template. With the jig in place we roughed out the housing area with a drill and 2-in. bit. Then using a router with extended base and the top-bearing bit, we cut the perimeter and smoothed the bottom of the housing. Since the edges of the housing were aligned with the center line of the log, we could use them as references to lay out the mortises, which we then cut by the good old drill and chisel method. We used a similar jig with a saw guide screwed to the top for making shoulder cuts on the ends of the logs. We now use a second generation of this technology (see overleaf), including a larger box jig combining template and straight edge functions that slides along the tracks of our horizontal bandsaw mill. The track is set up on a concrete slab and we keep it dead level via screw adjusters. To use the jig, we create a bed, a heavy plank set parallel with the tracks and with moveable blocks at either end. Centerlines of the blocks align with centerline of the bed. Then we screw 1⅛-in. plywood squares onto the ends of the log, again aligned with horizontal and vertical center lines. The blocks are adjusted to the length of the log, and the log hangs perfectly level on the edges of the plywood squares. The box jig slides into position and, for cutoff operations, gravity is enough to hold it in place. For routing operations, we clamp the jig to the rails. We use the bandsaw to cut the cheeks of the tenons. At some point we may be able to combine the box jig functions with the up and down mechanism of the saw, and then we'll really have something hot.

In the end, this project was easier than we antici-

Framing for the central spine takes shape in view of a watery paradise and will support the arched portion seen in the end view (facing page) of the finished house.

pated, even if the raising required exceptional care in the placement of locating pins for the scores of columns. The box jig was an unquestionable success and the accuracy of the mathematical calculations for producing the rafter cuts was a real boon, considering that the alternative would have been to attempt scribing either in the shop or at the site with lots of lifting and fitting, sweating and swearing. —Jeff Arvin

Jeff Arvin is a principal at The Cascade Joinery (Everson, Washington). Cascade's Joe Schmidt developed the jigs shown on this page and Ted Cook worked out the mathematical solutions to the rafter-plate problem. An article on the architectural design of the Thorburn House will appear in December's Fine Homebuilding *magazine.*

The box jig slides on the tracks and presents the worker with a variety of opportunities. Above, Cascade's Sam Harper uses the fence to make a shoulder cut. Below, the band saw raised awaiting setting for a tenon cheek cut and the table showing the square hole for routing housings.

Above, to clear irregularities and ready it for cutting a series of orthogonal joints, the log is suspended on carefully squared plywood plates screwed to the ends and aligned with the centerlines on the log. The plates rest on blocks firmly clamped to a bed plank sitting on the track. Below, Sam makes a level cut for a tenon cheek.

Below, the top bearing of the router bit follows the plywood guide to produce accurate housings for rectangular beams, needing only square corners chiseled. Although the housings now serve as reference surfaces for mortise layouts, which are then bored and chopped, an adaptation of the table to a portable chain mortiser cannot be far behind.

18th-C. Ulster Co. Lap Dovetail Dutch Barns

As I drove up a back road in 1981 in the southern end of Ulster County, New York, the familiar silhouette of a Dutch barn came into view, with its high peak, steep roof pitch, low side walls, clapboard siding and, most important, the large threshing floor doors centered in the gable end wall.

When I entered the barn a structural detail appeared that I had not seen in any of the several dozen Dutch barns I had observed in the previous half-dozen years. This barn had the typical H-frames supporting the roof, each comprising a horizontal anchorbeam joined and braced to two columns, with additional braces up to the purlins to help stabilize the whole unit. (See figure below right.) But these braces were uniquely shaped with ancient-looking lap dovetail tenons.

Dutch barns in America were built for about two centuries, from *ca.* 1630 to the second quarter of the 19th century. In plan they are three-aisle, much like a cathedral, with the central aisle or "nave" for unloading hay wagons and threshing, with crop storage above the anchorbeams, and the flanking side aisles for stabling farm animals.

Photos Greg Huber

Nieuwkirk barn dated 1766, Hurley, N.Y., original including roof but with one side aisle (left, above) removed. Typical early steep roof. Nine-ft. side wall.

Throughout the Dutch barn realm in New York and New Jersey, the most common joinery is regular mortise-and-tenon, blind or through, with the tenon surrounded by the wood of the beam it's joined to, and secured by one or more pins crossing the joint. (Regular mortise-and-tenon joinery was utilized in almost all vernacular ethnic timber framed buildings in America from the 17th century until the end of the 19th century or a little beyond. This joinery is not at all exclusive to Dutch framing.) Rarely, wedged dovetail tenons are to be seen; these are additionally secured from withdrawal by the flare in one edge of the tenon combined with a wedge to take up the necessary assembly space. The lap dovetail tenon, however, lies flush with the surface of the receiving timber. While its shape prevents withdrawal axially, it is kept in place only by friction at its edges and around the cross-pin.

Lap joints have an early origin in Europe and the dovetail form can be found in surviving 12th-century church roof framing in France and 11th-century tower framing in England. (See Robert Mark, ed., *Architectural Technology up to the Scientific Revolution,* and Cecil A. Hewett, *English Historic Carpentry.*)

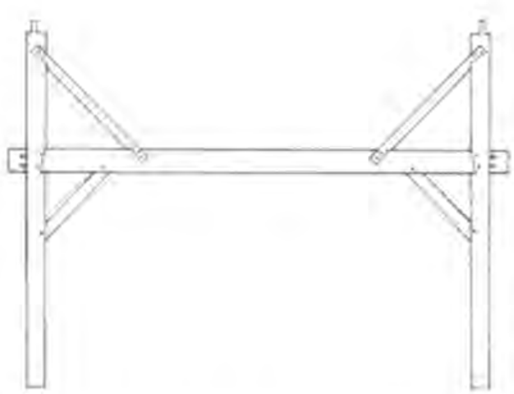
The advantages of lap joinery over the regular mortise and tenon may be the relative speed and ease of execution of the housing compared with a centered mortise. Housings require no deep auger work and can be laid out from the pattern of the tenon and cut directly on an assembly, whereas mortises require adjoining pieces to be disassembled and turned up for boring and chopping. Lapped braces can be added even after erection. This property might be conspicuously helpful when the joints are used for collar beams between rafters, since the technique allows piece-by-piece erection rather than lifting an entire assembly of two rafters and a collar. It is true that collars, commonplace in Dutch houses, were not often a part of the purlin-plate roof framing of the barns.

Finally, lap dovetail braces do resist tensile forces as well as compressive, should the former ever develop at braced connections. This is probably the chief function of the dovetail form of the joint.

Despite the advantages of lap joints, they are decidedly weaker than regular mortise-and-tenon connections. Roughly speaking, a timber is only as strong in bending as its weakest point, and the diminished area at the housing weakens the timber significantly compared with a centered mortise. Fortunately most Dutch barn timbers are sufficiently oversized to sustain the effect.

Where do we see lap joinery in Dutch barns? Ulster County, New York, and Bergen County, New Jersey (not discussed here) have nearly all the examples so far identified. Social historians may some day establish a link between the two areas. Perhaps significantly, both Ulster County and Bergen County also have the highest frequency of early stone-built houses, along with Rockland County, New York, where Dutch influence was felt.

The entire range of Dutch barns is confined to 18 counties in New York State in the Hudson, Mohawk and Schoharie River Valleys and Nassau County on Long Island, and to 10 counties in northeast and central New Jersey and the Upper Delaware River Valley. Outside the two major areas cited (Ulster and Bergen Counties) there are fewer than a dozen examples of lap joinery known—two in Nassau County, one each in Orange, Dutchess, Columbia and Greene Counties, New York, and two examples in Somerset County and one in Sussex County, New Jersey. Few of the Ulster County barns are original. Only three have their original roofs, eight have had significant roof alterations and seven have had timbers (anchorbeams and some H-frame columns) recycled into later barns. Ulster County boasts the greatest number of Dutch barns—86 identified to date—in any of the 28 counties where they occur. Eighteen of those barns have direct evidence of lap joinery.



Imaginary H-frame, showing anchorbeam with diminished shoulders, lower braces mortised and upper braces lap dovetailed.

When were these barns erected? Were they built over a long period of time, perhaps into the 19th century when the Dutch barn building tradition appears to have ended in

America? Did the barns with lap joints have other distinctive traits that would suggest attribution to a group of similarly influenced builders?

Ulster County was settled in the 1650s at Wiltwyck, later called Kingston. There is today no evidence to show what first-, second- and third-generation barns looked like. However, a few dates do occur, carved into timbers in three barns (fortuitously enough, all three have lap joinery). These dates are 1750 and 1766 (twice). In addition, there are three other barns associated with houses having datestones, two marked 1742 and the third 1765, and there is a fourth on a homestead with a credible tradition that dates it from about 1740.

Eight stone houses are associated with the 11 remaining barns. Six of these are firmly believed to date no later than about 1770. One is 1820 but is associated with a barn with a recycled anchorbeam from an earlier barn. The last may date no later than about 1775. The remaining three barns are found with post-1850 frame houses which obviously replaced earlier houses.

Two barns outside Ulster County have purlin braces with lap joints and early dates associated with them. At the first, in Greene County, New York, a 1743 datestone was found beneath the barn floor during a 1988 renovation, and the house at an Orange County barn site has a date of 1722, though the barn may date from somewhat later.

Although 18 barns do not provide an exhaustive data base, the consistent appearance of dates or associated dates between 1740 and 1770 seems to answer our first question. The use of lap dovetail joinery in Ulster County Dutch barns appears and disappears over what seems to be a limited period. Two barns known to be from before 1740 display no dovetail lap joinery: the Van Bergen barn, ca. 1680, formerly in Greene County, and the early-1700s Teller barn near Schenectady. (Unfortunately there are no other pre-1740 barns in the record.) Meanwhile, there are some 30 other Dutch barns without lap joints found with at least three associated houses with original *in situ* datestones marked, respectively, 1797, 1802 and 1808, suggesting the practice disappeared by the end of the 18th century.

What other distinguishing characteristics do the lap dovetail barns have in common? One is the style of marriage marks used to indicate assemblies in a frame. All of these barns were framed using Scribe Rule layout, each piece fitted to the next without interchangeability of parts (save perhaps braces), the method probably brought over from Europe in the 1600s and used until about 1825. Thus a framer would have to "keep score" among all the structural members to avoid confusion and error upon assembling. During the fitting process, with a chisel, gouge or knife the framer cut marks (marriage marks) into corresponding bent parts at the joints to assure correct reassembly later. For instance the anchorbeam and columns for an inner bent (say number III) would be marked on appropriate faces with three side-by-side 1-in. chisel cuts.

The ruinous Hoornbeck barn, Accord, N.Y., dated 1766, showing cup marks and the characteristic short verdiepingh. *Lap-scarfed purlin plate in background. See also cover photo.*

Of the 18 barns in this study, 13 show marriage marks. (The remainder have been too extensively altered to preserve such marks.) Ten have so-called cup marks. These were gouge-cut in two strokes from opposite directions to form a small round or elliptical cup. The cups at each joint would range in number from one to as many as 10 in the case of one of the columns in a 1766 barn. Interestingly enough, cup marks appear at only one end of H-frames, with chiseled marriage marks at the other end, apparently for maximum clarity. The three barns without cup marks include a 1750 barn that has no marriage marks in the H-frames at all and two barns with regular chisel marks. Only three other barns in the entire Dutch barn realm are known to have these marks. They include the 1743 Greene County barn, another barn in Greene County and a third in Ulster County where the house at the homestead was built in 1791. The last two barns don't have evidence of lap joinery.

Scribe Rule barns usually show 2-ft. marks on the faces of the anchorbeam, often flagged by a cut circle or half-circle at the line. These references allowed the builder to account for variations in the thickness of the columns when setting up a uniform outside width for the H-frames. Post-Revolutionary Ulster County barns built from about 1780 to 1820 often have these lines. But barns in other areas that seem to be sure-bet pre-Revolutionary *don't* have them. Barns in this category are the Wemple, Skinkle, Verplanck-Van Wyck, Bull, Schaeffer-Ingold and a dated 1759 barn in Dutchess County. None of our Ulster County barns with lap joints has the 2-ft. scribe marks, perhaps lending further proof of their pre-Revolutionary status.

With the establishment around 1820 of the Square Rule method of laying out, most repeating frame elements become interchangeable among bents, assembly during layout ceases and thus marriage marks become unnecessary. Two-ft. marks are not seen since timber variations are accounted for by standard offsets cut into timbers at the joints.

A second feature of our lap dovetail barns (and indeed most early Dutch barns) is a short *verdiepingh*. This is a Dutch term for the extension of the column above the anchorbeam, or the distance between the soffit (undersurface) of the purlin plate and the top of the anchorbeam. Without exception all barns with lap joinery have short *verdiepinghs*. Eight of the barns show a range from 52 in. to 66 in. Both 1766 barns have identical 54 in. lengths. Later barns in both New York and New Jersey have *verdiepinghs* that measure from about 7 ft. to as much as 18 ft. Many later barns in Ulster have *verdiepinghs* of 6 to 10 ft. The average in Albany, Schoharie and Montgomery counties is 8 to 10 ft. The last group comprises barns believed to represent post-Revolutionary building after the Brandt and Johnson war raids.

The anchorbeam-to-column joint provides a third linking trait among the lapped dovetail barns. Of the barns with observable anchorbeam-to-column joints, nine show diminished shoulders tapering to zero at the top of the beam and two have fully housed square shoulders. In Dutch settlements many early buildings show the diminished-shoulder style, though some had square shoulders, which became the standard with the arrival of the Square Rule period. The pegs at the lap joints vary little in diameter, ranging from ⅞ in. to 1⅛ in., with a single peg for purlin brace tenons and almost invariably two pegs for H-frame brace tenons. Such peg diameters are consistent with the early period. Barns from the late 18th century and later frequently have pegs of 1⅜-in. to 1½-in. diameter.

A fourth trait to examine is the position of the purlin brace connection to the column. In Dutch barns these braces can fall above or below the anchorbeam and vary widely in location. In the 10 barns with lap-dovetailed purlin braces, eight showed consistent attachment below the anchorbeam, from 20½ in. to as much as 39½ in. (One special case occurs in a rare, originally 2-bay barn. The H-frame column is unusually small, perhaps explaining why one brace is attached 4 in. above the anchorbeam and one brace 13 in. below. The array of purlin braces and H-frame braces with lapped joints and the large outside-wedged and extended anchorbeam tenons create a most dramatic and striking effect, as shown in the photo at right.) Low purlin brace attachments imply a short *verdiepingh*, which further implies low side walls and probably steep roofs. Early Dutch barns are generally thought to have had high peaks and low walls. Later barns often have braces somewhat above or much above the anchorbeam and frequently have moderate roof slopes.

The width of the central aisle or nave, measured outside face to outside face of the columns in an H-frame, is consistent in these barns. Of the 12 barns with measurable naves, nine range from 28 to 30 ft. This is considered very wide by Dutch barn standards. Two others are about 26 ft. wide and the small two-bay barn has a 20-ft.-wide nave. Many Dutch barns have naves of from 23 to 26 ft. wide but wider naves don't necessarily imply an early date of construction.

The lap dovetail joinery in Ulster County takes two basic forms determined by the surfaces of the dovetail itself and their relative positions. Twenty-nine dovetail joints were studied, of which 23 have type A configurations. Type A dovetails (left) have three surfaces, one continuous with the edge of the brace, and this unbroken edge usually faces down. (Remember that in these barns a lapped brace meets an H-frame column at one end and a purlin plate or an anchorbeam at the other.) Surface two, really the end cut of the brace, meets the uncut edge at various angles ranging from 45° to 90° with a preponderance at or very close to 90°. Surface three forms the dovetail and takes various angles with the end cut, depending very much of course on the angle of the end cut with the original uncut edge. Evidently certain combinations would be impractical. Type B dovetails (above right) have a fourth surface and in many cases the tenon stretches across the entire receiving timber so the far end is flush with the edge of the beam. Purlin

Secondary clasped purlin, ridge beam and pole rafter roof, barn in Accord, N.Y. Collars dovetailed to rafters, clasped purlins supporting alternating pole rafters, ridge detail mysterious.

Anchorbeam-column joint, Richer barn, ca. 1750, Saugerties, N.Y.

brace tenon lengths varied from 4 in. to 10½ in, with most about 8 in. H-frame brace tenons ranged from 6¼ to 18 in. long. In section, the short, stout H-frame braces varied from 7x6 to 10x7, compared with the longer, slenderer purlin braces of 4x3 or 5x4.

Curiously enough, all but three of the barns with lap dovetail joinery have greatly modified roofs. This is significant because the 30-odd true-form barns from the post-Revolutionary era have their original roofs in all cases but one, and that one has no lap joints, no cup marks and a fairly long *verdiepingh*.

The three lap dovetail barns with original roofs show a striking departure from the ordinary Dutch barn arrangement of hewn common rafters in pairs (no ridge-beam) extending unbroken from the peak over the purlin plates and out to the wall plate. In these three barns the ordinary hewn rafters instead alternate with quite slender poles and the latter are supported by secondary purlins clasped by the hewn rafters and collar beams, as shown in the photo below left. In addition, a ridge beam can be seen (though its connection with the hewn rafters is difficult to understand) and again supports the alternating pole rafters. It is tempting to surmise that all the lap dovetail barns may have originally had a form of this somewhat mysterious roof arrangement.

While significant economic changes were occurring in the period 1830 to 1850, new barn styles were appearing. Perhaps mid-18th-century Dutch barns with their steep roofs (in The Netherlands originally designed for a thatch covering) had proved inappropriate in the New World and so underwent radical alterations. Barns of the immediate post-war era were apparently well-enough adapted.

A substantial body of evidence suggests that Ulster County, New York, Dutch barns with lap dovetail joinery were all built in the pre-Revolutionary War period. All of the characteristics that seem to define them are broadly consistent with each other. They include the presence of cup marks, short *verdiepinghs*, peg sizes and diminished shoulders at the anchorbeam-to-column joint, dates and associated dates (on houses), the distances purlin braces fall below anchorbeam soffits, the general widths of naves and, conceivably, the secondary-purlin, ridge-beam roof style.

The evidence also points to the Revolutionary War period as the end point for lap dovetail construction. The effects of war may have reduced supplies of material and even labor; possibly (or even probably) it affected prospective owners and their readiness to have new barns built. After the war a period of adjustment and cultural change would have been normal and the new features appearing in Dutch barns were no doubt part of this picture. Fortunately, several pre-war examples still exist that reveal the thinking of earlier builders. —Greg Huber

The author is co-founder of the Barn Enthusiasts Group of the Mid-Hudson Valley and publisher of the Dutch Barn Research Journal.

The Voyages of Brungraber: Winter

SUNDAY 28 JAN 96. Whitecaps on Logan runways. Missed my JFK connection to Munich. Dad flew alongside my empty seat. Took a Singapore Airlines 747 to Frankfurt. Singapore Airlines is a trip in itself. The flight attendants wear sarongs. They pass out hot towels which are really towels and which really do refresh the user. They gave me a formal menu of the four meals to be served between NYC and Singapore. They also gave me a package containing toothpaste and brush, and a pair of what I believe are socks. I met Dale Kretzing in the Frankfort airport lounge, where Lufthansa serves free coffee, fruit, pastry and newspapers.Thence Lufthansa to Munich. Drove with Dad and Charles Landau to Ottobeuren and the Hotel Marni next to the immense monastery. Ate dinner at the town Ratskeller. I tried to watch the Super Bowl XXX. It started at midnight, local time. It came in very poorly and in German. I dozed regularly.

Photos Ben Brungraber

A completed Hundegger machine being readied for shipment.

29 JAN. Met Verner Richter, Tony Zaya, Bill Recarde and Dale at breakfast. Hans Hundegger showed up to help drive us around. His father spent ten years in a Siberian POW camp after WWII, escaped and walked home. His brother runs a sawmill on the a complex with the family farm and Hans's company. Sawmill uses a vertical, reciprocating gangsaw, with the operator sitting on the carriage, aligned with the log. Looks as though the operator is being fired through a time machine.

Hans started his business 17 years ago by building machine Number 1 for his brother. That machine led to orders for another, and so on. They still keep a machine over at his sawmill. They use it as the trial rig. The Hundegger plant employs 120 people. Their base pay is very comparable with our own (about 20 DM/hr, or $13.50/hr). They pay bonuses twice a year, based on performance review. These bonuses average several thousand DM. They all get a month's pay extra at Christmas. Workers get 4-6 weeks of paid holidays each year. Hans's brother-in-law, another Hans, manages the plant. The crew is organized into five teams, each of which takes machines from raw steel tubing to the trial run. Since they produce two a week (two went out on trucks this very day), the machines each take about two and a half weeks to produce. A subcontractor does all the painting, on a second shift basis. The machine is beautifully finished. High quality welding, neatly bundled wires, etc. There are photoelectric cells all over it which shut the machine off when people get too close (I did it often). They send out a newsletter to their machine owners. They do upgrades on older machines. They help to resell used machines. While we watched, the machine cut a post per Charles's specifications. From the time the rough 8x8x12 hit the machine, until it came out planed on four sides, took 12 minutes. No layout. The housings had to be squared up later. The tenons needed a quick edge-planing. We thought the post would have taken seven to eight man-hours in our shops and required one man-hour (at most) all told when using the Hundegger machine. We lunched at the same Ratskeller.

P.M. We went back to the Hundegger plant to watch a software demonstration. The CADWORK team was down from Hannover (500 km north). Three guys on the team: a lead programmer, a civil engineer and a carpenter who specializes in stairs. The engineer took a section from Tedd's book and made a 3-D model in about an hour, in spite of lots of kibbitzing and queries. This model goes to the Hundegger software, where the joint cutting is refined and translated into machine instructions. The software could revise a frame with simple keyed-in commands. He told it a new roof pitch, floor-floor height, width, eave height and bay spacing. Almost instantaneous regeneration of the model. Automatically generates lots of timber lists. This is a fairly expensive piece of software: DM23,000 to DM33,000 ($15,500-$22,000). There will be a trial version of it available on CD soon. *Must send for it.* The software needs a Pentium processor, 133mz and a ton of memory.

When the 3-D model was complete, the Americans sat down and ballparked the frame at $60,000-$70,000. Verner (who ran a timber framing company in Germany for ten years) thought the price in Germany would be about $17,500. The material would have been $10,800. The labor $6,700. He further claimed that a timber frame in Germany costs today about DM600 per cubic meter, planed and delivered (not erected). This is about .95/bf. It was Verner's considered opinion that one would go broke in Germany, offering nothing but all housed joinery.

30 JAN. Breakfast. Hans showed up and out we lit for Austria. Our agenda is to visit two shops which use the machine. Stopped first at Lerchenmiller. He had erected Hans's tennis club frame after another firm cut the timbers on their Hundegger. Now he has his own machine. Herr Lerchenmiller showed us a timber frame quote he had just prepared. The job was an L-shaped roof system, with eave plates, intermediate purlins on posts, a hip and a valley and a ton of jacks. The price for the 25,440 bf frame was $26,114. This included $16,946 for the material (.67/bf), $1,657 for the truck to the site (.07/bf), $1,592 for the dip into an anti-bug/fungus impregnant, $4,514 (.27/bf) for the shop labor on the 16,960 bf of compound joints and $1,407 (.17/bf) for the more straightforward 8,480 bf. This translates into a fabricated and delivered cost (not erected) of $1.03/bf. I am no longer surprised that our past quotes to Germans have been summarily dismissed as being too high.

This shop was fairly new, large and very well built. Tile roofs, paved lots and yards, exotic concrete silo for the super-sophisticated chip-burning heating system. Maybe a dozen employees (tops), including two guys on computer terminals. He had a very neat cross-section of his house type, which reminded me of how much I admired the German built-up roof systems. Lots of organic insulation (cotton, wool, hay, sawdust), strapping and tiles. The impressive tool room was full of abandoned-looking Mafell machines. They had shelves full of wondrous hardware: lags, split rings, spike grids with one and two sides, and in all sizes. There was a nice woodworking shop attached. In the timber shop he used an overhead crane and a standard forktruck. The big shop was about 40x80 ft., with high, glulam trusses. There were fun timber racks sticking out the gable ends, with a 10-ft. roof overhang to keep them dry. The racks were just 6x6s passed through holes in the gable end posts.

P.M. Met Karl Schafferer for lunch in some Austrian village. He had been raised there and had always worked there as a timber framer-company owner. Karl looks barely 40, and travels widely (he shared Charles's plane home, headed for heli-skiing in the Bugaboos). Curly brown hair, bright blue eyes, very bright and unassuming. I sat next to him at lunch and liked him a lot. He recently built a new timber framing shop and, rather than move his older Hundegger machine 500 ft., simply bought a new one and sold his old one for about $300,000. New shop is next door to his sawyer. A *fabulous* facility. Huge glulam beams in swooping shapes. Both the woodworking shop and the timber shop were about 40x100. An exciting entry to the integral office, with spiral stairs and a clear glass floor above the vestry. The design office is immense, high-ceilinged, block-floored and occupied by one designer who spends a lot of time on the shop floor. Another 10-man operation, tops. Has a Krusi tenon cutter in a corner, still seeing some use. No overhead crane, just a sideloading forktruck. The new building probably cost about $800,000. They were building an exotic lodge in the corner of the shop when we were there. Very complex structure. The contract was for about $100,000 but the thing looked like $250,000 to me. One man was running the machine, using a stick to help feed it, a drawknife to bark any wane that survived the planer and a beautiful block plane to touch up the cross-cut ends. He expected to cut an entire roof system in the day we were there. This was another L-shaped roof, with hip, one valley, 23 jacks, 40 commons, 5 posts, 8 plates and 4 purlins. A very rough estimate of the man-hours for us to cut the same roof is 240.

Logging operations are very impressive in Germany. They mostly cut the local spruce. They go through every acre at least once every five years. They usually bark the logs while they are still in the woods. They extract only a few trees and very carefully. Hans said that a logger who barks more than one tree with a skidder will not be invited back to the same stand. The logs are pretty high quality. They are stashed in neat piles everywhere. Saw them in parking lots propped out over cliffs along the highway. A little stack here, another over there.

The Hundegger system produces nearly finished pieces from blank timbers. Like the shoemaker's elves, it can also work while the master is away.

That evening we climbed to the base of the outrageous Neuschwanstein castle. This thing was built in 1850-1880 by Mad Ludwig II. The quintessential mystical castle on a mountaintop. Neuschwanstein castle was so foolhardy an investment that it threatened to bankrupt both the family and the entire area of Bavaria. Ironically, considering the work it took to build and the jobs it still supports, as well as the region's tourist spending, the thing might actually now look like a clever long-term investment. The indications are fairly clear, however, that his unappreciative family had him (and his psychiatrist) drowned. Had dinner at Hans's tennis club (he and four others started it and built it ; he also owns a piece of our hotel). He, Dale and Charles played Canadian doubles that evening while the rest of us drank beer, watched them sweat and told lies. The tennis *halle* had a huge glulam ridge and very deep common rafters, with a convoluted skylight package.

31 JAN. Went to see the biggest of the three companies, Baufritz. Met Herr Baufritz. No English, but a very bright classy, friendly and sophisticated man. Baufritz is 100 years old this year, 160 employees, big design office, maybe 20 designers/architects. Firm noted for green architecture and patented insulation system. Has a plant nursery on the premises. As well as a model home and a wind generator. They build two complete shells of homes in a week. They do prefabricated roofs and exterior walls. The Hundegger machine is in a soundproof booth in the center of a huge shop served by overhead cranes. It spits out timber pieces for the walls and roofs. They load it with simple pieces before they leave at night and come in to find fabricated timbers in the morning. They cut $2/bf laminated timber for the concealed pieces, rather than deal with the variability of solid-sawn timbers. The glulams were two parts, vertically—sort of like two 3x10s glued together into a 6x10. I stole two prefabbed plugs they use to remove visual flaws from timbers. The things look like shallow, tapered bungs, cut from branch wood with the endgrain showing. When installed they look for all the world like a knot.

I was asked not to take photos inside the plant. The walls use heavy T&G siding (2½-in. thick) and studs dovetailed into the inner faces. The walls are filled with insulation made of wood shavings and treated with some binder made of a dairy byproduct. They put in windows and doors and paint the whole thing. The outer finish can be stucco or wood. Herr Baufritz appears to be a genius. The plant is amazing. Huge. Lots of lifts and jigs to make work more efficient. Huge R&D budget. The roofs are prefabricated in sections which splice over a common rafter shipped separately. All the wood is prefinished. The machine started to look like a queen bee, laying eggs in the center of the hive, with an army of worker bees tending to their care. This place blew us all away. You could meet Herr Fritz on holiday, ask him what he does, and listen to him tell you that he builds houses. That would be a remarkable understatement.

While we were very impressed with the production capabilities of this operation, none of us seemed tremendously taken with the shell package. That heavy siding still looks a bit loggy for my taste, I guess. The European lust for stucco and wall surfaces which look like coarse shredded wheat is also too sophisticated for my taste.

P.M. Hans Hundegger's wife's uncle is on the board of the Roman Catholic Basilica in Ottobeuren. That was good enough to get us a full-blown tour, with a monk in attendance. We climbed past the clock (rebuilt in 1948—they got to clock rebuilding that soon after the war!) and up to the roof structure. This thing was built in just a few decades around 1750. The interior is flagrantly Baroque. To characterize this merely as ornate would be misleading. There are fully dressed skeletons of notables, housed in glass-fronted cases in most corners and niches of the place. The climb was strenuous. Jean Michel Klein was the master builder of this memorable building. A plaque in the attic proclaims that he was not a special man, but the evidence to the contrary is all around and compelling. They got the timbers and bricks up to the top (the dome is 110 ft. off the floor) by building a mile-long earthen ramp and driving teams of oxen uphill. The ramp became the scenic knoll nearby. The immense hewn timbers involved in framing this 60x60 clear area are breathtaking. Who were these guys who built this thing? Made me proud of our species—a feeling that is becoming all too rare.

Said our farewells to the Hundegger crew and Charles, Dad and I bolted for Zurich. Hans Stutz had booked us into a hotel near to the train station. Hans (yes, another one) stumbled into Charles's shop during his protracted, world-wide tour as a journeyman timber framer. Now he is in his second year of architecture school. Forty years old. Native Zuricher. Never married. Never licensed to drive. A sweet and attentive man.

1 FEB. Hans met us at hotel. We took off for the Starwood facility in Switzerland. Ernst Schilliger met us there. The name Shilliger has hung over the door for 120 years. He is about 35, unmarried. Ernst spent a year in British Columbia working with a sawmill there as part of his technical education. His English was exquisite. He used a cane, but breathtakingly fast. (He had been hit by a truck five months earlier.) This sawmill is built on the old family farm. Who knows how long it has been in the family? His great-grandfather was the first to go to sawing full time. His father invented Starwood glulam, the two-part material I saw at Baufritz. They sold the Starwood licensing rights to Shiller, a machine maker. Ernst now makes the Starwood on two of their glulam lines. Ernst Sr. has moved into helicopters. About 15 years ago, they needed logs badly and could only find them up high, above where the skidder roads were feasible. Now they have a fleet of helicopters and operations as far away as Katmandu. They were painting up a new, one-man, heavy lifter when we were there. The family also runs a restaurant and hotel right on the premises. Ernst's cousin runs the mill. He runs the operation. This is a spectacular business. I bet it would take at least $20,000,000 to buy it. Land is very expensive, so this is a four-story sawmill. Labor is also expensive, so this operation is incredibly mechanized and automated. The sawyer sits with six video screens overhead and two computer screens to either side, while he looks out over a huge sawmill. The first slabs are not cut off the log, but chipped off simultaneously. The chips are easier to handle and are more valuable—why not chip them right away?

Timbers fly through this place. I am not sure that I could keep up with a log as it is turned into an 8x8. They have absolutely no standardized sizes and carry virtually no inventory. Ernst said they have to provide timbers for people repairing 400-year-old buildings and building ultramodern new structures. Every timber and plank is custom cut for a client! I even saw a single log which had been ripped into inch boards, but not edged, then reflitched and banded for a customer. A multimillion dollar yearly business and they still custom saw individual logs.

Baroque splendor at Ottobeuren. Unseen are the attic timbers to support a 60-ft. clearspan.

We left and started to seriously wander. Headed along Lake Zurich instead. Went to Vitzplume. There a ferry docks regularly from Zurich. Right next to a train station. Day is overcast. Lake is lovely, deep, and cold. Bought what seemed to be an expensive train ticket (although all the Europeans cleverly design their currency to look like play money). What a bargain it turned out to be. We got on this cog train with two cars and no apparent engine. Closed, elegant cars, with lots of high quality woodwork. Started climbing immediately and steeply. Went by farms and homes. Stopped at stations. Broke magically into the clear sky of peaks, above the valley full of clouds. We are in the Alps. Got to a small town, with hotels and another cog rail line coming up from the far side. This town is reached only by train. Felt like it had about 3,000 inhabitants. No cars.

We walked most of the way back down. Sat at the first station from the bottom, Rigi-Klostorli, for a beautiful hour above the clouds and awaited our train. This may be the loveliest place I have ever been. I had the rest of our party detail for me the reasons I ought to leave with them, rather than simply settle and send for the family. I am still not sure that I made the right move there.

Wandered back through various mountain passes. Spotted lines of old tank traps, installed to protect the reservoir which supplies Zurich's water and power. Stopped at another magnificent monastery, in Einsiedeln, this one started to honor Meinrad the Hermit, a monk who was slain by two brigands nearby on January 21, 861 (no typo—861). They are still working on this huge place. Another nearly gaudy church both in scale and in ornament. This one houses the famous Black Madonna, a statue blackened miraculously through proximity to those ever-present candles. People come from all over the world to see her.

Returned to Zurich for dinner. Had trouble getting a table, without reservations. We did see a bunch of compelling eateries. We also strolled all over town, high and low, along the river, through the train stations, along the fanciest shops, by the oldest churches. This is one of the fine cities of the world, by my measures. Public transit is a marvel. You can wake up on the outskirts of Zurich, board a train into town, take a subway to the ferry station, grab a ferry down the lake, jump out and hop a cog railway to the top of a mountain, switch cog rail lines down to another town, roll back on another line to Zurich, then catch the train home. Dropped Hans off at his apartment and bolted for ski country. Charles and I have promised for years to ski with each other (actually, we threaten to ski each other into the ground). The European season has run much like the New England one. Lots of snow at Christmas. Big melt in January. We saw closed lifts. We made no reservations but pulled into Landerback with, literally, moments to spare in order to catch the ladies before they locked up the only motel in town. They had a 1920s phone and a funky place. We were thrilled to get the room. In the morning, we were going to decide between Davos and St. Moritz.

2 FEB. Consulted with proprietress at breakfast. Decided on Davos, but half-heartedly. Dad says: Why not look for one of Robert Maillart's best known concrete bridges? Why not? Look at a map and there it is, the most spectacular and only 15 miles from us, on the way to Davos. This looks easy, but we fail to reckon with Swiss geography. Dad had actually seen the bridge years earlier and is convinced that even the Swiss could not have moved it far. This previous sighting proved to be of arguable help in our search this day. His directions had the bridge spanning a canyon outside the village of Staarlingen. We got off the highway, settled for male-satisfactory directions in various garbled languages, and set off (most definitely) up a narrow paved road.

This road deserves a page of description. It was one lane. It had no guard rails at all. It was so windy that more than half of it was a blind turn. The rest was flagrant hairpins. There were hopelessly inadequate pullouts for passing, spaced about 800 yards (six turns) apart. We went by farms and homes. We climbed through forests. Charles and I had our seatbelts unclipped, ready to leave the old man to ride it out (he was driving his rental car). We guessed that 35% of American drivers could not have driven this road. Some of us believed that 25% of all Americans would not be able to ride in a car driven up here by others. I do not think that Jimmy Whitcomb could get our new crewcab truck up this hill.

After 35 minutes we were fairly sure we were not on the bridge road. We pressed on anyway, mainly because we had to know where this thing went. We arrived at a town. There were *two* small hotels in this town; at the top of this road—the only way in. Dad went into one, to seek revised guidance, and ran into a guest from Los Angeles. All the way back down into the valley and up another road—this one just as berserk as the first. Had to back down before natives in cars. Got to the bridge. It is awe-inspiring, if not flat scary. This is, without question, the most striking span I have ever seen. This bridge was built in 1929 by a college professor. It is narrow—almost one lane wide. A little diesel flat bed passed us on the span and all but shoved us over. We had to be 250 ft. above this incredibly rocky gorge. At the far end, a plaque showed the timber falsework they built to pour this bridge on. Hair-raising. I would have left it there, to rot out and drop into gorge, rather than risk life and limb for a few thousand board feet of recycled boards. I bet that never even occurred to the Swiss builders. Back down. This bridge visit was well worth the time and effort, but now we are clearly too late to ski.

Into Davos. Lots of security and roadblocks for some dramatic coming we never did establish. I spotted the *Eissporthalle* and asked to stop for a peek (and a pee, as I remember). Strolled the busy main street and ate sweets. Could not get into the rink, but looked into windows. This roof is nothing but hips and valleys, radiating up to meet at a peak over center ice. My book has the spans at 275 ft. The snow on the roof bore traces of various recent climbs and schusses. This building is worth traveling to see, and I almost drove by it in oblivion.

WE drive on these wild mountain highways. Clipped to the sides of cliffs. Avalanche roofs and cantilevered pullouts. There are wee villages on hillsides way above us, on both sides. These places will have five houses and a lovely stone chapel or church. This church business has been really powerful for many centuries over here. The big places are designed to drop you to your knees in awe. (A space with more than 100 ft. of headroom, built when people were even shorter than we are?) The little places are intended to reach you, no matter where you are.

I spot a covered bridge down a side street in one of the villages we are winging through. Get out and walk to it. Nice old truss, with some retrofitted iron strengthening gussets. Truss shows me nothing I cannot find in Vermont, but the fire extinguishing system is otherworldly. At one portal, two cases. The lower, bigger one is wooden, locked with a skeleton key, and painted with the symbol of a medieval axe. Clearly to help you chop at a fire. How do you get it open? The upper case is small and glass-doored. It is locked with a small key, but inside hangs the big key for the axe case. How long would this set up last in the States? This thing has been there for hundreds of years.

On the way back to the car, we notice the buildings lining the street. Dating to the 1400s, these half-home, half-barn structures are still occupied and covered with neat details. Tiny windows, thick walls (400 years of paint?) tiny triangular dormers with two sides all window and the shutters against the main wall, with gargoyle downspout at the bottom of the hip roof. For example.

I am convinced that one could pick a Swiss village at random. Choose a block of that village, equally randomly. Walk down that block and shoot a roll of 24 slides of the architectural detailing, none of which would bore an American audience of building nuts.

The roads include roofs of several kinds. There are lots of tunnels, long and short. There are open-sided shed roofs intended only to keep avalanches and rock slides off the pavement, and without obscuring the valley view. The most remarkable, though, was a tube that looked like a huge mole construction. No particular hills in sight; we just dove into a long and curvaceous culvert. I asked why. There was an old village close by. When the road got too popular and noisy, they spent millions piling dirt over it. Makes our pressure-treated sound barriers look kind of cheesy.

We started to get serious about reaching Garmisch in time to take the cable tram to the top of Germany. Charles had helped install the first snow-making equipment in Europe here in 1963 and spoke highly of the ride. Got to bottom of mountain barely in time to catch the last ride up. Another seemingly expensive jaunt which turned into a stolen experience. Two towers in 4,500 vertical ft., 30 mph 300 ft. above the ground. Straight up a rock and ice cliff to an immense building covering the peak. This thing was started in 1895. Water comes up in a huge tank, slung to the underbelly of the tram cars. A single flush must cost a buck. Where does it go?

We are at the top of the world. Surrounded by Alps. Another cog train gets near to the top, after spiralling up through a tunnel inside the mountain. There is a midstation on the train where skiers can still get out and walk out through a side tunnel to the top of a pitch stuck to the side of the mountain. Customs station on top, because the skiers can come from Austria on the far face. We got to stay there for an hour. Rode down with the last three employees. Saw the sunset through a small hole in the clouds right at the horizon— a real dose of "alpen glow." I was all alone on top of this building. On top of this mountain. From where I stood, watching the sun set, 95% of the terrain I could see was so magnificently inhospitable that I would have been watching my last sunset from any of them. Instead, I expected to dine and drink beer in Munich that night. Better get down. Walk around Garmisch and leave for Munich. There, hoof to the Hofbrauhaus. Hard to get seats along the big tables. Finally get served liters of beer ($7.50 each and worth it) and fine food in a very prompt and professional way. Oompah singing in several versions of pidgin German. Dad left early and Charles and I shut the joint.

3 FEB. What is there about Munich? I have only awakened two mornings in this town and had headaches both times. They pass quickly, though. Uneventful drive about, looking halfheartedly for the BMW plant. What else did I miss? How many times must I go back? Out to the airport and away we go. —BEN BRUNGRABER

In the next issue Ben will report on his summer journey to Japan.

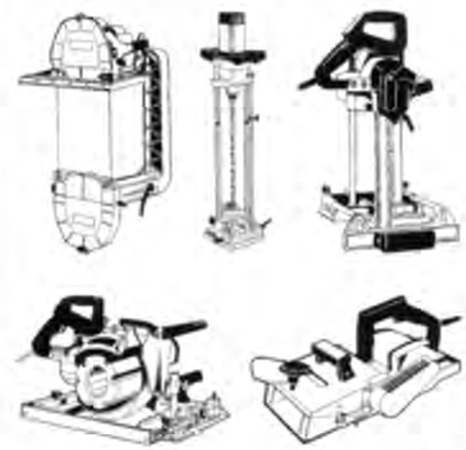
GUILD NOTES AND COMMENT

SINCE its inception, the Guild has relied on the generosity of its individual and business members for its financial health. We've been able to hold our own, publishing two great periodicals and hosting successful conferences, workshops and projects. To expand our programs and to be able to offer more to our members and reach out to a broader public require two things: raising more money and more efficiently managing what we have.

At a week-long Grantsmanship training workshop recently I learned that there are many funding sources for non-profit educational organizations like the Guild. Outlining some of the grant seeking process here may alert members to the opportunities when they occur.

Private foundations, corporations, and the government offer grants to support activities similar to the Guild's. Resources such as *The Foundation Directory* describe the grants available and allow one to target a funding search. Internships and scholarships are available, such as those provided by the National Center for Preservation Technology and Training at the recent Friendship Pavilion Workshop. Ambitious fund-raisers can seek to create *endowment* to fund ongoing educational programs. *Publications, videos, projects and conferences* can be supported, sometimes through sponsorships as seen at our recent Eastern and Western gatherings. Events for public service, especially if they involve education and community action, are prime candidates for giving. Numerous opportunities in historic preservation arise in the areas of documentation and demonstration of techniques. *Challenge grants* and *partnerships*, such as the arrangement we have with the Forest Service for the Dolly Copp project, give appropriate value to the tremendous power we have when we get together to build something. The Guild's involvement and presence, as exhibited at Malabar, Bend and York, encourages those with the big bucks or equivalent energy to join the fun. Outside of specific events and programs, there are more limited opportunities for *general support* such as operating expenses.

There are some guidelines for determining what programs are appropriate for grant proposals. For example, they usually must benefit the general public. The Guild is currently organized (for I.R.S. purposes) as a 501c6, or trade organization, mainly because our bylaws state that we encourage



"training programs for dedicated timber framers." This apparent limitation to professionals belies the fact that in practice our programs are open to everyone; but it prevents us from being a 501c3 educational organization and availing ourselves of numerous funding sources. The formation of the Business Council as a true 501c6 with programs benefiting primarily its own members allows the Guild to reclassify as a 501c3 and get on with its mandate of educating the public as well as its members.

Some other general rules of thumb:

Funding is usually available for expanding programs or initiating new ones, not for maintain existing ones. A grantor may ask, "If you've done O.K. so far, why do you need me now to keep going?" Grantors are not interested in keeping a sinking boat afloat, but are rather looking to participate in successful, exciting endeavors (which incidentally may help further their interests and improve their image).

Private funding sources (foundations and corporations) are generally interested in programs which address specific problems (such as reducing illiteracy or saving a vanishing resource), while government grants are more process-oriented. For example, legislators may decree funding to train a certain number of people; what those people accomplish with that training and what problems they will solve was long ago debated on the floor and rarely appears in the bill or the memory of those who passed it.

Grants tend to be given locally. Thousand of sources are listed in *The Foundation Directory* (available at most libraries), which gives criteria for selection, including subject areas and geographical limitations.

Many grantors consider proposals only from their own state. There seem to be many foundations in Texas (all that oil money perhaps), and sources for preserving historic structures are often limited to specific cities, with Ohio's as the leading contenders. Some grantors fund only specific types of programs, such as publications or workshops on a specific resource.

What makes the Guild attractive to a potential funder? All we need to do (and anyone writing a grant proposal should keep this in mind at all times) is remind ourselves why the world is better off because of what we do. It may sound romantic, but our biggest assets are an outstanding membership and the good works we perform. People give money to people (not to faceless organizations) and to worthy causes, and our track record of volunteerism shows that we're committed to doing our share. Other things working in our favor are the high visibility of a timber frame raising, its visual and spiritual impact, the uniqueness of our organization and our ability to network and organize a considerable amount

of talent in pursuit of a common goal.

The Guild has a few liabilities as well that need to be addressed. It lacks the permanent staff required to administer an ongoing grant-seeking process and the physical facilities to support it. Our brief history as an organization (impressive as it may be) will require careful scrutiny from a grantor. Finally, many grant proposals are name-driven, meaning that having noteworthy individuals involved in the proposed activity or on the organization's board of directors goes a long way towards establishing credibility and guaranteeing success in the eyes of the grantor. We need to get more well-known people in our ranks and involved in Guild activities on a regular basis.

Guild members can do a number of things to help make fundraising an effective tool for the future. Identify and nurture personal contacts (such as through clients or local organizations), especially if you know someone on the board of a corporation or foundation. Learn to recognize potential funding sources, such as organizations that promote the use of forest products or groups that promote education, housing, historic preservation or the environment. Investigate projects with a potential for funding, and see if the necessary elements can be included to make a successful proposal. Such projects might include training programs for museum or park employees; using timber framing as a tool for developing math skills in kids; getting TIMBER FRAMING and publications such as a joinery book or design manual out to a wider audience; erecting a bridge as an element in an alternative transportation system; raising a frame as part of a community action plan for affordable housing.

Once a project, contact or funding source has been identified, Guild members should contact the Board of Directors to obtain help in developing a proposal. A Proposal Planning Guide (available from the Grantsmanship Center—see address below) will be on file at the Guild office, but those with decent writing skills should consider taking a grant-writing workshop. Get published by writing about something you know; your name will add credibility to a proposal.

The Guild should again seriously consider hiring a salaried executive director or grantwriter to pursue funding if a campaign is to be successful. In the meantime, keep working to make yourselves, the Guild and timber framing known to those who would love to join us. —Will Beemer

The Grantsmanship Center offers publications as well as grant-writing workshops across the country. Scholarships are available to those sponsored by the Guild. Those willing to host a workshop can have two people attend free. The Grantsmanship Center, PO Box 17220, Los Angeles, CA 90017, 800-421-9512.

FRAMER'S JOURNAL

Hudson Valley Barns

LIVING and working in the Hudson Valley, I have many opportunities to look at historic timber structures. Most framing in our area conforms to well-documented styles (Dutch barns and houses, for example, and English three-bay threshing barns). Occasionally I find unique details.

Last summer I got a call from a neighbor whose 19th-century farmhouse had been gutted by fire. I was asked to give a valuation on the lost timber frame and as an aside the owner also asked me to take a look in the barn on the property as it was in need of some repairs. From the road the barn appeared pretty nondescript, but the inside revealed an interesting framing scheme. The floor plan was a standard three-bay, sidewall drive-through layout, but what caught my eye was that each of the four bents had at its core the posts and anchor beam of a Dutch barn. Girts had been added at the level of the anchorbeam to extend from the posts to the outside walls. These girts began in open mortises that accepted the protruding tenons of the anchorbeam in a sort of splined connection, as seen at right.

Only a month later I came across another barn about two miles away that was framed in exactly the same manner. The second barn also appears to retain the original purlin plates of the Dutch barn from which it grew. Although both of these barns represent some clever recycling of timber, they also show how (at least in this area of heavy Dutch influence) framers moved through the Dutch and English forms to the dropped-tie-beam American barn form that became most common in this area in the 19th century (see L. Andrew Nash, "The American Timber Frame, TF 37).

I recently began extensive repairs on such an American-form barn built around 1860. This three-bay barn measures 30x40 and has hewn timbers with vertically sawn braces and studs, Square Rule framed with a good number of recycled timbers from earlier Scribe Rule frames. The odd feature of this barn is a type of rafter foot (at right) that I've seen only once before in this area. The rafters are hewn hardwood roughly 5 in. square, tapering slightly at the ridge. The rafter foot is made by a simple level cut and spiked to the top of the wall plate. A 1-in.-square peg protrudes from the foot on the inboard side of the plate and registers in a notch lx1x2. The peg, quickly made and fitted, substitutes for any birdsmouth or other notch in the rafter foot.

Having been called to this barn in its "failing" mode, I have been able to observe the long-term drawback of this unusual joint. As the sills failed and the sidewalls dropped, the rafter feet have moved unrestrained to the inboard side of the plate, some to the point where 2x4s have been spiked to the plate to keep the rafters from falling off altogether. Another shortcoming of these too-simple rafter feet is the lack of any integrated framing for an overhang. There is no evidence on the plate of sprockets or any extensions having been sistered to the rafters to make an overhang. The need for most of the repair work I'm now doing can be traced back to the lack of sufficient overhang on the eave sides of the barn. —MIKE CARR

Mike Carr runs Claverac Timber Building in Hollowville, N.Y., focusing on preservation and restoration.

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