TIMBER FRAMING

JOURNAL OF THE TIMBER FRAMERS GUILD

Number 114, December 2014

Framing a Roof in Hispaniola

TIMBER FRAMING

JOURNAL OF THE TIMBER FRAMERS GUILD

NUMBER 114 DECEMBER 2014

CONTENTS

On the front cover, New Jersey Barn Co.'s Dale Emde guides hip home during roof-frame raising near Rio San Juan on the north coast of the Dominican Republic. Photo Alex Greenwood. On the back cover, framer Sam Moyer explains a point in Spanish to crane operator "El Maestro" before raising frame over resort hotel lobby. Photo Elric Endersby.

PO Box 60, Becket, MA 01223
413-623-8759 www.tfguild.org

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

Editor Kenneth Rower

Contributing Editors
History Jan Lewandoski, Jack A. Sobon
Engineering Ben Brungraber

Printed on Endurance Recycled, a 10 percent pcw paper ♻

TIMBER FRAMING (ISSN 1061-9860) is published quarterly by the Timber Framers Guild, PO Box 60, Becket, MA 01223. Subscription $45 annually or by membership in the Guild. Periodicals postage paid at Becket, MA, and additional mailing offices. POSTMASTER: Send address changes to Timber Framers Guild, PO Box 60, Becket, MA 01223.

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

1985

NOTES & COMMENT

New Guild Structure?

SPEAKING to a large, packed room at the members' meeting opening the Guild's 2014 national conference in August near Manchester, New Hampshire, volunteer executive director Brenda Baker, a board member 2004–09 and a past president come back to help, welcomed everyone to what proved a memorably successful gathering over three days. Brenda thanked all for their support and efforts over the past, difficult, year and reported to the members that the Guild was back on its feet, indeed having a banner year.

Vice president Mike Beganyi, of Burlington, Vermont, speaking for the board, briefly reviewed the improved position of Guild finances, helped notably by six $10,000 donations in the Visionary Partners program, as well as the progress in the Apprenticeship Training Committee (ATC) program (five apprentices and 32 journeyworkers) and the success of a Timber Frame Engineering Council (TFEC) workshop on timber grading. He also described two community building projects, one at Lake Naconiche in Nacogdoches County, Texas, and the other in Pemberton, British Columbia, both of which were unmitigated successes for the communities and for the Guild.

In publications, Mike reported that while the board intended to continue print publication of our quarterly journal *Timber Framing*, our monthly newsletter *Scantlings*, which has been distributed online-only for some time, would soon adopt an all-digital, user-interactive format, and that the Guild would commission a rebuild of our website, using funds from the Visionary Partners program, as well as issue a reinvented Resource Guide.

Mike briefly summarized several of the past year's challenges in governance and finance. The leading challenge now is to build a sustainable structure for a stronger Guild. The balance of the meeting was dedicated to a discussion of a proposal to accomplish this, which had been described to the membership earlier in the emailed *Weekly Guild Notes* of August 4 (us7.campaign archive1.com/?u=2b1940b096cd2c0126937f4f7&id=11ee78c4a 3&e=8c1f63641e).

Director-at-large Jonathan Orpin, of Portland, Oregon, who has been a director of the Business Council and last sat on the Guild Board 1991–93, moderated the discussion with the members, opening with the observation that the timber frame community had an opportunity to become stronger and more active by working more closely together. To this end, the board was committed to looking internally for the people, ideas, resources and energy essential to pursue the Guild's educational mission and to bring improved benefits to its members.

The origin of the proposal had been a discussion between a number of board members of the Guild and the Timber Frame

Business Council (TFBC) to find ways for both organizations to improve their effectiveness. The working group realized that there was greater opportunity to do so by looking to all of the Guild's constituency groups and agreed that most members of these constituency groups were members first of the Guild and only became members of the interest groups over time. For many, their commitment to the Guild transcends their commitment to their respective groups, which is a reflection of the strength and closeness of the community. This identity as one timber framing community animated the effort and led to the proposal.

The most distilled summary of the proposal would describe it as the reform of the Guild governance by better integrating the constituency groups—TFEC, TTRAG (Traditional Timberframers Research and Advisory Group), TFBC and ATC—into the leadership structure. The goal is to build a stronger timber frame community with a better organizational architecture facilitating better communication and closer working relationships between the board and the constituencies.

In doing so, the working group expected to encourage greater coordination of expended effort and resources, both human and financial. As Guild director-at-large Gabel Holder (Monroe, Georgia), put it, "For too long the constituency groups within the timber frame community have been operating independently, largely without regard for each other's efforts. The proposal [is] to merge the varied constituencies into a more cooperative and effective whole."

Using a simple analogy to make the case that better coordination can lead to a stronger, more effective Guild, Jonathan likened the constituency groups to fingers and the Guild to a complete hand. The fingers may perform distinctive roles but the whole member orchestrates the task.

Of the four groups, only the TFBC, the Business Council, is a legally distinct group, a separate corporation. The other three groups are not independent of the Guild. Additionally, the TFBC is much more significant financially. To integrate the TFBC into the Guild requires the two independently chartered organizations to merge, which raises a legal hurdle because they do not share the same tax status. The Guild is considered a nonprofit charitable organization, in IRS parlance a 501c(3), and the Business Council is considered a nonprofit trade association, a 501c(6). At the time of the meeting in August, while both organizations believed that this question would be answered favorably, they did not feel it was wise to spend the resources to confirm their belief before getting an initial read on member support for merging. (Since the members' meeting, the working group has determined that the two organizations can in fact legally merge and maintain both c(3) and c(6) status.)

Member reaction to the proposal was for the most part positive. Rudy Christian of Burbank, Ohio, a past president and a Guild director 1987–91 and 1994–98, strongly supported the proposal, saying that it had not been necessary or advisable for the TFBC companies to take themselves out of the Guild as a separate entity in 1995, and he welcomed the initiative to bring the companies back, believing they would indeed strengthen it. Rudy said he no longer recognizes a dichotomy between craft and business and believes the Guild and its members have matured in their views of the importance of business success to the Guild's own success in educating the public about timber framing.

Andy Roeper, president of the Preservation Trades Network as well as a Guild member, remarked that the Guild's mission need not be threatened by integration of businesses, assuming it met the challenge of "oh-so-carefully crafting job descriptions."

Jack Costantino, of Long Valley, New Jersey, a Business Council director and a frequent supporter of Guild activities (he has directly supported Guild workshops and training by offering scholarships), also expressed approval. As he often reminds us, timber framing is a well-kept secret, and he welcomed any effort that would better educate the public and make timber framing more visible. And Paul Freeman, president of the Business Council, spoke good-humoredly and at length about the advantages that would accrue to both the Guild and the Council if the latter were reintegrated into the Guild.

There were doubts. Ken Rower, the editor of this journal and a founding director of the Guild in 1985, questioned (in the absence of certainty on the c(3) vs. c(6) question) whether the Guild's IRS charitable status and educational mission would be compromised or threatened by the promotion of business interests. He also asked what the difference was now from 1995, when the companies felt they had to leave the Guild to form the TFBC because they were not getting the services they wanted. Jonathan answered simply, "Times have changed."

Perhaps the most eloquent dissenting observation was offered by longtime member Duncan Keir, of Huntington, Vermont. "I got into timber framing because I loved the craft," he said. "And I understand the industry side of it. It put my two kids through college. But the Guild was formed to support timber framing as a craft, not to support timber framing as an industry." Duncan expressed concern about what he saw as the Guild's recent missteps and the drift of the organization over the last several years. In contrast to Rudy's point of view, Duncan wondered whether the Business Council's interest in a merger was motivated primarily by a belief that the Guild could be used to more effectively market their member companies' services.

In the minds of some Guild members, then, perhaps there is a belief in a qualitative difference between the business constituency and other Guild constituencies, a difference that somehow disqualifies business participation. But, to take an example of existing collaboration, what of the Apprenticeship Training Committee's efforts? The Guild's published mission statement reads:

> The Timber Framers Guild is a not-for-profit corporation organized exclusively for educational purposes, to encourage the establishment of training programs for dedicated timber framers, to disseminate information about timber framing and timber frame building design, to expose the art of timber framing to the public, and generally to serve as a center of timber framing information for the professional and the general public alike.

Certainly, the vocational education offered to the apprentices appears to be fully on mission, but the benefits and the costs flow to and from the timber frame businesses that are fully integrated into this program. In fact, trade associations, true c(6) entities, often run or provide the main financial support for apprenticeship training programs.

And we now seem to have a legal basis for integrating the activities of a c(6) under the aegis of the Guild without changing its educational status and privileges, such as accepting charitable donations. Furthermore, and possibly more important, if the ruling sentiment at the August members meeting is any guide we can reintegrate the Business Council into the Guild without threatening the latter's beloved spirit and culture.

In the end, any proposed changes to governance will have to be translated into bylaw changes, which must come before both the Guild and the Business Council memberships for a vote. The challenge for the working group is to stay focused on the timber frame community and its best interests and to design a solution that advances its purposes. —Mack Magee

Mack Magee is a director-at-large of the Guild and liaison to the Timber Frame Business Council, where he is also a board member. He previously served on the Guild board 1990–92.

A Little Trouble in Paradise

FOR as long as we have been in the business of salvaging and rebuilding antique timber frames, the glory of working outdoors fades fast as winter approaches. It seems as if most of our snowstorms here in New Jersey either begin or end with sleet and rain. Between the lousy, damp weather and the short, cheerless days, productivity is greatly diminished. For many years we fantasized about a project on a tropical island complete with warm breezes, sandy beaches and rum cocktails. Be careful what you wish for. It may come true.

We used to believe that our business was recession proof because many of our clients had plenty of money. The financial mess that began in earnest in 2008 and dragged on proved us wrong. Very few construction projects were being initiated and there was not much call for our design services either. In August 2012 an unusual opportunity came our way. Plans were announced for a boutique beach resort at Playa Grande on the north coast of the Dominican Republic, on the island of Hispaniola. For more than 25 years my business partner, Elric Endersby, has spent part of each winter in the area and become enchanted with surviving vernacular buildings, many of which were neglected and ruinous. He studied and documented local examples of traditional architecture before purchasing and restoring an abandoned farmhouse dating to 1928. His work drew the attention of the beach resort developers who enlisted him to detail the proposed buildings in authentic Dominican style.

By chance, the general contractor for this project lives in Princeton, not far from our office. Before long, we churned out drawings for some 40 buildings, including concession kiosks, a gazebo, a bath house, tennis and pool pavilions and individual guest cottages. We soon progressed to a bar and the main pavilion, encompassing a hotel lobby and restaurant. Our involvement to this point had been all design work. Now we really wanted to build something. Since the hotel lobby was the largest and most significant building in the complex, we were able to persuade the owners to consider heavy timber construction for the roof. Once the schematic design (Fig. 1) was approved, we focused on the frame design.

We felt strongly that the roof design should be traditional. While we were unable to find a local building in the Dominican Republic with a suitable roof to replicate, our roof plan was inspired by a 19th-century plantation house roof in nearby Jamaica. At this juncture we needed to enlist a timber frame engineer to size the timbers and specify the joinery. Who better than Ed Levin? He had the requisite skills and experience, and he relished a challenge. Then living in Philadelphia, Ed was just an hour away. This project was a perfect excuse for collaboration.

At first Ed sent us sketches of several exotic roof plans that would have been appropriate in Tahiti. But before long he accepted and embraced the concept of traditional Caribbean design (Fig. 2). The hotel lobby was to be 24x40 ft. with a broad, open porch on all four sides. The structure required engineering for an active seismic zone as well as for not-infrequent hurricanes. The controlling design criterion was winds of 140 mph. When the project engineers in the Dominican Republic learned the roof was to be timber framed, they expected large bolted steel plates at the joints. The absence of steel plates in the plans raised concerns among the engineers and they requested a structural analysis, which Ed, in conjunction with Fire Tower Engineered Timber, provided. This report was sufficiently dense and technical that the local engineers seemed satisfied (or perhaps baffled). And, I suspect, somewhat curious.

Despite our wish that the timbers be as small as possible, frame sections had to be determined by the strength required for the 140-mph wind load, and Ed's calculations resulted in some sizable beams—the ridge ended up 6x12 and the hips 7x11. The joinery was a mixed bag. Mortise and tenon joints were stipulated for braces and purlins, while rafter-to-ridge and jack-to-hip rafter joints were to be housed and screwed, anticipating the difficulty of cutting these connections on site. Further rigidity to the roof frame was to be provided by solid sheathing surmounted by ¾-in. plywood screwed on top.

While always a little slow to produce calculations and drawings, with a bit of prodding Ed always came through for us. But as we packed our tools and prepared for our journey we still had not received the critical shop drawings. At this point I happened to ask a fellow framer, Jack Witherington, if he had ever had Ed provide engineering. Jack's advice: "You better call him twice a day." By now, I was concerned.

Airline tickets had been purchased, the timbers had been shipped and still no drawings. I became even more concerned when, just days before our departure, the drawings finally began trickling in. The shop drawings for the sticks were unlike anything we had worked with before, since most of our experience is not in new construction (Fig. 3). Who would dimension to a thirty-second? And all those odd angles! Was this really going to work? Our initial plan for this project had us arriving in the Dominican Republic in February, thus escaping the dreaded winter weather in the Northeast. Delays in the schedule—including a fire at the kiln that destroyed the first timber order—pushed our travel to July. So much for a winter getaway. Of course we are all accustomed to jobs scheduled for clement months, then being delayed until the middle of winter. You can't win.

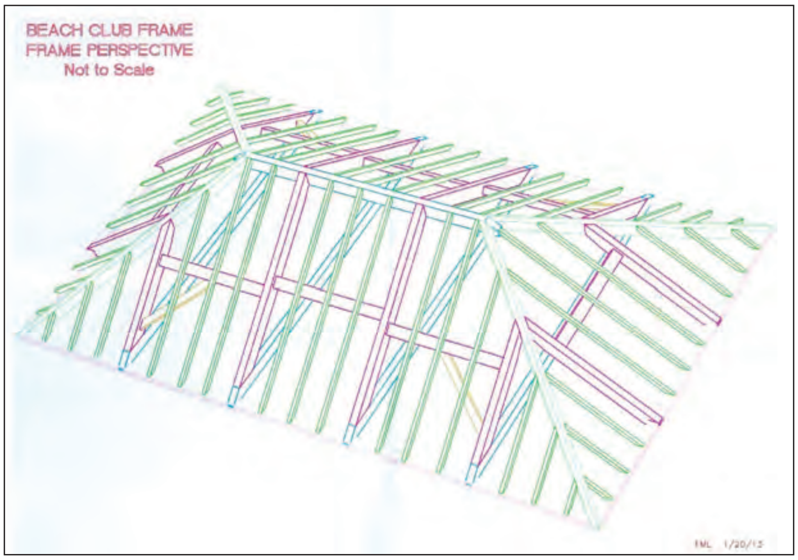
Some of the tools required for this work, such as 10-in. circular saws and chain mortisers, are not readily available in the Dominican Republic. We determined that if sturdy suitcases were carefully packed we could bring along what was needed. Each suitcase was carefully loaded and weighed to avoid huge excess weight fees. At Newark Airport, on the day of our departure, we thus found ourselves struggling across the concourse with backpacks and many cumbersome suitcases.

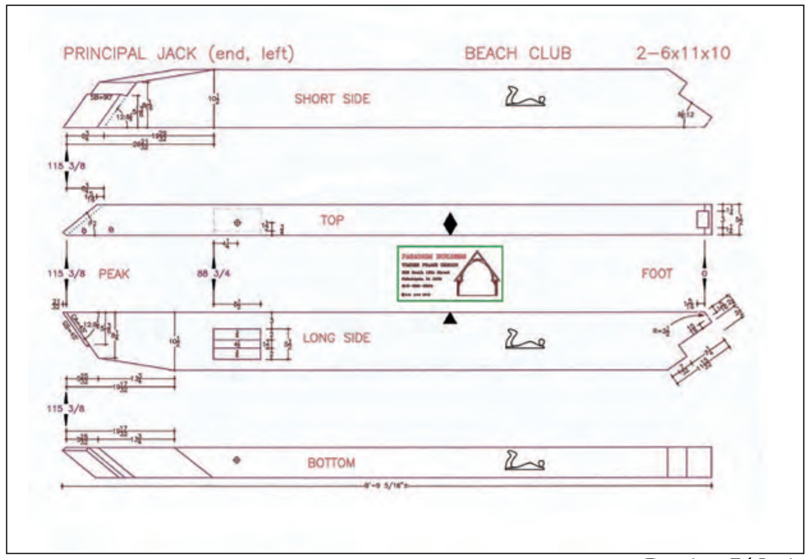
Since we had not bothered with work permits, it was a relief when we cleared customs at the airport in Puerto Plata and no one seemed to care that there were power tools packed in with the socks and underwear. Elric had flown ahead several days earlier in order to get his island house up and running. His last-minute substitution in his suitcase of tarragon vinegar and Hellmann's mayonnaise instead of two 10-in. saw blades has not been forgotten or forgiven. He greeted us at the airport with a modest rental car that we filled to capacity with all our gear. On the way to his house we stopped at the site and saw the timbers for the first time. Next, we had a cold cerveza at the beautiful nearby beach, then took a welcome swim. So far, so good (Fig. 4).

1 At right, Elric Endersby's color rendering of hotel lobby building.

2 Below, Ed Levin's schematic drawing of hip roof frame.

3 Below right, typical stick drawing that caused wonder in minds of restorers of antique frames.





Drawings Ed Levin

4 **Elric Endersby (left) and Dale Emde acclimating on the first day. Beach was 75 yards from worksite.**

Alex Greenwood

5 **Sorting pressure-treated Southern yellow pine timbers at edge of worksite, with forest offering shade during part of day.**

The pressure-treated Southern yellow pine timbers that we ordered had been milled reasonably straight and true—all in all, better than expected. Some had been sniped by the planer and we had concerns about how well things would fit together ultimately. Most of our previous work had been scribed, and we were not accustomed to working from shop drawings. We typically work with white oak, and it had not occurred to us that yellow pine was a species suitable for timber framing. A phone call to Tim Chauvin of Red Suspenders Timber Frames in East Texas (the western end of the species range) assured us that yellow pine would be fine for a frame. Yellow pine's cell structure is said to accept pressure treatment much better than other species. Termites in the West Indies are aggressive, and untreated timbers here would not long survive. So yellow pine it was (Fig. 5).

Our first day on the job we were issued hard hats and reflective vests. We then met with the project manager, Nelson, and his foremen, Smiley and Yellow, all skilled craftsmen, good natured and very helpful. While the workmen on this job, perhaps 75 in number, were Dominicans who spoke only Spanish, these three men hailed from Saint Lucia and spoke perfect English with the lilting cadences of the Caribbean. Whenever we needed a tool or some equipment, we were told "It is not a problem." Sometimes hours (or days) went by before what was not a problem was solved. But it was always taken care of. Of the many things that were not a problem perhaps the most vexing was the electricity. The local power grid is known to shut down daily for irregular intervals, so at the jobsite there were several large diesel generators. Voltage drops in long runs of light-gauge extension cords put a burden on our power tools. Since we were required to take turns making cuts, work slowed considerably. At one point the generator stopped running entirely due to a supply of bad fuel. More time lost.

When we checked the masonry walls on which we would be raising the roof frame, we were pleased to find things square and level. We were displeased, however, to find a wall thickness of 6 in. rather than the expected 8 in. as specified on the original plans. A site-made design change had preserved the outside dimensions of the walls while shaving 2 in. from their thickness, which meant there was noticeably less bearing than we had supposed for the roof frame we were about to erect. After a quick phone call to Ed in Philadelphia and a huddle with the local engineer, we made an inward adjustment to the wall plates that provided additional bearing and minimized the eccentric load at the wall. This modest change in the rafter seating, however, raised questions about the length of the hip rafters. We decided it would be prudent to cut them to length after the ridge and the principal rafters were in place.

Proceeding with layout and cutting, Dale Emde, who has worked with us for over ten years and is deft with a handsaw, made the complicated cuts on the hip and jack rafters (Fig. 6), while I worked on the ridge beam and the principal rafters. We had selected a flat worksite that afforded shade in the morning hours thanks to the tropical vegetation on a steep adjacent hillside. As the days were hot and humid, the shade was most welcome. Before long, we realized that the same hillside that blocked the sun also prevented us from anticipating the approach of the sudden and frequent rain showers. Each tropical downpour triggered a mad scramble as we gathered and covered tools. Shop drawings got wet and were hard to read. Often the shower would be over and the sun shining again by the time things were battened down. Most days this drill was repeated multiple times. One storm was sufficiently furious that serious flooding ensued, damaging roads and breaching a watercourse, and the entire resort construction site was flooded. At those moments, the advantages of a proper workshop might have outweighed New Jersey's lousy, damp weather and short, cheerless days.

After the power problems and rain delays, it became apparent that insufficient time had been allotted for all the layout and cutting. As we were concerned about completing the job on schedule, visits to the beautiful beach became infrequent. Then reinforcements appeared. Our former full-time and still occasional colleague Sam Moyer and his wife Casey Dzierlenga arrived, much to our relief. Sam had worked with us years ago before turning to making custom furniture. Having lived recently in Southern California, he knew enough construction Spanish that we could now communicate with the locals, previously an impractical proposition. Casey, meanwhile, had planned to videotape the project. Instead, since she is also a skilled woodworker, she spent more time with the mortiser than the camera (Fig. 7). With a crew of four, we made better progress.

The timbers were large and heavy, and we were relieved to find the crane that arrived on the morning of the raising was also large and heavy, 30 tons or so. The operator spoke only Spanish, but between hand signals and Sam's modest command of the language, all was well. On the ground, with the help of the crane, we assembled a unit of two tie beams, two sets of principal rafters, connecting purlins and the ridge beam, all sufficiently pegged, screwed and strapped together so as to be lifted safely into place (Fig. 8).

Next we plumbed, squared and braced this assembly in place before pulling a tape to confirm the requisite length of each hip rafter, which after all varied only slightly. As the hip rafters were being cut on the ground, the two other tie beams were lifted into place. Later, after the hips were fitted, we were able to send the crane away and finish the assembly by hand. With a bit of pushing and pulling and prying and tapping, we inserted jack rafters and the remaining purlins and braces. One important tool that we had been unable to bring along because it would have been far too heavy was a large beetle. Dale fashioned the head on site from a coconut palm trunk and fitted a tough handle of unknown species. The damn thing was really heavy but very effective. Dale's beetle was useful throughout the assembly and particularly helpful when "adjusting" the structure to insert jack rafters and purlins.

With time running short before our return flight to the States, we hurried to install the common rafters, each requiring custom cuts where it trenched over the purlins. As we repacked the tools, again carefully distributing the weight, this time without mayonnaise and tarragon vinegar, yet another storm loomed, this one a hurricane that threatened to close the airport. Clearly it was time to leave. We drove through gusty winds and pounding rain. As we approached our destination, we were not at all pleased to suffer a flat in a rear tire, too damaged to plug. We did have a spare but of course all the heavy bags had to be removed to gain access. We did finally make it to the airport on time, just barely. After checking in, as we awaited boarding, an announcement over the PA system called for us to report to the baggage screening area. The chain mortiser had raised concerns among the inspectors. The explanation took a while, and (yet again) we almost missed our flight.

Okay, we didn't make any money on this job. I suppose we lost money, but I don't want to know how much. We are certainly not the first timber frame operation to lose money on a job. But it was something that we had to do. We had been to the island before as tourists, and this time we were there purposefully. We did get to swim in the warm, clear waters of the Caribbean. We enjoyed the scents of a lush island and the different rhythms of the local music and the workplace alike. We ate well without spending too much. Mangoes were in season.

Fig. 9 shows the finished product, post–interior decorators. Given the opportunity, we would do it again. The beetle was too heavy to bring back. Left behind, perhaps it will come in handy on some future job—if the termites don't eat it first. Sadly, Ed Levin passed away just weeks after the roof frame was built. Certainly it was not among his most ambitious designs, but I do wish he could have seen it. I'm pretty sure he would have been pleased, and he surely would have enjoyed the adventure. —Alex Greenwood

Alex Greenwood (njbarncompany@aol.com) is a principal at The New Jersey Barn Co. in Ringoes, N.J.

Photos Alex Greenwood except photo below right by Elric Endersby

6 Dale Emde mastering deep compound-angle cut with Silky Katanaboy saw.

7 Casey Dzierlenga mortising principal jack rafter for a purlin.

8 Flying in principal rafter assembly with purlins and ridge.

9 Completed hip roof in service over hotel lobby.

Michael J. Cuba

1, 2 Old West Church, Calais, Vt., 1823, with interior view of pulpit, box pews and ends of three-sided gallery.

The Old West Church Amended

THE Old West Church in Calais, Vermont (Fig. 1), is a rare example of an early meetinghouse that has remained almost unchanged since its construction in 1823. The church is located three-quarters of a mile to the southwest of Abdiel Kent's historic 1837 tavern at Kents Corner. The town of Calais was granted to Colonel Jacob Davis, Stephen Fay and company (70 proprietors all told) by the general assembly of Vermont, then an independent republic, in session at Arlington October 21, 1780, for a fee of £480. The clearing of roads began in 1787, with the first permanent settlements in 1789. The first sawmill in Calais was established in 1793 by Colonel Davis and Samuel Twiss,[1] by which time Vermont was a member of the Union.

Across the road from Kent's tavern stands the oldest remaining sawmill in Vermont, built in 1803 by Joel Robinson. The population of Calais in 1791 was only 45 people but grew quickly to 841 residents by 1800. During the decade when the Old West Meetinghouse was constructed, the population grew from 1111 inhabitants in 1820 to 1539 in 1830. After reaching its peak of 1709 in 1840, the population diminished steadily to 684 residents in 1960. The town began to grow again during the 1960s as an enclave of the back-to-the-land movement.[2] By 2010 the population of Calais had risen to 1607.

As it stands now, the church measures 53 ft. 4 in. along the eaves walls and 44 ft. across the gable ends, with a roof pitch just over 8½ in 12. The largely unornamented exterior of the church is modest, if not austere, with white painted clapboards on three sides and red clapboards on the rear gable end. A simple steeple, 10 ft. square at the tower, rises in two further octagonal stages, from which a mast projects to support a comet-shaped weathervane. The uppermost stage was rebuilt after a fire in 1953.[3]

The interior of the church still retains its original box pews with the exception of the six removed in 1831 to make room for a pair of wood stoves. The church is open from floor to attic ceiling and has an upper gallery along three sides. Also retained are its original pulpit and unusual light-blue painted woodwork. The pulpit was lowered early on to its current position. Written in fronds of cedar in an arc on the wall above the pulpit are the words "Remove not the ancient landmark, which thy fathers have set." This quote from Proverbs 22:28 was placed there in 1886 (Fig. 2).

On August 18, 1823, the first meetinghouse society convened to establish a site for the building. They met again on August 30 to determine the footprint and design. According to Calais historian Dorman Kent, "The Frame was prepared and raised in October of 1823 and Lovel Kelton, a master builder of those times, had charge of the work."

Lovel Kelton was born in Warwick, Massachusetts, on October 12, 1773. A transcript of Kelton's journals, retained by the Vermont Historical Society, contains an entry from March 18, 1822, stating "moved to Calais; Saml Savins, Nathan Kelton and Josiah Hollister with me—winday."[4] Kelton's journals spanning from 1820 to 1840 offer insight to the life of a country carpenter. Involved with a number of prominent projects in addition to the construction of the Old West Church, he was as much a farmer as he was a framer and engaged in many odd jobs to supplement his income. On December 1, 1804, *The Political Observer*, a Walpole, New Hampshire, newspaper reported:

> On Tuesday last the new toll bridge over the Connecticut River which connects Brattleboro with Hinsdale in New Hampshire was opened for passengers. The bridge does the highest honor to Mr. Kingsley, the architect, as well as to Mr. Lovel Kelton and the mechanics who executed the work under their direction. . . . It has been pronounced to have been erected upon the best plan of any yet put into execution in this part of the Union, combining greater strength with less weight of material and promising more durability.

But little more than a year later, on February 16, 1805, *The Political Observer* carried this notice:

> We learn that on Thursday last the new bridge lately erected across the Connecticut River between Brattleboro and Hinsdale fell, and was crushed to ruins. The cause is said to have been the great weight of snow lodged on it. The private loss must be heavy and the public inconvenience not small.[5]

Entries in Kelton's journal from 1820 indicate that he traveled from Marshfield, Vermont, to Brattleboro to work on a bridge and perhaps to redeem himself. Other entries list mundane farm chores and details of the framing of houses, schools and barns for

HABS Frank O. Branzetti

Historic American Buildings Survey

HABS Ned Goode

HABS Frederick D. Nichols

Historic American Buildings Survey

3 Above left, Old Ship Church, Hingham, Mass., 1681, Sinnott's Type I.

4 Above, Congregational Church, Farmington, Conn., 1771, Sinnott's Type II.

5 Above right, Meetinghouse, Acworth, N.H., 1820, Sinnott's Type III.

6 Left, Congregational Church, Whitneyville, Conn., 1834, Sinnot's Type IV.

7 Right, Town House, Strafford, Vt., 1799, Sinnott's Intermediate Type II–III.

families whose names remain well known in the Marshfield region. Kelton's journal indicates that he had also constructed weaving looms, sleds, cart bodies, window sashes and chairs, among other things. Before the Old West Church, he had framed the Center Church, or Union Meeting House as it's also known, a prominent landmark in nearby East Montpelier. His journal entry of August 28, 1822, reads: "Ditto—raising the same, take 85½ days work fraiming the House—54 feet by 43—with 5 feet projection." By the next day he was framing a horse barn. Kelton also reports employing a local carpenter named Bucklin Slayton (mentioned in my TF 111 article "Lost in Translation," on the early use of the square rule).

Kelton began work on the Old West Church on September 22, 1823. Presumably, all of the materials had been brought to the site, and perhaps other preparations had been made. Kelton makes no mention in his journal of the number of framers who worked on the project, but we can assume that many hands were involved as the frame was erected only 22 days later, on October 13, 1823. Kelton had turned 50 years old on the previous day.

Although I had been drawn to the Old West Church by the intact nature of its features and finishes, what drew me in further was the evolution of its design. Edmund Sinnott's *Meetinghouse & Church in Early New England* outlines a typology of churches and meetinghouses throughout the region. He considers the Old West Church "originally transitional, now Type III."[6]

Sinnott's "Puritan tradition" classification follows:

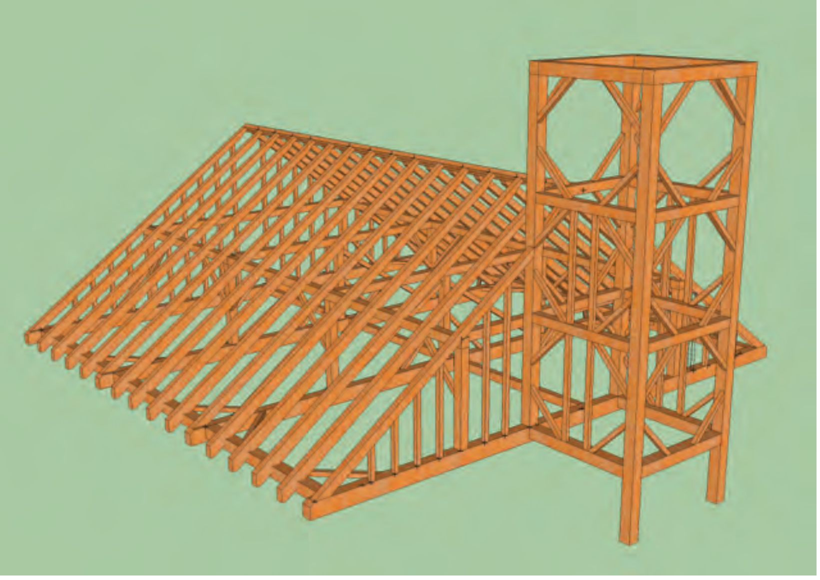
"Type I is the more or less square structure in the latter half of the seventeenth century and the first few years of the eighteenth. Its four-sided hip roof rises to a central cupola [Fig. 3].

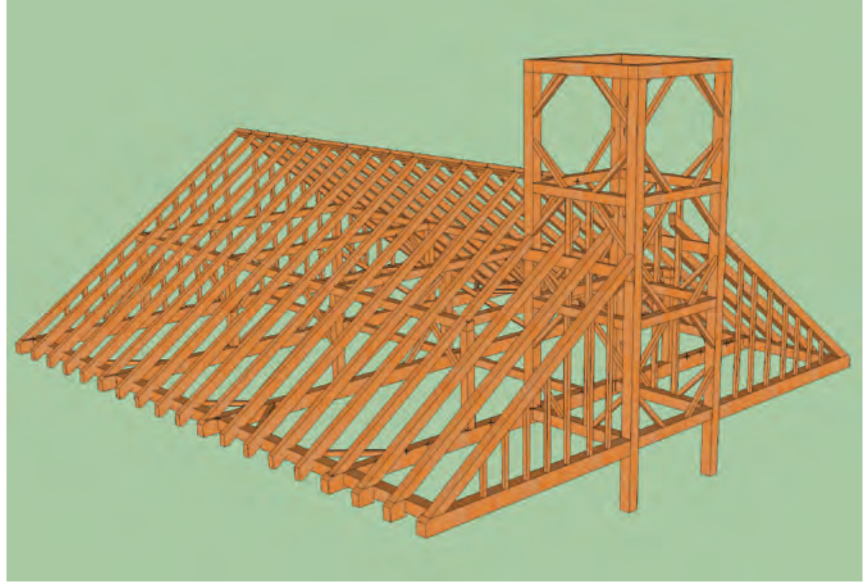
"Type II is the oblong, barnlike meetinghouse of the period 1710–1800, with its main entrance on one side, the pulpit opposite the entrance on the other side, and usually doors at the two ends. The steep roof rises to a ridgepole. The building may or may not have a tower and belfry projecting at one of its ends [Fig. 4].

"Type III is the church of the first quarter of the 19th century. Its main doors (sometimes there is only one) are at one end, the pulpit at the other. Over the front there is usually a porch or portico, provided with columns, pilasters, or other ornamentation. Over this, or partly set back on the roof, is a tower that carries a steeple or spire [Fig. 5].

"Type IV, built after 1825, is the Greek Revival church, with Doric columns, wide frieze, and the generally heavier ornament of its period [Fig. 6].

"Just before and after 1800, a few churches were built intermediate between Type II and Type III. They are like Type II in having a tower projecting from one end, but differ in having the main entrance also at this end instead of on the side, and the pulpit at the other end. These buildings differ from Type III in still having a plain tower rather than the more elaborate façade that came soon after. In this list, such structures are identified as transitional [Fig. 7]."





Dorman Kent's account of the Old West Church proposed that it had been modeled after the old church at Charlton Four Corners in Worcester County, Massachusetts. Documents from both Charlton (settled 1735) and Calais, including geneological records, clearly indicate that many early settlers of Calais, including Colonel Jacob Davis, migrated to Calais from Charlton. Charlton had been a part of the town of Oxford until 1775, and George Fisher Daniels's town history of Oxford records that members of the Davis family assisted with the founding of what ultimately became the first Universalist congregation in the country in 1785.

> At a meeting of the Universalist Society, 14 Sept., 1791, it was voted to build a Meeting-house, and on 12 Oct. Samuel Davis, Capt. Jonathan Davis and John Mayo were chosen to "superintend and build" the same. On 7 Nov. voted to build a house 46 by 43 feet with a porch or tower at one end, to be built in the Tuscan order, equal to the Ward Meeting-house in quality, and to appropriate toward the building the money due the Society from the town. It was also voted to let out the work "by the great," the covering and painting the outside and laying the lower floors, and the contract was awarded to Levi Davis of Charlton for £271, the lowest bid.[7]

The Universalist Meetinghouse in Oxford description specifies close to the same proportions as the original design of the Old West Church in Calais, which would have measured roughly 44 ft. square, with a 10-ft.-square disengaged tower centered on one end.

In addition to the similarities of the design and proportion of the two meetinghouses, records from the Universalist Church indicate that many of Calais's first inhabitants had been pew holders in Charleton. Records of the division of the use of the Old West Church between various congregations indicate a substantial proportion of Universalists.[8, 9]

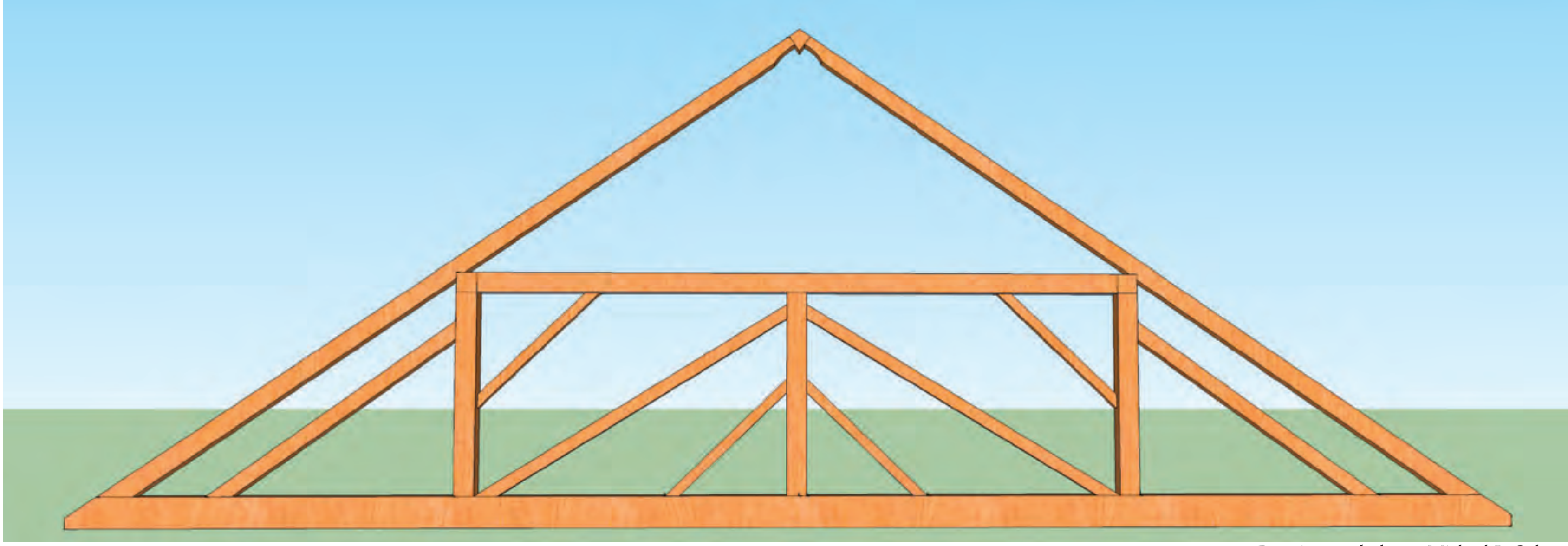
Unfortunately, the Universalist Church in Oxford has undergone numerous significant structural alterations over the years and some details have been lost altogether. As it stands today, the church is a martial arts center with no evidence of its earlier purpose but the tower where the steeple once stood. According to Daniels, the original steeple had a circular belfry that blew off in 1815. After two years of the bell being exposed, a new one was constructed by Rufus Moore and Jeremiah Moffit. In 1845, the interior of the church was divided at the gallery level to create two floors. The church remained in the upper floor and the lower section was rented out as space for retail shops. The congregation had disbanded by 1858. By 1861, the lessees of the shops had altered the exterior of the front gable by filling out the corners of the gable to the front of the tower and then created a portico by opening the front of the tower at the new gable end. With the exception of the inversion of the tower to create a portico, the modification of the façade is almost identical to those made to the Old West Church almost forty years earlier.

WHAT'S odd about the construction of the Old West Church in Calais is the alteration on the fly of the original design. The Calais town history records that the August 30, 1823, meeting of the First Meetinghouse Society in Calais "had agreed upon a building lot and drawn a plan 40 by 42 feet, forty pews on the lower floor, 5 feet by 6, and eighteen above, the same bigness." Exploration of the attic reveals that the frame had originally been designed to have four bents, creating a three-bay footprint roughly 44 ft. square with the 10-ft.-square tower at the east end (Fig. 8). The frame was subsequently filled out after the raising (but possibly before closing in) to yield a fourth bay at the east end, absorbing the tower into the gable and thus setting the steeple on the roof and requiring the rear steeple posts be supported on a tie beam in the roof framing (Fig. 9). Unused stud mortises can be seen at the fourth tie beam on either side of the steeple tower where the gable wall had originally been intended (Fig. 11).

The result of filling out the corners was a large foyer immediately inside the church, leading to three interior doors that mirror the configuration of the exterior doors on the east wall. Two additional doors at the north and south ends of the foyer open to stairs to the galleries above. The framing intended to define the east wall of the church, as originally conceived, maintains the proportions of the body of the church and separates it from the foyer. The framing in the attic makes clear that the decision to alter the façade of the church was an afterthought.

The roof framing in the Old West Church is unique among similar structures in the region at the time. The church is square-ruled, with most major timbers hewn 8x8 native softwoods. At first glance, it would appear that the roof system includes modified queenpost trusses in the second and third bents from the west, with a kingpost arrangement between the lower chords and straining beams (Fig. 10). Closer examination reveals that the queenposts are in fact purlin posts, supported by gallery posts below and lacking tensile connections. The quasi-kingpost arrangements at the second and third bents, however, maintain tension with the lower chord by tenons supplemented with iron straps.

The 5x5 braces extending from the tops of the kingposts to the lower chords near the purlin posts would appear to function as upper chords and perhaps help to stiffen the unsupported span of the tie beams between the gallery posts below.



Drawings and photos Michael J. Cuba

8 Facing page, far left, Old West Church, 1823, roof as apparently originally framed with disengaged tower.

9 Facing page, left, roof frame as completed, with fourth bay framed in to engage tower.

10 Above, truss with multiple braces above gallery.

11 At right, empty stud mortises at original gable tie beam (running across photo).

12 At right below, fourth-bay rafter on tenoned dummy tie-end.

In Figs. 8 and 9, an 8x8 purlin runs the length of the first three bays from the rear to support the 8x6 rafters at midspan. The rafters tenon into a five-sided ridge that extends from the west gable to the back of the steeple tower. The rafters tenon into the tops of the tie beams at each of the four original bents. The tie beams project beyond the post tops by almost 2 ft. to create the soffit. Segmented 8x8 plates tenon into the sides of each tie beam, aligned with the wall principal posts. Each bay has four sets of rafters notched over the outer upper corners of the wall plates, with full-dimension tails that terminate in plumb and level cuts matching the ends of the tie beams.

The foyer bay was formed by adding hewn 8x8 plate segments in kind with those in the other bays. Additional 8x8 timbers were tenoned into the sides of the front tower posts to create a segmented tie arrangement at the new gable end. Three sets of rafters were added to complete the bay. The new gable rafters tenon into the new tie beam ends and rest against the tower posts. The remaining two sets of rafters tenon at their feet into sash-sawn 8x8 dummy ends through-tenoned to the outside of the plates (Fig. 12) and rest atop a thick board spiked to the side of the tower, while the tops of the rafters run wild into the tower. The original gable rafters, at the fourth bent, are sistered to carry the ends of the boards that span the foyer bay. It would appear as though the frame was up and the roof boarded before the decision was made to fill out the corners. Unfortunately, accounts of the meetinghouse's history note that changes were made but give no detail as to the negotiations that led to this substantial change order.

The Old West Church remains an outstanding example of an early Vermont meetinghouse and offers a rare glimpse of a major design change apparently at the last minute. The building has served as a teaching tool for historic preservation students at the Yestermorrow School in Waitsfield, Vermont. —Michael J. Cuba

Michael J. Cuba (cuba@knobbhill.com) is a partner at Knobb Hill Joinery Inc. in Plainfield, Vermont. He has lectured and taught at Yestermorrow School.

Notes

[1]Historicsites.vermont.gov/vt_history/kent_tavern.

[2]Kent, Dorman B. E. "History of Calais" in *The Vermonter: The State Magazine*, Vol. 19, Nos. 10–11, 1814, pp. 163–72.

[3]National Register of Historic Places Continuation Sheet, Kents Corner Historic District, Calais, Washington County, Vermont.

[4]Vermont Historical Society. Lovel Kelton's journals 1820–1840.

[5]Quoted in Hayes, Lyman S. *The Connecticut River Valley in Southern Vermont and New Hampshire: Historical Sketches,* p. 158. Rutland, Vt.: 1929.

[6]Sinnott, Edmund W. *Meetinghouse & Church in Early New England,* p. 237. New York: 1963.

[7]Daniels, George Fisher. *History of the Town of Oxford, Massachusetts: With Genealogies and Notes on Persons and Estate*, p. 88. 1892.

[8]Kent, Dorman B. E. *Ibid.*

[9]Kent, Louise Andrews. "The Old West Church," undated pamphlet published by the Old West Church Association.

Ship's Knees of Maine

THEY say you can't judge a book by its cover, and this is certainly true of many old barns we poke our heads into. Plain-looking buildings often reveal unique timber configurations. Built by a 19th-century shipbuilder, a barn in mid-coast Maine (Fig. 1) is an interesting case in point. English tying joints are a platform for a striking array of some 28 ship's knees assembled into 14 inverted pairs (Fig. 2).

We typically see knees employed as bracing. Besides their natural strength and beauty, knees offer much less intrusion into interior spaces than traditional straight braces and were thus a natural choice for bracing in the confined spaces below decks in wooden ships. On Harpswell Neck, a peninsula jutting into Casco Bay down the coast about 35 miles northeast of Portland, we find this shipwright-built barn where knees aren't typical secondary bracing but rather principal framing members.

According to Mary Stockwell, author of *A Journey Through Maine* (2006), one-third of all wooden vessels in America were built in Maine during the mid-19th century. Shipyards dotted the shorelines. Some of the best timber in the New World floated down nearby rivers. The 400-year shipbuilding tradition in this part of the Pine Tree State runs deep. Beginning with a mast trade for England's Royal Navy in the early 1600s, ships have been built in mid-coast Maine ever since. The heyday arrived in the 19th century, the so-called golden age of sailing ships (and arguably the golden age of barns as well). The skills and materials of the artisans naturally crossed over to the houses and barns they also built. The ship's knee found itself in construction on land as well as in vessels offshore.

George and Emore Allen, the latter the builder of the barn with principal knees, ran a shipyard on the eastern shore of Harpswell, building primarily fishing schooners. There were at least eight yards operating at the height of Harpswell's shipbuilding, 1840–70. Just inland from his shipyard, Emore (1835–1910) built his house and barn sometime in the mid-1800s. When looking inside the barn, the builder's skill is obvious and the question arises, Why did this builder go to such trouble and expense for an outbuilding? Ship's knees naturally are valuable items, especially the oversize ones found here. The barn's largest knees display a body (trunk section) of 8 ft. 6 in. with an arm (root section) of 2 ft. 8 in.

According to an item in the *Monthly Nautical Magazine and Quarterly Review,* Vol. 1 (October 1854 to March 1855), "Prices Paid for Oak Knees at the Gosport [Va.] Navy Yard," the largest knees offered, 12 in. thick., had an 8-ft. body with a 6-ft. arm and sold for $21 each, or about $560 in today's currency. Large knees, even with more reasonable thicknesses and arm (root) lengths, must have been a considerable expenditure in Maine as well. Allen's barn has 28 of them rising to meet roof rafters (Fig. 3).

Surely regular posts would have sufficed and been more affordable? Was Allen making a statement, flaunting his maritime construction skills? Did his barn serve as a sort of showroom for clients? Or did this shipbuilder simply have extra knees from some other building project that he chose to incorporate?

The barn originally measured 40 ft. long. With two bays added at a later date, it now measures 32x61 ft. 6 in. The structure incorporates a hand-hewn frame with jowled posts flaring from the typical 8x8 at the base to 8x12 at the top. They are crowned with typical English tying joints (Fig. 4). The frame appears to be scribed, without housings or gains to indicate square rule, but no carpenters' marriage marks are visible. Boarding arrangements differ according to the side of the building. The south eaves wall has sash-sawn vertical boarding attached to horizontal hewn girts but the north wall is studded and clad with sash-sawn horizontal boarding.

Wall and aisle posts are 14 ft. 6 in. tall, the latter tenoned into the underside of the building's aisle tie beams. Rising higher, bolted pairs of up-and-down knees extend each aisle post to the rafters. The longer knee of the pair rises 8 ft. 6 in. off the aisle post, to be tenoned or lapped into common rafters (Fig. 5).

Where these knees were sourced is lost to history. They are almost certainly hackmatack, one of two species (the other being oak) widely praised for knees during the period. They bear circular saw marks, which, if local, date them to post-1860. In his *History of the Lumber Industry in America* (Vol. 2, 1907), James Elliott Defebaugh reports that the first circular saw did not come to Maine until 1860. The 48-in. blade, which came from Baltimore, was first put into use some 100 miles to the north of Harpswell on the Kenduskeag Stream, near the city of Bangor. For boarding and heavier stock like planks and timber, the new technology did not displace sash saws in Maine (in use since 1623) until decades after 1860. If the barn is older than 1860, then, the knees must have been sourced out-of-state. The possibility also exists that the knees and the entire roof framing are replacements, added when the barn was extended 21 ft. 6 in. in the late 19th century. Like the knees, the timbers of the rear bents are circular sawn.

Supporting this theory, the barn's scribed frame of hand-hewn timber with English tying joints is not at all typical of Maine in the second half of the 19th century, although traditional building practices persisted longer in isolated areas than elsewhere. English tying joints, for instance, are found in the easternmost county of Maine (Washington) in barns dated as late as the 1870s. In far northern Maine (Aroostook County), hand-hewn H-bent frames were built as late as the mid-1930s.

In 19th-century Maine, so-called "knee diggers" made a living harvesting ship's knees. In the 1880s, thousands of Maine-sourced knees were accounted for in an 1884 special report of the U.S. Department of Agriculture:

> Ship's knees are a forest product of considerable importance. These are obtained entirely from the trees of the larch (Larix americana), otherwise known in this State as hackmatack and juniper [sic]. It grows on very low wet land. The chief locality for the production of ship's knees is the towns along the Piscataquis River Valley; and there were shipped over the Bangor and Piscataquis Railroad during the year 1882, 198 full cars of ship's knees, or a total of 30,000.

In the late 20th century and until 2006 when he was killed in a logging accident, Newman Gee of St. Albans dug and sawed ship's knees (see TF 24), and today at least one other Mainer, Oliver Cote, of Hope, continues to harvest these continuous-grain braces to supply shipbuilders and timber framers. —Don Perkins

Don Perkins (don@ourbarns.com) is the author of The Barns of Maine: Our History, Our Stories *(2012).*

1 Barn, Harpswell Neck, Maine, 19th century.

2 View of central aisle showing array of ship's knees bracing central aisle tie beams and standing in for aisle posts.

3 Detail of uniquely combined knees replacing upper aisle post.

4 English tying joints at aisle wall.

5 Inverted knee with exceptional body length of 8 ft. 6 in., lapped to rafter above. Others in array are tenoned to rafters.


1

Photos Don Perkins


2


3


4


5

Structural-Ridge Swiss Roofs

TWO primary methods of roof framing are used in Western timber framing, in a number of variations. The most familiar is what could be termed the *standing roof*, where rafters are securely seated into a tie beam or a purlin, or on plates tied transversely, and lean into each other at the peak. The primary support for the roof structure, then, is what lies under the bottom footing of the rafters.

The second method is what could be termed the *hanging roof*, where the rafters are supported by a central structural ridge beam and may lean against purlins, themselves supported by end walls, as well as on side walls. The ridge beam provides the primary support for this roof structure, where in traditional applications the rafters are often joined to each other at the peak in pairs, over the ridge beam, but to nothing else.

Standing roofs take on a variety of forms ranging from the simple peaked roofs common on small structures to complex trusses. With its great diversity, this is the most widespread method of roof framing throughout Europe and is almost universally the method of choice in North America. The hanging roof is far less common in Europe, though on a global scale it may be the more common approach. In Europe it is found largely in the log building cultures of Scandinavia and the Alps as well as timber frames in parts of central and eastern Europe. The concept is far simpler than the standing roof, and far less variation exists.

Vernacular roof framing methods practiced throughout continental Europe stem largely from two main sources. While there is some lingering Roman and Classical influence, for the most part folk architectural forms are derived from Germanic and Celtic sources. Germanic methods are the most common, not solely limited to the German-speaking countries but also found in the various nations of western Europe where Germanic peoples settled at the close of the Roman era about 400 C.E. This vast sphere of Germanic influence includes not only Germany, Austria, Switzerland, and the Scandinavian countries, but also Britain, France, northern Italy, and Spain.

Celtic forms, a classification used by German building scholar Hermann Phleps in his important 1942 work *Holzbaukunst der Blockbau* (translated in 1989 by Roger Macgregor as *The Craft of Log Building*), were once widespread throughout central Europe and modern-day France, but are today largely extinct. The progress of history and the expansion of Germanic culture have limited surviving Celtic building forms almost exclusively to the Swiss Plateau, which lies between the Jura mountains and the Alps at the heart of a once very broad Celtic cultural range. Unlike their counterparts in the British Isles, continental Celtic peoples built large rectangular houses with floor plans that are still reflected in later houses found in the Alps and the Swiss Plateau (Fig. 1).

It is important to note that these techniques were not developed by the Iron Age Celts but rather distributed by them across a broad area. The practices themselves can be traced back as far as the Neolithic period, well before the Celts emerged. The use of the term *Celtic* in this sense likely follows an old convention to refer to aspects of European culture that predate the arrival of the Romans in the middle of the first century C.E.

The distinguishing characteristic of the Celtic building style is the framing of the roof. This is perhaps the most important aspect of any timber framing tradition, as it defines how the entire frame is assembled and arranged. Unlike Germanic cultures, which developed complex and sophisticated concepts of roof framing, Celtic roof frames evolved from very simple post buildings with a row of central posts supporting a ridge under the rafters. Note that the related concept in Scandinavian log building has a different origin, derived from closely spaced purlins set into log end-walls. At first heavy planks were laid over the purlins, a configuration evolving over time into rafters laid over more widely spaced purlins.

The Celtic style of room framing practiced on the Swiss Plateau has more in common with Classical framing methods than it does with the Germanic traditions spread throughout most of Europe. Classical stone architecture, for example, derived from a more ancient form of wooden post-and-lintel construction that relied on a roof structure supported by a ridge beam and purlins. This style of roof framing was employed in Roman villas and other buildings that typically had walls built of stone, or on the less sophisticated structures of light half-timbered construction (*opus craticum*).

The Celtic roof employed the basic principles used by ancient Romans, although in a more well developed form. Except for the invention of the tie-beam truss, Rome's timber construction, in contrast to its great achievements in stone and concrete, was rather simplistic. Before the Romans conquered the Swiss Plateau in the first century B.C.E., a sophisticated timber framing practice was known among the latter's people, as attested by numerous excavations (Fig. 2).

The cultures of northern and central Europe depended far more on wood as a building material than did Rome, and they had access to much more suitable timber resources. It stands to reason that they would develop more sophisticated timber framing methods as a result. Though we like to think of these ancient cultures as being primitive compared to the Romans, significant cultures thrived well beyond the Classical world in ancient Europe. Celtic roof frames, however, are based on the same principle of post-and-lintel construction that served as the basis for Classical forms. In contrast, Germanic carpenters abandoned this technique at an early stage, and the framing and joinery techniques used in Germanic building cultures would develop along a much different line as a result, a line that includes the English and French traditions.

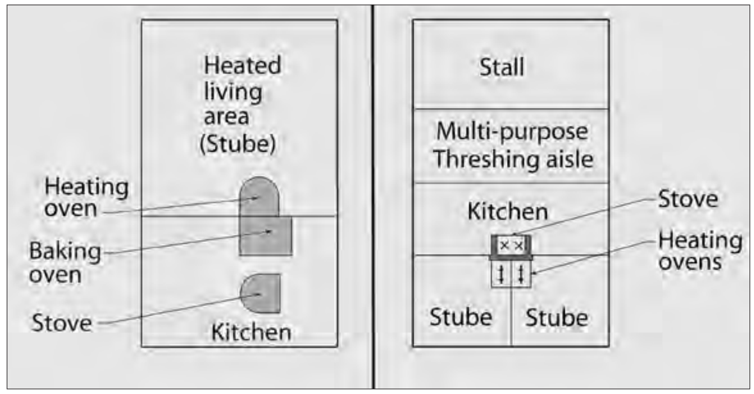
The typical Mediterranean roof style was a low-pitched gable roof supported by five longitudinal beams, reflected in the familiar end elevation of classical stone architecture. The Celtic roof, on the contrary, developed as a steep roof supported by three longitudinal beams and a fairly complex system of bracing. This is the prototypical roof form found throughout the Swiss Plateau that would evolve over the centuries into a variety of different forms (Fig. 3).

A roof with a structural ridge functions very differently from a roof without one: depending on the connections at ridge and wall, rafters might press inward on the walls rather than outward (or neither). In the familiar forms of roof framing without structural ridges, the natural tendency is for the peak to fall under its own weight. Since the rafters are securely fastened to the top of the wall, the lower connections are forced outward, attempting to overturn the wall. The shallower a roof is pitched, the more extreme the outward thrust. This thrust may be resolved by locking both eaves walls together transversely with tie beams (which may be some distance below the top of the wall), or base-tying both rafters in a pair to create a rigid triangle.

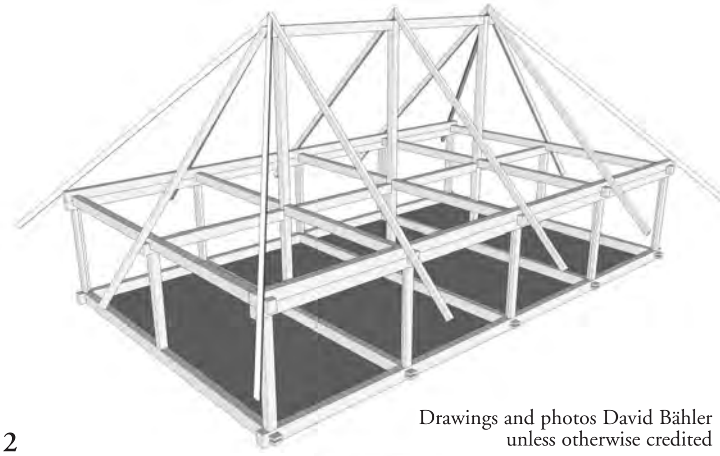
When a structural ridge supports rafters, the ability of the peak to fall is eliminated. Where the primary anchor point in the standing roof is at the rafter's foot, here the primary anchor is at the peak. In fact certain old traditions that employ a ridge beam forgo fastening the rafters to their lower supports at all. This arrangement would not find approval in modern building codes but seems to have performed well in service. Standing rafters seek a horizontal position, that is they attempt to "flatten out," causing the peak to fall and the walls to be thrust outward. Rafters hanging over a structural ridge seek to rotate about the ridge, meaning that they press downward and (if not level-seated) inward on the walls. An unsecured (untied, unbraced) structure with a standing roof would fold outward under the pressure of the rafters, while an unsecured structure with a structural ridge would topple in on itself. The inward force in the latter case is more exaggerated when the roof is steeper, and is negligible in a structure with a shallow roof pitch. This method, then, is inherently well suited to the construction of shallow roofs.

Resisting outward thrust requires joinery designed to resist tension, which is much more complicated and exacting than compression joinery. The simplest solution to this problem is the base-tied rafter pair, such as in the English tying joint for principal rafters, or in the High German *Sparrendach* tradition in southern Germany, where every rafter pair is seated directly into a tie beam (Fig. 4). Low German (northern Germany), French, and some English and North American methods rely on rafters seated in the plate, which is in turn secured with a heavy tie beam.

Resisting inward pressure, however, is comparatively easy and simple. On most structures the framing of interior partitioning walls is sufficient to keep the walls straight. Where extra reinforcement is necessary, such as within a barn, simple spanning beams (*Spannbalken*) joined with nothing more than a stub tenon are all that is needed. The shoulders of such a joint are more than adequate to resist inward force generated by the rafters. Even in steeply pitched roofs where the inward pressure is greater, these simple spanning beams suffice (Fig. 5).

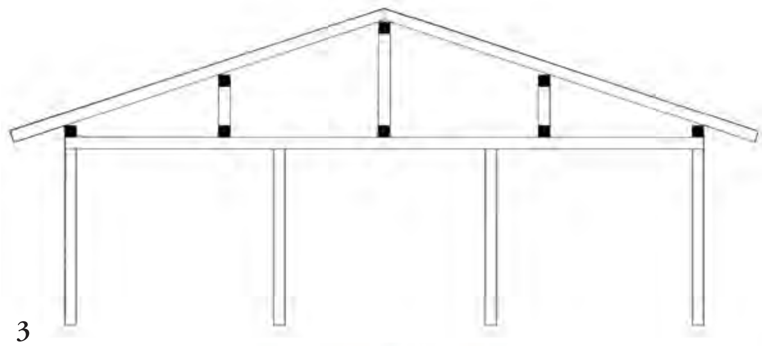


1



Drawings and photos David Bähler
unless otherwise credited

2



3

4

5

1 Swiss Plateau floor plans. Lefthand plan (after Max Gschwend in *Schweizer Bauernhäuser*, 1971) depicts excavation from Federseemoor, dating to Neolithic. Righthand plan depicts typical early modern layout divided into living and agricultural sections. Stone Age example displays aspects of modern structures such as ground plan with 3:5 proportions, entry through kitchen and arrangement of oven, whose exhaust heats living area.

2 Conjectural reconstruction of pre-Roman (first century B.C.E.) dwelling, after Gschwend.

3 Etruscan temple constructed of wood, antecedent of familiar Classical forms, drawn from descriptions given by Vitruvius.

4 Simple *Sparrendach* or standing-style roof, where each rafter pair is seated into tie beam, which often doubles as ceiling joist.

5 *Spannbalken* in service, horizontal beam here connecting two purlins to resist inward movement. Ballenberg Museum, Hofstetten, Canton Bern.

The pure standing-style roof is generally found only on the smallest structures, for example on small American log cabins and modest timber-framed houses, and what is technically a standing roof by virtue of the rafter connections often employs features similar to those of the hanging roof. Though they are uncommon, some hybrid roofs even have seated rafters and a structural ridge. The most common Germanic form throughout Western Europe, and familiar as well to American framers, is the standing-style roof supported midspan by two heavy purlins, from the ancient Viking longhouse to the classic Dutch- and English-style barns (Fig. 6).

Adding purlins does greatly reduce thrust generated by rafters, but only a ridge beam can eliminate it. In cases of seated rafters with a structural ridge, the secure fastening on the rafter feet is necessary only to resist uplift by wind forces.

Perhaps the most immediately obvious advantage of hanging rafters is the fact that it is possible to pass them over the exterior walls. There is no joint reducing the strength of the rafter above the wall, and so it is a simple matter to extend them to form generous overhangs (Fig. 7).

Rafters that are deeply seated cannot be extended very far past the walls because of their loss of cross-section and are typically projected at a fraction of their full depth. Structures with seated rafters might lack any overhang at all, while others employ short stub rafters kicked out at a somewhat shallower angle than the roof to provide some protection for the walls, whereas hanging rafters may be extended several feet past the walls, even in overhangs that to our eyes appear excessively large (Fig. 8).

But the chief structural advantage of the ridge is the great ease with which the system can be adapted to any roof pitch. The design works equally as well on a shallow-pitched roof as it does on a steep one. Simple standing roofs are incompatible with a low roof angle, as we have seen, even if ameliorating modifications are possible, such as the addition of purlins. But in general the structural ridge is better suited to low pitches and is the simplest solution.

The prototypical form of the ridge roof as found on the Swiss Plateau is called *Hochstudbau* (high post construction), with ridge beam supported by tall posts that reach up from the foundation, clearly derived from ancient post-and-lintel construction, and with joinery often reflective of this archaic origin (Fig. 9).

The Neolithic post and lintel frame (in this context 3000 to 2500 B.C.E.) tended to use tall forked posts to support the ridge, which was lashed in place. This evolved into a bridle joint, where a fork at the top of the ridge post captures a necklike reduction cut into the ridge beam.

This simple form of roof framing has survived in many examples, but most regions along the Swiss Plateau developed the concept further. High post construction imposes a strict design limit on a structure; the central row of posts dictates that the floor plan must be divided along the ridge. Carpenters in the Middle Ages developed methods of redirecting the roof load by placing the ridge post on a horizontal beam which is in turn supported by two side posts. This allows the more practical division of the space into three partitions that do not necessarily have to be equal. The side posts might be carried up to support intermediate purlins, resulting in a roof supported at five points much like ancient Mediterranean roofs. This multiple post-row construction is generally referred to as *Mehrständerreihenbau* (Figs. 10 and 11).

In the Romandy, the French-speaking regions of western Switzerland, this pattern was developed to an extreme. Particularly in the Jura Mountains, we find large, wide stone structures with roofs supported by seven rows of posts holding six purlins and a ridge beam, not to mention the purlins located above the walls (Fig. 12).

Here the posts often are not seated in timber sills, rather they rest on heavy stone pillars. One might be tempted to link this construction with an ancient Roman influence, but it is known to descend from the same timber tradition still practiced on the Swiss Plateau to the east.

Carpenters in the central region of the plateau developed high post construction in a different direction. Here the roofs are very steep, built to support thatch. Farmers wished to have houses with large open attic spaces so they could store large quantities of hay, which led over time to the development of *Hängewerk*, a version of kingpost-truss framing.

The typical method of high post construction in this region uses a tall post (the *Hochstud*) combined with two long main braces or *Sperr-Rafen* (blocking rafters). To free up the loft space and allow easy movement through the middle, local carpenters invented a simple truss to take the place of the intrusive tall post. The blocking rafters are enlarged and capture the top of the ridge post. The ridge extends perhaps halfway to the loft floor, where it is joined into a crossbeam. The interrupted post is called a *Hängesäule*. The resulting framework supports the ridge load and carries it to the walls (Fig. 13).

The use of trusswork led to the development of a widespread building tradition throughout the region, commonly employed in the roof construction of castles, churches and the like.

6 North American barn (its tie beam cut for more convenient hay storage) with standing rafter roof supported midspan by heavy purlins, technique having ancient Germanic roots. Cass County, Indiana.

7 Rafters projecting over flying purlin, without joints or fasteners, to form broad overhang. Ballenberg Museum, Hofstetten, Canton Bern.

8 *Aufschiebling*, roof sprockets joined into primary rafters and projected at slightly shallower angle to form overhang, configuration also used in North American barns without flying purlin support. Ballenberg Museum.

9 *Hochstudbau*, roof structure supported by walls and ridge posts descending to foundation.

10, 11 *Mehrständerreihenbau* (multiple-post-row construction), where multiple uprights through interior support roof structure. Ridge posts typically land on upper cross beam rather than sills, so as not to intrude into living space.

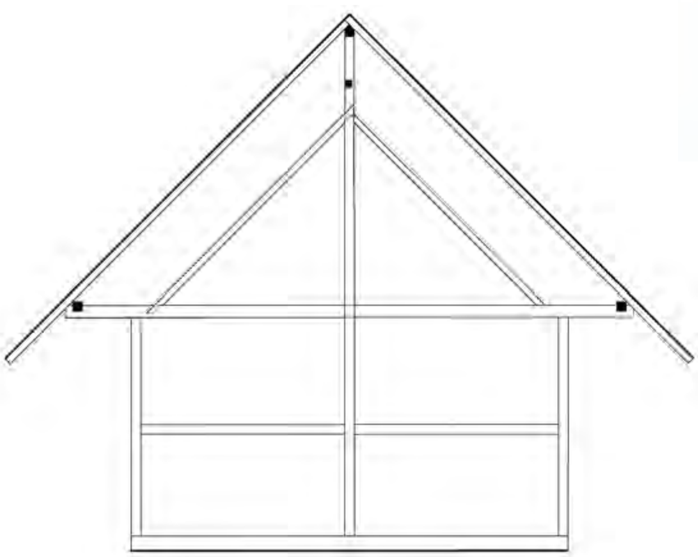
12 Typical framing of western Switzerland and Jura Mountains, with seven support beams (six purlins plus ridge beam) for rafters.

13 Raised truss form common in Upper Aargau and Lower Emmental regions of Swiss Plateau.

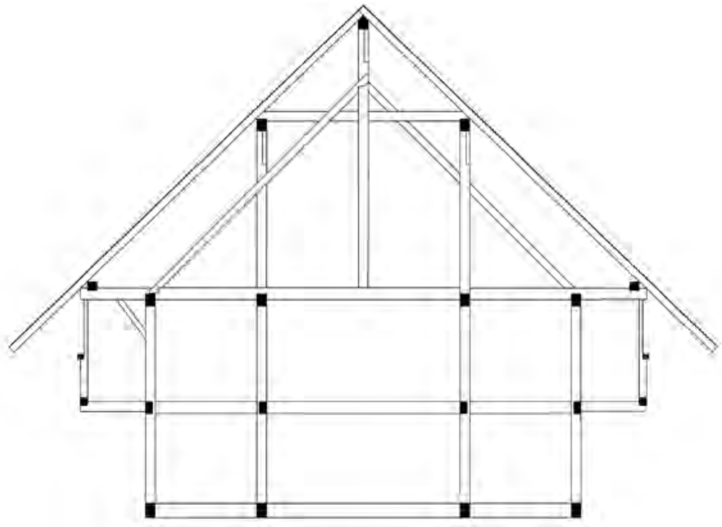
6

7

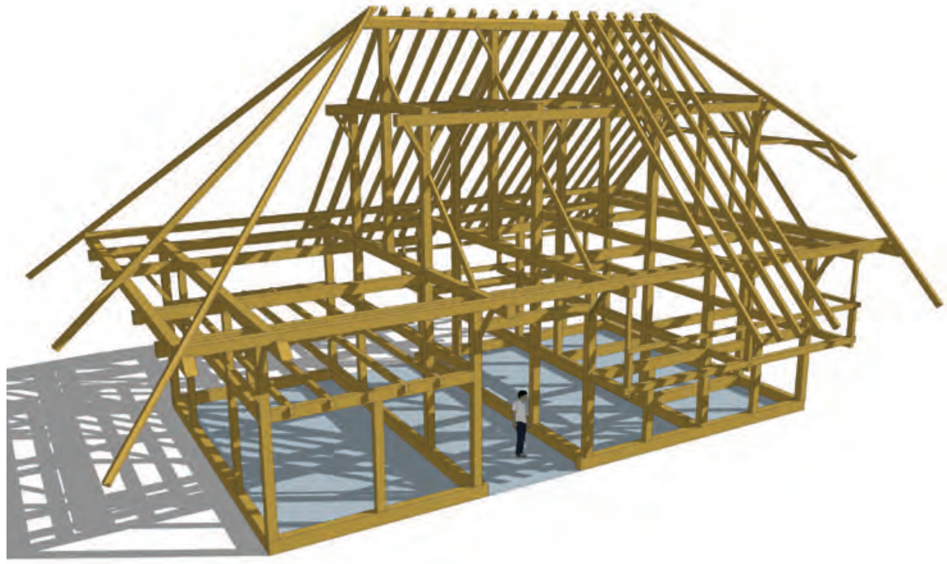
8



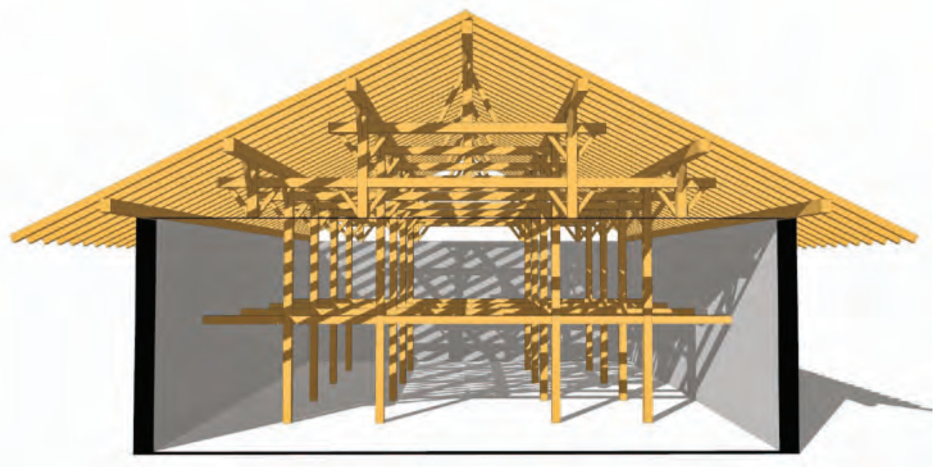
9



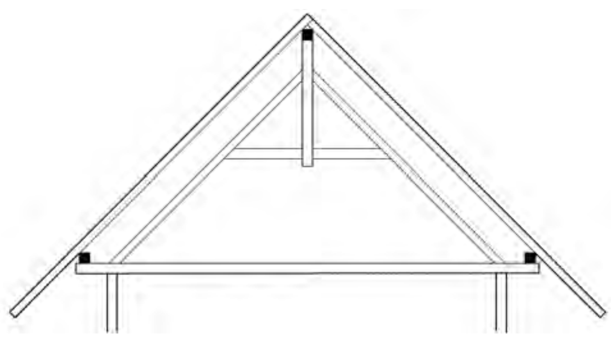
10



11



12



13

Elsewhere on the plateau, other methods were developed to solve the problem of mobility in the loft space. The most common is to use a modified form of multiple post-row construction, where a beam is laid across the purlins and supports the ridge post, creating an open passage between the purlin posts. Variations of this technique use different methods of bracing (Fig. 14).

Roof structure detached from the framing of the walls evolved later. In the early forms we have been discussing, the primary support posts rest on sills and extend through the entire height of the structure, mandating that the layout of the rooms is at least partially defined by the framing of the roof. Later, a self-supporting roof frame, or *Dachstuhl* (roof chair), instead rests on top of the walls and does not impose definite limits on the floor plan below the attic (Figs. 15 and 16).

The detached roof frame offers a tremendous advantage over older methods. The simplest rests on support posts terminated at the attic floor beams. This system, the *Stehendem Stuhl* (standing chair), relies on posts to support the roof and is particularly common in the Canton of Zürich, where it can be seen in structures dating back to the beginning of the 16th century, and in the central part of the Canton of Bern, where it might be found combined with high-posted framing.

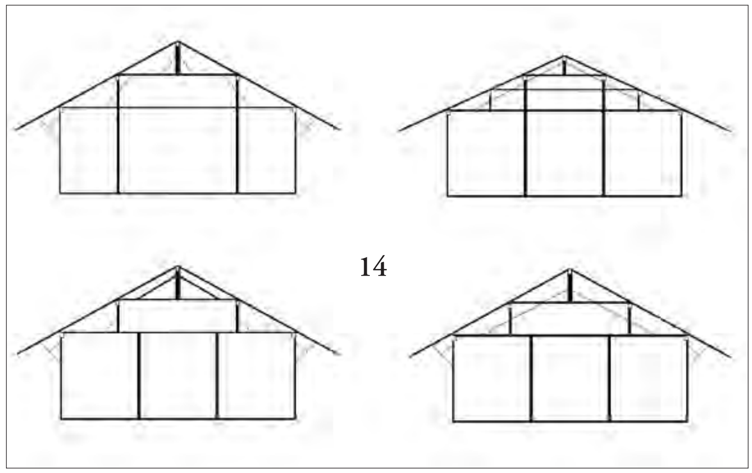
It is not uncommon on newer structures to find a ridge supported beneath by the construction known as a *Liegender Binder* (lying or leaning truss), seen in part in Fig. 17. The inward-canted support posts (*Binderstrebe*) support an upper beam (*Spannriegel*), which in turn supports purlins and a short ridge post. (A tie beam required to resist the thrust of the canted supports is unseen below.) There is some confusion as to the origin of the practice. It may have been introduced from the cities such as Bern and Basel that relied largely on Germanic building methods rather than the Celtic traditions used in rural areas.

One also might encounter instances where a structural ridge and a series of heavy purlins are supported by a true clear-span truss. This is rare, as most structures are partitioned on the interior, eliminating any need for such a clear span. The objective is generally an open roof space rather than an open hall underneath. When the latter is required, however, some form of truss is naturally required. One occasionally encounters a compound truss, where a queenpost truss supports additional truss-like framing for the ridge beam (Fig. 18).

Most architecture on the Swiss Plateau features some form of hipped roof, ranging from the archaic forms with a full hip on both ends of the structure to modern styles that have a *Krüppelwalmdach*, a quarter-hip (Fig. 19). Half-hips are common and, in the Canton of Bern, roofs appear with a half-hip on the front (Fig. 20) and a full hip on the back. In the Alpine regions, structures typically have full-gable roofs.

The structural-ridge roof lends itself easily to the construction of roof hips. The nature of the hip reflects the nature of the roof support structure. A high-posted structure without purlins, for example, lends itself to the construction of full-hip roofs, while a post-row structure lends itself to the construction of half-hips.

Where there are midspan purlins, it is a simple matter to extend the purlins forward of the gable wall to support a beam that in turn supports the jack and hip rafters. These hips are constructed by tying a heavy center rafter into the ridge beam which passes over the hip purlin. Jack rafters are then fastened to the end of the ridge beam and rest on the ends of the hip purlin. Full hips are constructed in a similar manner, with the rafters resting on a hip purlin that rests on the lower support purlins for the primary roof plane (Figs. 19, 20).



14 Alternate forms of multiple-post-row construction as found throughout the Swiss Plateau (after Gschwend and Jäggin).

15 Structure with *Dachstuhl*, or roof framing separate from wall structure, in Affoltern im Emmental, Canton Bern. Framing with plank infill. Roof posts land atop crossbeam running entire width of structure without interruption.

16 Detail of roof structure from same building, as viewed under gable overhang. Two purlin posts visible, with braces lapped to collar, and central angled brace back to unseen interior ridge post.

17 *Liegender Binder*, truss assembly constructed to support purlins and ridge beam, resulting in broad overhang and single roof plane.

18 Liebfrauenkirche, Zürich. Queenpost truss with complication of superposed ridge support.

19 Quarter-hip roof framing. Hip rafters sit across support beams held in place primarily by opposing jack rafters and descend to intermediate support beam in framed overhang.

20 Full- and half-hip framing. Hips descend respectively to wall plates and intermediate support beam in framed overhang.

The ridge roof has advantages over other methods of roof construction, as we have seen, but it also has disadvantages, principally the difficulty in constructing an open attic space of any size. It's simpler to construct an open attic with a standing roof. From the turn of the 19th century, builders abandoned ridge-supported roofs in favor of standing rafter roofs with a kicked-out lower roof to form a broad overhang.

A roof structure relying on a structural ridge is a simple, straightforward structure. The design opens itself up to many possibilities and is easily modified to fit different circumstances. It is less elegant in appearance than other forms of roof construction, such as truss framing, and is not suited to the construction of grand open spaces. It is, however, a thoroughly practical approach that effectively avoids (rather than solves) difficult challenges in timber framing. —David Bähler

David Bähler (dbahler@live.com) is a carpenter near Kokomo, Indiana. He wrote previously on Swiss framing in TF 106 and 110 and will lead a framers' tour of Switzerland in May 2015.

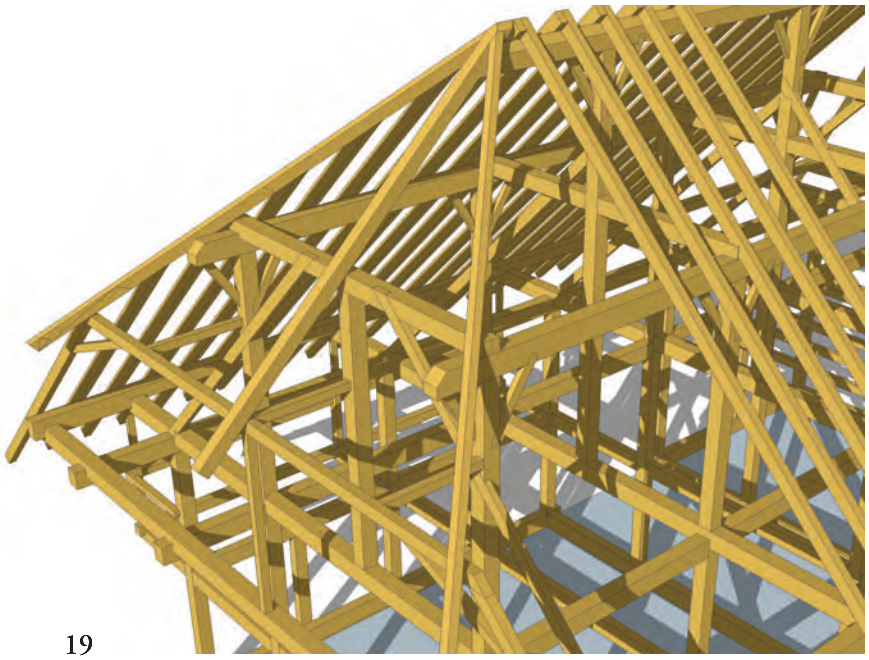
15

18

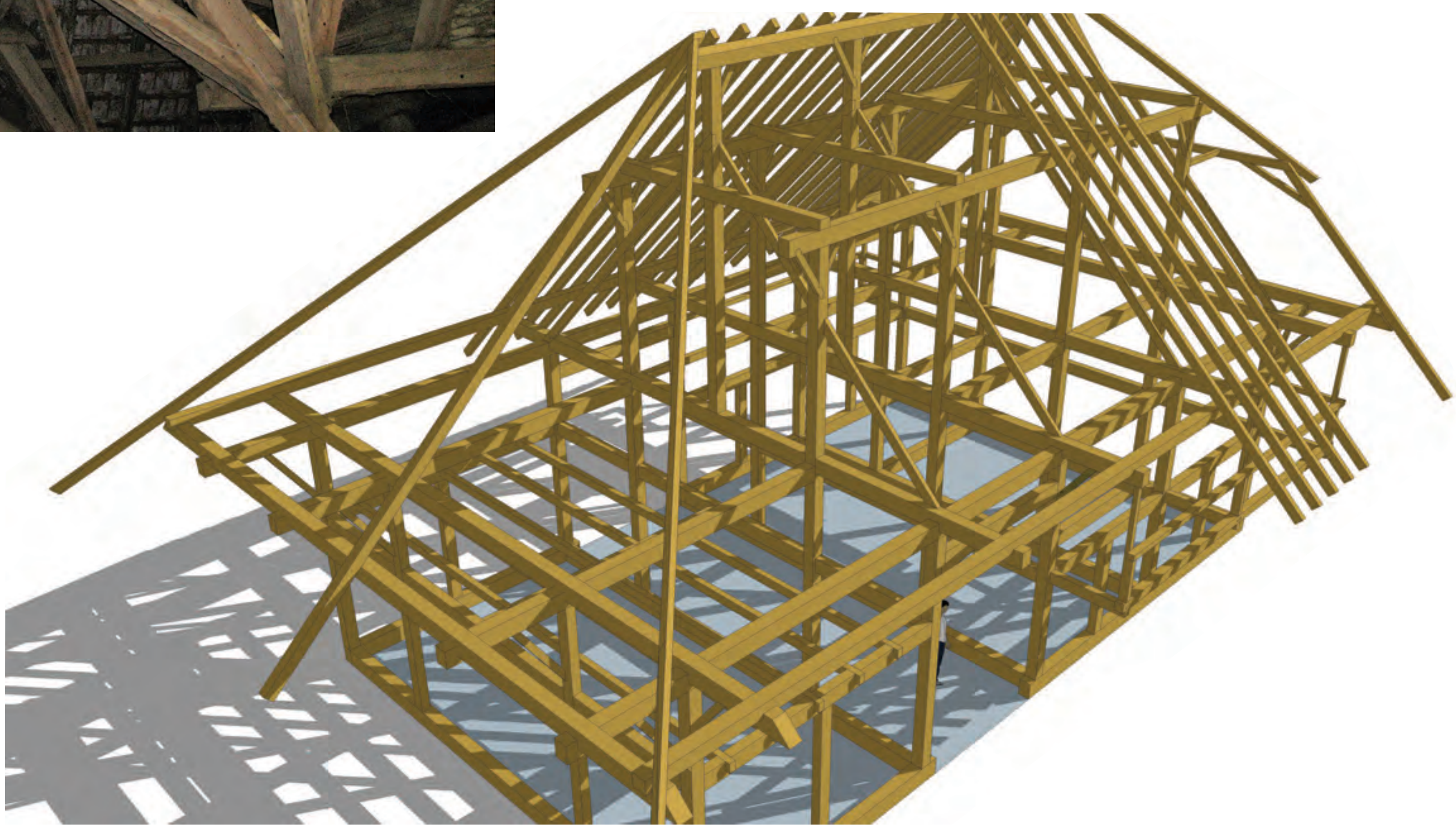
Wikimedia Commons

16

17



19



20

Guild Conference Slide Show 2014 (II)

THIS year's annual conference slide show in August at Manchester, New Hampshire, produced a crop of images of recent work by Guild members and friends. A selection follows. Additional images appeared earlier in the September issue of TF.

1 Pine squared-log and timber dwelling, 5x5m by 6.5m high, designed and built by Anna Siekierska (resting from her labors) and Jakub Szulc in southeast Poland near Sanok, site of Guild's Gwozdziec Synagogue project in 2011. Rye straw chinking.

2, 3 Artist's and writer's studio, Middlefield, Mass., framed in white pine to a modified Jack Sobon design and cut by Heartwood School students. Design and general contracting by Uncarved Block in Becket.

4 Silver Park Main Pavilion, Missoula, Montana, length at centerline about 122 ft., built by Teton Timber Frames, Driggs, Idaho, of white pine sinker logs from the Blackfoot River. Architectural designer, James Hoffman Architects, Missoula; engineer and project conception, Jennifer Anthony, Fearless Engineers PLLC, Missoula; timber frame designer, Curtis Milton, Monolithic Building Services, Jackson, N.H.

Photos: above, Jakub Szulc; below, Brad Morse; bottom, Krista Miller Larson

Linda Balfour

Brad Morse

Philip Hamrick

5–7 Barn 30x46 ft., Duanesburg, N.Y., ca. 1840, as found (top left), during extensive repairs (middle) and after closing in (right), celebrated by owner's extended family. Beech and chestnut posts, pine and hemlock beams. Restoration work by Kim Balfour, Delanson, N.Y.

8 Barn 30x60 ft. with unscarfed 30-ft. tie beams in Washington, Conn., all in rough-sawn white pine from client's property and used for storage, machinery and office space at a working organic farm. Design by Brad Morse of Uncarved Block, Becket, Mass., engineering by Annette Dey of Alstead, N.H.

9 Horse barn 36 ft. 8 in. x 76 ft. 8 in., Bishop, Ga., designed by Pro Building Systems, Atlanta, and built of resawn dry Douglas fir by Holder Bros. Timber Frames, Monroe. Upper brackets support 6-ft. gable overhang, lower brackets a framed pent roof over doorway.

10 Cover 22x45 ft. for existing footbridge over creek and wetland, CMAC Performing Arts Center, Finger Lakes Community College, Hopewell, N.Y., built by Keith Holcomb of Fairport, N.Y., and designed "to make the 180-ft. trip from box office to amphitheater more interesting." Posts each side go to longitudinal girders tied transversely and supported on concrete columns. Oak, chestnut, elm and hemlock agricultural salvage timbers.

Keith Holcomb

A Grand Old Lady Keeps Her Hat

CHRISTMAS is almost upon us with its traditional exchange of Christmas cards, often enough depicting the village church and its steeple set in a snow-covered landscape. Those interested in timber framing will perhaps be considering how the steeple was constructed and actually built.

Building spires on top of church towers in Europe was a fad that started around 800 years ago. Today, while there are still many historical spires around, the exact number has never been determined, nor is it clear how old they are, how they were built or how many were destroyed and rebuilt. The only comprehensive work on European steeples was published in German in 1909 by Friedrich Ostendorf, professor at the Technical University in Karlsruhe. With the help of his students, he spent over a decade collecting information on English, French, Italian and German roof framing and filled 66 sketch books with drawings and notes. Many of the structures he visited were subsequently destroyed in the two world wars, making his investigations extremely valuable. He identified the construction of medieval and postmedieval wooden spires as being a predominately German phenomenon and published sections of some 40 examples in his book.

Several doctoral theses since then have dealt with the construction of groups of spires. One has specifically concentrated on twisted and deformed spires, and occasionally the restoration of a wooden spire has resulted in a small article, leaving possibly hundreds of European spires practically unknown and ready to discover.

Several large historic timber-framed spires still stand in Germany today. The oldest is probably over the huge west tower at the Roman Catholic church of St. Patrokli in the town of Soest in Westfalia (N 51° 34.293′ E 008° 06.468′). The entire tower is over 250 ft. high, of which the spire alone rises 120 ft. with an upper octagonal part 45 ft. in diameter over a lower square section. The oldest parts have been dated with the help of dendrochronology to ca. 1190.

Another impressive spire can be found crowning the west tower of the Lutheran church of St. Johannis in the town of Lüneburg in Lower Saxony (N 53° 14.865′ E 010° 24.746′). The spire alone is approximately 185 ft. high including a massive lower frame set inside the masonry walls. The top of the spire reaches over 350 ft. above ground level and was completed around 1384. These two superlatives were however not the largest according to Ostendorf.

The oldest of three spires that I investigated some 20 years ago is twisted in three sections (Fig. 1). This spire sits atop the stone crossing tower of the Collegiate Church in the village of Rasdorf in Hesse (N 50° 43.143′ E 009° 53.825′). Several repairs and additions to the framing have reduced the original timber material over the years, but enough remains to reconstruct the original design. Dendrochronology dated the youngest piece of original timber to the year 1349.

Photos and drawings © Philip Caston

1 Spire of Collegiate Church, Rasdorf in Hesse, Germany, 14th century.

The octagonal stone tower rises to about 78 ft. above floor level, the upper stage of which is the belfry. The transition to the spire is made by two parallel wall plates that sit freely on the top of the masonry and form two consecutive rings. The octagonal timber spire is taller than the masonry at about 85 ft. high, bringing the whole tower including the spire about 160 ft. above ground level.

This large twisted spire attracted the attention of architectural historians at the end of the 19th century, resulting in a simplified plan and section being published in a renowned atlas. Ostendorf used this as the basis of his drawing published some ten years later, but even his improved version does not capture the complexity of the design and its subsequent modifications. It became necessary to prepare a series of measured drawings and spend several months recording all the idiosyncrasies, to unpeel the younger modifications and to reveal a clear picture of the original and then present the facts in a series of explanatory drawings.

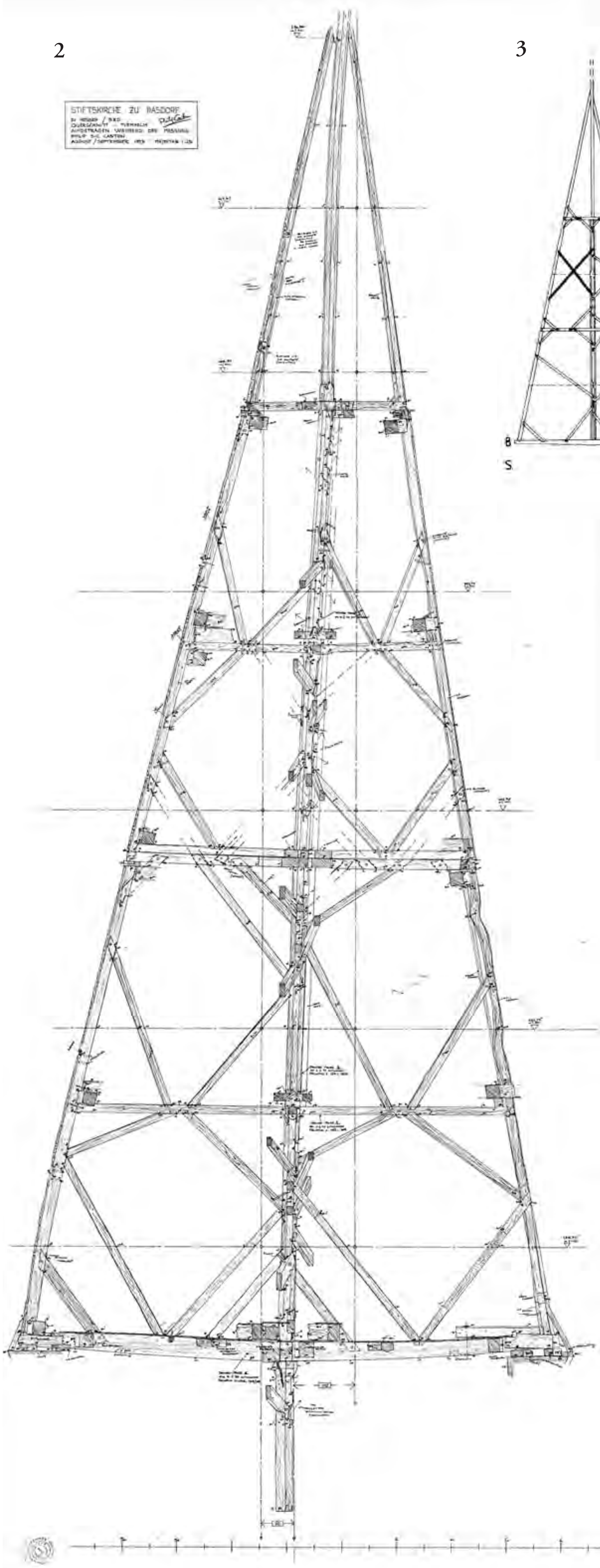
Fig. 2 shows how the spire was recorded to capture as many details as possible, as well as the deformation, and reveals the framing stages.

The spire is an octagonal conical shape, and the unknown builder, who would have been a craftsman framer, could in theory have chosen a variety of ways to make this three-dimensional object. He chose to fabricate four three-stage triangular frames that all intersect in plan view along their vertical central axes (Fig. 3).

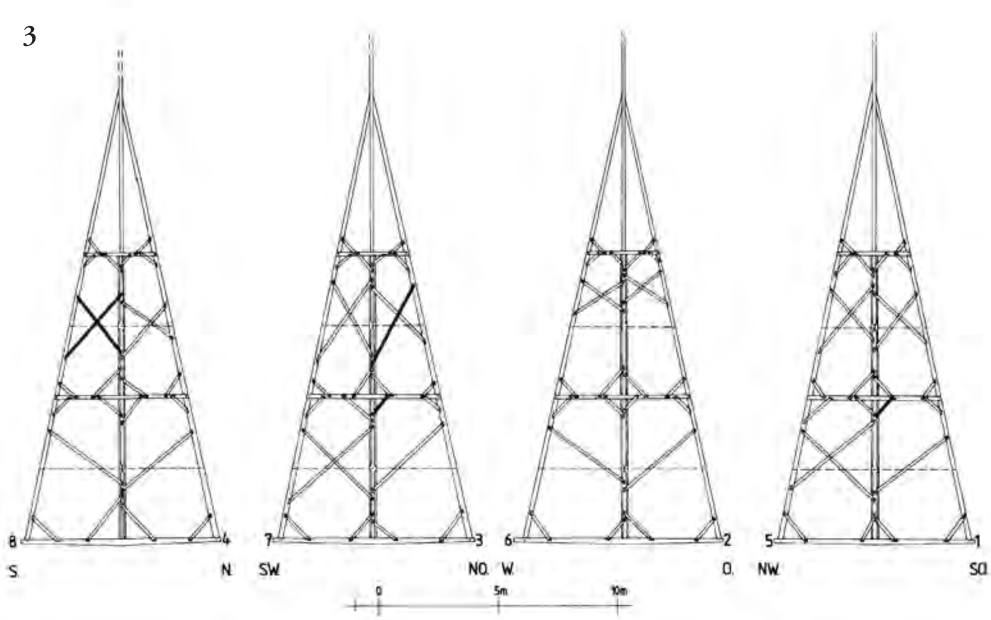
At nearly 100 ft. long, the rafters if continuous would have had to be joined along their length, but in fact they are interrupted. The overall rafter length is divided up into three stages and each has its own independent section. The lower two stages of framing are capped with ring plates, and the upper section has its rafters attached to a central post at the apex (Fig. 4).

The central post, or mast, similarly divided into the three stages, is common to all four triangular frames, linking them together where they intersect along their central axes. To achieve this intersection of different planes, the central post was given an octagonal section so that each plane can join it without compound angle connections.

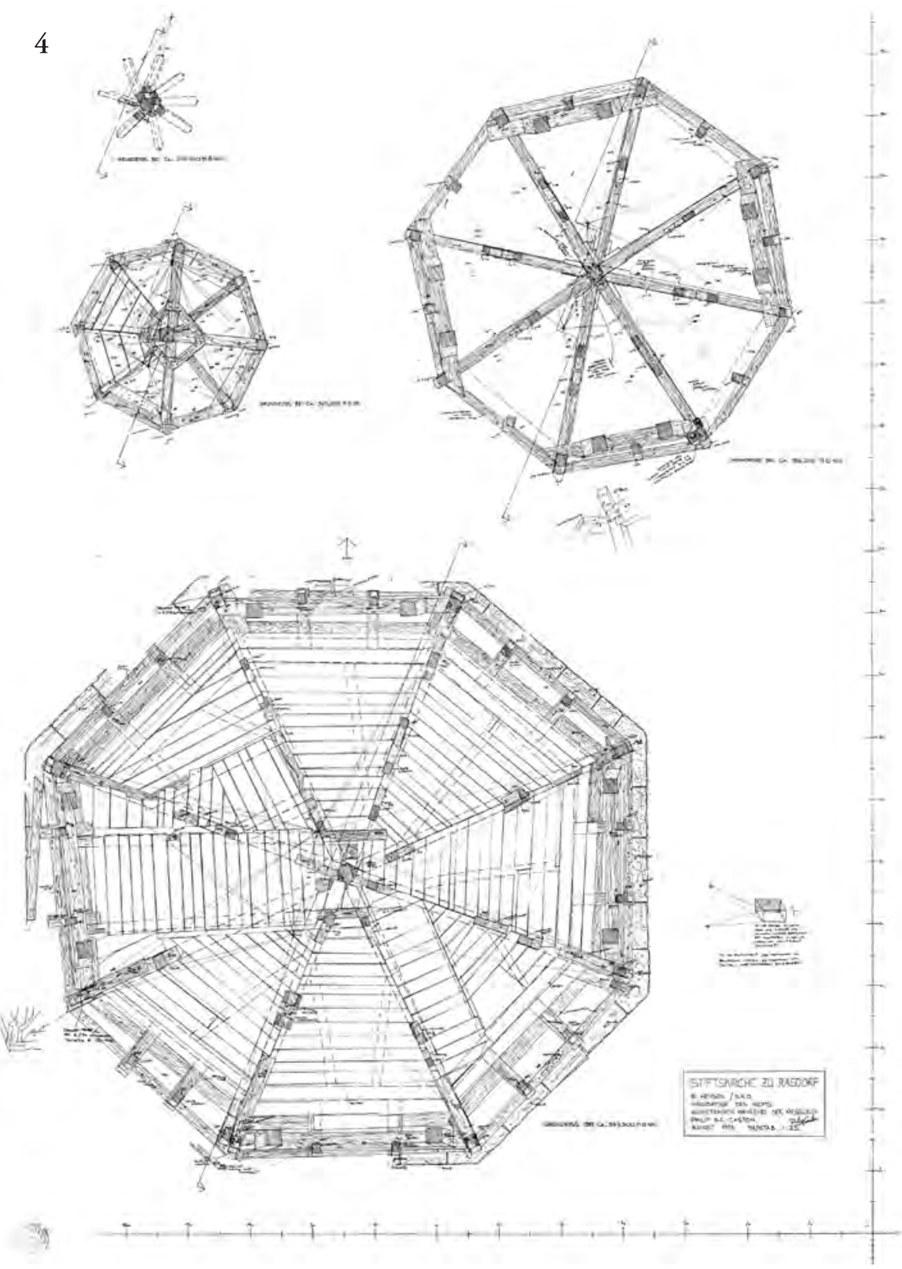
2



3



4

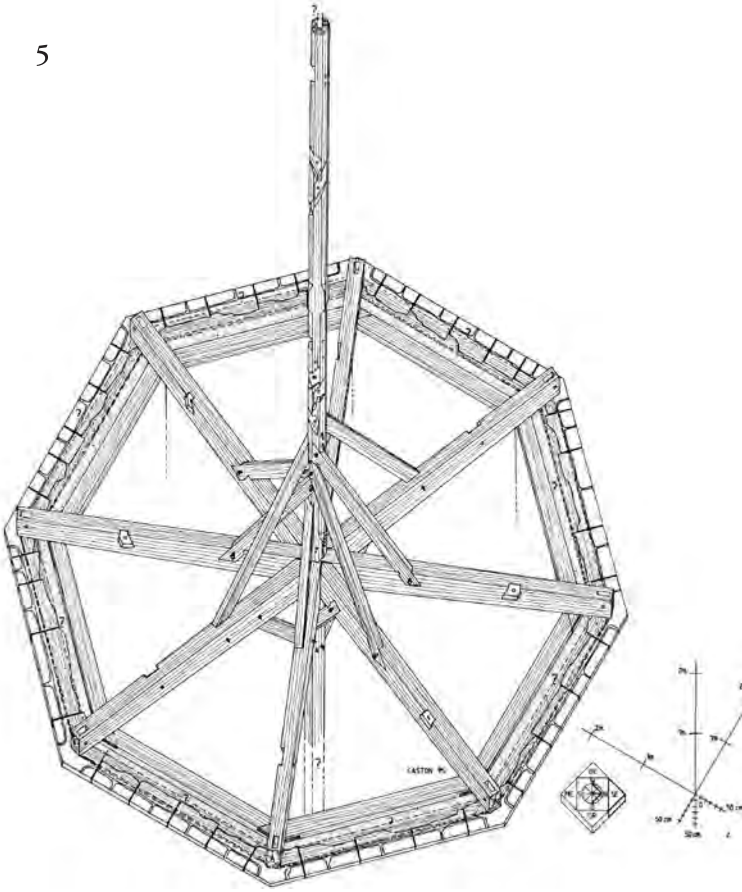


2 Spire measured and drawn on site over many weeks in 1993 at scale of 1:25. Measurements taken from independent vertical-horizontal grid set up using level and plumb-bob and marked off in spire with colored string. Section chosen to document maximum deflection of spire toward southwest.

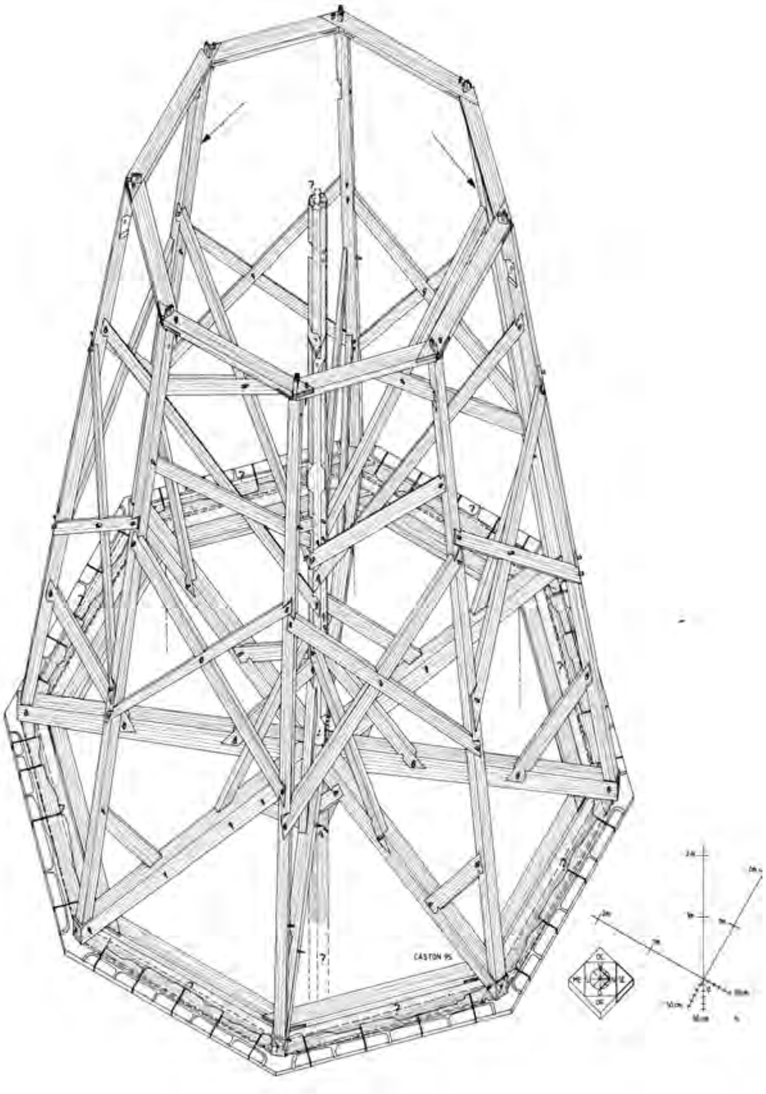
3 At top, four vertical frames of original timbers span between opposite corners over central axis of spire, divided into three stages. Each frame shown with original braces reconstructed from recesses found (white) or from comparison (black).

4 Above, plan views of ring plates and tie beams at base of each successive stage and connection of rafter peaks with mast.

5



6



5 Mast held in position by eight lower bracing pieces.

6 First stage nearing completion, hip rafters locked in place by ring plates, bracing in adjoining faces and in plane of frames.

7 Process repeated for middle stage, braced mast first.

8 As uppermost tier of tie beams was replaced (19th century at latest), reconstruction here based on tier below.

This design is a mixture of two- and three-dimensional thinking. The basic layout of the elements in each frame is two-dimensional and is taken from the standard scribing practice for roof framing used in Germany at the time. The design is heavily influenced by the process. The triangular rafter-and-tie-beam frame would have been laid out flat, i.e., tipped over to a horizontal position, leveled and mounted over a setting-out template. For the purposes of assembling the further elements, the front of each frame becomes the upper surface. The struts and bracing are added, sometimes overlapping other elements, by dropping them into notched lap joints without moving the already assembled parts of the frame. All the parts are set flush with the front (upper) surface. When one frame is finished it is disassembled and stored and the next is set up in the template and built in the same way. The central posts remain on the template and are rotated 45° to accept the next frame.

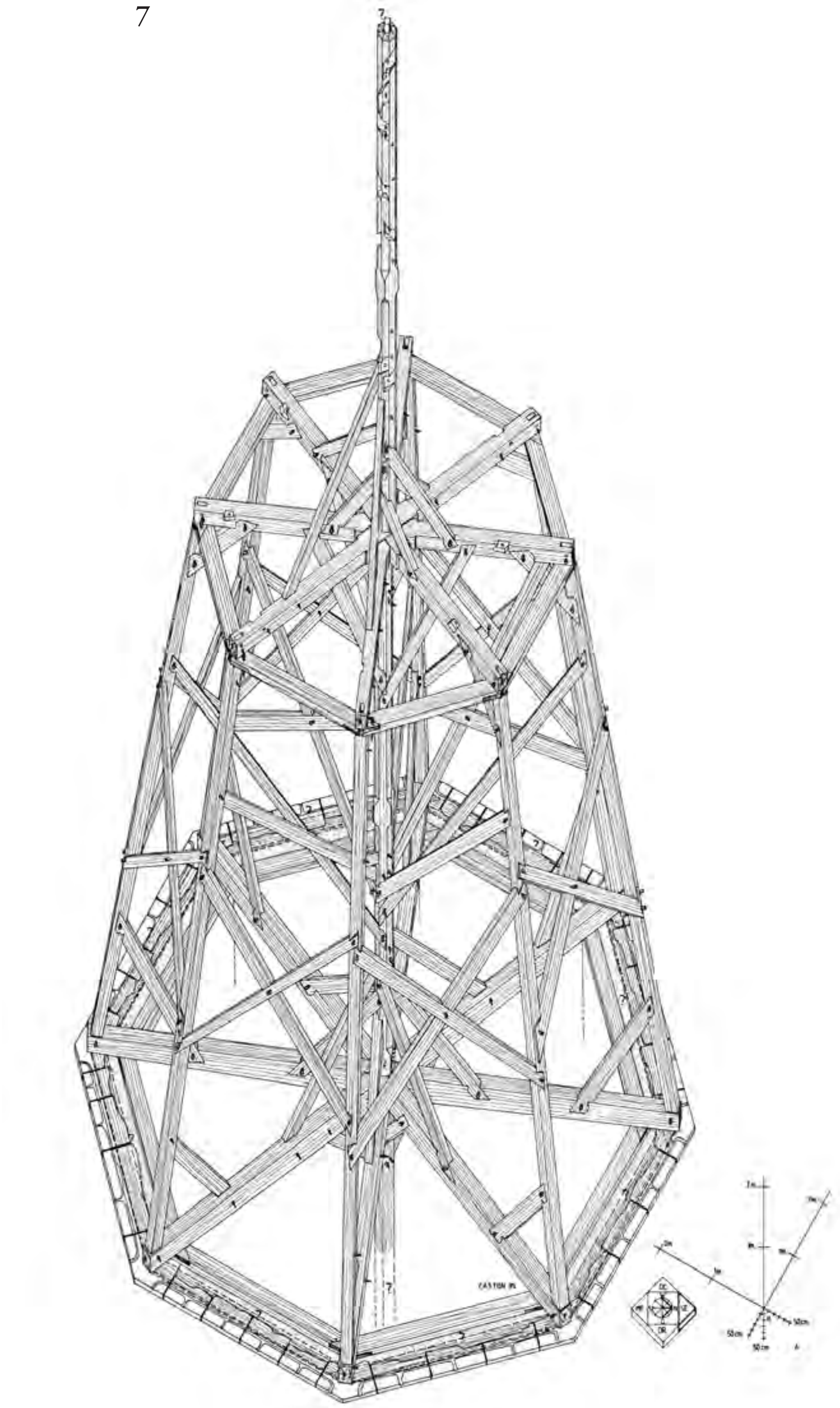
The four intersecting spire frames cannot be simply stood up in their respective vertical planes, and the framer had to think three-dimensionally when it came to actually erecting the assembly. As we have seen, he decided on building three separate stages, thus dividing the hip rafters and central post into three sections. In addition, a fourth post section is mounted under the lowest tie beams, and is likely to have been supported lower down in the tower and divided the lowest tie beam spans in two.

Only two of the four tie beams span continuously from one side to the other. These are at right angles and halved where they intersect at the center. The other two appear to be interrupted and merely butt into the angles made by the two continuous tie beams. I could not ascertain any secret tenons or other connections and it is only the short bracing pieces fixed to the posts with notched lap joints at their ends that hold them in place (Fig. 5).

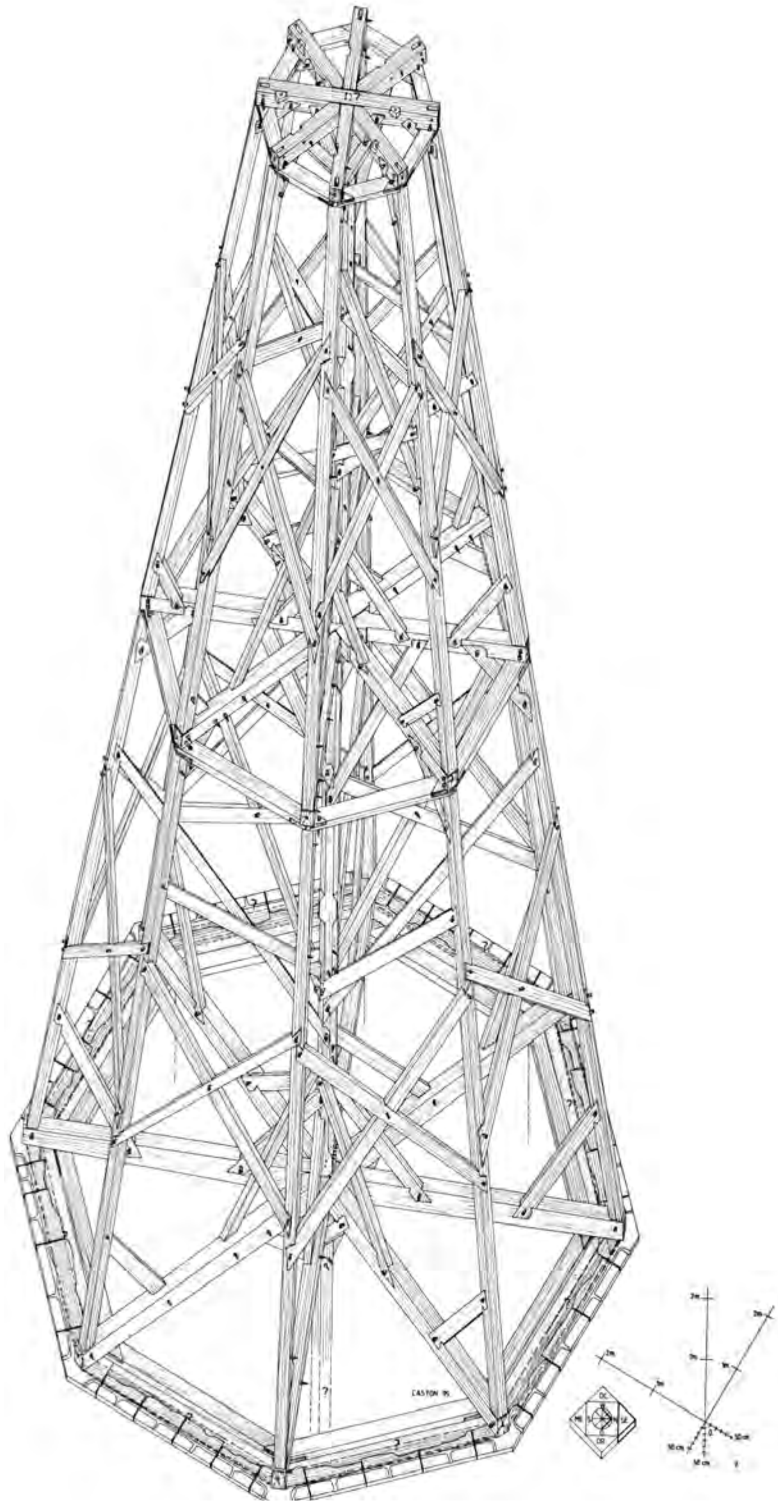
The next piece to have been erected is most likely the center post in the first stage as shown in Fig. 5. As this post is part of all four triangular frame stages, it has four sets of notched recesses for the four sets of bracing pieces, all set at different angles. In order to accommodate their connection, each brace is a different length and connects at an individual height up the post. These braces stabilize the post and lock the four tie beam ends in place at the same time. The post can then be used to stabilize each hip rafter. Two of the eight hip rafters were stabilized with a pair of crossed braces. These rafters (indicated by arrows in Fig. 6) are at right angles to each other (refer to corresponding mortises in Fig. 5), which may indicate that these were the first to be erected. The remaining six are tied back with just one brace at midlevel.

The resultant truncated cone is shown in Fig. 6. During the erection process each hip rafter was tied to its immediate neighbor with a pair of crossed braces set at midlevel in the plane of each face terminating in lap-dovetailed joints. The framers also had to stagger the joints, giving each rafter a unique set of stopped recesses. To make sure that the correct pieces were used, a simple marking system of small notches denoted each of the eight hips, starting with one notch in the southeast corner and ascending to

7



8



eight in an counterclockwise direction. The upper ends of the rafters were cut as long tenons which protrude through the ring plate and into the tie beams at the bottom of the next stage.

The ring plate consists of eight individual planks with each plate spanning between two rafters. The ends of each plate overlap the adjacent and are half-lapped and pegged. The rafter tenons intersect these joints, requiring the plates to be cut out around them. It is not clear how the tenons and plates were actually assembled, but the mortises in the plates are open toward the outside face, making it at least possible for the rafters to be swung into their final position rather than being static, and the plates attached from the inside. Once all the parts are assembled, the corners lock up and work on the next stage can commence.

Building the second stage is a repeat performance of the first. The ring plate has the same function as the wall plate, the center post supports the new layer of ties at midspan as before and the ties are of the same design but with smaller dimensions. They would have been the first elements of the new stage to have been erected and are held firmly in place with tenons, as well as being pinned and with lower bracing pieces connecting to the lower center post and lower rafters. Then, as below, the second stage center post would have been erected and held in place with eight bracing pieces with the double function of holding the short tie beams in place and stabilizing the post (Fig. 7).

The second-stage hip rafters would follow. The majority were secured to the center post using pairs of crossed braces. In one case just one brace was used and the southwestern rafter was not secured at all (no recess). The face bracing, ring plate, uppermost tie beams and tie-to-rafter bracing pieces complete the second stage as in the previous stage (Fig. 8).

The third and final stage forms the apex of the spire's cone shape and is constructed slightly differently. The tops of the rafters converge on the center post. It was impossible to determine from within the spire exactly what kind of joint was used, but it seems likely that the top end of each rafter is notched or housed in a recess in the center post. The northeastern rafter revealed an interesting detail. Horizontal sticks were inserted at regular intervals through the side of the rafter from the base to almost the top (Fig. 9). All had been broken off at both ends leaving just short stubs or holes. These were obviously the remains of a ladder whose rungs had protruded beyond the two adjoining faces and must have been used just during the erection or at least until the external boarding was fixed.

Each rafter is tied back to the center post via a single horizontal brace, tenoned into the tie beam and tied back to it with a small diagonal brace. As each rafter is fixed to the same center post and tied to its neighbors via the ring plate at its base, this geometry forms a series of stable triangles negating the need for any further bracing in the plane of the faces. The framing is complete (Fig. 10) and would have been covered in boards and shingles or slates as it is today to provide the final weather protection.

The majority of the original medieval timbers are still in place and still serving their original function, thus the original design could be accurately reconstructed as shown in the figures. Two serious threats to the spire, however, could have substantially changed this situation. The first was over 200 years ago, on September 10, 1785, when the spire was hit by lightning. It was not ignited nor was there any other serious damage. The real danger came from the trustees of the church who wanted to rebuild the tower and spire in the then-fashionable baroque style of architecture, which would have incorporated a new domed crossing. The prince-bishopric administration rejected two proposals (for which we are thankful), and the spire was repaired by modifying the existing structure.

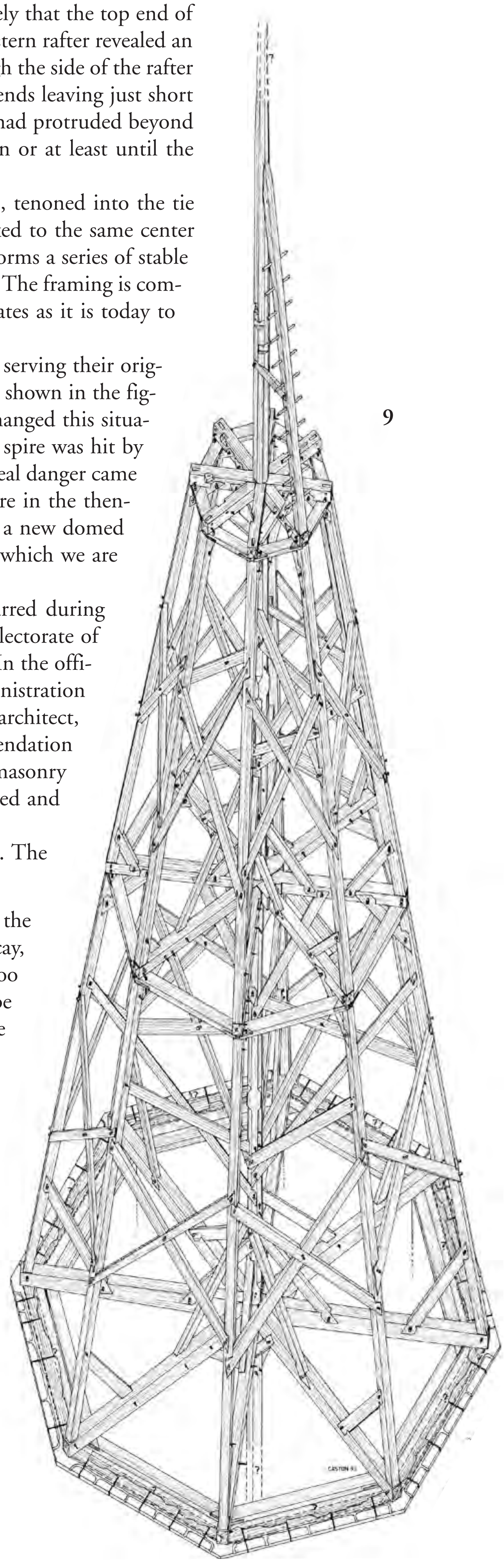
The second close shave came some 60 years later when damage occurred during maintenance work. This time the same administration, now part of the Electorate of Hesse, intended to let the spire fall into dilapidation, later to be replaced. In the official report on the state of the repairs dated March 27, 1841, the administration refused to carry out further repair work based on the decision of its master architect, who considered the spire to be misshapen and overly high. His recommendation was to secure the tower so that no damage should occur to the bell cage or masonry and let the timber spire continue to degenerate until it could be dismantled and replaced with a more graceful structure.

In a reversal of roles, the church now took up the defense of the spire. The diocese's own master architect wrote back:

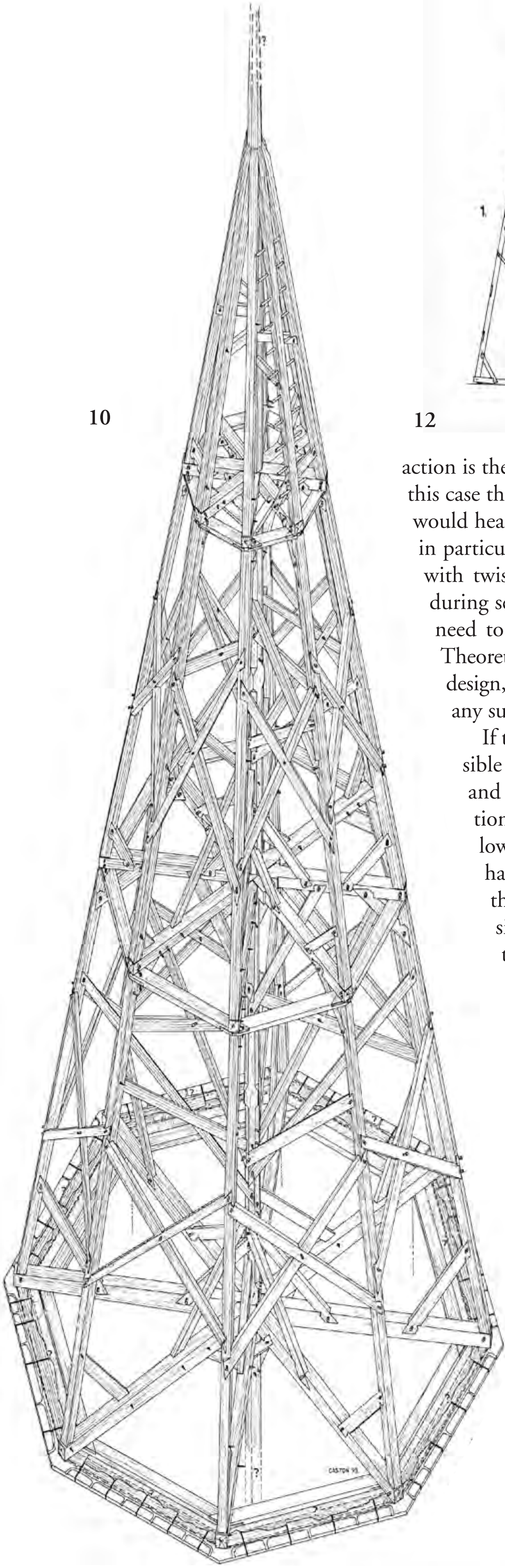
> As the proposal to make just spot repairs to the spire would endanger the interior, the clock, the bell cage, and the vaulting, causing them to decay, furthermore another apparently more graceful construction would be too expensive and the ancient history of this consecrated building would be lost and then appear as if a grand old lady in her traditional costume would suddenly be adorned by a trendy headdress which would make her a laughing stock, it is my opinion that the Electorate's master architect's proposal be opposed.

Luckily for us, the diocese master architect got his way. In the chain of argument it is interesting to see that the "ancient history," the old spire with its original materials, is considered to add to the value of the building and is prized above a new and modern replacement. We do not know how the diocese master architect got his way, but probably, as it would be today, it was the fact that he proposed the cheaper alternative.

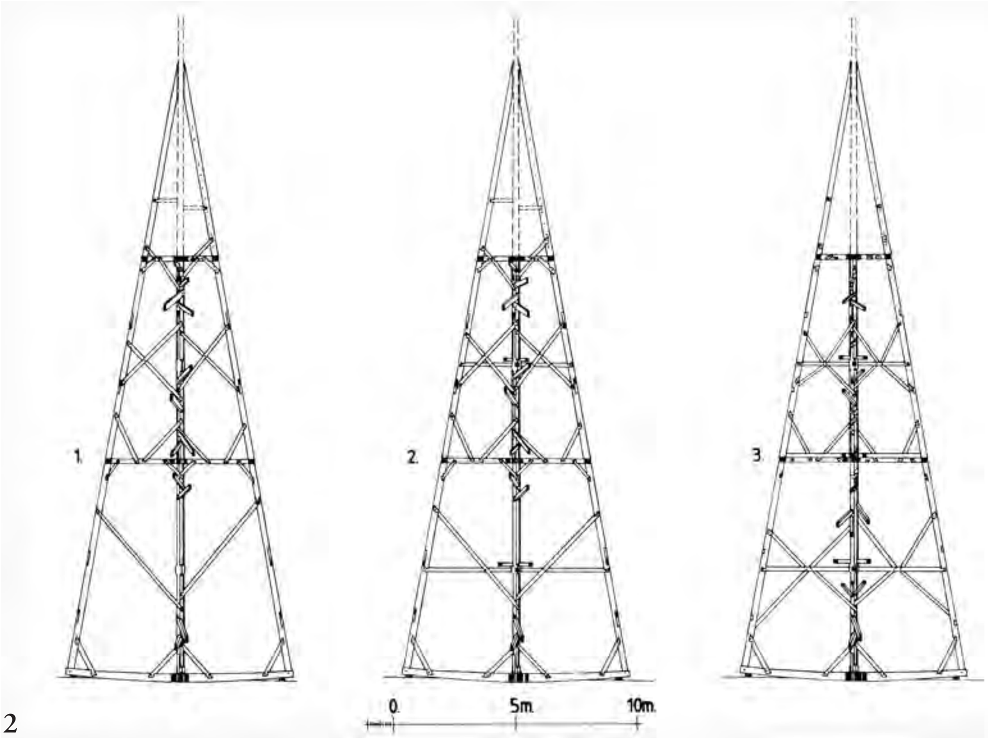
The measured drawing revealed a slight lean to the southwest, but the more obvious deformation, the twist, can best be seen by laying a plan of each stage one over the other (Fig. 11). The base of each rafter and center post in each stage post is hatched, as is the top of the upper stage, and the rafters and post are shown transparent. The rafters in the lower stage do bow out slightly but are otherwise straight, the lower tie beams sag (Fig. 2) and the central post is slightly twisted, which gives the appearance of the bottom stage once being overladen. Possibly a heavier roof covering or a pile up of snow or its own dead weight was too much at some point. Another suggested explanation for a twisting



9

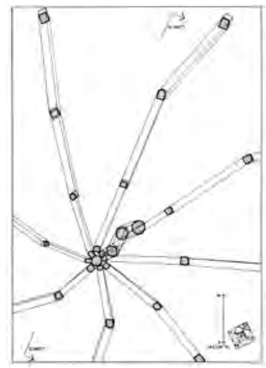


10



12

action is the center post reacting to the heat of the sun. But in this case the post is in the middle of a large volume of air that would heat up around the post on all sides, not favoring one in particular. Perhaps the center posts were made from trees with twisted grain, which might have initiated a rotation during seasoning because of reaction wood, but this would need to be established by a new inspection of the spire. Theoretically the twist we see could also be by deliberate design, but there is no written or other evidence to support any such speculation.



11

If the rotation were to continue, then it might be possible to determine the cause, but several modifications and repairs have stabilized any movement, "freezing" the twist in its current position. The first of these was the insertion of horizontal collars at mid-level of the lowest and middle stages (Fig. 12) at an unknown date. These no longer exist, having been replaced in the 19th century. Their original connection recesses in the center post and rafters remain, except for one likely location on the north side never mortised. If these collars had been part of the original design, then they probably would not have been attached to the central post in such an amateur way. These collars and the majority of the bracing were replaced with smaller-dimensioned unshaped sawn oak pieces that can be easily distinguished from the original medieval oak members (Fig. 13). The trunk of one of the replacement collars was felled between 1833 and 1849, linking it and the rest of these members to the diocese master architect's intervention to save the spire.

The 19th-century repairs also included an additional tie beam at the base of the middle stage and a new tie beam ring and upper stage central post (Fig. 14). The two main tie beams are halved at their right-angle crossing, but the connection of the intermediate tie beams has been changed. The intermediates form trimmed joists, each one connecting into a short trimming joist spanning between two adjacent main ties.

9 Rafter with ladder rungs probably erected to allow worker access to apex for remaining rafter peak placement.

10 Original framing complete. Braced in every plane, spire should not deform in expected conditions.

11 Despite thorough bracing, overlay of plan sections taken at tie-beam levels shows over 4 ft. of horizontal displacement at top of spire.

12 Phases of framing: original 14th-century design; first modification to stiffen frame (18th century?); new collars and bracing c. 1841.

13

14

15

13 Replacement 19th-century collars join mast awkwardly in upper half of second stage.

14 Top tier of tie beams reached by elderly wooden ladders. Last ladder at upper right.

15 Stiffening trestle added late 19th century.

16 Author in 1998, with notched-lap brace.

In addition, the center post in the middle stage received a full height secondary post and in the lower stage it received an additional half-height support above a new collar. A further stabilizing of the spire followed with the insertion of a series of trestles, each comprising an upper and lower sill stiffened by a pair of crossed braces, under the rafters (Fig. 15). This system is described in a famous German textbook, *Lehrbuch der gotischen Konstruktionen,* by G. Ungewitter, 1890 (and still in print). The Rasdorf trestles could not be dated, but the resemblance of their arrangement to the textbook description suggests that the trestles could have been added at around this time. As they had to be inserted into the existing spire framing, they could not quite follow the book. The lower sills of the trestles sit directly on collars and tie beams, but the uppers are wedged in tight and are bolted to the rafters for additional stability.

Each of these different repairs reflects the tactics of its time. They are in themselves a valuable historical collection and should similarly be preserved in future restorations (Fig. 16). This is what happens when a grand old lady keeps her hat—a tribute to the combined efforts of many generations. —Philip S. C. Caston

Philip Caston (caston@hs-nb.de) wrote about Cambridge University's Mathematical Bridge in TF 113. For original research on American steeples, see TF 83, 85–87 and 89 or "Historic American Timber-Framed Steeples in PDF" at tfguild.org/publications/guild-books.

16

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