TIMBER FRAMING

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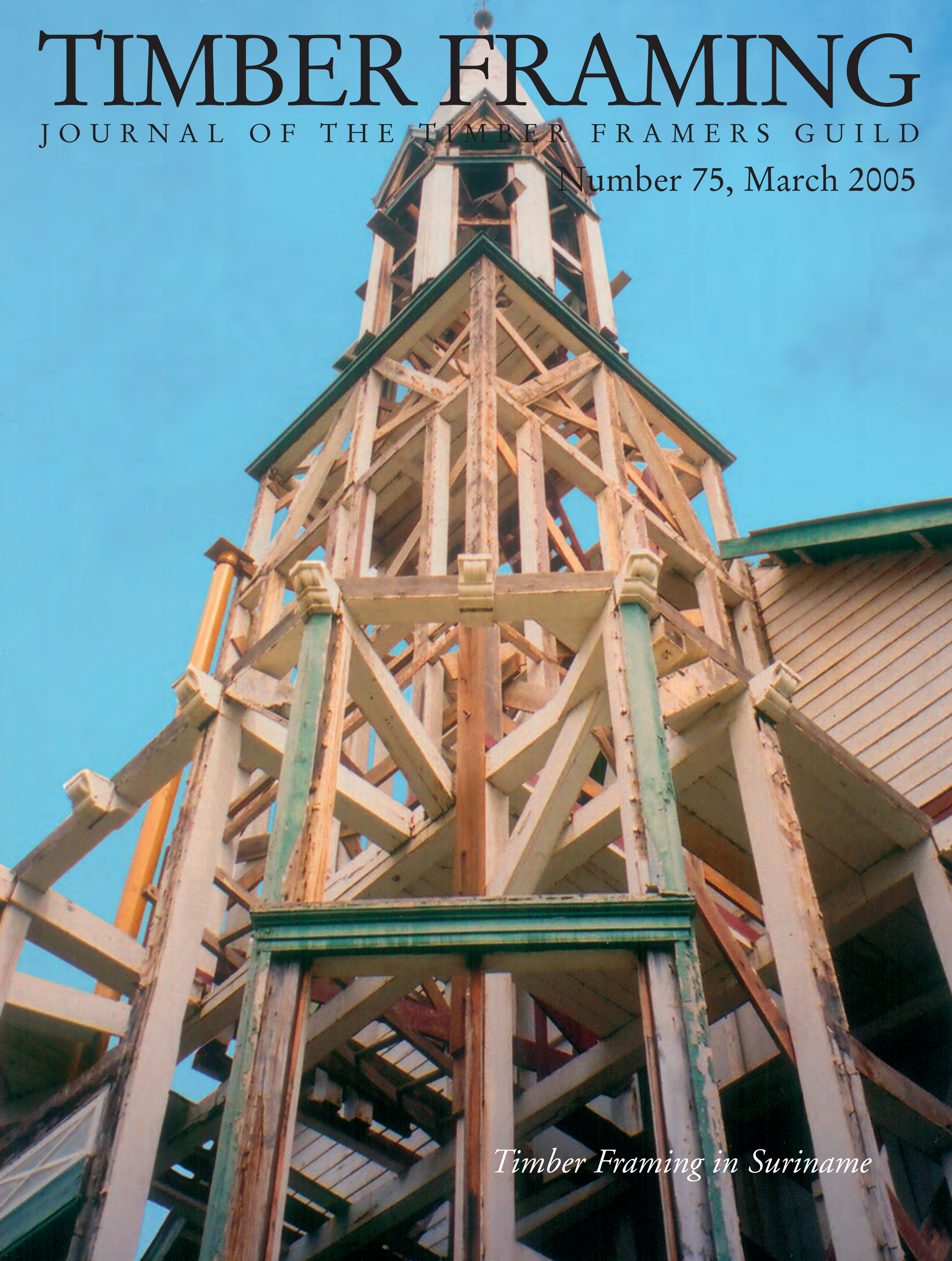

Timber Framing in Suriname

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On the cover, restoration underway of the Evangelische Broeder Gemeente (Moravian) church tower at Nickerie, Suriname (Carel van Hest, architect in charge). The tower, put in service in 1902, is 75 ft. high and measures about 14 ft. 2 in. by 17 ft. 7 in. at its base, tapering to 10 ft. 8 in. square at the top. Photo Carel van Hest.

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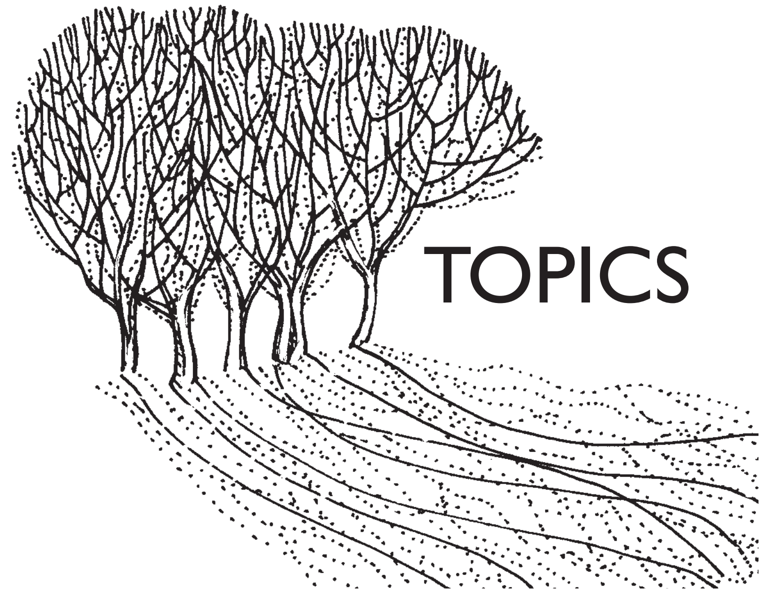


TOPICS

A Polish History Lesson

THE remote village of Narew, in the northeastern part of Poland, is neither unique nor especially significant compared with thousands of other villages of unrecorded structures throughout the country and Eastern Europe. Significant structures such as churches stand in Narew today because of sporadic renovation. Other religious buildings, especially synagogues, have not fared as well. All of the synagogues in the region were deliberately destroyed during World War II (although many had been documented by hand on paper in 1923). In addition, the region lost a Russian Orthodox church to fire in the last decade and another was partly burned.

I went to Narew last spring to help document two 18th-century timber-framed churches with professors Rick and Laura Brown of the Massachusetts College of Art and 15 of their students; Nat Crosby, an adjunct faculty member from Wentworth Institute of Technology's architecture department; and the Guild's Ed Levin. Two Polish anthropologists, our translators and two Lithuanian architecture students joined us for 16 days. I was willing to go for a history lesson and the opportunity to photograph some amazing structures that aren't expected to last through this century. Their demise is not expected for structural reasons (indeed, these buildings are magnificently engineered), but rather because of the likely failure of any wood structure supported only by dwindling numbers of aging parishioners.

Poland's villagers are now slowly accepting the idea of the importance of conservation efforts. One kind of conservation, if only on paper, is through significant documentation in photographs, architectural drawings and first-person accounts from villagers. I was ready to be as hands-on as possible; bell towers, attics, narrow gaps and third-story balconies were where I wanted to be. I had a 4x5 field camera and new hiking boots.

Our group had three teams: measurers, photographers and site historians. The measurers collected data by laying tape measures and other instruments to each wall, floor, beam and molding, and entering the information into computers equipped with CAD software. Photographers collected countless images, and the site historians gathered stories from local residents and nearby villages.

Measuring was the most intensive part. Over four days, we scurried up scaffolding, leaned from ladders, crawled on catwalks, traversed transepts and performed other calisthenics to capture the measurements needed. Of course, it's impossible to capture everything that has happened during each church's lifetime—the baptisms, confirmations, marriages, wars, invasions and religious celebrations. Like other cherished centers, Narew's churches are living entities. They remained open and active during our visit (we saw a wedding, a funeral and a blessing of the fields during our four days) and we scheduled around their events. All was quiet, sacred and welcoming inside. Throughout our stay, women periodically entered the Catholic church to pray. The Orthodox church was closed except for scheduled events. Our discussions were hushed and held in remote recesses of the church, if not outside or at lunchtime in the priest's home nearby.

America's no-calorie, non-dairy, sugar-free, low-carb, low-fat and low-content fast food does not prepare one for the amazing tastes of Poland's slow food: *pierogi* (plump little dumplings filled with meat, cabbage, and cheese), *golabki* (a traditional rice and beef filling wrapped in cabbage), *barszcz z uszkami* (beetroot with different dumplings), *bitki wolowe* and *kasza* (both grits), *kotlet schabowy* (breaded pork chops), as well as *kielbasa*, fresh cheeses and vegetables, hearty breads, homemade doughnuts, soups and stews. After hours of travel and miles of trekking, it was easy to accept a crostini with *smalec* (a traditional spread made of beer and fat also known as fried lard) without thinking twice. I did think twice about having a second. We were offered *piwo* (beer), *wino* (wine), Zabruwka (a favorite brand of vodka), Hoop brand cola, and something I called "jam water"—water infused with strawberry or cherry preserves.

Green. Around the churches as far as the eye can see is a healthy green. Abundant expanses of fields and lawns are speckled with the brown-gray earth tones of houses, barns, tree trunks, roads and the infrequent horse-drawn wagon. According to one older Narew resident, the fields around the village used to be pasture and the common property of the whole village. This common ground was divided about 15 years ago and parceled out to each family. There were also fields, and each family owned its own very long and narrow field. These fields were divided further when the children wanted to get a piece from their families.

I had the opportunity to visit one villager in her home when I tagged along with the site historians and their guide, Jaroslaw Szewczyk, from the Technical University of Bialystok. (Bialystok is the closest metropolitan area, with about 30,000 people.) The villager came to the fence of her property as our ragtag group passed by. To be honest, I was the ragtag one of the bunch, lugging a tripod, field camera and 20-lb. backpack around in 85-degree heat. I was just glad someone offered to let me in out of the sun. Speaking through our translator, the villager was excited to hear that Americans had come all the way to Narew to look at architecture and to connect with residents. She was a good hostess, giving us a tour of her home, offering us homemade doughnuts, showing us a handmade lace tablecloth she would sell in the market and performing for us two Belarussian folk songs (for which she had won awards as a young adult). Her husband came in from the field, scythe in hand, and offered me homemade plum brandy. It was quite good, though I was nervous about getting back out in the noonday heat and swooning under the weight of the pack. The women were allowed to refuse politely.

The house interior was typical for the region, with a stove in the central living area and additional rooms extending outward. In general, these stoves are very large, up to 10 percent of the room, and complicated because of their multiple uses—for cooking, heating, bathing and even winter sleeping (this stove had a built-in sleeping loft). It's typical to have several parts to the stove, sometimes requiring two or three chimneys. The room with the stove continues to be the center of family life in the home, and our hostess was happily anticipating the arrival of a new stove. I would have photographed this room, but she asked me not to.

World War I aerial view of Narew, Poland, showing Orthodox church cupola and roof at lower left and Catholic church at upper right.

According to Jaroslaw Szewczyk, wood was used for all construction through the 1960s until a shortage in the territory led to a ban on its use in the 70s and 80s. Of the houses that remain in Narew from before World War II, both ancient and modern but all in similar style, those with exposed wood were predominantly dark brown. Others were painted white or yellow (thought to mimic the 19th-century tradition of plaster or clay painting respectively). Some were sheathed in shiny pale yellow, green or peach vinyl siding. Most construction from the 90s uses concrete or terra cotta blocks, eventually covered, perhaps years later, in stucco. Some residents believe concrete is richer and better than wood, and they cover the latter with clay or cement (not a new practice). Regardless of their materials, all of these houses are plain structures with small amounts of external ornamentation, or none. The most vibrant colors, intricate ornamentation and best craftsmanship can be found in the churches.

Originally constructed in 1508, the Catholic church in Narew was the first and remains the only one of its kind in the region. Inside, brilliant reds, yellows, golds, silvers and blues mingle richly (overleaf). The tall plank wall panels are a testament to the importance of the structure within the community. We were told that the original planks for its walls would have been cleft from the log, rather than sawn out, and dressed with axes; today, its plank walls come from sawmills built by Germans in World War II to exploit the tremendous wood resource in the region. As for structural walls, whereas houses in the area were built with round logs, the logs in the church had been impeccably refined—hewn square, planed, expertly fitted and intricately painted. When we visited, lengthy streamers of hand-dyed red, yellow and white fabric flowed outward from the center of the ceiling down to the pews in preparation for a first communion celebration, suggesting a giant Maypole. Numerous carved statues populate the altar and shrines while even more loiter piously overhead on each of the six central columns and crossbeams.

In our quest to open every door, measure every nook, note the slightest detail, we made a few remarkable finds: original paint in a room behind the altar believed to be dated before 1758, bullet holes in one of the towers and, most important, the door to a hidden space created by a late renovation.

"They found it?" was the official translation of the parish priest's reaction to our find. "Of course!" was our reply. Accumulations of lumber leaned quietly among years of dust against a large wall of flat, tightly fitted logwork, the backsides of the logs normally seen only from the interior of the church. Today, a board-and-batten

Nat Crosby

The Catholic church in Narew, originally built in 1508.

T. Barbour (3)

Details of hidden 19th-century front (left) and free-standing bell tower.

skin, the new exterior wall of the church, allows about 30 in. of space to view this ex-exterior, the structure's early 1900s façade, finished in the plain style of most rural Polish architecture. A privileged viewer has the chance to see deep scars from its previous existence, and a three-paned window rendered useless by the skin on the outside. Standing in this hidden space, I felt suspended in time. Although the church has two attached towers, a detached wooden bell tower fulfills its duties from 20 yards away and, less majestically, doubles as a shed. The upper floor has a square hole in the wall with enough room to accommodate a 35mm camera, allowing us a perfect vantage point from which to photograph the church. As it turned out, we were not the first to shoot from here.

During World War II, a German sniper was stationed in the right front tower of the church, ridding the landscape of the advancing Russians through a window. Upon figuring this out, the Russians used the cover offered by the bell tower to get a comrade close enough to eliminate the German. The Russian entered the bell tower and, in the same hole from which we photographed, must have set his sights on the window, blindly spraying bullets in an attempt to get rid of the sniper. The glass has been replaced in the window, but a scattershot pattern of bullet holes remained on the inside wall of the church tower.

THE Russian Orthodox church, a short distance down the road, is filled with artificial plants and paintings of Biblical import. The walls are painted in what could be called walk-on-water blue. Silver is the abundant accessory on the altar, walls and ceiling. Noticeably different from the Catholic church, the Orthodox church has no interior columns and offers perimeter wall seating only—and the entire sanctuary was off-limits to the female members of our team. In that room it was also required that an official of the church handle the tape measure over a sacred area of the floor. The church remained closed during the days we were there. We did not dine with the Orthodox priest as we had at the Catholic church, and we could see him only by appointment. The best glimpse some of the team had of the priest and parishioners was while witnessing an evening wedding we were invited to attend.

The interior of the Catholic church decorated for a first communion.

Nat Crosby

Ilan Berube in the attic. Note archaic lapped braces.

Researchers Jason Loik and Brendan Dillon penetrated the attic of the Orthodox church to view timbers that had survived fire 40 years ago.

Ilan Berube

Antoni Pilch, resting his lute in favor of his voice, with his quintet in an after-dinner concert at Wysoka Manor.

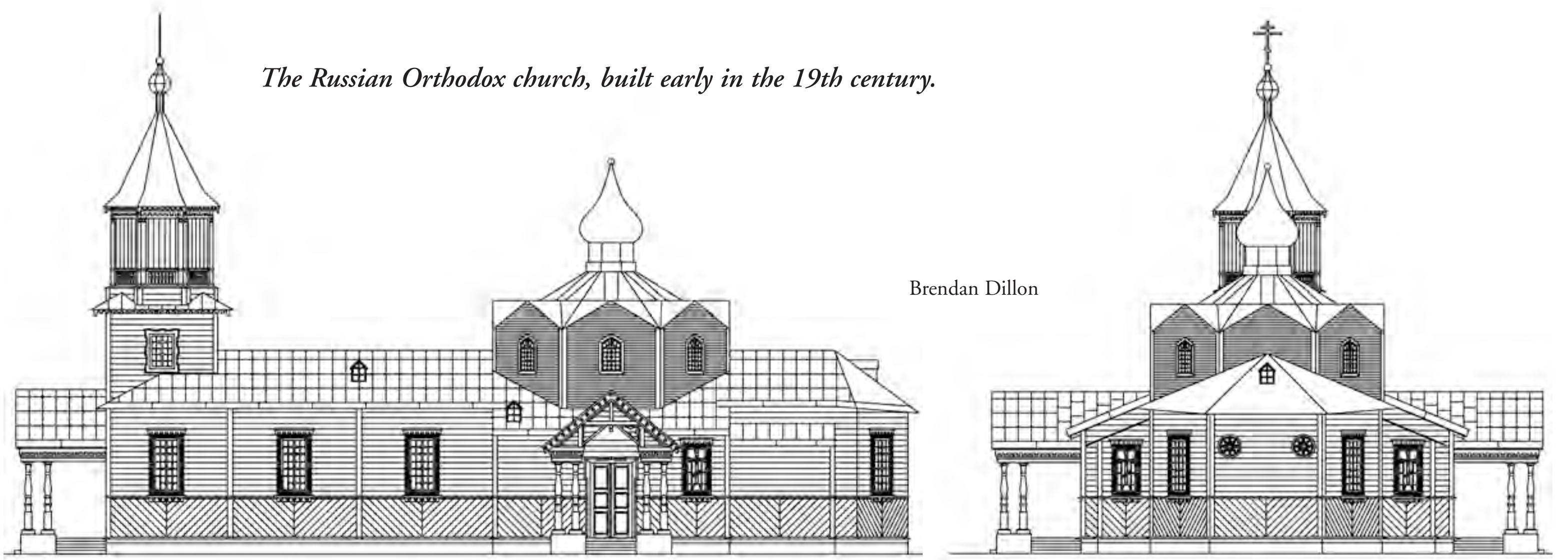
Perhaps the worst enemy of these structures is fire, and the Orthodox church is not unscathed. A portion of the attic displays a charred reminder of the susceptibility of a wood structure to fire—but is also a testament to its strength. To examine the timbers, two students forced their way through a crawlspace barely large enough for an average male torso and returned thoroughly begrimed. They reported finding expertly carved marriage marks on sturdy beams with joints intact despite the fire.

Poland's modern history is one of repeated invasion and occupation. Yet its villagers, with little for resources, continue to carve out lives full of meaning. (Consider the tale of the Polish farmer who climbed up a tree barefoot and came down with shoes.) I embarked on my adventure with little knowledge of Poland's culture and customs but came back with a rich understanding of community pride and individual identity and their importance in a meaningful life.

All of the Polish citizens who organized, aided, fed, housed, entertained and informed us offered us the most amazing kindnesses, hospitality and patience. The love they hold for their country, its traditions and people could be heard in the smallest kind word or the grandest performance. No one embodied this spirit more than Antoni Pilch and his family, who hosted our team for two days and nights in the southern village of Wysoka. Mr. Pilch is an expert tour guide who worked ceaselessly to ensure that our limited time was filled with as much culture as possible. An accomplished lute player, he gave a solo performance on one night and on the other played with his quintet after dinner. We listened in the candlelight, exhausted from the day, motionless, and it was marvelous. When, days later, I landed in Boston, hailed a cab and endured a ride with a driver simultaneously shouting into his cell phone and switching lanes on the highway, I wondered how I could ever have become conditioned to such behavior. —Thom Barbour

Thom Barbour (tbarphoto@yahoo.com) is a photographer in Boston.

The Russian Orthodox church, built early in the 19th century.



Brendan Dillon

Lessons of the Woodlot

All photos Jack A. Sobon

WORKING up a timber right from a tree in the forest has always been a fascination and a delight for me. Throughout my career, whenever the situation availed itself, there I was, squaring up a log with a broadaxe right where the tree was felled. Many of my clients had woodlots that could provide timbers for their house or barn. Often the longest ones (the plates and ties) or the specially shaped ones (curved and crotched) were procured on site. It gave pleasure to both the clients and me. But the vast majority of the timbers for my clients were purchased from a local sawmill and I was not involved in their selection, felling and preparation. I merely placed an order and waited for the timbers to arrive, as is the practice of most framers. Though occasionally I knew where the timbers were being cut, I was always left wanting to be more involved in the process.

When I purchased my own 8-acre wooded building lot in 1980, I had the raw materials for my own dwelling as well as a supply of specialty timbers for my clients. I was in the woods more often, selecting, felling and hewing. I also purchased an Alaskan-type portable chainsaw mill for sawing out timbers and boards (the portable band-saw mills were uncommon then). Still, I ordered most of the timber for my jobs from the local sawmills. Again, I was left wanting!

The idea that a timber frame builder could (or should) have his own supply of timber was introduced to me by Anthony Hicks of Britain. When he told me that he owned or leased a total of 1000 acres of British oak for his own work, I was spurred into action. Finally, in 1993, I was able to purchase a 60-acre woodlot across the road from my property that was well stocked, fairly accessible and suitable for my business. My new woodlot would be a working forest, an experiment in managing for sustained yield and an education for me. After 11 years of stewardship, I now reflect upon the lessons learned from that woodlot and offer them to others who might be contemplating such a business investment.

Know your forest. You can't be a responsible steward unless you understand what you are managing. Pick up a field guide and start learning to identify your trees, especially in the winter. Never cut a tree unless you know what it is. My woodlot has 28 different kinds of trees. Some are not native. The blue spruce, Scots pine, and Douglas fir were planted as Christmas trees. Some species (American elm, Northern red oak, and black birch) are represented by a single mature specimen. Had I not been able to identify these individuals, I might have cut one by mistake, reducing the diversity of my forest unknowingly.

Which forest type is it? How old are the trees, and how old is the forest? Is it stable or in transition? Every forest is different. One that grew back from an old field will be far different from one that was cut over periodically but never tilled. Because of the effects of man, most of our eastern forests are in transition. If left alone, they will, in a century or more, revert back to a climax forest. A climax forest is one in which the mix of species in a forest remains relatively stable—that is, the seedlings on the forest floor are the same species as the mature trees. It is self-perpetuating. The forest found by the colonists (old-growth, or virgin, or primeval forest) was for the most part a climax forest (some areas were already under cultivation by native Americans).

But, in truth, nothing in nature is ever truly static. Insects and pathogens can destroy entire species and climate change can upset the balance, so even a climax forest is in a slow transition. Today there is global warming, expected to change the species growing in our northern forests. Understanding all these influences should guide your management decisions.

On my woodlot, the forest types vary depending on such factors as soil type, soil disturbance, solar aspect, ground water and elevation (the property drops 400 ft. vertically from one end to the other). Along the field edges grow pioneer species such as white and gray birch, pin cherry and aspen. In an area cleared 60 years ago, there is an almost pure stand of Eastern white pines about 90 ft. tall. Much of the woodlot is typical northern hardwood forest, sugar maple, American beech, yellow birch and a spattering of Eastern hemlock. But there are lots of red maple, black cherry, and white ash trees interspersed. There are also pockets of northern softwoods such as red spruce and balsam fir. Diversity in a woodlot is a good thing, not only from the utilization standpoint, but also for the stand's resistance to loss from disease and insect infestations and its ability to adapt to climate change. Diversity also makes my regular forays into the forest for exercise and relaxation more interesting.

Since my forest has a mix of species, it's imperative that I use a similar mix of species in my buildings to retain the diversity of the stand. I also need to understand how different trees propagate. For instance, white pine needs abundant sun and bare ground to grow.

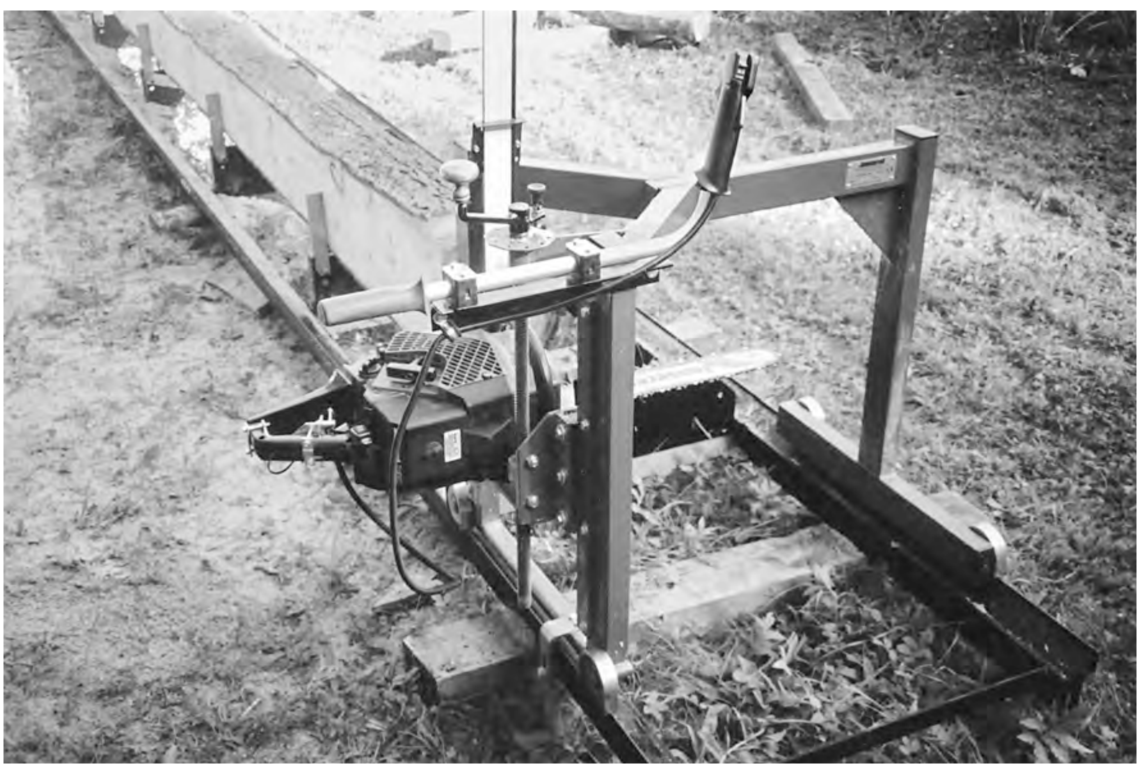
Felling a tree and squaring it right in the forest provides a measure of personal satisfaction that's hard to exceed.

A small clear-cut must be created to propagate the species. However, it would be a waste of time to create the clear-cut if there isn't a large pine nearby with mature cones ready to seed it.

One would think a southern aspect preferable for growing timber. The opposite is true. North-facing slopes are best as the soil retains more moisture through the summer, and moisture is the single most important factor in a tree's growth. The trees in my mostly north-facing sloping woodlot have grown measurably in these past 11 years. I occasionally measure the leader on the top of a pine after I fell it. (The leader or candle is the slender stem above the last whorl of branches that indicates the season's height growth.) On 80-ft. trees, I have measured leaders over 30 in. Now that's growth!

Of all the trees that I have, the Eastern white pine would reign supreme in most respects. It grows fast, straight and tall, head and shoulders above the rest, works easily, the heartwood has moderate rot resistance and the timber shrinks relatively little (its radial shrinkage is the lowest of any US commercial species). It can be (and traditionally was) used for almost everything made of wood. It isn't always my favorite though. Depending on my mood and what I'm building, all the varieties have their advantages.

Design for your forest. In Europe, the frames of old timber buildings were shaped by the forest. Their configuration made the best use of the available resource. Many of the misshapen trees ended up as crooked timbers. There were curved, elbowed, flared and



Jonsered 600+ mini-sawmill combines large engine with narrow-kerf bar and ripping chain, takes about 45 minutes to set up and serves well for small operations. Lengths up to 17 ft. can be cut on the tracks supplied, longer lengths by installing more track (author's rig cuts 37 ft.). For large jobs, a portable bandmill is preferable.

This 18-ft. beech double crotch was hewn to 7 in. thick and the edges left round. Having your own woodlot gives you the freedom to select trees personally to frame special effects, as in the weekend cabin at right above.

This 109-ft. white pine snapped off in a storm. Even without the 6 ft. lost at the top, the tree yielded 825 bd. ft. of inch boards. Broken tops invite rot and will in time render a tree useless except for wildlife.

A 200-year-old sugar maple from the forest's pasture days takes considerable growing space but is spared for its aesthetic and ecological value. A myriad of creatures call it home.

even the occasional crotched timber. It is precisely full utilization of varied trees that makes those old frames so appealing today. Here in the New World, the colonists were able to select the straightest specimens of the preferred species and burn the rest as they cleared vast areas for farming. After a couple of generations, the design of frames had adapted to the virgin timber available here. Scarfing of the longest members wasn't necessary—timbers as long as 60 ft. could be used. Long straight timber was the norm. Now it is a luxury we can no longer afford. We must again allow our frames to be shaped by the forest.

Soon after purchasing my woodlot, I strode among my trees with a project cutting list in hand. I began selecting and felling trees and checking off the list as I went along. As each de-limbed tree lay prostrate, I carefully decided how I would buck it (cut it up) into log lengths to best advantage. As I checked off pieces on the list, I began to notice that the trees were yielding many more short logs (8-10 ft.) than I needed. In fact, by the time I was finished, I had a dozen or so extra short logs. There were others of varying diameters and lengths that also didn't fit the list. It was apparent to me that, as a designer, I should rethink my frame designs to better utilize my trees. In other cultures where timber framing remains an active tradition, buildings make use of multiple sizes and types of members, from large, straight timbers to crooked ones to small wattles and battens. It's just good economics.

I also noticed that there were occasionally some rather high-quality and large-diameter logs shorter than 8 ft. Commercial sawlogs are 8 ft. and longer. Shorter logs don't stack well on the log truck or process well through most sawmills, so they are typically left in the forest. I found them perfect for sawing out stock for braces, trimmers around stair and chimney openings and purlin posts and struts in roof framing. Logs 5 to 7 ft. can be easily accommodated on a portable sawmill.

Tall, straight white pines are reserved for the longer plates, purlin plates and tie beams. In my forays, I make a mental note of the locations of these arrow-straight pines for future projects. I never cut a tree that will produce a 40-ft. timber when I only need a 30-footer.

Manage for quality. It's a natural tendency to high-grade a woodlot—that is, always to take the best of the standing timber. As the best-quality logs command the highest prices, the practice is far too common in the timber industry. Continually removing the best-quality and healthiest specimens drastically reduces the overall value of the forest. One is left with genetically inferior growing stock.

A much better approach is one that will improve the quality of the forest. Select trees from crowded areas that need thinning. The remaining trees will benefit from the added growing space. Pick trees that appear to be dying, trees with missing tops, scarred trees and coppice trees. Most poorly formed trees still have some usable lengths. Occasionally, when sawing such logs, hidden defects appear that render a log unusable. More often, though, I find the sawn timber of better quality than I expected.

And of course, use those crooked trees! Design them into your projects. Curved braces, arched collars, crucks and cranked tie beams all add character to a building. If you don't have an immediate use, set them aside for future projects. Use the weird stuff; it's beautiful!

Coppice trees, multi-trunked trees that sprout from cut stumps, yield surprisingly good timbers. Because they are in close proximity, the faces of the inner trunks of the clump are often devoid of branches and subsequently yield more clear stock. Coppice trees that have reached a useful size, say 6-in. dia., can be thinned to one or two of the best trunks and left to put on more size—which they do very quickly because of their proportionally larger root system—or the whole clump can be cut. Remember that coppice trunks leaning more than about 10 degrees off vertical will contain reaction wood and thus are likely to bow when sawn.

The sawing site should accommodate the logs, the mill and a firewood operation as well as a sawdust pile, slabs and stickered lumber.

Whenever a violent storm passes through my woodlot, I can't wait to get out there to check on the damage. Uprooted trees and those with snapped-off tops are truly windfalls. I view them as gifts from nature. They should be harvested before decay enters the wounds or the wood becomes infested with borers. Those windfalls of poor quality or in inaccessible locations can be left for wildlife. In my woodlot, I expect a dozen or so good-sized trees to succumb to storms each year.

When following these guidelines, you will still occasionally be cutting some high-quality material. Use it where it can be appreciated: a chamfered summer beam over the living room, a carved door head or mantle—or even some book-matched boards. Don't assume a log has to become a timber.

Plan the operation. Establish a processing area with good vehicle access on the edge of the woods, a generous area to accommodate the portable sawmill, the log pile and a firewood-cutting area. Plan it so the logs coming out of the woods are easily rolled onto the sawing bunks. Allow areas for storage of sawdust, slabs and stickered lumber piles. Marketing these byproducts helps offset the logging costs.

Many woodlots already have a trail system established to work the stand. If not, some careful thought must be given to planning out skid trails. It's best to stay well away from wet areas but, if a crossing is required, install a culvert. Trails should follow ground contours to minimize gradients and prevent erosion. You can phase the roadwork to spread out the expense, but work out the master plan first. Trails can be 200 to 400 ft. apart depending on the terrain. Because you will be dragging some long logs too, it's best if the trails meet each other at 45 degrees or less to minimize cornering problems. When laying out skid roads and trails, there is a natural tendency to pick a route right by all your best trees. Why? These larger, mature trees, free of branches, often are surrounded by more open space. Cutting a trail is much easier there. Resist the

Animals can play an important role in small-forest management. Oxen are adept off-trail and in tight or wet spots. Teams can be hooked in tandem for heavy pulls.

temptation; pick a route through poorer quality trees. Stay 16-20 ft. away from the trunks of mature trees. Disturbing the ground damages roots and can make them vulnerable to rot, which can work its way up into the trunk.

If there are steep areas, wetlands, rare habitats, or especially pristine areas in your forest, it's prudent to leave them alone. The commercial value of timber standing in the woods, as distinct from the value of sawlogs delivered to the mill or the even greater value of finished materials at the lumberyard, is so ridiculously low that many landowners opt for a hands-off policy for part or even all of their woodland. Aesthetic worth can surpass material worth. How much is a standing tree worth commercially? Take for example a white pine, 12-in. diameter at breast height (4 ft. 6 in.). It might scale at about 80 board feet. The median price in fall of 2004 for standing pine here in western Massachusetts was $75 per 1000 board feet (7½ cents a bd. ft.). That makes the tree worth $6 on the stump, a pittance for its 50-plus years of growth. The same diameter tree in beech, likely 75 years old, would fetch $2. On the other hand, if the tree were a rare, veneer-quality red oak, black cherry or sugar maple, it would be worth a whopping $56 on the stump. (It is thus clear that *we* add the value, at least the monetary value, to the tree by felling, bucking and transporting it and then sawing, planing and transporting it again as finished lumber.) In the face of such a trivial incentive, one can easily understand the reluctance of a landowner to log sensitive, inaccessible or scenic areas.

Winter Logging. The ideal time to cut is in winter with the ground frozen and some snow cover. The forest sustains less damage because it is dormant. The ferns, wildflowers and mosses are unaffected. Wet ground is frozen and hard. Bark is tighter to standing trees and less likely to be skinned off when a log bumps it. Logs are easier to skid and will be cleaner for the sawyer's saw blade. The animal population also suffers less. The few birds that winter over are not nesting, except for owls. Winter cutting also gives the sawn timbers a chance to dry out before warmer weather arrives, and with it the sap stain fungi that particularly infect white pine.

How will your logs be brought out of the woods? In my woodlot, I've used oxen, horses, four different tractors and a 'dozer, all having some advantage. Oxen are slow but steady and are adept in deep snow, tight places, thick stands and wet areas. If there are few trails in your woodlot, oxen may be the best choice. Horses are faster than oxen but work best on trails. Even in non-winter logging, animal feet do very little damage. But, since the logs are not lifted off the ground, there is damage to the ground and embedded dirt on the logs. However, for most operations, I don't think it makes economic sense to keep animals. It's best to hire a teamster.

Most of my work I now do by tractor. I have a four-wheel drive, 30-horsepower tractor with a logging winch mounted on the three-point hitch. It's small enough to be maneuverable yet big enough to pull out any of my logs. If I can get to within 100 ft. or so of the log, I can winch it out. I always cut my logs to length where they lie rather than skid out tree lengths and buck them at the landing. Snaking out 60-ft.-plus trunks can do a lot of damage to the residual stand.

How much woodlot? How large a woodlot do you need for your business? I have read that the average eastern forest can produce 400 bd. ft. of commercial timber per acre, per year, indefinitely. That doesn't include firewood and timber volume from natural mortality. The actual biomass production would be quite a bit higher. I have found that cutting timbers produces the greatest board foot volume per tree. Evidently there is less wood lost to saw kerfs than with boards and, if there is some wane on your timbers, part of your board foot volume is air. Finally, by making use of crooked parts and small-diameter wood, you could likely double the average annual harvest.

Since tree growth depends on such factors as water, soil, solar aspect and, of course, species, how much a certain stand will produce each year would need to be determined by observation of the conditions and careful measurement of the existing inventory. A local consulting forester could help with this work. About 50 acres of my woodlot is in timber production. If I can harvest, say, 600 bd. ft. per acre per year, then I can cut 30,000 bd. ft. annually without depleting the stand. In past years, I did come close to that number twice—and still half the acreage is untouched!

A single horse like the Belgian shown here can pull out moderately large logs. Horses work best on trails.

Economics. I'd like to say that you will increase profits by supplying your own timber, but I won't. A selective cutting approach that balances economics with ecology is likely to take longer and cost more. But having your own woodlot can be a definite advantage. First, each job will provide more work for your crew and thus more dollars per job. You will do about a third fewer jobs each year for the same income. That means less job pricing, fewer contracts, less travel and fewer clients. Second, you can get started the moment a contract is signed. There will be no more stoppages waiting for timber to arrive. Third, you can promote your operation as a sustainable one. Clients can tour your forest and see the operation. Some of my clients have visited my woodlot while oxen were pulling out the logs for their house. It was a special day for them, giving their house-building project some unique memories. It is hard to put a value on that. Finally, if you do a decent management job, your standing timber will increase in volume and value despite the removal of thousands of board feet of timber over the years. And, land (forested or not) is always a good investment.

The intangibles. Apart from the business advantages of the woodlot, there are other satisfying rewards. The woodlot is a laboratory to study the effects of your management and to test out your theories. You might make some important discoveries. After all, you're experiencing the entire process, from making observations of forest change over time, to felling, skidding, sawing and working up the finished product. It's uncommon today for any individual to be involved in more than one stage of the total process.

The woodlot can also be the focus of children's school projects, from maple sugaring to finding birds' nests. The trails can be used for hiking and cross-country skiing. And the woodlot is a great place to get away from phones, faxes, computers and other annoyances, and just collect your thoughts. —Jack A. Sobon

A 30-horsepower 4-wheel drive tractor with logging winch is quite maneuverable off-trail and can pull logs over a ton in weight.

Paddleford Truss Framing

PETER PADDLEFORD (1785-1859), of Littleton, New Hampshire, was one of northern New England's most respected bridge wrights in the first half of the 19th century. He probably began building bridges before 1830, but nothing is known of the early part of his career. In the mid-1840s he developed his own bridge plan, the Paddleford truss. Competing designs such as the Town lattice truss and the Howe truss had eliminated most traditional timber framing details, but Paddleford returned to the old ways. His truss required a high degree of building skill, and it became a dominant building type through the 1890s from Orleans County, Vermont, eastward across northern New Hampshire, and on to Oxford County, Maine. Twenty-one Paddleford trusses still stand. So far as is known, the design was used only for bridges, and not for church roofs or any other kind of long-span framing.

Paddleford was a celebrity in his day, but he died relatively early and his persona was gradually forgotten even while his truss type remained recognized. One old Maine account quaintly refers to bridges of the "paddle foot" type. The area of truss distribution is sharply defined. Just west and north of the Orleans County examples is Town lattice truss territory. To the east of the Oxford County examples, the Long truss was once standard, while to the south of New Hampshire's Paddlefords, various other trusses were used.

We have no existing examples by the master himself. The last one was Joel's Bridge in Conway, New Hampshire, but it was lost to arson in 1975. Peter Paddleford retired in 1849, largely turning over his business interests to his son, Philip Henry Paddleford, with whom he had been in partnership for more than a decade. Philip Henry was also a bridge builder, but primarily a millwright. Other builders carried on the Paddleford tradition, including Captain Charles Richardson, Jacob and Horace Berry, the Broughtons, plus others less well known. Many small details of both trusswork and covering are consistent across the entire territory of the truss distribution, suggesting a common origin in the master's example. Other details show variation because of local traditions or later evolution of the design. Before examining these details, we may ask, "What exactly is the Paddleford truss?"

Timber bridge trusses. Many trusses used in covered and non-covered timber bridges are of easily defined form, such as the Town lattice. Others can be harder to distinguish from one another, such as the Burr and Wernwag designs. Fortunately, the Paddleford truss is easy to identify. There really is nothing else like it, although some aspects of the Childs building tradition are theoretically similar. The three Childs brothers were from Henniker, New Hampshire; their existing Rowell's Bridge (1853) at West Hopkinton resembles a Paddleford truss. In 1846, Horace Childs patented a design with a similar load path but using iron rods instead of Paddleford's timber tension ties. Paddleford did not patent his design, perhaps because shortly after he developed it, one George Thayer received a patent for something that looked quite like it, although no Thayer trusses are known to have been built.

Bridge truss terminology varies somewhat from that of barn framing, recognizing the fact that the load pattern is different from that in a wall with the structural support of its continuous foundation. A truss is a self-contained structure and delivers its load only to a small space on the abutments at either end, and in addition to an intermediate pier or piers if the bridge is too long for a single span. Most trusses (except the Town lattice) employ vertical posts with various framing arrangements between them to bring the load to the ends of the truss. In a bridge, the interval between posts is called a panel, not a bay. The diagonal compression members are braces, not struts. The top and bottom horizontal pieces are chords, not sills or plates. From an engineering point of view, the brace in the end panel has a chord function, because it brings the top chord stresses down to the bearing point on the bottom chord at the end of the bridge; however, from the point of view of the framer, this brace is just like any other brace in the bridge, and is usually not called a chord. The joint between chord and post is known as a panel point.

In roof trusses crossing a building, a bottom chord may double as a tie beam between the structure's walls, but such is not the case in a bridge. There, the tie beams connect the top chords of the trusses themselves, overhead across the roadway. Below, the beams crossing between the bottom chords also carry the deck, and are

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Fig. 1. Multiple kingpost truss bridge at Eaton, Quebec. Vertical rods are later additions. Guard rail (or strake) about a third of the way above the floor is not part of the truss. Photo 1994.

Fig. 2. The Paddleford truss. Sunday River Bridge, Newry, Maine, built by Hiram York, 1872. Note substantial guard rail, not functionally part of the truss. Photo 2004.

known as floor beams, not joists. The term deck is convenient to describe the entire floor assembly, but some framers prefer to call it a floor, because the term deck seems to have been derived from metal truss terminology.

One of the oldest bridge trusses is the multiple kingpost. Here the braces from a central kingpost deliver their load, not directly to the abutments, but to the bottom of another kingpost, which itself is braced to the next, all the way to the ends of the bridge (Fig. 1). Such a truss has been used for bridges in many parts of America. To add strength, Theodore Burr combined it with a superimposed arch, usually bolted to the truss frame and springing directly from the abutments, though some variants tie the arch to the bottom chord instead. When bearing on the abutments, the arch delivers outward thrust as well as downward load and, if the abutments are not massive indeed, there is risk of failure.

The Paddleford contribution. Peter Paddleford developed a new way of strengthening the multiple kingpost truss. Instead of an arch, he added a diagonal tie to each panel. Judging by the framing details, the tie was intended to work mainly in tension, relieving some of the compressive force from the accompanying brace, which goes in the other direction. The braces meet the posts nearly at the panel points, but the ties do not. They are staggered, and overlap the panels, framed through the chords about a third of the way to the next panel point (Fig. 2).

Paddleford's diagonal ties are the most distinctive feature of his truss form. There has been much discussion of why he went past the panel points. The most likely explanation is that he wanted to avoid the loss of critical least-section that would result from framing yet another member at the same place. But the ties also help support the bottom chords between the panel points.

Floor beams in timber trusses are most often placed on top of the bottom chords, but heavy loadings introduce bending moments if the beams are placed in mid-panel. Although this is sometimes done because bridge chords are typically massive anyway, more often the floor beams are located only at the panel points. The spans between them are then much too long to be bridged by floor planks laid directly; instead, stringers must be placed on close centers atop the floor beams first, and then the planking runs crosswise. This additional framing reduces the vertical clearance of the roadway. In the Paddleford truss, the staggered ties help to support the bottom chord in mid-panel, reducing the bending moments and allowing the floor beams to be spaced atop the bottom chords throughout the length of the panel, not just adjacent to the posts at the panel points. Floor planks can then be laid directly and the stringers are eliminated. This may be an accidental advantage, since Peter Paddleford himself framed his diagonal ties somewhat closer to the panel points than later builders, where the ties gave less support. However, no Paddleford trusses use stringers in the floor system.

Many Paddleford trusses also present supplemental laminated arches, and there has been much discussion whether they are original. Certainly the existing arches in these bridges are not; much work was done in early 20th-century New England to reinforce covered bridges for motor traffic by adding laminated arches, or by replacing earlier light arches with heavier ones. Some engineers have asserted that Paddleford trusses could not support even their own dead load without the arches, but this proposal is highly questionable. Engineers are often misled by overstated figures for dead load of timber, developed in the 1930s with the often-waterlogged timber of open bridges in mind. Close examination of the existing stock of Paddleford trusses shows that those with arches usually have empty mortises in mid-span on the posts and overhead tie beams, where wind bracing was removed to place the arches, strongly suggesting that the arches were a later addition.

Framing features consistent to all Paddleford trusses. Certain distinctive framing features are found in all Paddleford trusses, and it may be assumed that they trace back to Peter Paddleford himself. The diagonal truss ties have been discussed already. Chord framing is another such feature.

Older truss forms use a large-dimension single stick for the top chord, and occasionally for the bottom chord, too. However, it is difficult to make mortise and tenon joints strong enough to carry the tensile stresses in a bridge. Burr trusses commonly used a mortise and tenon, held with two small treenails of about ⅞ in., for the joint between post and top chord. But the bottom chord carries the entire live load and floor. Standard Burr truss procedure was to use a two-part bottom chord, with the posts lightly but securely lapped into both halves, and extending through underneath with sufficient relish to prevent shear parallel with the grain from undoing the joint.

Paddleford continued this procedure of building up a chord from several smaller members, but he carried it further. The bottom chords typically have four laminae (oriented vertically) instead of two as in a Burr truss. There are pairs on either side of the posts, which are lapped into the inner faces of each pair. Between the two halves of the chord, there is usually a small space (except at panel points), liberally treenailed across. The truss ties, on the inside faces of the posts and braces and lightly lapped into them, pass between the two parts of the inside half of the chords, into which they are also lapped on either side. Top chord treatment is usually similar to the bottom chord. The posts pass all the way through with a lengthy relish, typically at least as long as the thickness of the post itself, or 8 to 10 in. The truss ties pass through the inner pair of chord laminae.

Paddleford's tie beams. A third distinctive feature of the Paddleford truss is found in the tie beams overhead (not to be confused with the tension ties in the truss itself). The same system is found in all examples and surely traces back to the master.

In most covered bridges, the overhead tie beams are mounted directly on top of the top chords. In the Paddleford truss, the tie beams are instead framed on top of the post ends by means of a mortise and tenon held with two treenails. This arrangement buys additional interior clearance, since the posts pass higher than the top chords by a generous relish. When this amount is added to the height gained because stringers are not needed in the floor system, Paddleford trusses have interior clearance of about 15 in. more than competing designs with the same truss depth.

The tie beams are generally about 7x7, somewhat smaller than the posts. In most bridges, they are framed flush with the face of the post toward the nearer end of the bridge; rarely, they are framed all into the same face throughout the bridge length except for the last end post, where they always face out. In either case, one panel between tie beams ends up a little longer. Lateral X-bracing between the tie beams uses mortise and tenon connections secured with wedges in standard covered bridge practice.

Portal style is an architectural rather than a structural feature, but one particular style is widely distributed throughout Paddleford territory and known from old photographs to have been used on bridges built by Peter Paddleford himself. The portal opening is a graceful elliptical arch, and the portal itself is boarded with narrow horizontal clapboards. The portal is also deeply overhung; a lengthy projection of the top chords extends well past the end of the bridge floor, and the portal drops down from it. Neither overhung portals nor elliptical arched openings are specifically Paddleford features, but horizontal narrow clapboards show an unusually elegant touch and, when all of these features are found together, we see influence of the master's style (Fig. 5 facing page).

Variable features in the Paddleford system. There are differences in chord treatment throughout the truss range. Judging from the former Joel's Bridge, Paddleford used the four-part chords described above. However, since the two laminae in the outboard half of the chord assembly have no ties passing through them, there is no reason why they cannot be a single timber except to simplify splices between the sticks. Indeed some bridges do use just a single, thicker member here, so that the chord assemblies have three laminae rather than four. In other bridges, the usual space between the

Fig. 3. Paddleford bridge at Groveton, New Hampshire, built by Captain Charles Richardson in 1852, showing typical framing details in the system. This bridge is somewhat the worse for wear, having served heavy traffic on US Route 3 until 1939. It was stabilized by Milton S. Graton in the 1960s and has outlasted its steel replacement. Note the four-part top chord with a space in the middle and the truss ties lapped through each face of the inboard chord laminae. Where the chord passes a post, the bearing shoulder is hidden because the second lamina in has been reduced in height. Note also the lock notch at the end of the tie beam to keep the rafter from slipping off. Photo 2004.

Fig. 4 (at right). Panel point in Sunday River Bridge. Note the unusual five-part top chord with no space in the middle. The bearing shoulder in the post is visible where the second lamina is reduced in thickness but not in height. Photo 2002.

Fig. 5. Typical Paddleford style portal on the former Stevens Village Bridge, Barnet, Vermont. Photo by Henry A. Gibson, 1948, from the archives of the National Society for the Preservation of Covered Bridges.

chord halves is filled with a fifth lamina. This provision is rare in top chords, which are in compression. It is more common in bottom chords, which are in tension and where the fifth lamina helps counter the section loss occasioned by splices in the other laminae.

Some bridges use a hidden reduction where the post is lapped to the inner chord laminae, such that it appears these laminae break completely at the joint. The inner laminae are reduced in height where they cross the post, creating the apparent breaks, while the passing full-height outer laminae conceal the upper and lower shoulders of the trench on the post. In other bridges, there is no such hidden reduction and the laps into each face of the post are clearly visible (compare Figs. 3 and 4, facing page).

All Paddleford trusses have overhung top chords, but the end panel treatment varies widely. If the end panel has a tension tie like the rest of the panels in the bridge, then it needs the top chord extension to frame into. However, many Paddleford trusses lack this tie in the end panel, and they still have overhung top chords. Such a design helps protect the ends of the truss from decay caused by frequent wetting from wind-driven rain.

The end bearing point presents a related variation. Some Paddleford trusses bear only on the last panel point, while others place the entire first panel over the abutments and bear on the first two panel points (surprising, since the entire first panel then looks like wasted material). This end panel lacks the tension tie, but not consistently. It is difficult to tell how Peter Paddleford handled these framing details because the existing examples, built by his followers, vary so widely.

Placement of the tension ties in the trusses is consistent throughout most of the Paddleford territory, but not all of it. Nearly always the ties are placed across the inside face of the trusses, and lightly lapped in. But at the western edge of the truss range in Orleans County, Vermont, the ties were deeply lapped, to be flush with the inside face of the posts and braces. This treatment is associated with bridges built by John D. Colton, but it is not known whether he originated the style. An odd variant found in Pittsburg, New Hampshire, bridges has the ties overlapping the posts as usual, but then they end in mid-air and do not continue on through the chords. Clearly the unknown builder didn't quite get it. One former Paddleford truss appears to have had the ties on the outside face of the truss instead of the inside, but this was exceptional. Some outside ties are found at Groveton, New Hampshire, but they are later additions.

In a bridge, the load on posts and braces increases toward the ends of the structure; these panels carry not only their own loads, but also those delivered from nearer to the center of the bridge. It is a mark of sophistication in framing to increase post and brace size toward the ends of the bridge, but this principle was not generally understood until the publication of Squire Whipple's pioneering engineering study in 1847. Peter Paddleford developed his truss a few years earlier; did he vary his post and brace sizes? Unfortunately we do not know. Many Paddleford trusses do indeed increase these dimensions toward the ends, but sometimes only for the posts, which will typically vary from roughly 7x8 up to about 10x8 (sometimes the center post must be larger because it loses section by having braces shouldered into it from both sides). The earliest existing bridge that varies its timber sizes is the 1859 Albany Bridge in New Hampshire, built right at Peter Paddleford's death and a decade after his retirement. It appears likely that the innovation of appropriately increasing timber sizes was introduced into the tradition by other builders later on.

A final feature that varies throughout the system is the treatment of the rafter-to-tie beam joint. Many covered bridges carry the rafters directly on the top chords, but this is impossible in the Paddleford truss because of the large relish on the post ends. Nearly all Paddleford trusses have just one rafter per panel, mounted to the outer ends of the tie beams. Sometimes the rafters extend well past the ends of the tie beams, producing a very deep roof overhang. Usually there is an elegant lock notch to prevent their slipping off, but sometimes a simple birdsmouth is used. In other examples, the rafters end at the tie beams and are secured with a hidden joint, but the tie beams themselves extend well beyond the post tops, so these bridges too have a good roof overhang. Paddleford's own bridges used both styles, although the latter seems to have been more usual. When the rafter extension is used, the effect on the portal is graceful, like a bird about to take wing.

The Paddleford truss demonstrates the principle that one person can make a difference. The design preserved a high level of traditional framing skill in northern New England throughout the 19th century and is still a significant part of our stock of historic bridge architecture a century and a half after the designer's death.

—Joseph D. Conwill

Joseph D. Conwill, of Sandy River Plantation, Maine, is a photographer and the author of several books about covered bridges. He edits the quarterly Covered Bridge Topics *for the National Society for the Preservation of Covered Bridges. During travels from 1966 through 1977, he visited every covered bridge in North America. His photography is included in various collections, including the National Archives of Canada.*

Timber Framing in Suriname

SURINAME, on the northeast coast of South America, was known as Dutch Guyana from 1667 when its English occupiers ceded it to Holland by the treaty of Breda, in exchange for New Amsterdam. In 1948 the country took the name Suriname after that of its principal river, and gained its independence from Holland in 1975. Its territory amounts to about 63,000 sq. mi., its inhabitants to about 420,000.

The development of timber construction in Suriname was closely connected to the swift growth of the plantation economy at the beginning of the 18th century. Small 17th-century sugarmills had developed into large sugar factories situated in immense wooden buildings about 60x130 ft., bigger than the Cathedral of Paramaribo in the capital city. The heart of the factory was the wooden sugar-press powered by a large wooden tide-mill. During the 18th century, 150 of these sugarmills were in full use. None has survived.

The first mills were undoubtedly constructed by immigrant European millwrights in Suriname. Also, complete mills were prefabricated in Europe and shipped to Suriname. Gradually, local craftsmen, mainly slaves, mastered the new construction techniques. Young slaves served as apprentices and underwent a training of many years. Some had the opportunity to buy their freedom and established themselves in Paramaribo as free craftsmen. Slavery was legal in Suriname until 1863.

At the beginning of the 19th century, the wood-framed mills were replaced by iron ones and, not much later, the tide-wheels were replaced by steam engines. The time of the master millwrights came to an end, and much construction knowledge vanished. Large barns were still being built, but the intricate wooden machinery was no longer needed.

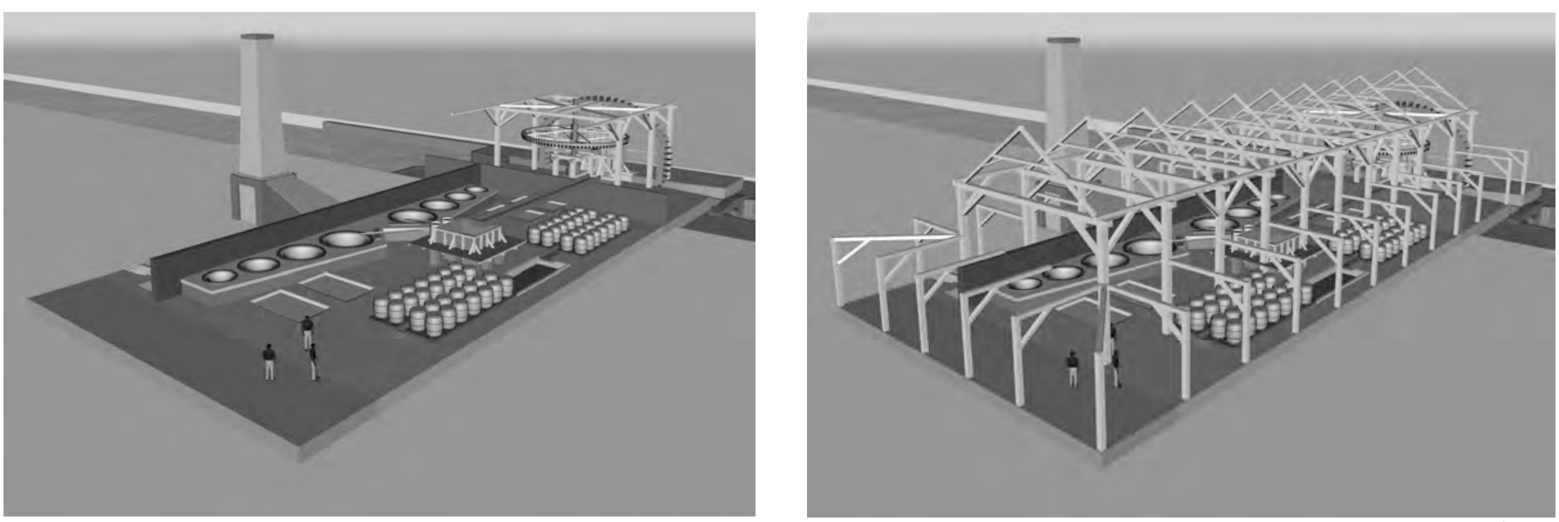
Apart from heavy timber carpentry for mills, barns and wharves for river boats and barges, other woodworking crafts were only slightly developed. There must have been some production of carriages. Nothing is known about furniture production.

In Suriname the use of hewn *vierkant* (four-edged or square) timber was common practice. Typical 18th-century sizes were 10x10 for heavy construction like sugar factories and coffee barns, and for smaller work 8x8, 6x8 and 6x6. During the 19th century, commonly used sizes were reduced to 6x6 and 5x5. Flooring was 1- to 1½-in. thick. Frames were constructed with durable local woods like greenheart (*Ocotea rodiaei*), brownheart (*Vouacapoua americana*), and balata (*Manilkara bidentata*). Exterior siding was produced from kopie (*Goupia glabra*) and interior sheathing or paneling from the soft and easily worked wana or pisi (various species of *Nectandra* and *Ocotea*) woods. Floorboards might be sawn from local kopie wood but more commonly were of imported North American pitch pine. Roof shingles were riven and shaved from walaba wood (*Eprua falcata*). Bricks were used for roof covering if fire resistance was required.

Timber was produced at *houtgronden* (timber estates), where a normal concession measured between 2500 and 5000 acres. The owner would engage a number of slaves permanently on the concession to cruise and harvest it. Since timber was converted and moved solely by manual labor, transportation was the limiting factor and a short distance between tree and river was critical for economical exploitation. Slave labor was not inexpensive since its indirect expenses were in fact larger than for paid labor. To reduce transportation, timber was hewn and sawn where the tree was felled, so that only valuable material was transported. The writer M.D. Teenstra visited early 19th-century timber estates and described their workings in 1835 in *De landbouw in de kolonie Suriname*:

> After the tree has been cut, it is hewn square. The norm for this task: one slave will do four trees in one week. Most of these trees will be hewn two to three ft. square, and have a length of 25 to 50 ft. Then the trees are sawn into 1-in. and 1½-in. boards right on the spot were they were felled, the norm being two slaves will saw 18 boards of 30 ft. in one week. These boards are then carried home by maids . . . upon their heads. It is not unusual for the distance to be more than two hours, through dense bush all the way. Still, they will do two such journeys a day.

During the 19th century, production methods modernized. Small steam-powered sawmills appeared and animals provided lumber transportation. Production grew. In the 20th century, yet another system developed: large sawmills were erected near the rivers and the logs were transported to the mills on barges or rafts. Log suppliers met heavy competition from the bushmen who lived on the upper parts of the rivers and controlled the whole interior of Suriname. Whereas estate crews might have to cut far from the rivers, as Teenstra reports, bushmen felled only the timber close to the rivers and thus were able to produce more cheaply.



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Drawings of water-powered sugarpress reconstruction with factory layout and frame at Sinabo estate, 1750. Building measured about 60 x130.

Felling a tree, 1910.

Resawing timber at a building site, ca. 1850 (detail of drawing by Huygens, ca. 1850).

In normal circumstances, supply and demand would meet. But in times of exceptionally heavy need for timber—for example, after the 1821 and 1832 Paramaribo fires—the suppliers could not fulfill the demand. Shrewd businessmen quickly obtained large quantities of pitch pine from the southern US to fill the gap. In those days, even complete buildings were constructed with the American wood. Pitch pine was not a new product to the area; it had been used for centuries as a flooring material. Apparently it was cheaper than floorboards made of local kopie wood.

The 18th century. A typical 18th-century Suriname timber-framed house would have large rooms next to the street and a group of smaller service rooms (called the gallery) at the back, laid out symmetrically with a central hall flanked by rooms to left and right. The frame would consist of one-story-high wooden posts in the front, middle and back, supporting the floor beams. If the front rooms were large, the span of the floor beams would be too long and they would be augmented at midspan by an unsupported bridging beam attached beneath, whose sole function was to spread the loads over several floor beams.

The frame was stabilized by diagonal braces at all corners. Originally, these braces were quite long in the European style but, as carpenters grew familiar with the small windloads in the country, they reduced the bracing to a minimal size sufficient for Suriname circumstances. Traditional timber frame construction has been in use in Suriname for over 200 years, and only in the middle of the 20th century were more modern (but certainly not more beautiful) construction methods introduced.

Typical 18th-century wooden houses at the Waterkant (water's edge) in Paramaribo, with symmetrical façades and placed on a high brick base. Painting by Dieterich, 1797.

Carel van Hest

Early 19th-century house near Zeelandia Fortress under restoration in 1997. Roof framing and floor beams are 6x6, posts 5x6. Below, short knee brace typical of the period, but in this case not at 45 degrees. Architect C. van Hest.

Philip Dikland

LET'S examine an old townhouse in Paramaribo, the capital. The Cellier townhouse at Gravenstraat 14 in Paramaribo was built about 1750 for the French Huguenot Jean-David Cellier. Only the main building has survived. All the backhouse buildings (kitchens, storerooms, well-pit, slave dwellings, carriage houses and horse stables) have long since vanished. The main building is a fine example of Suriname timber frame construction in its full glory. What remains of the heavy brownheart frame (the roof framing is gone) is still in top condition after 250 years. The house was meticulously restored in 2001, but the frame needed hardly any repairs at all.

The Cellier house resembles a small French mansion in Louis XIV style, although with less luxury and refinement than its European counterparts. It has a formal, symmetrical layout set on a high brick base with an elegant entrance staircase. The grey-painted woodwork mimics the stone of the French models. The interior finish and certainly the frame are original. Exterior siding may have been renewed several times.

The timber frame has always been exposed. Each post and beam has been carefully corner-beaded (*kraal* finish), which would have been a waste of time if the builders had intended to conceal the frame. Archival documentation of the house does not mention paneling nor the use of gold-painted leather wallcovering, the fashion of the day.

The French formal style prohibited adaptations to the tropical climate. Balconies or large eaves were not included in the style, so the walls of the Cellier house endured the heavy tropical showers and the harsh sun without any protection or shade. In the 19th century, a balcony was added to the windward side of the building and later extended to become a full-fledged gallery, which greatly improved living conditions in the house.

In 1959, while the building served as a boarding school, it was joined with its neighboring building at Gravenstraat 16. The timber roofs were removed from both addresses and a third floor was added that also bridged the connector between them, the latter built by their common owner in the 19th century. (It remains unclear why the necessary space could not be found within the large attic under the original roofs instead of mutilating the old houses.)

The 2001 restoration adapted the building to the needs of a modern office while restoring it to its original shape, its 18th-century heritage carefully preserved. The original shapes of the roof and dormers were reconstructed from old photographs. Fascia details were patterned after contemporary models. For reasons of budget, the main roof frame was not reconstructed in wood; instead, a simple steel frame was built to the correct pitch (the dormers were reframed in traditional manner, however). The original slate roof covering was likewise not brought back, in favor of modern grey-colored galvanized steel.

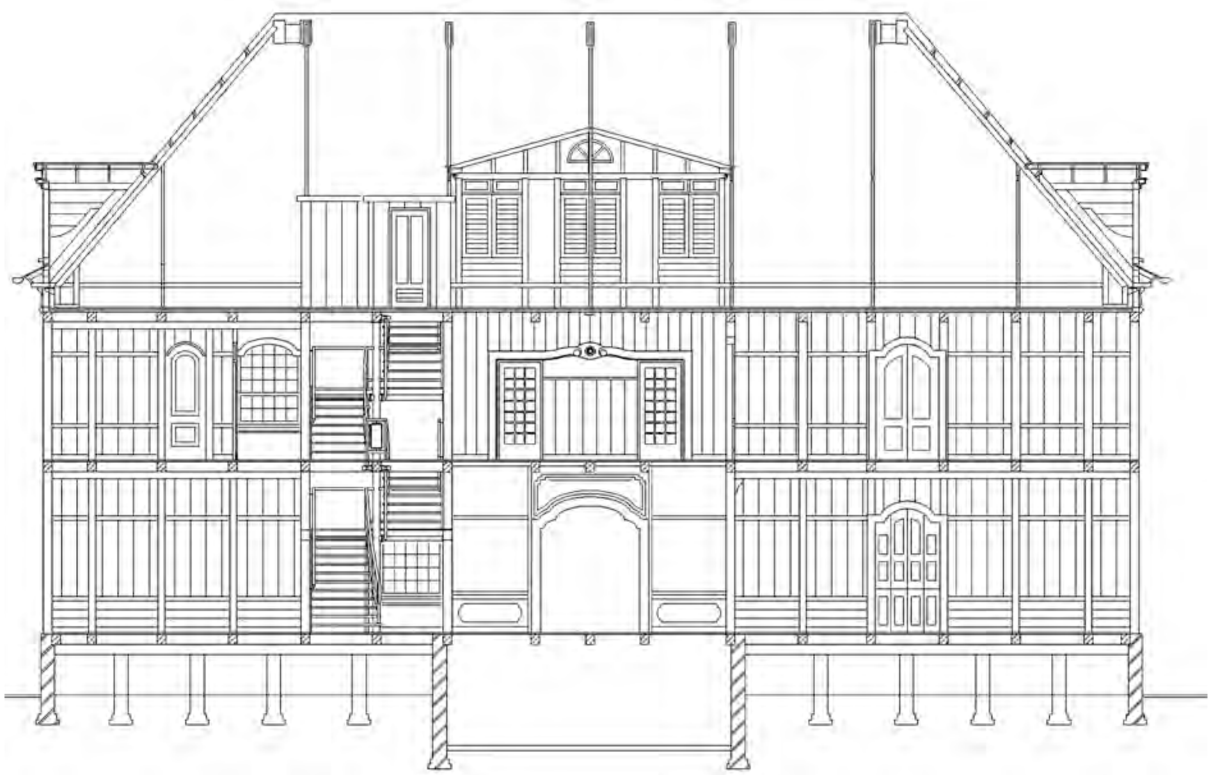
With the exception of its new attic and roof, the building was restored to its 18th-century state. Many of its details survived untouched and just needed some polishing. Others could be restored from traces. For example, the house was fitted with 19th-century wooden louvered casement shutters. But the slots in the posts indicated the former existence of counterweights for sash windows. Sash windows and counterweights were restored.

As the building contains no ceiling cavities or paneling to cover mechanicals, an elegant exposed chase carries them horizontally and specially designed "bookcases" conceal them vertically.

Facing page, longitudinal section of the Cellier house looking toward the partition wall between front and rear rooms. Posts and beams 9x11. Floor beams on about 5-ft. centers. Span of beams 19 ft. 10 in. (front) and 11 ft. 10 in. (rear). Floor-to-floor height 12 ft. 8 in. (ground floor) and 10 ft. 9 in. (second floor).

Gravenstraat 16 (left) and Cellier house (right) at 14 after the 1959 removal of the roofs and construction of a continuous third story. The infill section between the two houses dates from the 19th century.

The Cellier house restored to its old glory. Modern fireproof structure to left replaces wood-framed infill.



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Early sugarmill (1707) at Waterland estate, with high hip roof, exposed frame and long corner braces. Drawing by Jean-Louis Volders after the original by Dirck Valkenburg.

So-called **toognagel** *joint between brace and beam. One pinhole is bored straight across, the other strongly draw-bored.*

Floorboards are applied directly to crossframes of coffee barn.

Photos this page by Jan de Bruin

1808 coffee barn at Peperpot estate. Three aisles, closely spaced crossframes, no joists between the ties.

Builder's nameplate, 1808.

Assembly mark within joint.

J.F.A.Cateau van Rosevelt's 1865 design for the new national hospital building, the largest wooden building in Suriname.

Of the more than 1000 large production buildings once on the plantations of Suriname, only two have survived, the coffee barns at Peperpot and Wederzorg plantations. The former stands about 20 minutes' drive from Paramaribo and is open to visitors, though the barn is in poor condition (facing page).

Production buildings were set up in the same three-aisled fashion as Dutch and Dutch-American agricultural barns, with cross-frames of large central span (20 to 26 ft.) flanked by two narrower side spans (13 ft.). The middle span might be multi-story (coffee barns) or single-story (sugar factories). The Peperpot coffee barn (photos facing page), was built in 1808 by a master carpenter named P. Kerkshoven, who carved his name elaborately into a plate above the west entrance door. The plate has vanished but is visible in old photographs.

The Peperpot building measures 42 ft. 8 in. x 98 ft. 5 in., quite small compared to the sugar factories of those days. However, it was thoughtfully designed. Kerkshoven knew that the top floors would be heavily loaded with coffee and therefore put the cross-frames only 5 ft. 3 in. apart, in the manner of a Dutch-American house. This spacing also made it possible to place the 2-in. floor boards directly on top of the tie beams without the need of any joists. And, last but not least, 5 ft. 3 in. is a good space for double doors and windows. The central aisle was constructed with 8x11 posts and beams, the side aisles using 6x7 timber. The building is heavily braced. It was probably prefabricated in Paramaribo and shipped to the site. It has assembly marks hidden within the joints.

The 19th century. Wood-framing techniques did not change during the 19th century, but the size of the timbers was reduced. A 19th-century carpenter would choose a 6x6 beam when his 18th-century counterpart would have used an 8x8. Styles changed, not so much for production buildings but certainly in houses. The 18th-century sash windows were replaced by swinging wooden shutters with adjustable louvers—likely in pursuit of greater ventilation and shade—and then sash windows returned with a modern 19th-century pattern. But the most important change was the introduction (around 1850) of balconies at the front and back of the houses, creating a much more comfortable indoor climate. From 1860 onward, the balconies became fully integrated with the house, and a new building type with surrounding galleries came into existence. It found its most elaborate expression in the 1865 national hospital building in Paramaribo.

Nassylaan 23, Paramaribo. Example of a 19th-century house with balconies and wooden louver shutters instead of glazed sash.

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Repair and replacement of galleries on the 1865 hospital building. A projecting canopy will be added to provide further protection.

Perspective section of Ne Ve Shalom synagogue, looking toward the west façade. The architect J.-F. Halfhide constructed the building so that the columns bear only vertical forces. The roof is heavily braced, and the galleries make some stiffening contribution through their floors and ceilings, but the façades have almost no bracing. Wind loads are extremely low in Suriname, and Halfhide probably considered the siding stiff enough to counter these small loads.

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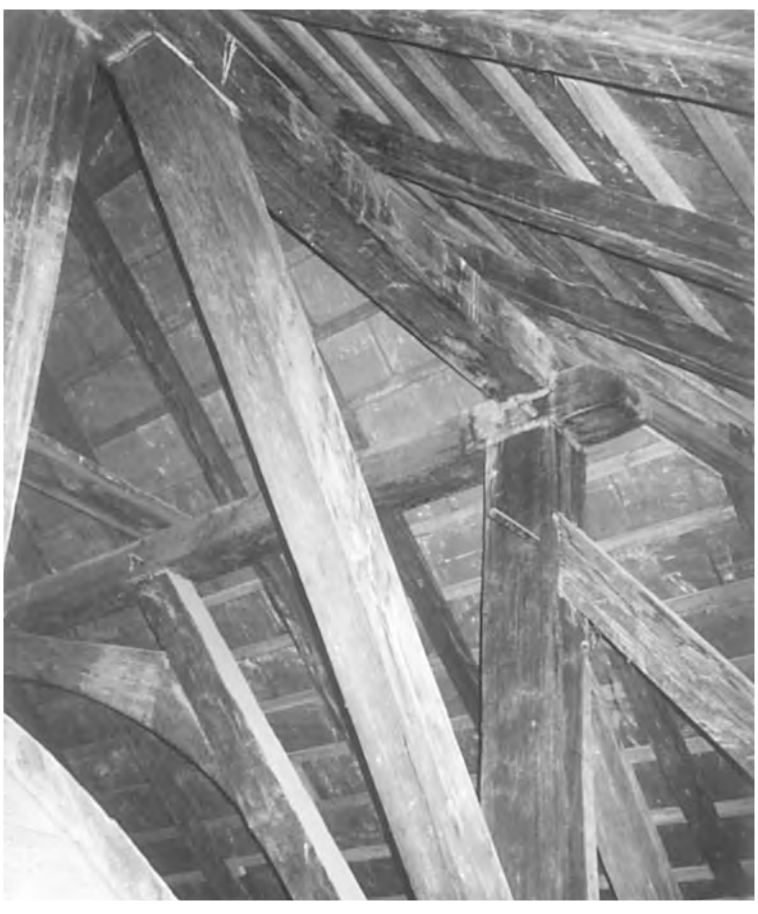

View of one of the synagogue's main roof frames.

View of the women's gallery.

South façade of synagogue. Gravestones in the foreground (but not the graves) were moved from an 18th-century cemetery.

The neoclassical-style Ne Ve Shalom synagogue, in Paramaribo at Keizerstraat 82, was built in 1835-37, with Surinamese master carpenter Jean-Francois Halfhide as architect. The building, 50 ft. 6 in. x 82 ft. in plan, sits on a low brick foundation (note ventilation ports), fronted by an imposing colonnaded porch. The main space on the ground floor is for the male congregants, while the women are seated in the second-floor gallery, according to Orthodox practice. Structurally, the synagogue is probably the sturdiest timber frame building in the country. It consists of six crossframes on about 12-ft. centers. These frames, with a total span of 50 ft. 6 in., have a central aisle span of 28 ft. 10 in. flanked by side aisle spans of 10 ft. 10 in. The round columns that support the main span have a diameter of about 15 in. It's not clear how they are constructed; possibly an 8x8 post is hidden within. The façade posts are 5x6. Roof frames are made mainly of 6x7s.

The roof construction is extensively braced while the building underneath has almost no bracing at all, strange as it may seem. However, the roof framing is designed so that there are no horizontal forces on the columns. Hence, after 169 years, the building stands perfectly plumb.

Interior view toward the west façade. To right and left are the stairs toward the women's gallery. The column-to-column distance is 28 ft. 10 in. Side spans are 10 ft. 10 in. The minor dimension of the plan runs left to right in this picture.

At work in 2001 on the 19th-century frame of the Frederiksdorp doctor's house, stripped of overhangs and gallery. At right, house fully restored in 2003.

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The Frederiksdorp coffee plantation on the Commewijne River dates back to 1747. The main house and production buildings have long since vanished, but the small estate manager's house has survived along with another called the doctor's house. Mentioned in inventories of 1768 and 1775, the estate manager's house probably dates back to the 18th century. The building is mostly original, including an 18th-century type of indoor gallery. The house was carefully restored in 2002-2003.

Framing in the main is 6x6 hardwood. The no-nonsense character of the building is clearly visible: no fancy detailing here as in the Cellier house, but a very simple finish except for the arcade and railing of the front gallery. After all, it was the estate manager's house, not the great house of the owner.

All the remaining estate buildings were built in the second half of the 19th century, the doctor's house probably around 1850. It started as a small house with only a front gallery and was enlarged several times to its present shape, which also includes an aft gallery. It was restored in 2003.

The Frederiksdorp estate manager's house was 60 percent termite-infested. Most wood framing was replaced, as shown in the photo above, taken from the back of the house. New construction is all greenheart wood. At right, the small but well-detailed house as restored in 2003, photo taken from the front. The large tank, formerly a boiler, now holds rainwater for drinking and washing. The provenance of the bust is unknown.

Philip Dikland

Grote Combeweg 29, Paramaribo, traditional style, early 20th century.

Stichting Monumentenzorg

1930s residence, Paramaribo, a more modern design (demolished).

The 20th century. The 19th-century building tradition continued up to about 1920. After that, traditional construction techniques gradually eroded. New designs evolved. Buildings were no longer symmetrical but instead presented an informal array of shapes. Posts and beams were no longer in line but instead irregularly placed. Once again, timber sizes were reduced. Large buildings were set up using 5x5 timbers, and small buildings were constructed with 4x4s. Around 1950, the Bruynzeel Timber Company in Paramaribo introduced a totally new construction technique based on American platform framing, with timber sizes 2x4, 2x6 and 2x8. Quickly, the new construction method replaced the traditional heavy timber system. It is of course a much cheaper method, but it lacks the charm and craftsmanship of the old ways. From 1960 onward, factories for the production of concrete blocks were set up. Since that time, Suriname's architecture has shifted completely to concrete. Wood is now considered the poor man's material and is only occasionally used in architecture. The architect Ari Verkuyl is one of the few who still believes in the beauty of the material, and in it he has realized exceptional designs.

—PHILIP DIKLAND and CAREL VAN HEST

Carel van Hest (cvarc@sr.net) and Philip Dikland (info@kdvarchitects.com) practice architecture in Suriname. For further information (in Dutch) on historic buildings, visit www.surinamehelppagina.com, link to gebouwen and then 01.historische gebouwen Paramaribo.

Philip Dikland

A Bruynzeel-style house in Paramaribo, built ca. 1970.

Unconventional residence in Parimaribo designed in 1984 by architect Ari Verkuyl, who framed the building using utility poles roughly hewn with an adze, and covered the broadly overhanging roof with traditional walaba shingles.

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New framing for the estate manager's house at the Frederiksdorp coffee plantation on the Commewijne River, Suriname. Photo KDV Architects. *Story page 16.*