TIMBER FRAMING

JOURNAL OF THE TIMBER FRAMERS GUILD

Number 54, December 1999

Raising an Obelisk

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On the cover, from left, Jim Kricker, Wyly Brown and Rick Brown survey the partly raised obelisk at Fletcher Granite, Chelmsford, Massachusetts. Photo by Mark Lehner.

Published Quarterly
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Subscription $25.00 Annually
Or by Membership in the Guild

ISSN 1061-9860

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GUILD NOTES & COMMENT

My Eastern Conference

The Guild's 15th Eastern conference October 29-31 at Fairlee, Vermont, drew about 300 to the southern shore of Lake Morey, which (several days running) sparkled for the occasion under benevolent autumn sunshine. The brighter colors were gone from the surrounding hills, exposing green, ochre, black and tan. I commuted to this conference (a first for me) since I live only a few miles up the Connecticut River from Fairlee, and so I skipped the dinners and most of the evening festivities. I returned one evening for the slide show, which displayed the usual range of interesting recent work but was delayed so long by promotional speeches in favor of upcoming Guild projects that half the audience had left in exhaustion an hour before the end. The nice gentleman from Gould Farm seemed unaware that timber framers build *pro bono* because they love to build, not because they feel guilty over the injustices and misfortunes of life.

I went to a preconference workshop (another first for me), the John Miller-Curtis Milton compound-roof show, which got off to a tentative start but accelerated into a really informative day. I have never much admired roof valleys, since on the outside they collect snow and debris and will sooner or later almost certainly leak, and they are angular, threatening and unpleasant to be under on the inside. But people will demand bump-outs and wings on their houses, so build valleys we must. The deliberate Miller and the mercurial Milton make an odd couple, but if you want to know All About Angles, they can tell you—and, according to your temperament, show you different ways to get to the same result.

Dave Dauerty, Jim Kricker and Jack Sobon's outdoor workshop, "String, Adze and Eye," I did not see, but the evidence—one completed A-frame, in a sort of Anglo-Saxon script (facing page at left)—stood tall and handsome for three days on the lawn in front of the Lake Morey Inn. During the conference proper, Jack offered a copiously illustrated talk about his work ("My Life With Crooks"), and this led me to appreciate the beauty of his designs. I had been aware of his use of natural forms in timber frames, which I accepted as a curiosity, but these forms are often beautifully organized within the frame as well, a separate and distinct achievement.

I made a piece of paper at Laura Brown and Susan Norlander's papermaking workshop. A slurry of cotton linter (you could take some from the filter in your clothes dryer) lay on top of the water in a tray. I took the screen provided, dipped out a layer of the slurry, carefully inverted it onto a small blanket and pressed it until the linter released from the screen and lay evenly on the blanket. Next day I had a piece of paper. Not very strong, but there it was.

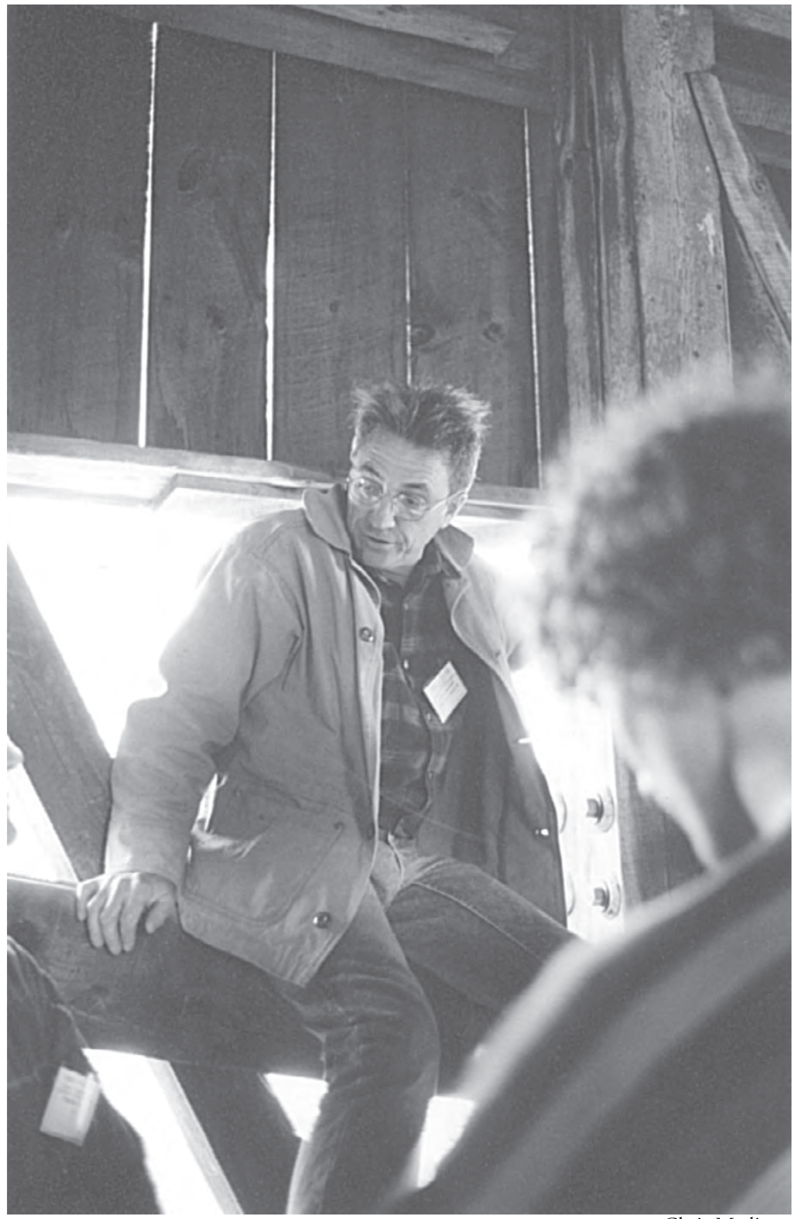
A talk on timber framing in Central Europe proved to be a discussion of the latest in engineered wood and computer-aided design in Switzerland. Nothing against this sort of thing, life must go on. But I was surprised. The young man gave out a miniature scarf joint made on a joinery machine. On the outside it appeared to be a bolt-of-lightning scarf. Inside (you could slide it apart axially) it proved to have lengthwise slot dovetails. Amazing.

I had a long talk with Merle Adams, who has turned his Montana company into a cooperative. Everybody has (or ultimately will have) an equal share. Wages and salaries follow experience and responsibility level. Profit is distributed purely according to time put into the company. There is an administrative board. Merle says it pleases him to think the company structure will survive him, and it pleases him even more that the company will no longer put all its weight on one post (him). A good thing, too, since Merle later that day wrecked his knee playing handball with Paul Freeman.

It would not be exaggerating to propose that this particular conference belonged to Jan Lewandoski (facing page, at right). They say that if you want to get a thing done, give it to a busy man. The Guild's executive directors assigned Jan (1) a presentation on his latest work in Boston with Chinese carpenters restoring an imported 18th-century Chinese house; (2) the bus tour Friday afternoon, which took some 90 sightseers up the ornate steeple and into the remarkably clean and undisturbed attic of the large and graceful 1798 meeting house in Strafford, Vermont, as well as to a brace of covered bridges; and, not least, (3) a plenary presentation on one of his favorite subjects, the erection of church steeples in 18th- and 19th-century New England.

The Chinese carpenters naturally have their own way of doing things, even unto

TIMBER FRAMING, Journal of the Timber Framers Guild, reports on the work of the Guild and its members, and appears quarterly, in March, June, September and December. TIMBER FRAMING is written by its readers and welcomes interesting articles by experienced and novice writers alike. Contributions are paid for upon publication at the rate of $125 per published page. ♻



Chris Madigan

their own style of sawhorses, which resemble tanktraps, and their own appliance for transferring dimensions from cylindrical post to rectangular beam (a kind of caliper). Jan showed film clips of a Chinese hand-raising. "You will notice," he said, "that there are always a lot of people about in China." No diagonal braces, though.

As for raising church steeples, there are at least three ways to do so: build a tall stage outside the church and carry up the pieces one at a time; build a stage inside the church and work your way up through the roof with telescoping parts; build a complete steeple on the ground in front of the church and lift it into place. In the case of the telescoping frame, each assembly rises from the assembly below and fits inside the latter. If you go into church attics, Jan said, you will find the best framing around—house frames don't do much work, after all—and in steeples you will often find the most interesting work, since steeples must deal with dynamic loads. If not the wind, then the eccentric loading of a swinging bell, which he said has the effect of throwing three times the weight of the bell against the side of the steeple. Our ancestors did not always design successfully for these loads.

One nice thing about working on steeples is freedom from the nuisances of plumbing, wiring and plaster, and another is that the "owners" don't bother you much about the work—they don't want to come up there.

It is rare, Jan said, to find an American church steeple properly founded. The European (especially the Italian) method of setting a tower on its own foundation was used here at first, but after 1800 steeples moved onto the church roof, where they generally rested on sleepers running from the front gable wall (good) over the lower chords of one or two clearspan roof trusses (not so good), thus putting half the steeple load over sweet air. If vestibule posts are the logical way to carry the load at the back of a steeple, why are they so rarely found? Style drives structure, Jan observed, not technology. Technology tends to catch up and help do something that fashion has dictated.

WITH customary panache, co-executive director Joel McCarty closed the conference by thanking Bill Keir and Terry Brennan for their "immoral support," presenting John Miller with a Franklin Park Memorial Clamp (which Miller immediately hid against his breast) and handing retiring director Tim Chauvin a plaque for his service on the board (which Tim shortly matched and raised by singing the timber framer's shanty that he introduced at the Habitat raisings in 1989). Over the decade, Tim has brought much notice to the Guild with his workshops in Texas, and much benefit to Texas with his Red Suspenders timber frames. Yo heave, Tim, put another beam home in its place.

Though his was not the last voice heard, George Kobayashi, proposing with a grin that he hadn't been given time enough the day before to finish his True Customer Service presentation, wanted to leave us with "something that someone says in passing, and it sticks with you," to wit: *all personal growth involves risk* (Leo Buscaglia) . . . *to love is to risk not being loved . . . only the person who risks is free.* That might stick with me, along with Terry Brennan's observation (after Jung) that the intellect is but a speck on the sea of emotion. —KEN ROWER

Raising an Obelisk

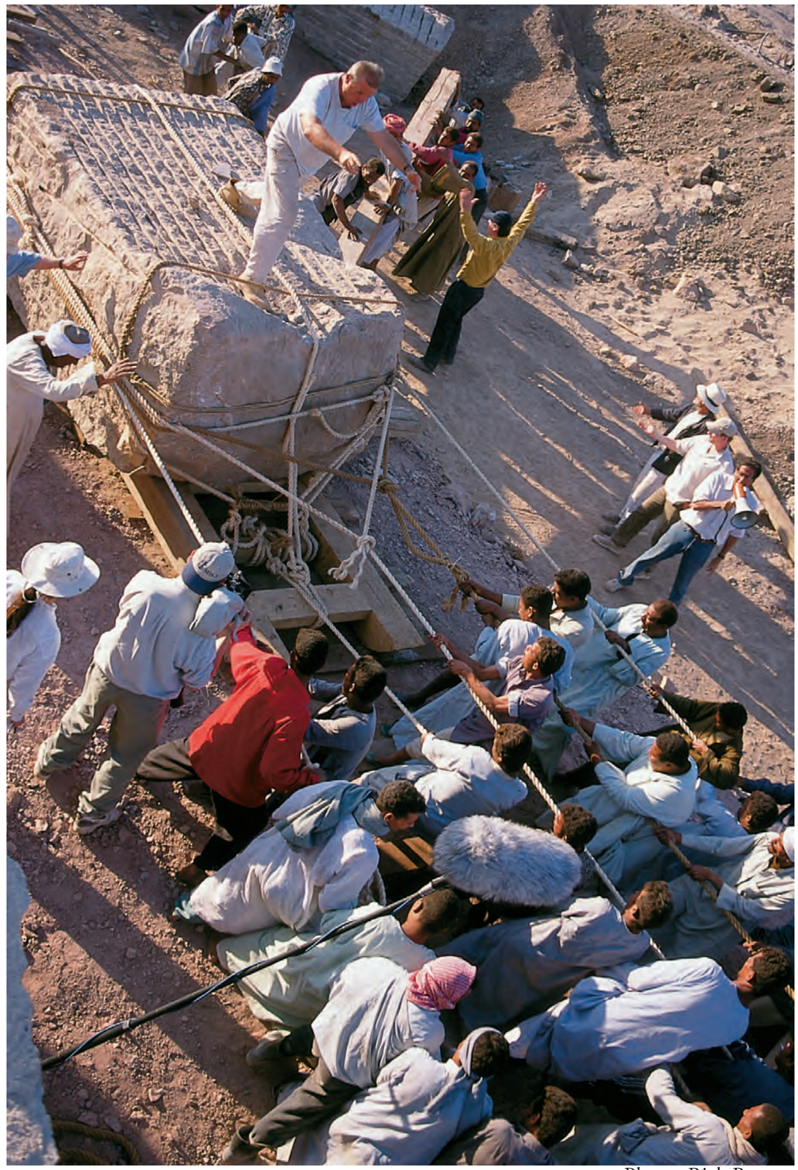
SINCE early times, obelisks, some of them huge, have been removed from Egypt to cities such as Constantinople, Paris, Rome, London and New York, but always re-erected using the most recent technology of the time. In 1994 and 1995, Public Broadcasting System's educational science series NOVA produced a film of an attempt to raise an obelisk using probable Egyptian New Kingdom technology. This attempt provided vital information, but the film crew departed Aswan, Egypt, leaving their obelisk resting on the ramp at a 35-degree angle to the ground. The producers geared up for another attempt in 1999. I agreed to make a replica of an ancient tool (a bronze core drill for stone, shown below) in exchange for an invitation to travel with the film crew to Egypt. Shortly before departing, the film director Julia Cort asked if I would, in addition, construct a timber-framed device to help raise the obelisk. I agreed in exchange for another invitation, this one for my anthropologist, timber-framing, jack-of-all-trades son. Next thing we knew, Wyly Brown and I were on our way to Egypt, proudly carrying our reproductions of Middle Kingdom stone cutting tools and an abundance of woodworking tools that would be vigorously checked by every baggage inspector from Boston to Cairo. It is right that inspectors should be a little unnerved by suitcases laden with bronze cylinders, 21-in. chisels and a chain saw.

Arriving at the Aswan quarry 440 miles south of Cairo, we discovered the film crew and extras reenacting the overland transport of a 25-ton block of granite lashed to a wooden sledge sitting on lard-lubricated timbers set in the sand, seen at right. Teams of laborers levered on the sides and behind the sledge while 170 people pulled on two sets of ropes under the direction of structural engineer and project designer Mark Whitby (London), nautical archaeologist and ancient rigging expert Owain Roberts (Wales) and stonemason Roger Hopkins (Massachusetts). The air was filled with dust, shouting and frustration.

By the end of the day, the stone had been moved all of 20 ft. Wyly and I met with Mark Whitby to discuss the timber device we would soon construct, and he anxiously presented us with a schematic sketch and the sense that time was a-wasting. We were concerned about the basic theory and that several details were not fully understood.

Wyly and I fast-track designed with engineers Henry Woodlock (England) and Iolo Roberts (Owain's son). We rounded up a substantial pile of 20-ft. 10x10 Southern yellow pine timbers left over from the 1994 raising attempt. Additional materials were delivered (for cash) via the local donkey cart. Abdul Alim, proud of his participation in the construction of the modern Aswan Dam and now our construction manager, led a team of Egyptian workers hired to assist in the raising of the stone. This group, which Henry named the "Happy Gang" because of their enthusiasm, quickly built a temporary woodshop with a grass roof to protect us from the hot desert sun. We began cutting timbers for the levering apparatus, which we entitled *The Hand of God.*

The drill, with instructions.



Photos Rick Brown

Roger Hopkins cheering 170 pullers in their contest with 25 tons.

We inscribed names on all the wooden parts: Dave, Ed, Joel, Grigg, Al, Jim, Mikey, Ellen, Laura, Donna, Bob. If people inquired, we told them, "These are the names of the timber framers who should be here with us." Of course, these were the names of our trébuchet-building mates in Virginia and Scotland. On several occasions, we telephoned home to mechanical engineer Grigg Mullen of the Virginia Military Institute, at that time working on the Guild's Project Horizon Workshop in Lexington. He would pull his calculator out of his pocket (we presume) and verify the load capacities of our late-night designs. Thus shooting from the hip, Grigg played an important role in our contribution to the project. For the next five days, the building was fast and hard, dusty and dry under a constant hot desert sun. The Egyptian bystanders fell completely under a spell when I cranked up my orange Husqvarna chainsaw. For a few days I was Mikey Goldberg on the upper Nile.

Raising an obelisk was not an official Timber Framers Guild project, but it's no accident that, in the end, a good number of Guild members became directly involved. The Guild constantly defines and redefines itself. Craft, history and public service certainly are its concerns. But as an artist, educator and part-time

The raising derrick lashed to the obelisk waiting on the ramp.

timber framer, I am very interested in the creative problem-solving skills of many Guild members, and in their undertakings. When given a problem, many of these maker-thinker-doers can find a solution using hand tools, hard work, principles of physics—and cooperation.

Our raising apparatus was a derrick of sorts, designed to reduce the pulling load required to rotate the obelisk cartwheel-fashion into its final position. Opposed, canted sets of X-braced 10x10s were tenoned at 45 degrees into a 20-ft. timber sledge framed with dovetailed ties to hold the runners parallel. Trapezoidal blocks installed between the canted arm sets increased the compressive strength of the system.

IOLO Roberts and Wyly lashed the entire structure onto the obelisk waiting on the ramp (above). Ropes encircled the belly of the 33-ton beast, then passed over the outstretched arms of our frame and to the ground. When pulled down, the obelisk would drop onto a pivot log on the lower bearing wall. Continuing the pull would bring the obelisk, rotating in its own length, down to the pedestal stone sitting on grade. In preparation, Wyly gathered the group together to pay respects to the ancient builders who had come before us. Now our hard work would be put to the test.

Mark Whitby first tried to pull the obelisk with four 2-in. ropes stretched over the derrick and down to snatch blocks attached to telephone poles lashed to two granite deadmen. Later in the day, a 3½-ton granite counterweight was added to the system to assist the pull. Later still, a front-end loader (probable Middle Kingdom technology?) entered the picture. Ropes regularly stretched and finally broke. The obelisk persistently turned out of its intended line of rotation. Nearing the end of the day, 170 enthusiastic pullers lined up in a final attempt to rotate the stone. As the pullers tugged, inspired by traditional chants, the obelisk would rhythmically raise its head but the pivot log on which it rested continued to slide closer and closer to the edge of the bearing wall, too close to continue safely. The order was given to call it a day. That night, back at the New Cataract Hotel, the engineers decided to abort the mission. Once again the mystery of the ancient obelisk builders remained veiled. Wyly and I stood in amazement. How could we give up so easily?

At the time, I could not speak for the historical accuracy of the project, but I believed that if we gave it more time and paid attention to some critical details, this method would succeed. Mark Lehner, the Egyptologist on the scene, frequently emphasized the importance of historical accuracy in method. His vigilance and genuine interest heightened my own. My first thought was that rigorous organization must have been the rule in ancient Egypt, given the vast numbers of people needed to build. Our experience in Aswan showed the importance of carefully chosen persons for every specific task. With this in mind, I eagerly began to develop my own ideas on how to proceed.

Wyly and I visited several historic sites on our journey home. In Karnak (below) and Luxor we saw obelisks still standing on their original pedestals. In the hall at Karnak we walked between hypostyle stone colonnades of a scale beyond belief (overleaf). To build these halls, the Egyptians would literally fill the

An ancient obelisk in its native habitat, at Karnak Temple.

Rick Brown

Above, the hypostyle colonnade at Karnak. Above right, Wyly Brown considers the unfinished obelisk still in the quarry at Aswan. Tool marks from the dolerite balls used by the quarrymen to pulverize the stone are discernible at the bottom of the man-sized channel.

temple with earth and pull in the large stones on man-made ramps. The inclined plane and a unified workforce seem to have provided them with a sufficient method.

For several thousand years, granite was extracted from the Aswan quarry for ancient monuments and statuary. In the quarry lies an unfinished obelisk (above right) weighing over 1,000 tons, apparently abandoned when a crack in the stone was discovered. This ruin reveals the ancient method used to remove granite from the quarry. Egyptians cut the stones out of the ground using a dolerite ball, harder than the granite. Quarrymen would line up shoulder to shoulder and with the balls pulverize the stone, creating channels around the perimeter of the desired block. This painstaking process would continue until they reached the required depth. Then, by the same means, they would undercut the block until it could be levered off a narrow remaining spine.

The Egyptians produced a multitude of structures, some of the largest and most precise in history. They used natural resources: soil, stone, wood, fibers (for rope), unlimited amounts of sand and large numbers of people. Through keen observation and experience they came to know and understand how these materials would behave under certain conditions. There is no evidence of pulleys, capstans or the knowledge of iron at this time. As far as we know, they used only simple mechanical aids such as wedges, levers and rollers. And so should we.

WE are all familiar with the center of gravity of the seesaw at the school playground. The apparent weightlessness of an object resting on a fulcrum is a captivating perception. In ancient times, the discovery of this physical phenomenon may have conferred near magical powers and generated sacred interpretations. Dieter Arnold's *Building In Egypt* (Oxford University Press, 1991) refers to evidence found in several cities and temples that workers pivoted large pillars at their center of gravity as early as the Fourth Dynasty (ca. 2600 B.C.). Once supported at its center of gravity, a large object can easily be moved by a single person. This technique will work with a seesaw at the playground, a 250-lb. timber post or a 500-ton obelisk. We chose to work with this technique as the first element in our proposed simple system.

R. Englebach in *The Problem of the Obelisks* (T. Fisher Unwin, 1923) suggests sliding the obelisk down a funneled earthen chamber to the top surface of the pedestal stone below, using sand somehow to stand the pillar upright. But this is the equivalent of driving an automobile through a tunnel without a steering wheel. It may be possible to get through the tunnel, but much is left to chance, and at best the obelisk would suffer some bouncing and bashing of outer surfaces on tunnel walls. This seems a crude way of handling a polished stone. Further, every obelisk in Egypt was erected on a pedestal with a pronounced radiused groove, the so-called "turning groove," carved quite near one edge across its top surface (seen at the back edge of the pedestal in the drawing at right). This groove would seem to have been designed to receive the heel of the obelisk at a fairly steep angle and locate it securely while it was pulled over, or "turned," into its final upright position. Using a funneled chamber would not be a likely procedure for arriving at the precise target of the turning groove.

Nonetheless, Julia Cort believed that Englebach's sand method, adapted by Roger Hopkins in NOVA's 1994 and early 1999 efforts with a 2-ton representative obelisk, provided vital information and was worth pursuing.

Dry sand flows freely. When a hole is placed low in the side of a box of dry sand, the sand will flow downward through the opening until the remaining pile reaches an angle of repose, the maximum slope at which the pile will stand without flowing and bear a load. In addition, smooth downward movement is a natural characteristic of sand-flow. Evidence in the papyrus Anastasi I, as translated by Dieter Arnold, suggests the possibility of lowering a monument into position by progressively removing the sand from the sides of a supporting pile in a chamber below: "Empty the space which has been filled with sand under the monument of thy lord."

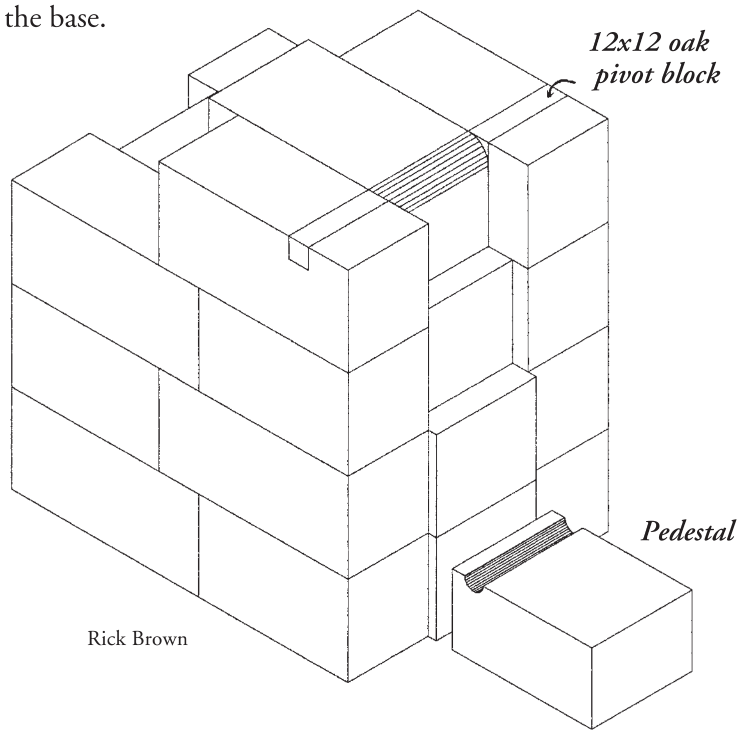
I was determined to stick with this problem and to get an obelisk upright. My sculptor, builder, timber-framing wife Laura now became engulfed in my obsession. Laura and I made drawings and constructed and tested two concrete models. Mark Lehner and Julia Cort visited our studio for a demonstration. Surprising me, Mark enthusiastically supported the method. "This is Egyptian, archaic and simple," he said, "an idea I believe will work."

Shortly afterward, Julia Cort approved our construction calendar and offered funding to conduct a design development workshop inviting VMI's Grigg Mullen, the ever-ready traveling engineer with calculator, Jim Kricker, the New York millwright and rope and rigging expert with *his* 7,000-lb. dynamometer, as well as VMI cadet-on-leave Andy Smith and our own Wyly Brown armed with long-handled hoes. Laura and I were delighted with the new problem-solving firepower on our obelisk-raising team. Jim Kricker suggested a single rope sling around the obelisk, notably simplifying our thinking about stabilizing the tall, slender granite shaft during the raising. During a four-day workshop at our studio in Norwell, Massachusetts, we poured a 6-ft. concrete obelisk and built a 3x4x8-ft. sand pit and ramp holding a ton of sand to test and refine our idea.

The Aswan experience had alerted us to the importance of *knowing the ropes.* Jim Kricker inquired at The Cordage Institute in nearby Hingham and found suppliers for large quantities of Manila rope similar to that used by the Egyptians. Manila's natural fibers align with use, increasing its strength and diminishing its stretch. Using Kricker's dynamometer, we tested inch-and-a-half and 2-in. rope using the known load requirements for our raising. The amount of stretch in the rope under working loads was a factor in setting the height of the bearing wall so that the obelisk would land on or above the turning groove in the pedestal.

Reminding ourselves of the frustration when 170 pullers were unable to raise the stone from a 35-degree position on the ramp, we decided to find out what angle we needed for the final pull, when most of the sand would be out of the box. Grigg Mullen calculated pulling requirements for our proposed 25-ton stone at a number of different angles. He proposed a 75-degree angle, which would (for example) require a 37-lb. pull from each of 135 pullers. Such a light load would insure an easily controllable final pull. One Egyptian temple relief shown by Dieter Arnold depicts a symbolic erection of an obelisk with ropes by Ptolemaios XII Neos Dionysos. The angle of the obelisk in the relief is—you guessed it—75 degrees.

The scene now moved to Milford, New Hampshire, where Dave McCormick, Fletcher Granite's yard supervisor, used two cranes to pull a 65,000-lb. (175 lbs. per cu. ft.) chunk of Kitledge gray granite out of Fletcher's quarry there. Then the scene moved to Fletcher's headquarters in Chelmsford, Massachusetts, where the inspired quarrymen took great pride in skillfully shaping the block into an obelisk measuring 36 ft. overall, including the 42-in. pyramidium, the topmost portion where the four sides taper sharply up to a point. The finished stone, 42 in. square at its base, tapered to 30 in. square at the base of the pyramidium and weighed 49,500 lbs., with its center of gravity equidistant from its four surfaces and 14 ft. 1 in. from the base.



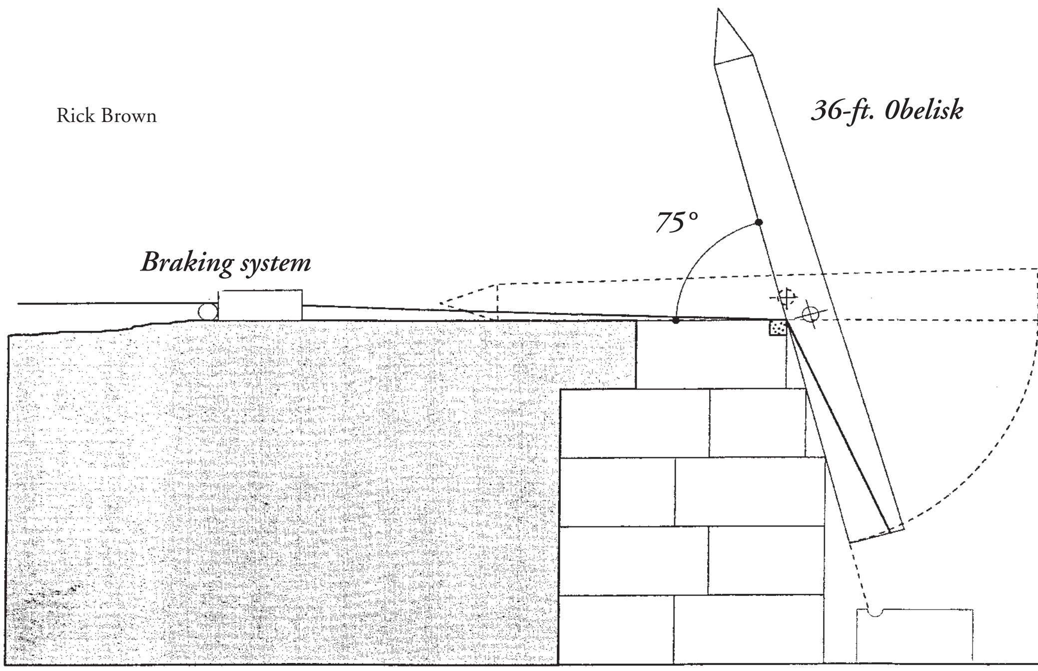
Orthogonal drawing of 18-ft. granite bearing wall with stepped center section and plumb flankers. Shading lines indicate radiused portion of the pivot block above and 13-in.-wide turning groove in the pedestal below.

On August 24, 1999, Al Anderson of Blue Ridge Timber Framing arrived and hit the ground running (though he brought his fishing pole). Over the next three days he supervised the construction of the bearing wall, ramp and sand box. The bearing wall comprised large granite blocks in a three-bay system (drawing above), with the central bay offering a stair-stepped 75-degree face and the outer bays plumb to restrain the obelisk if necessary. Our ramp of crusher-run gravel ran in a gradual slope up to the rear of the bearing wall. Fletcher provided precast concrete blocks tenoned together to make up the walls of the box.

Around noon that same day, Jim Kricker drove up in his one-ton flatbed truck, riding low on the axles with a spectacular load of hemp, some of it 3-in. Smiling from ear to ear, Jim had never in his life imagined a project that would require so much cordage. Using a simple lever, Jim and Grigg pre-stretched the rope to the load limits required to raise the obelisk. We developed a controlled brake-release method. Three 3-in. lines, each wrapped three times around the 12-in. oak brake logs at each end, provided six points of controlled release which would allow us to lower the obelisk slowly into position.

Was any timber framing involved in this project? It's a fair question. After leaving our dusty derrick dead in the desert, we hadn't used much wood to speak of. We did have a beautiful veneer-grade white oak pivot block (labeled in the drawing above), made by Wyly and my colleague Ellen Gibson, which provided a soft bearing surface for the obelisk to rotate around from horizontal to the 75-degree position against the bearing wall. Laura made the saddle, a tenoned structure with carved housings to hold the ropes wrapped around the butt of the obelisk. Wyly made a plumb square, based on the ancient Egyptian pattern shown in W. M. Flinders Petrie's *Tools and Weapons* (Constable & Co., 1917). We strapped this device to the side of the obelisk to observe its angle of rotation (facing page, lower right). Andy carved hardwood long-handled hoes (facing page, top), similar to those used by ancient Egyptians, to pull the sand through the sandbox portals. Our pedestal stone allowed for a 16-in. margin around the base of the obelisk. The turning groove was 5 in. deep, 13 in. wide.

Rick Brown



General scheme of raising. The challenge is to bring the shaft over to land in the turning groove, while managing its tendency to slide forward as it rotates about the pivot block. Sand not shown.

On Sunday, August 29, we filled the box with sand and finished the ramp. Granite blocks and gravel buttressed the sand box. Late in the day the obelisk was laid with its center of gravity over the pivot block on the bearing wall. Next day, we rigged the obelisk, tensioned the 3-in. steering ropes and began to lower the stone. Portal captains Wyly and Andy directed two teams made up of students from the Massachusetts College of Art and National Guardsmen from Hanscom Air Force Base. Through the 4x5-ft. portals on either side, the sand was symmetrically removed with hoes to a line of workers who carried the sand away in baskets.

The sand had been preheated to 160 degrees and delivered (still hot) absolutely dry to assure free flow. As sand was removed, the sand remaining inside the box flowed downward toward the portal consistently maintaining an angle of repose of 35 degrees. We used this natural slope to support the weight of the obelisk, and the fluid quality of the flowing sand to gently rotate the obelisk to the turning groove. As the sand flowed out of the sand box, two symmetrical slopes formed a ridge down the center of the box in line with the obelisk, and as the ridge descended, the base of the obelisk came down with it, and the pillar gradually rotated around the pivot block above. We had learned from our models that when sand is removed even one scoop at a time, the obelisk moves in turn. This provided very precise control of the process.

After every five degrees of rotation, Jim Kricker measured the profile of the sand to record the relationship between the angle of repose and the position of the obelisk. By the end of the day we had reached 45 degrees. Mark Lehner observed that this was already greater than any of the previous attempts and things seemed completely under control. Looked like a good time to stop for the day.

On Tuesday, we continued lowering the obelisk, knowing that rotation beyond 45 degrees would entrain rope stretch. The distance from the pivot block above to the turning groove on the pedestal below had been calculated by taking the distance from the base of the obelisk to its center of gravity (14 ft., 1 in.) and then adding an allowance for rope stretch based on our testing plus a generous safety factor. (Overshooting the turning groove cannot be corrected and therefore was not an option.) The workers on the hoes maintained tremendous control on the symmetry and the sand flow. Every scoop had an effect on how the obelisk moved. The actual placement of the symmetrical hoes in relation to the toe or heel of the obelisk was critical in controlling rotation versus forward slippage as the stone moved closer to the final 75-degree angle. Casual removal of sand could result in disaster. Our obelisk team remained focused and slowly piloted the stone onto the stair-stepped bearing wall at 75 degrees, resting on 20 in. of sand directly above and in line with the turning groove. Coming in 20 in. high meant that we had had far less rope stretch than we anticipated. The sand had carried a greater load than we had expected. Hurrah! We did not overshoot the target.

Now the brake-release method would be put to use. The two brake release teams were led by Al Anderson and Jim Kricker, while Grigg Mullen and I went inside the sand pit (facing page) to remove the final 20-in. cushion of sand between the obelisk and the pedestal stone. Simultaneously, the two ends of each rope were released in small increments, repeated by the next pair of ends until all three sets of ropes had been equally released. This cycle of release was repeated again and again as the sand was removed and the obelisk slid down the 75-degree pitch of the bearing wall until it came to rest in the turning groove. The brake release method was very safe and verified our guided rotation theory.

The next morning, we removed the saddle and the steering ropes from the obelisk and the brake logs. We packed up our tools and went home until our return 10 days later for the final pull. During that period, the sandbox and remaining sand were removed. The obelisk rested safely in the turning groove and against the bearing wall, fully rigged and ready to be raised the last 15 degrees. When we returned, on a beautiful, crisp, clear fall day, nearly 200 eager pullers from The Massachusetts College of Art, Fletcher Quarry, Hanscom Air Force Base and the film company joined the obelisk team to complete our task. We spent the morning on final layout of pulling ropes. Two opposed lateral brake lines led from a central harness at the pyramidium to deadmen at the sides, and two brake lines led aft to the brake logs. Four forward pulling lines gathered into a single braid at the harness. The braid would avoid any twisting caused by unequal line pull.

Our experience in Aswan demonstrated the importance of having a unified pulling force. The creation of such a team reenacts a significant feature of Egyptian building history. Pulling the obelisk to 90 degrees is a delicate operation. At 75 degrees, the obelisk has a high and forward center of gravity. After the initial pull towards upright, the load diminishes rapidly. At 86.5 degrees, the obelisk develops a forward motion. Lack of attention might result in the ultimate disaster. We invited the Guild's Joel McCarty, an expert in on-the-spot group management, to bring his hand-raising experience to direct an on-site pulling school. Using our 6-ft., 300-lb. concrete obelisk, the pullers learned fingertip control and experienced firsthand the physical principles necessary for the job.

The pull would be divided into two parts. The first would bring the obelisk from 75 to 86.5 degrees, to be held there with a propping wedge dropped down between the shaft and the bearing

Laura Brown

Grigg Mullen (silver hardhat) and Rick Brown hoeing sand out through portals, allowing obelisk to descend to turning groove. Below, Grigg relaxes on the brake logs wrapped with 3-in. line, which served as release winches. Below right, the shaft is ready for the final pull.

wall. The second pull would bring the obelisk to 90 degrees. Joel organized his trained pullers into four teams of 28 people, each team on one rope, standing (for safety) about 100 feet ahead of the obelisk. Grigg Mullen was nominated Single Voice to direct the 112 pullers. Al Anderson and Jim Kricker, our brake and alignment team, released tension on the rear brake lines simultaneously as the 112 pullers tugged the obelisk off the bearing wall. Laura and I lowered the propping wedge between the bearing wall and the back of the obelisk to hold the space we gained as the obelisk moved higher and higher to the crucial 86.5-degree angle. Single Voice gave the word to release the lines to give the pullers a rest before bringing the stone to vertical. Grigg then surveyed the site, refocused the troops and called the final pull. All 112 pullers pulled as one while the brakemen eased off tension on the rear brake ropes. The obelisk moved with the grace of a magnificent bird and without a single sound gently came to rest on its solid base. Our hand-raising Egyptian-style was now complete.

—Rick Brown

Rick Brown teaches at the Massachusetts College of Art in Boston. His last adventure with NOVA and the Timber Framers Guild unfolded last year at Castle Urquhart in Scotland (see TF 50), where he organized the precision casting of 14,000 pounds of lead to be mounted on the throwing arm of a fixed-counterweight trébuchet. PBS's "Medieval Siege" will air February 1, 2000, and "Pharaoh's Obelisk" will air February 8.

Photos Rick Brown

A Visit with Jim Kricker

Above, Jim Kricker explains the steps in getting to the finished casting from the foundry pattern shown here and made in his shop. At right, inside the Kricker house, where music is part of the day.

FOR millwright Jim Kricker, it all started in boyhood near home in Ulster County, New York, with an aluminum boat repair. That led to essays in boat-building in Maine, and then in 1978 to the building of the Woody Guthrie, a 32-ft. gaff-rigged sloop commissioned by Pete Seeger as part of Seeger's efforts to reunite New Yorkers with the Hudson River. Jim still lists the Woody Guthrie, which he built with his brother and friends at their parents' property in Bearsville, among his most interesting experiences. (The others are a building a windmill on Long Island and trébuchets in Virginia and Scotland—see TF 44 and 50.) Were he forced to build only one thing, Jim remarks, it would certainly be boats. Indeed it was a boat, a schooner headed for the Virgin Islands, that brought him together with Jean Whelan, who, the story goes, picked him out as the only competent sailor on board. They married in 1982.

Today, he says, "Most of my time is spent in the office. I enjoy it to certain extent, but it's a challenge to accept this as my role." The office, mind you, is a tiny corner tucked between the big, lofty woodworking shop, served by overhead crane, and the smaller machine tool shop, on his property in Saugerties. The office itself has just room enough between the big drawing board and the cluttered desk for Jim and a visitor to slip past one another while examining volumes of photographs. "I like to have my hand even on the smallest detail," he says, "but I'm getting more comfortable with having people work with me and head up jobs." Generally he works with a crew of three and sometimes a fourth. "I would like to increase that a little bit, but it's tough to stay the right size."

Jim calls his outfit Rondout Woodworking after the creek in Kingston where his first shop was located, at the Hudson River Maritime Center, and where the group produced early jobs such as a grist mill shaft and a water wheel. But in fact a good deal of Rondout's work is in metal. (Water wheels especially are most durable welded up.) "What I really enjoy is doing machine work on metal rather than wood," Jim says. "If you take away the machinery, then I prefer to work with wood." On the other hand, he does allow that work at a forge, and welding, offer similar tactile experiences to working wood. He compares the pleasures of this utterly focused work to sailing a boat, "completely comfortable, no conscious thought process, your body and mind take over." Naturally, this state of affairs is not always the case: "If you want to embarrass yourself," Jim grins, "there's no better way than with a sailboat!"

Nowadays the workshop is some distance from Kingston, at the end of a network of dirt roads in Saugerties. Comfortably spread apart in woods of pine and hemlock, oak and maple (but also chestnut oak, shagbark hickory, hornbeam and ironwood), at about shouting distance, stand Jim's little forge, the big new shop built in 1990, 12-year-old daughter Susannah's polychrome-roofed playhouse and, at the top of the system, Jim and Jean's house.

The house, which in small ways is still a-building, is a place of comfort—warm, clean and orderly, with plenty of light and good colors (Jean is a painter)—and, not least, one of the larger bathrooms on earth. There is a piano in the living room and a model trébuchet in the vestibule.

Susannah is an accomplished violinist, quite tall and willowy like Jim. On a Saturday morning she was off to Poughkeepsie with Jean for an orchestra rehearsal, while Jim baked the bread and made the minestrone soup for lunch, and patently took the phone calls. Jim says if he didn't have so many "away" jobs, he'd take up the piano.

Photos Ken Rower

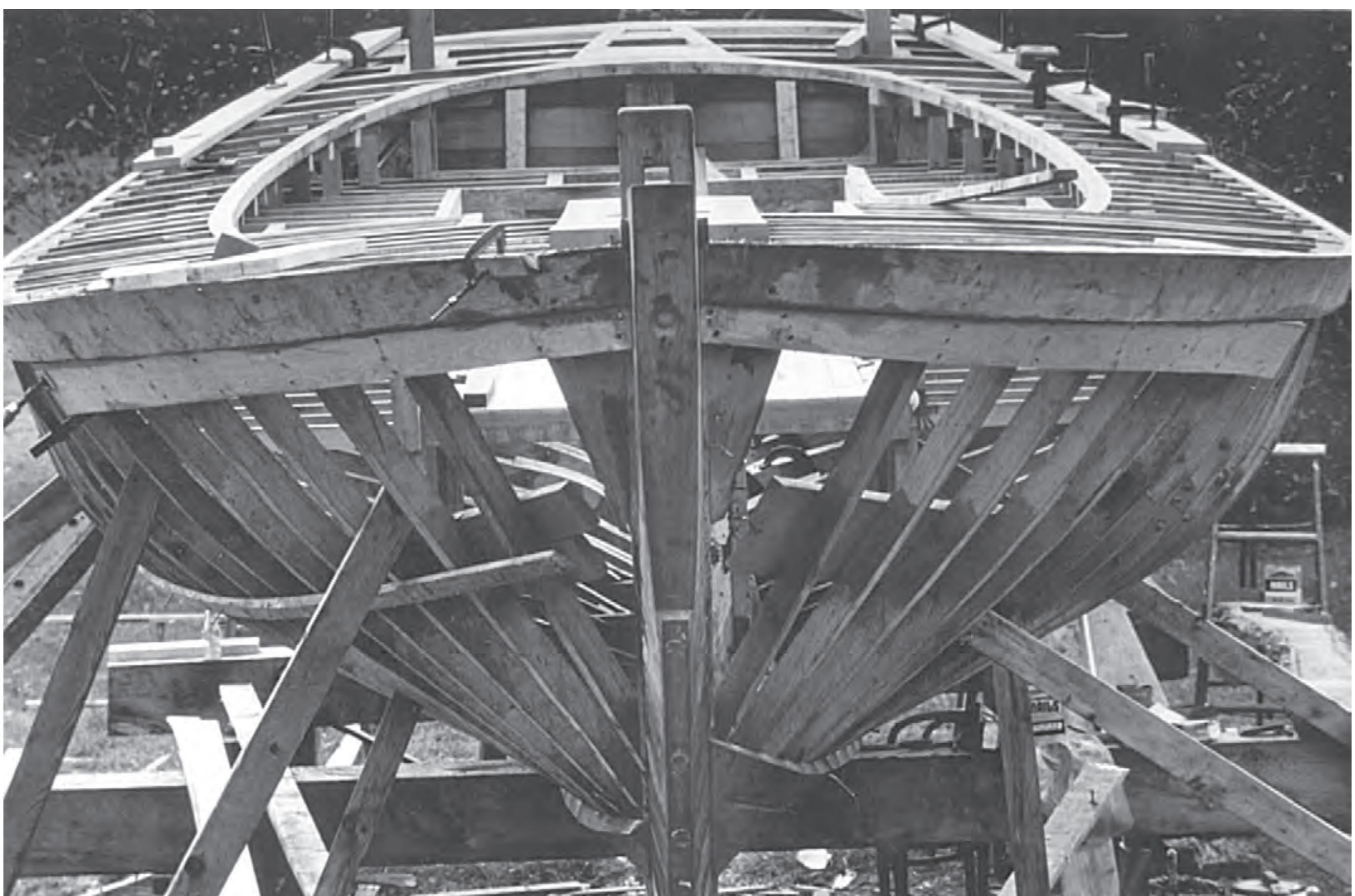
The main part of the shop, served by broad doorways on adjacent walls. The attic above is laden with hardware, foundry patterns and special-purpose timber such as lignum vitae, as well as traces on the floor of lofted work. Below, one of Jim Kricker's stoves (both taps are hot). Below right, the magisterial ship's saw that sits just outside the shop and permits tilting of the frame (and thus the blade) while stock passes through on the level.

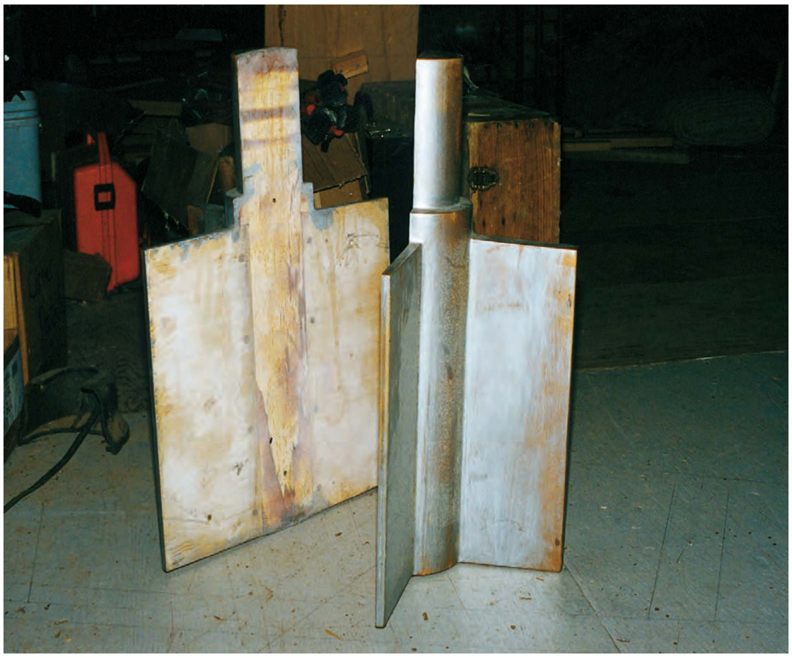
With so much of Rondout's work in repairing, restoring and reproducing historic working structures, some of which regularly stay wet, the durability of wood species is almost always a question. Is there a simple answer? "There are so many factors," Jim says. "I wish when I'd started out that I'd taken samples out in the woods." Lacking the results of such a long-term, controlled test, "I go by the book." Still, he offered a few specific observations from experience: "I've not found white oak to be as reputed. Cypress posts in the garden rotted at grade. Locust posts are still good after six or seven years." And on the question of favorites: "If somebody had to get a favorite wood out of me, it would be white pine *and* white oak." These happen to be the traditional materials for water wheels—white pine for the buckets, white oak for the rest—and, by no accident, Jim built the cabinets in their kitchen with white oak panels and white pine rails. One day he will get around to the finish staircase. —Ken Rower

Selected work of Jim Kricker and Rondout appears on pages 12-15.

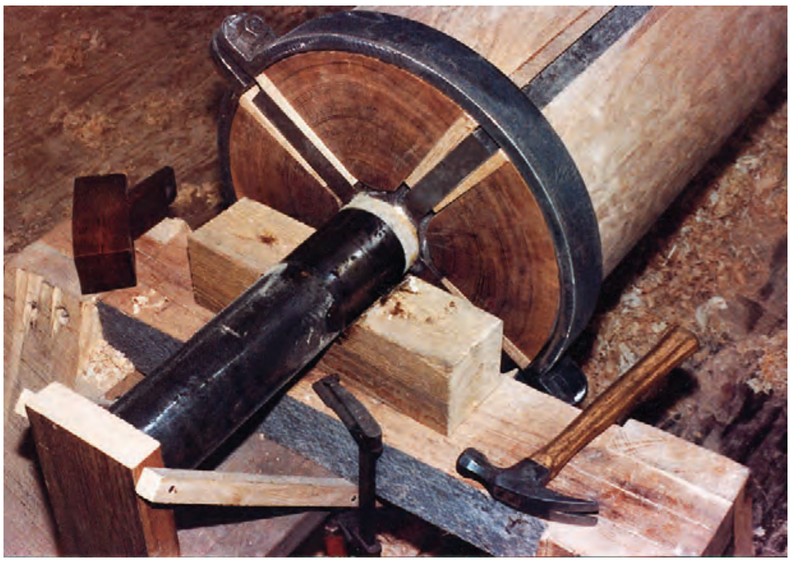
Photos Emilio Rodriguez

At the shop in Bearsville, New York, 1978, the builders of the Woody Guthrie. From left, Mark Wetteray, Don Taube, Jim Kricker, Pete Kricker, Andy Mele, Calvin Grimm. Below, the hull under construction outside.



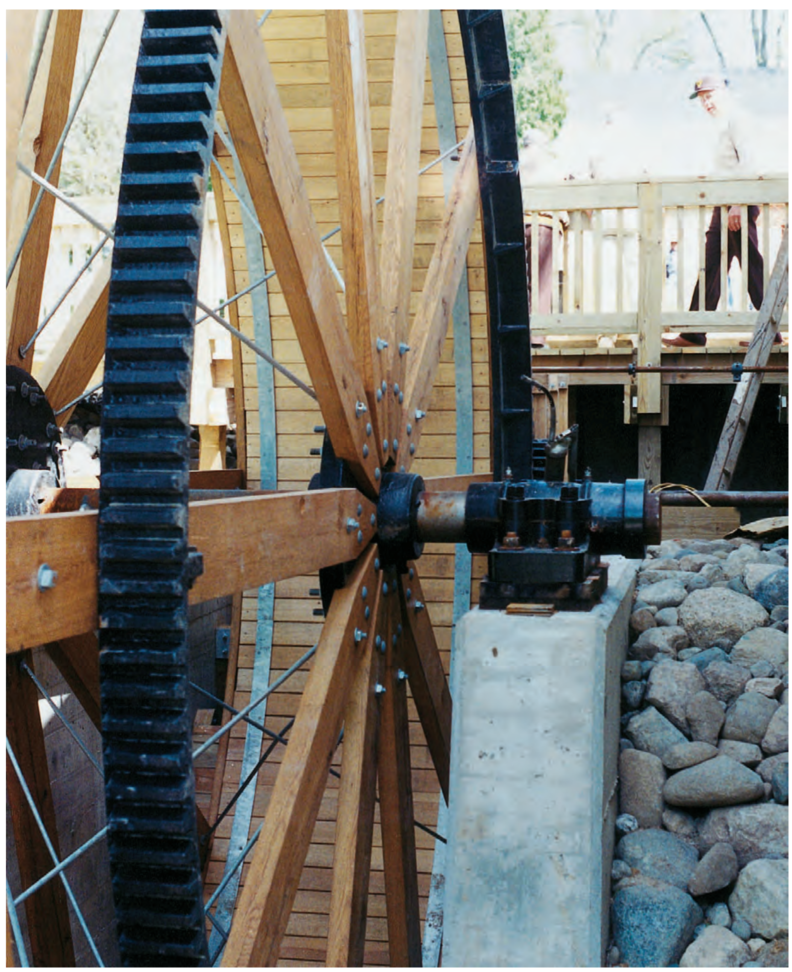


Above, split pattern for casting iron gudgeon shown below installed in shaft log for 1991 water wheel in Lake Buena Vista, Florida. At right, Rondout's Wayne Ford with wooden gears for the same job.



Photos Rondout Woodworking

Below left and below, 20-ft. low-breast water wheel in Ray Township, Michigan, with wooden buckets and arms, cast iron hubs and a 16-ft. cast iron segment gear and pinion.



Long Pond Iron Works 24-ft.-dia. water wheel, reconstructed in 1994 from the remains of a double wheel at a Civil War blast furnace site at Hewitt, New Jersey. The crank arms at each end of the shaft drove pistons to provide the draft for the furnace, of which nothing remains save the foundations. Below, Rondout's Bruce Murray removing the substantial iron shaft and hubs.

Photos Rondout Woodworking

The J. Corwith Windmill, Water Mill, New York. Ca. 1800, this Long Island smock mill (only the cap turns into the wind) was disassembled and rebuilt in 1986-87, which required replacement of nearly all the timbers in the tapered octagonal base. The machinery inside was also restored or replicated, including the windshaft, wooden gears and flyball governors. Below, the cap with dormer under reconstruction.

Early Woodworkers in Massachusetts Bay

IN 17th-century Ipswich, Massachusetts, like all towns settled by the English in the period, a quantity of land called the commons was set aside to be managed by the town. To make use of the town land, one had to be a *commoner*, someone who owned a house in the village, since the right of commonage belonged with the house and transferred from owner to owner. Firewood and fencing were necessities for every commoner, from wealthy merchants to fishermen to artisans. Members of this community required their share of these items and depended on the availability of such resources, the town orders regulating their use and the economics of obtaining them.

Throughout the first three decades of the town's existence, the Ipswich Town Records contain scattered mentions of the granting of liberty to commoners for the felling of trees from the commons. Most of these grants specify white oak, the tree most favored for a multitude of purposes by the English settlers of the town; many grants are to artisans for their trade.

But in the middle of 1666, and continuing through the end of 1671, the town records show a great number: 594 grants of liberty to fell trees were made during this half decade. A total of 185 different individuals received these 594 grants, some commoners getting but one or two, others half a dozen or more. In 1665 a town committee determined that there were 203 commoners; therefore, about 95 percent of eligible commoners received a grant for wood from the commons during this period.

Further, the grants are very specific, detailing the number of trees granted, the purpose for which the trees were to be cut and often the species. A number of grants were for more than one purpose, and a total of 794 specific purposes are given for the 594 individual grants. For example, the carpenter Thomas Burnam received grants of white oak to build a sawmill, to make a pair of great wheels for the mill, to make pails and measures, for sills for a building, for 300 or 400 fence rails and the necessary posts, and for a lean-to. Freegrace Norton, another carpenter, was granted trees for sills and sleepers, for parts of the mechanism of a grist mill, for joinery work to be done for townspeople and for a house.

Artisans' work set them apart from the nonartisan population. The abundance of data on artisans in contemporary Ipswich allows for a generalized picture of the day-to-day of at least a part of their lives, a picture which can be drawn with reasonable confidence because it can be confirmed many times by the available evidence.

For an instant, the clouds clear and the subject appears in brilliant relief against the background. Then the clouds come back, to part again at another time, revealing something else about the subject. Enough of these breaks in the clouds—the chance occurrence of what was written and preserved—and something of their lives can be determined.

We now look at the groups of woodworking artisans who lived and worked in Ipswich —the carpenters, coopers and joiners, whose trades were intimately involved with the local forests. The individuals and trades to be examined are found among the 185 men who received grants for trees between 1666 and 1671. In the 594 such grants there may be no explicit reference to the trade of any given one of the 185, but somewhere else in the public records is solid evidence indicating their occupations.

CARPENTERS—about two dozen—made up the largest group of wood-using artisans in 1660s Ipswich, and there was a correspondingly large amount of work. Thirteen of the 185 who received grants can be identified as carpenters. Carpenters naturally used a wide variety and a large amount of materials from the forest, and, as the number of new houses and barns and the number of repairs to existing buildings indicate, they would have used a constant and fairly large number of trees. For the frames of their buildings they almost invariably used white oak (there were many sources of demand for that species). The trees they would have chosen were, however, of small to medium size. Since the principal framing members of a building were hewn from the log, a rather time-consuming process, carpenters chose the smallest possible tree that would contain the square or rectangular timber they needed. A 7x7 post 12 ft. long would require a tree about a foot in diameter at the top end. Such a tree, grown in a thick forest, would not be much more than about 15 in. through at 2 ft. off the ground, not a very large white oak.

The principal competition for such trees was fencing, since such a moderate-sized tree could yield rails 6 to 8 in. wide. Trees for frames, however, did not need to be particularly good. Crooked boles, crooked grain, knots and twist, all negative characteristics for trees that are to be riven, make little difference to the carpenter, so the number of possible trees available for framing members would have been much greater than the number of trees that could be riven. Smaller timbers, ranging from 3x4 to 4x6, used for joists, studs and common rafters, were typically sawn from a tree that had been hewn square or rectangular. In the earliest days, such sawing was accomplished by hand, using the pit saw; after the middle of the century, sawmills accomplished the task. One carpenter, Thomas Burnam, was granted privilege to set up a sawmill on the Chebacco River in 1667. Chebacco, or Essex as it came to be known, seems to have had plenty of forest.

Besides oak for the frames of buildings, carpenters needed pine to be sawn into the boards to sheath the walls and often the roof, for flooring and for most of the interior finishing—paneling, doors, shelving and so on. The exterior covering of Massachusetts Bay buildings was typically shingles for the roof and clapboards for the walls. Since these items were riven from the log, the trees for such products needed to be of high quality, straight grained and free of knots. The carpenters had three species to choose from: white oak, Atlantic white cedar and white pine. The grants generally just specify a tree for shingles or a tree for clapboards, but there are several references specifically to white oak for these uses. Several carpenters, all of whom came to Ipswich in the first few decades of the town's existence, accumulated large holdings of land in Ipswich: William Whitred, 260 acres; John Andrews, 150 acres; Thomas Howlett, 100 acres; and William Story, 100 acres. These early inhabitants of Ipswich obtained their holdings when land was easier to get than it would be later in the century. It is possible that, in addition to the general desire for land as a means to accumulate wealth, they had relatively more woodlot than farmers did.

Coopers comprise the next group of wood-using artisans. There were at least five in Ipswich during this period: Thomas Boardman, Sr., Josiah Clarke, John Kindrick, John Low and Sherborne Wilson. There may have been others as well. This number of artisans practicing a very specialized craft says much about Ipswich at the time, for these people were in essence the packaging industry, and Ipswich had much to package.

Coopers were in demand right from the beginning of settlement in New England. Since most sorts of trade required casks, whether within the Colony or abroad, the cooper had to follow right behind the farmer or fisherman.

The cooper was a true specialist; he did nothing but make casks. There were two distinct sorts of cask: those made for dry goods, and those meant to hold liquid. The former were the simpler to make since they did not have to be watertight. A cask meant to hold liquid, however, required near perfect workmanship. The materials varied as well. Watertight casks could be made only from white oak, since only that species possessed the required strength and flexibility, as well as a watertight grain. Dry casks could be made from the red oaks, which, because of their long, open pores, were permeable to water.

A coopered cask is a deceptively simple-looking object. The body of the cask is made up of relatively thin stock cut into narrow staves of wood, never more than a few inches wide. A cask by definition is wider in the middle than at the ends. Hence each stave has a similar shape, tapering from a maximum width in the middle of its length to a lesser width at each end. The joint between adjacent staves is produced only by the careful mating of the two adjacent edges. Since the cask is round, the edges of the staves must have a bevel such that there is good contact between the two edges. This angle is achieved with the aid of that ancient measuring tool, the eyeball. A cooper must learn during apprenticeship just how to hold the stave as he planes its edge so that the width varies in just the right way. He must also do other things by eye: taper the width of the stave just the correct degree with an axe, and know how many staves of what size and taper are required. The proof of the work was in the result: the cask did not leak. Furthermore, each size cask required a different set of formulae, and the precise capacity of each cask was regulated by law.

In 1641 the Massachusetts Bay General Court passed requirements for the sizes of casks and their packing. Casks for "any Liquor, Fish, Beef, Pork or any other Commodities to be put to Sale, shall be of London Assize, and of sound and well seasoned Timber." The court created the position of Gauger of Cask, whose job it was to measure each completed cask. He signified his approval by a mark. Each cooper, for his part, was required to have a distinct brand with which he, too, marked his casks. The gauger of cask was most likely a cooper himself, since determining the capacity of a cask would have been among the mysteries of the trade. Gaugers were required for "every Town within this Jurisdiction, wherein any Cask are made." The packer may or may not have been a gauger, since packers were required "in every Town where any such Goods are packed up for Sale." Their job was not to measure capacity, but to see that the contents were well packed, "that is to say, Beef and Pork, the whole, half or quarter, and so proportionately, that the best be not left out. And so Fish, that they be packed all of one kinde." Staves were also regulated: hogshead staves were to be 3 ft., 2 in. long or longer, barrel staves 31 in.

On January 3, 1643, the town of Ipswich passed an order indicating the value that had come to be placed on pipestaves, roughly prepared pieces of white oak from which coopers elsewhere would fabricate pipes: long, thin barrels used particularly for the transport of Port and Madeira wine. Pipestaves had become a useful means for the New England settlements to gain foreign capital and were exported to Spain and Portugal. The 1643 order specifies pipestaves may be included in the list of goods suitable for the paying of taxes.

The coopers in Ipswich were among the chief users of timber from the commons. Grants of trees to them usually carry the admonition that what they make of the town's trees must be for the "use of the town," meaning that they could not make barrels or staves for export from trees from the commons. Almost anyone, another sort of artisan or even a farmer, if he were reasonably handy with a hewing hatchet, could have produced pipestaves. Although the town expressly forbade the export of wood from its forests, there was no such limitation on privately owned woodland, and many pipestaves made their way from Ipswich, as from other coastal towns, to the principal ports whence they would find their way to the Continent.

COLONY orders about the gauging of casks seem mostly designed to regulate trade within the Colony. But a 1646 Colony order regulation pertaining to pipestaves seems to have been written specifically to meet the demands of foreign markets:

"Whereas information hath come to this court from forraign parts, of the insufficiency of our Pipe-staves, especially in regard of worm holes, whereby the Commodity is like to be prohibited in those parts, to the great damage of the Country;

"It is there for Ordered [that in towns] where Pipe-staves use to be shipped [there be] viewers of Pipe-staves. . . to be sworn diligently and faithfully to view and search all such Pipe-staves as are to be transported to any parts of Spain, Portugal, or within either of their Dominions or elsewhere, to be used for making of tight Cask, who shall cast by all such as they shall judge not Merchantable, both in respect of worm-holes and due Assize, viz, that are not in length four feet and half, in breadth three Inches and half without sap, in thickness three quarters of an inch and not more or less then an eighth part of an inch then three quarters thick, well and even hewed and sufficient for use."

Ipswich would have fallen under all of these regulations. There was oak enough that the making of staves became a cottage industry. There was enough produce, both animal and fish, that casks were needed for the packaging of those items in great quantity. There was, as well, quick access to the ocean, allowing the easy export of staves. Hence, there was a ready market for the wares of the cooper. John Winthrop noted in 1633 that Ipswich was "the best place in the land for tillage and cattle," and the inhabitants had "many hundred quarters to spare yearly, and feed, at the latter end of Summer, the Towne of Boston with good Beefe."

As to our final group of woodworkers, the joiners, William Searle, who came to Ipswich in 1663, is the first person to be mentioned in the Ipswich Town Records specifically as a joiner. Thomas Dennis, who followed Searle in 1667, is the second. In the case of these two, the title "joiner" may refer more to the apprenticeship they had served, and less to the sort of work they actually did. Each is paid by the town once for work done.

According to the town records, in 1663, the year Searle came to Ipswich, it was "Agreed with William Searles, to make seates at the two corners of the Meeting-house. Foure seates . . . . To line the back seat downe to the ground . . . . To be about seaven foote long . . . . To be finisht by the middle of Aprill." Later at the same meeting the selectmen were instructed to pay £5-0-0 "for the two seates at the two corners of the Meetinghouse."

In 1681, Thomas Dennis was paid "For foure window frames, bought of Tho: Denis £l-5-0." If these were the only references to the two men, they might be taken for carpenters rather than joiners. Thomas Waite, a carpenter, repaired Mrs. Cobbit's seat for £0-18-0, and his son Thomas Jr., also a carpenter, built, with Nathaniel Lord, seats in the meetinghouse. In 1690, Joseph Fuller was paid £l-9-4 for meetinghouse windows. Joseph Fuller is called a carpenter by Waters; he was, indeed, paid £0-10-0 "for hewing timber for ye Meetinghouse,"carpenter's work. In 1683, Theophilus Wilson, long-time keeper of the meetinghouse, was paid for a number of items: "To Mr. Wilson fr keeping & sweeping, & ringing £8-8-0 . . . to soe much for boards & nails . . . £1-18-0 to 24 foxes, & mending the meetinghouse £1-7-0 . . to 2 Frames for the meeting-house windows £0-12-0."

Wilson is not clearly called a carpenter, although a number of the tasks for which he was paid seem to have involved at least some facility with tools. (He was at least a successful fox hunter, for he was paid the 1 shilling bounty many times.) His window frames were about the same price as Thomas Dennis's.

The activities of carpenters and joiners in fact seem to have overlapped many times. The standard example is that of William Averill, cited many times, who was brought to court in 1659 for nonperformance of a contract. He was to frame an addition to a house 18 ft. square, floor, clapboard and sheathe it, and "make 4 windows too [2] stole windows of 5 Lights apeece and to [2] Claristory windows of 4 Lights apeece also a garret window to Casments between studs pertitions and dors to Close it to his house and mak it tite betwene also to make a table and frame of 12 or 14 foot Long and a joyned forme of 4 foot Long and a binch Behind the table"—all for £12-0-0. When Averill, only called a carpenter in the records, died in 1691, his inventory contained joiner's tools. Abraham Tilton Jr., a carpenter who with his father built the new meetinghouse in 1700, was also paid (separately) £6-0-0 for the communion table. Tilton's table fetched fully half the cost of Averill's whole addition and furniture. A general carpenter might do some small joinery on the side, but the large price for the communion table indicates that it was skilled joiners' work.

AN example of what an artisan did about his farm is contained in the will of John Emery of nearby Newbury. John Emery Sr. was a joiner, as was his eldest son John. To the two of them is attributed some of the most visually spectacular of the existing furniture of the period. When Emery made his will, he had apparently given half his farm to John, his eldest son, and indicated that another son, Johnathan, a carpenter, should have the other half "upon Condition and in Consideration that the said Johnathan shall maneg and manure that one halfe of the saide lands both upland and medow for the use and proper behalfe of me the sd Emry and my wife: . . . att his own Charge till my upland acording to our order . . . and also laye it in the barne or house harvested we to take the Care of it for thrashing . . . also to Cut one halfe of al the medous and make and bring whome the hay thearof for me or my wife: on the sd land also to lay halfe the dung . . . to make and maintaine all fenses belonging to sd lands and to repair the barne & housing thear unto belonging."

Manuring, plowing, planting and harvesting would have taken some time; at least John Sr. would do the thrashing. Add to this the maintenance of fences and buildings, not to mention the cutting of firewood, and Jonathan would have been able to work at his trade only part of his time. That this was the typical situation for the Ipswich artisans is shown by the numerous grants in the last half of the 1660s to artisans for fencing materials and for agricultural buildings. Searle and Dennis, no less than their contemporaries, were farmers and artisans.

Another view, the account of a legal dispute from Essex County court records, 1681, puts the artisan-farmer in perspective.

"Writ: John Davis v. John Tolly; debt; for four wainscot chests made by his order and delivered to him in his house.

"Nathanill Kirtland, aged about thirty-four years, deposed that he brought from John Davis' shop at Lyn four chests and delivered them to John Tauly at his house in Salem. Davis told deponent that Tauly had them to carry to Newfoundland.

"Eleaser Lenesey, aged about thirty-five years, deposed that Davis looked at a chest in Tawleay's house and the latter told him to make two or three as good as that for 25s. each.

"John Longley, aged about forty-two years, testified that on May 6, 1681, he heard Davis at Tauley's house call the latter a cheating knave, with many other absurd expressions, challenging him out of his own house to fight, threatening him. He also took hold of a wainscot chest in the room, threw it up and down in the room, breaking several pieces of the front of the chest, etc. Davis was very much in drink.

"Samuell Ingols, aged about twenty-seven years, and Nathanil Willson, aged about nineteen years, deposed that the chests were worth 30s. each."

Davis won his case.

These joined chests must have been fairly elaborate. The average value of a joined chest has been calculated at 15 shillings, but it is not clear whether this is an average taken from inventories, in which case it included used furniture, or whether it is of new pieces. An artisan's daily wage at the time might be 2s6p (2½ shillings; 20 shillings equalled 1£). Davis's 25-shilling chests, representing perhaps 10 days' work neglecting materials, were a cut above average, probably in line with the elaborately carved chests attributed to the Searle-Dennis school. The value of a rod of sufficient five-rail fence was earlier determined to be 2½ shillings. A joined chest, then, was worth about 10 rods—165 feet—of sufficient five-rail fence. The amount of fence required to protect even an acre thus cost the equivalent of five elaborate joined chests.

Thomas Dennis was probably an average sort of person in his community, one of perhaps three or four dozen artisans, men who also farmed in a small way. He took his turn in public service and was occasionally called by the honorific "Goodman." Between cutting firewood, tending to a small farm and making items like window frames, he did manage to produce some of the finest carved furniture in the New World, but how much of this sort of work he actually did still remains a mystery. —ROB TARULE

Rob Tarule (rtarule@together.net) teaches history and woodworking at Goddard College and builds 17th century-method furniture at his workshop in Essex Junction, Vermont (www.heartofthewood.com). This discussion is adapted from his unpublished doctoral dissertation, "The Joined Furniture of William Searle and Thomas Dennis."

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Photos Joanna E. Morrissey

Eastern Design Expo '99

Winner of the People's Choice Award in the Design Exposition at October's Eastern Conference at Fairlee, Vermont, this horse barn with attached living quarters on Martha's Vineyard, Massachusetts, was timber framed (and completed) by Cranston Timber Framing of Peterborough, New Hampshire. The building was designed by architect Phil Regan of Oak Bluffs, and built up-island at Chilmark. The Douglas fir frame is boarded in pine, with cypress panels for the five horse stalls. A tack room and grain room complete the arrangement.

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