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Where Pegs Come From

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On the cover, Ed French turns pegs on the backknife lathe at Scott Northcott's establishment in Walpole, N.H. Photo by Brian Wormington.

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TOPICS

Eyes Wide Shut

I WOULD like to see more spirited and thoughtful exchange on the subject of timber framing automation, specifically the trend toward investment in computer-numerically controlled (CNC) cutting machines. The discussion so far has mostly centered on the craft-versus-capitalism issue, and I fear that many timber framers who are about to acquire automated cutting machines see this as the principal issue.

Once they are willing to accept the "capitalist" label, they view the acquisition of a CNC cutting machine as a fairly simple step, akin to replacing a typewriter with a computer and laser printer, albeit on a much larger scale. Such thinking ignores the dark side of these machines. As a founder of a CAD/CAM company with 150 employees and growth in two years from zero to $15 million in sales—it was sold to Harris Systems after five years—I know about dealing with company growth and anticipating changes. Here I want to discuss two subjects in which I have specific experience: the areas of software and CNC technology; and the technology's financial impact on the health of a company.

Technological considerations. CNC machines are software-driven and are useless without reliable embedded code. Timber frame companies are too small to develop their own proprietary modeling software, and they are naturally using the software that the CNC machine manufacturers have subcontracted to another company. There are two potential problems with this situation: code stability, and finger pointing when there's a problem.

From my experience, the only thing that generates stable software is volume: when there are many copies of a particular piece of software sold and in use, the combined experience of many users proves to make a reliable product. Unfortunately, the number of copies of the modeling and control software for these CNC machines to date is so minuscule compared to a mainstream software application that the code has not yet proved stable. Thus, bug fixes and workarounds are to be expected, and I do hear reports of daily or weekly updates. The challenge is to get the frequency of such changes to an acceptable level that fosters a production environment.

Second, the CNC coding does not seem to permit tool path verification, a standard feature in CNC applications. As a result, it is possible to produce a perfect geometric model and still end up with a mortise cut in the wrong place. When problems arise in the timber cutting process, there is the inevitable finger pointing as to whose responsibility it is to correct the problem. That doesn't help the timber framer who has seen, to his horror, a 20-ft. timber cut in two.

Financial considerations. The justification for the purchase of such machines is to save money: simply put, automation will reduce the amount of labor to cut a frame and will produce more margin and hence more profit. Thus, in order to decide whether automation makes sense for a particular company, the company's managers need to understand the amount of direct labor cost in each frame the company cuts. This number is derived not simply by subtracting the cost of the wood from the selling price, as there are other numbers that need to be included: overhead, other labor (designers and any office staff, plus the owner's salary), and contribution to profit.

Rather than trying to build such a model from textbook accounting terms, let's try backing into the number for *direct* labor cost by creating a hypothetical "average" timber frame company with a hypothetical "average" frame. (I actually think my estimates for the indirect costs are low, but I'm trying to make a conservative case.) First, the *indirect* costs:

Non-woodworking labor expenses: four employees or equivalent (designer, salesperson, accountant, trucker-raiser) plus owner, $175,000. Overhead: utilities (heat, light, power, phone), tools and maintenance, gasoline, office and shop space, insurance, etc., $38,000. Profit at 9 percent, $67,500.

These costs come to $280,500, or $18,700 per frame if the sales volume is 15 frames a year at an average selling price per frame of $50,000. Let's suppose average frame size at 2,000 sq. ft. and average timber content at 8,000 bd. ft. with an average timber cost of $1.50 per bd. ft. or $12,000 per frame. Thus the direct labor cost calculation:

Selling price	$50,000
Indirect costs	18,700
Timber cost	12,000
Direct labor cost per frame	$19,300

Now, you may object and say that this is not realistic, because a company that builds 15 frames a year is not a likely candidate for automation. But remember, the purpose of this exercise is simply to come up with a number for the labor cost per frame. I am trying to make the most attractive possible case for automation by deriving a number within the context of a non-automated company, rather than for a company with some automation already in place (which would see much less benefit from CNC cutting). The result above is not far from the generally understood one man-year per frame production rate (and I know of shops that do better than a half man-year per frame). Given this $19,300 per frame labor cost, let's say that we hope to reduce it by 50 percent with CNC, to $9,650.

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Acquiring the machine will incur certain capital and labor expenses. The capital costs will be financed with debt, and the increased expense and debt service must come from the $9,650 per frame savings. So the question is, How many frames does the timber framer have to cut in order to break even?

If the machine costs $400,000 and the facility to house it another $100,000, let's suppose this expense is financed with a 5-year note at 8 percent interest, for an amortized cost of $125,000 per year. Some new labor costs and overhead arrive with the machine. Expressed annually:

3 Machine operators	$120,000
1 CAD designer	50,000
1 CNC programmer	70,000
15% for overhead and benefits	36,000
Subtotal	$276,000
Facility operation	20,000
Note payment	125,000
TOTAL	$421,000

If the total labor savings per frame is $9,650, it would take a volume of 44 frames a year just to break even—break even, I repeat, not to earn more money but simply get back to where you were before you bought the machine. If the realized savings per frame is less than $9,650, the number of frames required to break even increases.

There is the argument that after buying the machine, you will lay off some cutters and have a labor savings. This probably won't happen in the first year of operation. But consider what happens if the labor savings is only 25% *and* you save $100,000 in salaries from layoffs. Then the number of frames for breakeven goes up to 66 frames, not down. The point is that the calculation is extremely sensitive to the actual savings.

You may argue with my figures and assumptions, and they will vary from timber frame company to company, but the fact is, fixed costs are just that. The complexity of the effort requires additional overhead in terms of personnel and facilities, and the costs are significant. Every timber framer who is considering investing in a CNC machine must do this calculation using the company's own figures.

Complicating the model is the fact that there is a learning curve for every company that buys a CNC machine, and it may take up to a year or more before personnel can become fully productive.

I am not a Luddite, as you who know me will agree, and I don't advocate only one—hands-on—approach to cutting timber frame structures. But I have to question why so many timber framing companies are so interested in buying these things. Where is the economic sense of the huge investment in CNC machines for companies that are simply too small to afford it?

I have facetiously referred to the whole situation as a timber frame arms race. Now that a few prominent framers have the bomb, others are scrambling to get one themselves. But will they use the weapon, or is it only a deterrent? Remember the neutron bomb, the one that kills all the people but leaves the buildings standing? I fear that the CNC cutting machines may be the current timber framing bomb, only too effective in killing the companies and leaving the employees alive but deprived of earning a living.

—Brian Wormington

Brian Wormington runs Acorn Woodworks in Otis, Massachusetts.

Spar Wars

TYPICAL North American framers have much in common with their counterparts here in Britain. Generally they are quite bright (if not bright enough to get into something more rewarding), they have come to timber framing having done something else first, and often they have an alternative outlook. They are frequently interested in environmental and ecological issues, always interested in their craft, love tools and share a similar if not identical language.

We have also rubbed shoulders with our European brothers (and sisters), French and German, who have proper guilds and live where timber framing is a fairly normal sort of activity, and where it never died out as it did for us. I've always put the dieout and subsequent rediscovery as the reason for the difference between us and the Continentals. Having never lost timber framing as a regular sort of activity, they have little reason to be as evangelistically revivalist about it as we are.

I was going to say "enthusiastic about it as we are," but it has been pointed out to me that there are some major differences between learning in a technical college or trade school and the seven-year apprenticeship of the French Compagnon, which requires vision, enthusiasm and the dedication of a monk. I'm told by Paul Kirkup that only six or seven pass every year, and that even our German journeymen admit that the French system is more thorough.

Paul (who works for Carpenter Oak & Woodland in Devon), in the thirst for greater knowledge, moved his family to France for six months, to work for a French timber frame company. His new workmates could not fathom what had motivated him to do something so odd. To them it was just a job and, as with much in the later part of the millennium, was becoming devalued. In the particular shop where he worked, tools were generally all-metal club hammers and metal chisels, and apparently there were even *bisaigues* whose only role was as common pry bars.

The tradition had worn old in all senses of the word and has little of the vitality associated with timber framing as we know it. There is a hell of a lot of framing, and much of a contemporary nature including glulam and metal-joined "timber engineering." This view is borne out by the experience and reports of others who have been disappointed to find that rather than being a feast of framing, it's just another job, nothing special, little magic, just another brace in the wall.

Against this background, coupled with the high cost of labor, it should come as no surprise to find inventive engineers in Germany and Switzerland coming up with machines that reduce the expensive human element. It's the industrial revolution of timber framing, and it's here. You can't turn the clock back, de-invent the machine or stick your head in the sand. You, I, we all, have got to find a way to deal with it.

Building is very different here in the UK, compared to North America. We don't build much in wood. In fact, most mortgage lenders will not contemplate lending on a timber building. Nonetheless, there is an increasing number of frame building companies setting up in a niche market.

You should also know that most shops I've visited in the US have many more power tools and fixed machines than we use, and although we are intensifying our use of mechanical aids, most of our framers would see the average North American timber frame outfit as very mechanized.

At the moment, in order for us to be able to take on the Stirling Castles (see TF 47), Windsor Castles, and similar large restoration projects, we need to maintain a disparate (or desperate?) skills base and support a certain critical mass in terms of numbers and varieties of people. These major league projects don't come along in a nice programmable stream. More likely they roll up in twos or threes (like London buses, as we would say). So to keep the people busy (and paid) during the times when we are not building these big projects, we need a steady flow of more normal-size projects, the so-called bread and butter.

We used to build a steady and regular stream of smaller domestic buildings, typically garages, garden structures, sheds and outhouses. This business has gone to other people who have very glossy, slick marketing and big advertising budgets, but can only or will only build to a modular system, seem to cut a lot of corner and, from the feedback we get, frequently leave their customers dissatisfied.

If the CNC machines are applied simply to aping or producing poor facsimiles of traditional timber frames, then we will see a steady decline in the quality just as we see anywhere else where quality has been placed second to ease of production. Of course, hand-built frames will continue to be made, just as cars are made by hand—Morgan and Aston Martin, for example—in this age dominated by the Fords and Nissans. It's easy to predict that they will be only available to the well heeled, and the decline in numbers of experienced, hand-skilled framers will have an adverse effect on the numbers of old frames being conserved or repaired.

There are undoubtedly hard-nosed commercial frame builders who will have few qualms about sending their competitors to the wall. There are also framers (not TFG members) who will turn out poor work with or without The Machine. Some major corporation, it has been suggested, could notice the machine's ability to churn out "desirable,"

mass-produced "custom-type" homes, and would have the serious resources required to iron out all of the kinks. Then where would we be? They won't have any qualms about squashing the user-friendly, timber frame cult types.

It would seem that we have been a bit slow to recognize the threat, and quick to adopt positions, when we should have been adopting policies and showing the direction forward that might have enabled us to harness the menace to our mutual advantage. I am as guilty of this as any, having been aware of automated joinery machines for nearly 10 years, but rather arrogantly dismissing them as not relevant. I had heard a lot about the fact that they couldn't handle oak (and therefore were not going to like our timber with its "attractive undulation of line and level" one little bit), and that they were easy to break. We're good at that!

But the affable Hans Hundegger came to see us one day and told us all about his company's K2, which addresses most of our previous concerns and which can do lots of other useful things like handle round timber and cut and drill all those irritating slots and holes that metal connectors need. Therefore, the K2 could take care of our adventurous, contemporary "timber engineering" projects.

I was very pleased to discover that Hans did not have horns, was not the Devil, and in fact seemed like a thoroughly nice chap. He is plainly very clever, apparently a good employer, and, I'm told, very popular with his staff. There are about six other manufacturers of automated CNC machines, but Hans has put the time and effort into the North American market (and the TFG) the others haven't.

Hundegger has 120 people at the factory, and turns out three machines a week. Eight hundred or so, I believe, have been sold in Germany. But they have also been shipping a K2 every fortnight to North America. The list of people who have been to see them in Germany this year reads like a who's who of the Guild, and the rate of signing-up seems to be accelerating.

What then is motivating people to invest staggering sums in this heavy metal?

There will be people who want the machine because it's a new (albeit expensive) toy, or because they want to be at the bleeding edge, or because they feel they have to jump on the bandwagon or get left behind. Although parallels have been drawn with nuclear proliferation, there is an important difference: in the arms race, one spent astronomical sums and hoped not to deploy the hardware. In Spar Wars, one spends astronomical sums and hopes to have the hardware deployed 24 hours a day. People have put them to work, but possibly without consideration of all the possibilities.

For some the attraction might be a reduction in the employment burden. I raise this point in full knowledge that we are talking about people here, and the TFG is, above all, people. But, at the same time, I know that there are owners and bosses who find the role of employer and the human resource management that goes with it a source of great stress.

But I quote Jonathan Orpin, who recently had this to say to Timber Frame Business Council Boot Camp recruits preceding last spring's Whistler conference: "Anyone who thinks they can bypass the messiness of personnel and joiners by buying a machine, and thinks they can throw a CNC machine, a computer jockey and three laborers at the craft of timber framing, please leave now, as you will only screw up our hard-earned market."

I very much agree. But isn't this what most people are trying to do? Let me draw another parallel. You mow lawns for a living using an ordinary lawn mower. Then one day in a fit of madness you buy a 400-hp John Deere tractor and a 9-ft. mower. What do you do next?

Smart move: you get work mowing 40-acre fields for silage and hay, you make money, you are still a grass-cutter.

Not-so-smart move: you continue to mow the same lawns, only you can't get your new rig round the trees, paths or edges, so these no longer get mown. Some places you can't even get through the gate. You do poorer work and you probably lose money. You are still a grass-cutter.

DO you recognize anybody here? If you are a timber framer you probably use the Hundegger to mow the lawn! Only you end up lifting the turf to take it to the machine.

During the boot camp I stood up during the (highly informative) CNC debate, and *loudly* said to the assembled throng that they had better look each other in the eye and decide if they are going to put each other and their work force on the unemployment line. Because, if they don't find, develop and exploit alternative markets to their current area of operations, then there will not be enough of the traditional timber frame work to go around. So rather than drive the existing market into more intense competition, effort would be well spent finding ways to broaden the market.

Those who are going to stay true to their colors as non-CNC framers need to think very hard about what they can do to emphasize the difference, building frames that the machine can't, while those people who survive on volume need to diversify and include new areas (the hay field approach). Such alternative markets might include the supply of the type of "faux framing" or "trim-ber framing," much in evidence at Whistler, which might as well be bulking up a TFG member's turnover as anyone else's.

If we were to buy a CNC machine, I can legitimately say that we would use it to build functional, cheap farm, industrial and commercial buildings. In the UK these are exclusively built in concrete and steel, whereas in France, Switzerland and Germany many are built using wood. You could argue that the sustainability and environmental grounds are enough to justify this, but the enterprise could be made to work profitably using cheaper softwood than our usual oak. We should also be able to supply cheap softwood frames to realize our objective of building low(er)-cost housing.

It has to be acknowledged that the Europeans seem to be able to make this work. There can't be literally thousands of CNC machines in Germany, France and Switzerland if they can't be made to pay for themselves. There are also a few people in the US who have taken delivery of or placed orders for their second machine. They must think it works, both as a method and financially.

I suspect that the European users are taking an approach near to the one that I was outlining: plain, functional, dull, cheaper, more utilitarian everyday buildings with shorter service lives. This also means that there are many more continental Europeans living in timber frames than there would be without the machine, and they are all built out of lovely renewable sustainable cellulose.

Such an approach results in both frame design and joint detail being rationalized and simplified (or dumbed-down and bastardized, according your point of view) to suit the methods or tools available. This can be plainly demonstrated by thinking about the way we as individuals or individual companies cut frames in our own yards. I know that we have made concessions to our power tools. For example we predominantly used to cut 1¼-in.-wide mortises until the advent of the chain mortiser. Now the consideration of whether or not to use 1½ in. or 1¼ in. has been lost: they are all 1½ in. to suit the tool.

It becomes clear that this is not a black-and-white issue, with the so-called Luddite chisel fascists on one side and the machine-head capitalists on the other. There's more of a grey scale, ranging from those, resplendent at one end, who work entirely with hand tools (using not even early devices like the 19th-century boring machine, but rather a brace and bit) and only in hand-converted timber, spread across to the robotic, 24-hour, seven-day-a-week CNC shop at the other.

We all sit somewhere on this line between the extremes. We could, before the CNC era, justify our positions by the fact that we applied our tools (electrical or otherwise) by hand to the timber and could, as "guiders of the cut," claim to be craftsmen. The difference was not significant enough to most people to spark off more than the occasional debate, and having "more Mafell than most" could not reasonably be seen as a significant threat to either the craft or the worker.

But the CNC machines don't involve human handling, and they replace craftspeople with programmers, machine tenders and forklift drivers. Naturally this is what is polarizing opinion. It could go either way, and we should all be united in pushing it the right way to the mutual advantage of all, not falling into self-destructive bickering.

Referring back to the parallels with the nuclear arms race, what I have publicly stated is this: We will buy a Hundegger, install it in a shed here and train up the staff (both of them). If anyone else round here buys one, I'll plug it in! —Bill Keir

Bill Keir (wjkeir@netcomuk.co.uk) is managing director of Carpenter Oak & Woodland in Bristol, England. He plans to attend the October conference at Fairlee, Vermont.

D-I-Y in Alberta

MANY people dream of building their own home some day—a home perfectly suited to their lifestyle, built with the craftsmanship and love to last generations, a home they could truly call their own and of which they could be proud. We had such a dream and are living proof that dreams can come true! People often ask us why and how we did it. The "why" part should be obvious to anyone else who has had the dream. As for how, this is our story.

Whitecourt is a forestry-based community of approximately 8,000 people located about 2 hours northwest of Edmonton, Alberta. We moved here in the fall of 1989 and soon purchased 80 acres of forest land a few minutes' drive from town. Like so many other owner-builders, our initial plan was to build a garage, then live in that while we built our house. We really had no idea what we were getting ourselves into.

Doug Scatcherd

February 1997, the author, Carol Doering, and her father Lloyd cutting 40-ft. 10x10 spruce timbers.

Doug and I had done some research into various building methods and had decided to try building a "stackwall" garage. It would be relatively inexpensive and not very difficult (although very labor intensive). With the help of family and friends we managed to complete that project (26 ft. square with a loft) over a period of about nine months while both working full time. Needless to say, we spent nearly every evening and weekend working. We were very satisfied with the end result but decided that we did not wish to build our house using the same technique.

Again like many owner-builders, we became comfortable living in our garage and took our time getting started on the house. Over the next six years we investigated other building techniques and became excited by the idea of building a timber-framed house. Rather than jump into a large project with no experience, we decided to try our hands at building a couple of small timber frame buildings. We began by building a 12x20-ft. shed one summer, using plans from Jack Sobon's book on timber framing. That project went well, so Doug decided to attend a two-week framing course at Fox Maple in Maine. Our next project was a large workshop, 20x30 ft., which we designed ourselves. The idea was that if we were going to cut the frame for a house, we would need somewhere to do so out of the elements. Our final "practice" project was a wood-fired, timber-framed sauna located close to the house site that could serve as our tool shed during the house construction.

Carol Doering

September1998, outside complete (exclamation point).

By the summer of 1996 we had built pretty much everything we could except the house, so we decided to start putting together plans. We wanted the help of an architect familiar with timber frame design—hard to come by in western Canada. Letters were sent out to a number of designers and in the end we hired Andrea Warchaizer of Springpoint Design in New Hampshire to help us out. Although we already had a basic floor plan in mind, we needed help with the specifics and with the design of the frame itself. The design took approximately 5 months to complete but would likely have gone faster had we not been forced to communicate strictly by phone and fax. The final design had approximately 1,350 sq. ft. on the main floor plus an additional 350 sq. ft. in the second-floor loft. The main floor included a combined back entry porch and utility room, laundry room, guest bedroom, large bathroom, living room, front entry room and a sunken kitchen-dining room. Upstairs was the master bedroom with half-bath and walk-in closet plus a small sitting area overlooking the living room below. We decided to include a large dormer window in the frame on the south side of the house, even though we had no experience with valley framing.

CUTTING of the frame started in January of 1997. Since Doug works for the local forest company, we were able to purchase most of our timbers in custom sizes directly from them. However, the frame plan called for nine timbers that were too large for the local mill to provide. We had decided to use continuous top plates and purlins, which meant we would need five timbers (including one for the single-story shed on the front of the house) 40 ft. long, ranging from 8x12 to 10x10. In addition, we would need four crossing girts 22 ft. long, ranging from 8x12 to 8x14. We would have to find some other source for those large timbers. In the end we purchased a large chain saw and a chain saw mill and cut the required nine timbers ourselves from white spruce logs. It took us two full weekends to saw them, but they turned out very well. The rest of the timbers in the frame are lodgepole pine.

Carol Doering

Doug Scatcherd preparing timbers in the workshop built for practice.

Over the next five months, we spent nearly every evening and weekend cutting the frame. Since the timbers were roughsawn from the mill, we had to plane each one and size and square each joint location. Our investment in a 6-in. power planer and a chain-mortising machine certainly paid off. Since there were usually only two or three of us around to move even the biggest timbers, we had to come up with some inventive ways of transporting them into, out of and around the shop. By May the timbers were almost done. We decided to stain them before raising, both to help protect them from dirt and because it was easier to do so close to the ground.

An engineer friend, Don Chambers, of Walters, Chambers & Associates in Edmonton, had designed a slab-on-grade foundation for us, and we spent the next two and a half months getting the foundation in place. We had decided to use a radiant in-floor heating system, which, together with all of the water and sewage lines running under the slab on two different levels, made the foundation relatively complicated. However, we persevered, and by mid-August we were ready to raise the frame.

On August 16th, 1997, we hired a crane and gathered a group of about 20 friends and family to raise our frame. Separate frames for the front and back porches were raised later with the help of a couple of people and a tractor. The raising went well with no major glitches, which was certainly a relief for us! Thunderstorms threatened throughout the day, but the sunshine held. We started around 9 a.m., and by 5 p.m. we were nailing a spruce bow to the peak under clear blue skies.

We spent a week of evenings squaring things up and pegging the joints between the bents, as Doug had been taught to do at the workshop. Then we started on the roofing. First we laid down prestained, 2x6 tongue-and-groove pine across the rafters, followed by a vapor barrier. Next came the insulation envelope. We had decided not to use stress-skin panels, mainly because of cost. Andrea suggested using Larsen trusses (invented here in Alberta in the '80s), which we could easily build ourselves, to frame an insulation space more than a foot high above the pine ceiling. These assemblies comprise 2x3s as upper and lower flanges, on the idea of an engineered floor joist, except that the Oriented Strand Board web is not solid for the entire length, and it's fastened to the sides of the 2x3s (photos facing page). Applied to the house, the trusses form a curtain wall (or roof) to contain the insulation. One of the big advantages of this system is that it drastically reduces the effect of thermal bridging through the roof and walls, since the only material running from a heated inside surface to a cold outside surface is the spaced ⅜-in. OSB webs. We used both glue and screws to attach the webs to the 2x3 edging. The ends of the trusses support the roof overhang.

The very solid frame takes shape under doubtful skies, but was completed in sunshine by day's end.

WE wanted our house to be very well sealed and energy efficient, so we specified 16 in. of blown-in cellulose insulation in the roof, for a rating of R60. Acoustical sealant was applied to the edge of each truss before it was attached to the roof anywhere that a nail would penetrate the vapor barrier. The mesh used to contain the cellulose insulation was then stapled over the trusses. Since the roof is a 12/12 pitch and the trusses run horizontally across the rafters, they lie at a 45-degree angle to the ground and, unrestrained, would tip sideways down the roof. To restrain them, we nailed 2x4 strapping across the trusses from the peak to the eaves. This strapping also helped contain the mesh for the insulation. Since we planned to use metal roofing but did not want solid sheathing, we then applied an additional layer of 1x4 strapping, this time running horizontally. Once all of the strapping and mesh were in place, the roofing contractor blew the insulation into place.

The only breaks in the roof are a plumbing vent and the chimney for the woodstove (which has a fresh air intake under the concrete slab). We covered the roof with "snap lock" metal roofing and a vented ridge cap. The air space provided by the strapping allows the necessary air circulation between the roof covering and the insulation.

Carol Doering

Doug installs the base for the wall insulation framing. Half-inch blocks nailed to posts ease fitting of drywall later.

Once the roof was complete, we started on the walls. The first step was to nail ½-in. spacers onto the backs of the timbers along all outside walls, to provide a space for slipping in ⅜-in. drywall later on. We then nailed 2x3 horizontal strapping to the spacers and stapled the vapor barrier to the outside of the strapping. This method served three distinct purposes. First, it provided the required attachment surface for framing an insulation space as we had done on the roof. Second, it provided a space between the drywall and the vapor barrier in which to run wiring and thus minimize the number of breaks in that vapor barrier. Finally, it provided sufficient space to allow installation of drywall from the inside once the house was closed in.

The Larsen trusses used for the walls were 12 in. deep (final insulation value R40). On the tall end, walls had to be built in sections to stretch the entire height. Screws were used to attach the trusses to the horizontal strapping. Trusses were placed around all window and door openings where the OSB webs ran the entire length of the openings. Again we used acoustical sealant to seal any potential nail/screw holes in the vapor barrier. Treated plywood plates were sealed and bolted to the concrete slab to provide a base for the lower ends of the trusses. These plywood plates (and therefore the wall itself) extend 2 in. beyond the concrete slab to cover the rigid insulation that was glued to the outside of the slab.

Once the wall trusses were in place, mesh was stapled to the outside of the trusses and cellulose insulation was blown in. Additional strapping support was temporarily added on the inside of the walls during the blowing process to prevent too much bulging of the insulation. The vapor barrier contained the insulation on the inside of the house. The outside of the house was then wrapped and the windows and doors installed. We chose fiberglass frame, triple-glazed, low-E windows for energy efficiency. Shortly thereafter the boiler was installed and the heat turned on. It was early December, and the place was finally closed in! It had been almost four months since raising day.

THE next nine months we spent finishing up the inside of the house and installing siding and trim on the outside. The only jobs we did not do ourselves were the drywall finishing and construction of the kitchen and bath cabinets. We decided early on to install hardwood flooring upstairs but struggled with how to finish the main floor. Since there was radiant heat, we didn't want to reduce the efficiency by installing hardwood or carpeting. We considered slate tile, but the cost was prohibitive. In the end we decided to go with a decorative finish on the concrete floors themselves. We hired a company called Sunwise Systems (from Kamloops, B.C.), to help us finish the concrete. A scoring machine cut whatever pattern we wanted in the floor, then each area was stained and sealed with a clear topcoat. We also incorporated a few small acid etchings in various locations around

Olenka Bakowski

The author (on the inside) and Doug applying the insulation framing to a gable end. Note horizontal strapping and beads of sealant under crossing points.

the floor. In some areas we cut regular grid patterns (ranging from 16 in. to 24 in.) to give the appearance of tiles and in other places ran a simple border around the edge of the floor. The concrete in the main area of the house had been power-troweled and has a marble-like appearance in the finish. The kitchen-dining area was hand-troweled, and the resulting finish has more of a terra cotta texture. We highly recommend this type of floor to anyone using concrete. It is extremely durable, easy to clean, relatively inexpensive (around $4 a sq. ft.), totally custom, and it looks great. Everyone is amazed when we tell them it is concrete.

In September of 1998 we were finally ready to move in, after almost two years of seemingly nonstop work in addition to our regular full-time jobs. Had we known at the start how much work this project was going to be, we might not have ever started. But, of course, it all seems worth the effort now. The total cost has been significantly higher than we had anticipated (approximately $100 a sq. ft.), especially in view of the fact we did almost all of the labor ourselves. However, we made the decision early on to build an efficient house using quality materials, and once you start down that road there is no use scrimping on the way. Our selection of windows and doors, radiant heating, thick cellulose insulation, metal roofing, solid surface countertops, etc., certainly contributed to the relatively high construction cost.

Photos Carol Doering

Blowing in the cellulose insulation. Steel roofing goes on as cavities are filled.

Our house is proof that it is possible for owner-builders to build their own timber frame houses, but it's not easy. There were many days when we had to drag ourselves (or each other!) out there to work, and we sacrificed almost all of our free time for the better part of two years. It also takes a fair bit of general construction knowledge to build your own house. Having built some smaller frames was invaluable experience when it came to cutting the frame for the house. And, having help from people with considerable knowledge of electrical systems, plumbing and general construction was priceless. Not least, family support was vital. This home was built almost entirely through the labor of four people, ourselves and our two fathers, Lloyd Doering and Don Scatcherd. Without their help and enthusiasm, we probably would never have finished, and we owe them both our heartfelt thanks. And to our mothers as well, Gloria and Betty, for looking after us during the construction when we were often too busy to look after ourselves. They should all be as proud of our accomplishment as we are.

Well, that's about the end of the story. For those who have the dream, we hope we have both inspired and educated you just a little bit. If you'd like to learn more about our project, we are always happy to talk about it. —Carol Doering

Carol Doering and Doug Scatcherd can be reached at cds22@telusplanet.net. *More information on Larsen trusses can be found in* Fine Homebuilding 20 *and its Spring 1994* Houses *issue.*

Floor craftsman Chris Bartsch acid-etching the floor in the front hall.

The decorated concrete floor and steps in the dining room.

Holding the Timber Frame Industry Together

Scott and Judy Northcott with friend Rhody. Photos Brian Wormington

UNDER a clear blue sky, with a slight breeze that makes us forget it's blackfly season in New Hampshire, Brian and I set out on a mission to learn about the less glamorous but all-important part of a timber frame: the pegs that hold it all together.

Navigating the back roads around Walpole in south central New Hampshire is never easy (a prominent local timber framer invites prospective clients to the shop as a test of their seriousness), but we can't miss the turn off Walpole Valley Road, at the sign advertising SHAVINGS. At road's end is world headquarters of Scott Northcott Company, the primary source and largest US supplier of timber frame pegs.

The first greeter is Rhody, rescued from the animal shelter, followed by a smiling, white-bearded Scott Northcott. Since this is a family-run business, we soon meet Scott's partner and manager, Judy, and at least two sons who help out when they aren't in school. Other visitors may drop by, for the Northcotts are gracious hosts ready with a guided tour, fresh pot of coffee, and good conversation around the kitchen table, laden with Judy's home-baked sweets. The house sits conveniently across the drive from the shop, and the machine noise comforts Scott. If there is noise, there are pegs being made.

On our tour, first stop is the yard where the stacks of stock are air drying in the open. Three or four times a year, Berlin Lumber on Route 22 in New York's Columbia County delivers a million inches of wood (about a 45-ft.-trailer load) of different sizes and lengths. The turning squares, left over from sawing timber, are mostly oak, but there can be birch, ash, or cherry as well. "I take whatever he's got," Scott explains in his distinctive New Hampshire-ese. Recycling, reusing and giving back are his constant themes, and we hear these terms often during our visit.

Next, sons Ben and Dan demonstrate the antique novelty turning machines. They, along with brother Christopher and sister Julie, represent the third generation of family wood turners. They all have worked through high school and into college, though Julie is now married and holds a degree in fashion design. "It's an ideal business with four kids," Scott explains, "because the work has always been there if they wanted to earn money. It's also ideal with college-age kids," he laughs, "because we can qualify for financial aid."

Scott boasts that Ben and Dan have inherited their grandfather's mechanical abilities and ingenuity. Judy's father, Felix Damaziak, owned a sawmill in Walpole, New Hampshire, and helped Scott and Judy buy a woodturning business across the river in Bellows Falls, Vermont, in 1974 when job prospects were bleak. To learn the business, Scott gladly gave up working as a substitute teacher and in fast food places. All but one of the lathes were moved to the present-day shop built for the purpose, and Scott turned all the expertise he had gained in college pursuing a history degree to the job of making icepick handles, drawer pulls and other woodenware.

Throughou 19th century New England, woodturning was practiced wherever there was a water source. And practice the inexperienced woodturners did at the beginning, to produce turnings of acceptable quality. Scott credits his father-in-law with his eventual success. "I couldn't have done it without Felix," Scott freely admits. "The belts would slip, and the machines would scream and make odd noises. He kept these old machines running."

Roughsawn squares from New York State, mostly oak, season and await turning.

Photos Brian Wormington

Scott uses an antique lathe to make a large peg suitable for bridge use.

The next lesson to learn was how to make a profit. Scott recalls an early expensive lesson: making 5,000 birch spice-rack drawer-pulls ½ in. diameter and ¾ in. long at a price of ½ cent a piece, for about $25 in all. "It took a week for me to set up the machines to make them. I knew I wouldn't make any money, but once I make a commitment, I do it. But only once."

The current business dates to 1977, when Felix discovered in a conversation with local timber framer David Howard that the birch dowels he bought from the hardware store were expensive and too weak for use as pegs. Felix began making oak pegs up to 7½ in. long; but as demand increased for greater quantities and pegs of different sizes, Scott took over the business and the rest, as they say, is history.

Today, novelty items like drawer pulls, rocking horse handles and the chisel handles for Barr Tools are a small part of the business, and production to date has increased to about 300,000 to 400,000 pegs annually. Indeed, the timber framing industry could use Scott's Peg Output Index as a way to measure the vitality of the timber framing business. The past year has been a boom time for framers, and Judy confirms that peg sales are ahead of last year.

Lately, they have been doing more metric pegs, "a lot more in the last month," Ben says. How many? I ask. "We don't analyze anything for a couple years," Scott explains. We will just have to wait to find out if certain automated timber cutting machines are having an impact on peg production.

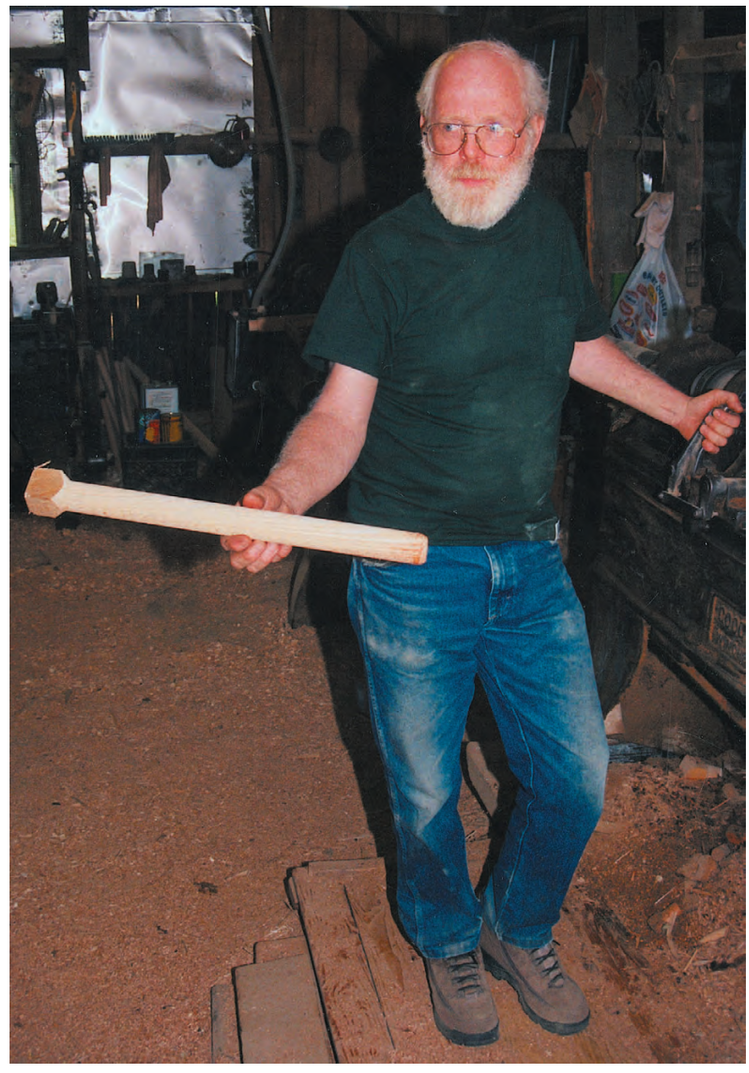
Prices for the majority of pegs range from 18 cents for a 6-in. peg to 35 cents for a 12-in. tapered peg. Only a few thousand of the larger pegs are made each year, with prices ranging from 45 cents up to $3 for a large bridge peg.

Peg diameters range from ⅝ in. to 2 in., and lengths range from 1 in. (plug stock) to 24 in. or more. Scott also makes 1½-in. trunnels, like those for the covered bridge on display at the recent Smithsonian Institution's Folklife Festival, held for two weeks in June and July in Washington, D.C.

Peg terminology can be a bit confusing. "As far as I'm concerned, there is no difference between trunnels and pegs because we have people from all over the country inquire about trunnels when they mean pegs of any size," Scott explains. "However, I understand that covered bridge builders refer to trunnels as pegs that are 1½ in. or larger."

Scott donates many of the pegs for Guild projects, including most recently the frames for the Smithsonian festival, Project Horizon in Lexington, Virginia, the COLTS woodshop in Huffman, Texas, and the Effinger gazebo last year. His generosity derives from the philosophy, "If you do ten good deeds and only one comes back, then it was well worth it. In our case much more has come back to us than we have been able to give."

There are few competitors in the peg business. A couple of shops make hand-hewn or octagonal pegs, the latter for about $1 each, and other turning mills make dowels. "But these mills typically require a minimum order of a thousand," Scott notes. "That's a small order, and they would prefer not to get it. For me it doesn't matter whether you order 10 pegs or 10,000. The key to my business is I want to develop relationships with lots of small businesses. I don't want big orders from big companies who want a large quantity of novelty turnings in a short amount of time. And the social part of the business is very enjoyable."



Scott peg-dancing with the finished product.

An array of Northcott's turning work. The infamous spice-rack drawer-pull is visible on the right near the lower corner. Below right, Dan turns down flatted 1-in. pegs to ¾-in. round. At bottom right, the template from a regular peg customer.

Back on the tour, at the 50-year-old dowel machine, acquired last year from Tom Harris of Architectural Millwork in Hadley, Massachusetts (see TF 46), Ben can make pegs from ¼-in. to 2-in. diameter in small increments. With this machine, it's easy to change roll sizes and make different size pegs fairly quickly. The machine works like a kind of reverse lathe, with the knives spinning rather than the stock. As Ben feeds the machine, running 2,000 to 3,000 ft. without needing to sharpen the knives, the dowels shoot into a bucket.

Dan (at right, below), still in high school, runs the novelty lathes, made by the Goodspeed Machine Company of Winchendon, Massachusetts. Still in business since 1851 and still in the same town, Goodspeed has a Web site with photos of new machines that don't bear much resemblance to the antiques Scott uses.

One novelty lathe makes 1¾-in. wooden pulleys for a loom by Harrisville Designs in Harrisville, N.H. Its operations are timed and mesmerizing to watch: a knife makes the groove, the sawdust shoots out in a stream, a bit drills the hole and a saw cuts off the pulley.

Scott's newest employee, Ed French, operates the backknife machine, dating to 1910 or so, as shown on the front cover. The lathe has three knives: one to change the square stock to a round dowel, another to taper it, and the third to smooth or plane the wood. The machine is accurate to a tolerance of .001 in. On it, Ed can make about 200 pegs an hour.

After turning, pegs go to the tumbler (a whisky barrel in a former life) where they tumble against each other and wax for about a half-hour to become finished products. A separate tumbler for shaker pegs does not have wax, as buyers often want to stain them.

A huge mound of sawdust fills one building at Northcott's. The sawdust is recycled as mulch or donated to local farmers.

The stock room holds the inventory of special peg sizes for regular customers. Timber framers send Scott a template of what they consider a 1-in. (or other) hole to be. There is also a supply for timber framers who sometimes forget to order the pegs they'll need for a job. Every month, Judy confirms, she must send a box of pegs to arrive the next day at a job site.

"I'm proud to say that after 25 years, I do know how to build a peg," Scott remarks.

But isn't it boring? "My response is, I eat every day, and so long as I can provide a product or service that people want, I'm happy."

—Janice Wormington

Janice Wormington operates New Vista Communications (janicew@vgernet.net) in Otis, Massachusetts, and manages the Guild Web site.

Oatman's Last Voyage: Ludlow to London via Dublin

Ludlow's high street. See also back cover. Photos Paul Oatman

IN all my travels, Shropshire and Herefordshire were the lands of embellished enchantment. I'm quite certain that hobbitmaster J.R.R. Tolkien could find his creatures living here. My destination was Ludlow, a town not covered in most travel guides. I learned of it only in conversation with an Englishman in Amsterdam.

The area around Ludlow is thick with timber frames—both cruck and box. Oak has been called the weed of Herefordshire. According to Nikolaus Pevsner in *Buildings of England, Shropshire* (Penguin, 1958), "Shropshire was an uninhabited wilderness until the Iron Age because the area was composed of Glacial and Triassic clays of a type abhorred by early cultivators, partly of dense oak woodland which effectively resisted every attempt at penetration." With the arrival of the Iron Age came the ax, its steely head biting into the oak as butter, and wheeled ploughs finally tamed the land for habitation. During the Elizabethan era, Shropshire became prosperous, and the new clothiers and old nobility chose to continue to build their houses of oak instead of brick or stone. They felt that much more display of design could be achieved with oak rather than stone, the reverse of the rest of the country. Ludlow was a frontier town, and the town grew around the castle.

The castle was built by the Normans in the late 11th century, one of a long line of fortifications along the Marches to keep out the Welsh. In *Studies In Building History* (Pope, 1961), A. J. Taylor states, "Wales caused trouble until Edward I's conquest in the 1280s. From 1277, he based armies of both soldiers and craftsmen at Chester so that what he gained could be consolidated with the construction of a chain of castles around the peripheries of North Wales." The 900-year-old castle at Ludlow features examples of Norman, Medieval and Tudor architecture. A new town was laid out with a rectilinear street plan.

Ludlow has always been a market town, serving the needs of a large rural area. The town prospered on the collection and sale of wool and the manufacture of cloth in the 16th century. The town today is rich with timber frames in the ornamental style. Square panels are filled with an array of patterns: concave-sided lozenges, some cusped, some spiked, lozenges within lozenges, herringbones, just about any imaginable pattern. Carved oak brackets and beams predominate in Ludlow frames.

The western marshes have no cities and only a few towns, and this area was never industrialized. Thus it has retained much of its original charm and may even be a place to visit in the summer season. Ludlow still has a number of butcher shops interlaced with other small business shops for everyday needs. One medium-size supermarket sullies the townscape, but the distasteful effect of McDonalds and malls seems still years away. The castle hosts a Shakespeare play in late June. The Mortimer Trail, 30 miles long, makes for a nice two- or three-day walk through countryside of ancient farmsteads, including earthworks of 8th-century camps, and forests and rivers retreating and flowing into villages of enchanting beauty, culminating in the Welsh border town of Kingston. One can walk with a pack or if traveling with baggage can hire a service to bring luggage daily to a village inn that crosses your path.

I rented a car in Ludlow to take a tour on the self-guided, Black and White Village Trail. It comprises 14 villages in a 40-mile circular route. In retrospect, I should have rented a bicycle, not just for economy, but for the sheer beauty of the countryside, which can best be observed at a slower pace. All of these villages are storybook- picturesque, and each has its own history.

On my first stop, I strayed a few miles west of the town of

Modern timber-framed house by Border Oak. Infill is specially designed for the weather.

The real Big Pink? The unusual close-studded Stawne House (1696) in Weobley.

Leominster to visit the Border Oak timber frame company. The owner, John Green, spent an hour with me, giving me a tour of the sawmill and his shop. His style is unadorned square panel framing, which blends in extremely well with the local buildings. He's developed a production-oriented infill system to keep his frames safely exposed to the weather.

Weobley is an almost perfect timber frame village (but with a stone church). Two of its houses have escaped the black and white, or magpie, look—the coating of infill with white pigments and the oak beams with a black pitch—and their timber has retained its natural weathered silver-gray color. One is the Stawne house above, which has (and probably has always had) pink-colored infill.

John Able, one of the few master carpenters who achieved recognition in his time, built the grammar school. Able was born in Hereford and buried in Sarnesfield at the age of 97 in the year 1694. He had a major influence on the design and ornament of the buildings in these villages and towns. Cecil Hewett in *English Historic Carpentry* (Phillimore, 1980 and Linden, 1997) refers to Able as the builder of the great new roof of Dore Abbey, "an example of what was considered to be the best carpentry then possible." Weobley was unaffected by bombs during the Second World War, but ironically the market hall and a number of timber frames were destroyed by fire in 1943.

Bell Square, Weobley. This 14th-C. frame is thought the oldest in town.

Pembridge, another village on the trail, has a fine 16th-century market hall and a bell tower (below) to boot. The timber inside the bell tower is massive—eight mutually X-braced posts form a square and rise to the lower truncated pyramid roof. The building is dated to the late 14th century. I wanted to take some pictures of the frame, but the machine inside, which eats coins to spark a light, was out of order. According to Pevsner, the patron saint of building critics, "Pembridge with its twice truncated pyramid roof is the most impressive of all Herefordshire steeples, externally as well as internally."

Eardisland has been cited by many English authors as perhaps the prettiest village in England. Herefordshire has a local roof tradition for its houses and churches, an arch-braced collar beam roof, with or without tie beams, and above the collar beams kingposts or foiled raking struts. This motif, the foiled or cusped raking strut, is also used in the windbracing.

Back in Ludlow, after a hard day of house-watching, I was sipping a pint and fell into a conversation with a local mate named Peter. He laughed heartily when I told him I had spent the day looking at magpies. He told me I was misinformed: "A magpie is what you call a bloody thief, Yank!" Peter then suggested we walk to the Raven, a working-class pub on the outskirts of town. I toasted with carpenters, butchers, farmers and guys on the dole. The last invited me to go poaching with them. They use ferrets to chase the rabbits from their tunnels into bags held by the poachers over the exit holes. I declined the invitation because I was the kid always caught holding the bag, and since this was a foreign country it seemed to me they might yank a Yank a bit tighter.

Pembridge's "twice-truncated" bell tower.

Hereford-style roof framing.

I did accept the invitation of a farmer called Jeff James to visit his farm the next day. I walked the two miles from town, and found Jeff in the field in back of of his 16th-century house, a plastered-over frame. He was splitting wood while about 30 yards away a little yellow car driven by a child accompanied by a small dog whipped around the field on a well-worn path. Jeff explained that

On the fly somewhere in Herefordshire.

it was good to give his nine-year-old daughter Stephanie a head-start on driving. "Let's all go for a ride!" he cried. He had a 1978 GMC pickup and a 1980 Pontiac TransAm, acquired in Missouri in 1980 where, after packing up in England, he had bought a farm, only to be crushed by the three-year drought that caused the demise of many Midwestern farms. Jeff's family had put down stakes in Missouri a hundred years earlier, and he claimed descent from the same clan as Jesse James, the famous 19th-century Missouri outlaw.

We piled into the 1980 Trans-Am and blasted out into the English countryside, flying through hedgerowed lanes at break-neck speed, making picture stops (above), pub stops and a church stop where Stephanie played the organ while Tiny the dog and Jeff sang. After church we sped through the rolling hills of Shropshire into the mountains of Wales where the houses turned to stone. It was a great day, and Jeff's wife, Diane, made me enough sandwiches to feed the entire train I took through Wales to Holyhead the next day.

From Holyhead I sailed to Dublin, where I was met by Joe Fitzmaurice. We had worked together in the early 90s as finish carpenters in the Big Apple. Joe advised me where to travel out of Dublin, which he referred to as "beyond the Pale." This expression has roots in the Latin *palus,* a stake or fencepost driven into the ground to fence off territory under the rule or protection of a certain group. The Romans did this, but the English Pale of the 16th century, before Cromwell swept cruelly through southern Ireland to put down the pro-Royalist rebellion, is better known today. This area originally included Dublin, Cork, Drogheda, Waterford and Wexford. These areas were under British law. The Irish never looked upon British rule as a blessing, and by the 16th century the English Pale had contracted to a 20-mile area surrounding Dublin. Later, Kipling's "beyond the pale" came to describe a dismal place for social outcasts, those beyond the bounds of moral or social decency.

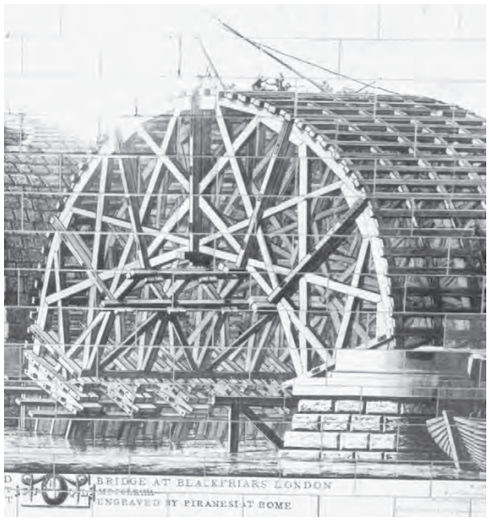
There are no extant historic timber frames in all of Ireland, according to the local equivalent of the National Trust. On a day trip to Glendalough, we visited the ruins of St. Kevin. The cathedral, built in the 10th century, was the largest in Ireland. According to F.W.B. Charles in his *Conservation of Timber Frame Buildings* (Hutchinson, 1984), "As in all structures of corbelled stonework, the profile tends to be shaped in the form of an elbowed cruck rather than a segmental arch. Also in rectangular buildings of corbelled construction, there is a weakness at the ridge midway between the end walls. At Kevin's Kitchen this point is supported by an internal elbowed stone arch. Elsewhere the roofs have collapsed and it is believed that wooden supports, of cruck form, must have held them up until the wood rotted."

Also on the grounds is a tower where the monks would retreat when the Vikings (the original magpies?) came looking for booty. There are a number of these "watch and wait" towers across Ireland, this one being over 1,000 years old, 103 ft. tall and still straight. These lofty structures saved many church trinkets, manuscripts and monks' heads from destruction—the highest tribute to their construction.

FROM Dublin I flew to London, and walked that city for a week. London has seen a lot of fires and bombs and not much is left in the way of timber frames, but a complete list of existing frames can be found on page 84 of *Design of the Globe*, published by the Bankside Globe Project, which can be browsed or purchased in the Globe Bookshop on the South Bank of the Thames. The Globe Theatre reconstruction (see TF 37) has been covered extensively, and the only two cents I can add is to mention the cats Portia and Brutus, who now reside at the theater. These two employees were hired to eat the mice who have taken up residence in the roof thatch.

The riverside walk was my favorite. It follows the Thames's seven bridges from the bankside area and ends at the Globe. Poetry

The stage in use at the reconstructed Globe.



Blackfriars Bridge centering, London, as engraved by Piranesi.

from many English writers is etched in concrete pads along the walk, the Thames being the theme. My favorite was a ditty by William Morris from *An Earthly Paradise,* recommending that we "dream of London, small, white and clean" as "the clear Thames borders its garden green."

Besides the Globe reconstruction, the roof of Westminster Hall is a timber framer's must-see. You have to stand in line with people who want to watch Parliament in action, but the open-roofed hall is the first thing you see upon entering. I was lucky enough to wait only minutes. If you write the American embassy in London, they can put you on a special line and you might even see it in summer. Much has been written of this roof (see TF 30), originally framed ca. 1395.

Two details I learned from a bobby who found my interest interesting. First, he led me to the top of the hall and showed me the hammer beam where, he said, the severed head of Oliver Cromwell, whose remains had been exhumed by the restored King Charles II, was mounted and left to drip and rot; the stone floor still bears the stain. (By the Restoration, Cromwell had been in the ground 20 months, so make of the story what you will.) The bobby then recounted that when the IRA picked the hall in 1972 as a bomb drop, luckily the blast just shook the foundation and loosed a 15th-century tennis ball from the rafters.

And with rafters to foundations, French, German, Dutch, English and Irish (not many Irish rafters), my head had been filled all these weeks (and, with foresight, my camera with film), for my mind is little and does not hold many things. I had a bon voyage! —Paul Oatman

All-around carpenter Paul Oatman of Pioneer, California, took his camera in previous articles to Chartres, Hessen, The Netherlands and the English counties. This article is the last of six.

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