

Guelph '92: The Story of a Bridge

DRIVING back with my family from Ontario that Sunday night in mid-June, we crossed into our home county in Pennsylvania as the earth's shadow began to etch an arch into the sphere of the moon. Nature's awesome curve of the lunar eclipse was a reminder of the fair line we had just struck with the camber of the new Guelph covered bridge.

Four weeks earlier I had travelled to Guelph as one of the "Mayfly" Guild volunteers, recruited by Guild volunteer coordinator Jonathan Orpin of Rochester, N.Y., to assemble the Town Lattice trusses for the new 120-ft. span pedestrian timber bridge over the Speed River. Monday morning at eight the crew was briefed in the rain by timber bridge expert and Guild construction foreman Jan Lewandoski (Stannard, Vermont) above the rumbling sounds of lumber trucks and a crane setting up to unload within the snow fence cordon around the site.

Doug Lukian of Quebec jumped up on the flatbed and began to rig bundles of the green Douglas fir for unloading as the crew of 14 scattered across the level worksite of compacted gravel. Several framers began moving and sorting timber with a forklift. A center aisle separating the two truss layout areas was measured and aligned with the two concrete bridge piers curing in the Speed.

The crew muscled dunnage into position to serve as framing ways, a level working grid for truss construction. Starting at the center of what would become 132-ft. trusses, we laid rented fir beams (industrial salvage) in both directions on 12-ft. centers and blocked them up to equal elevations.

By Monday noon the wet weather turned to summer. Lewandoski instructed the crew in layout of the chord horizon and camber offsets at each 4-ft. station. A team for each truss began hauling and positioning chord timbers. The ends of each chord timber were carefully cut to butt flush to the next piece, with slightly increased lengths along their top sides, yielding radial angles and forming the camber along the entire chord length. Pieces with natural sweep were sought for this job.

Well-sawn timber was not a luxury we enjoyed. Timbers varied in width from 11¼-in. to 12¾-in. and in thickness from 2⅜-in. to 3¾-in. This was a serious setback but our tight schedule did not allow for a reorder. Upon this discovery, Jan together with Paul Ide and his Vermont crew showed us how to make adjustments for varying lumber sizes in each piece. Differences in chord timber depths were generally thrown up or down depending on upper or lower chord location, the fixed points being the notches in the passing posts on 12-ft. centers. Chord pieces butting at different thicknesses were chosen for the outermost or innermost layers of the chords to avoid gaps in the centers of the laminations that would invite drilling and pinning difficulties.

Chord timbers were laid out so the butt joints between the 24-ft. 3x10s and 3x12s never fell at a diagonal lattice intersection, but always in the spaces between the crossings, which insured that all pins could be used at each crossing without risking a split chord end.

The first layers of chords were blocked or toenailed to the ways in their final positions and the second layers were placed over the first by taking the camber offset dimension again at every 4-ft. station along the horizon and then matching the arc of the first layer as closely as possible. By Monday evening the first two layers of the four chords in each truss were in place and the Mayflies had become a smooth working team.

ON Tuesday morning, layout for lattice spacing began along the face of the four chords on both trusses. Lattice timbers were forklifted down the aisle between the two emerging trusses as Erich Kemp of Buffalo and Tom McNellis from New York's Catskill region unloaded the different size lattice members into their relative positions in the design. At the ends of the trusses, 3x12s were used to carry the greater loads to be transferred back into the piers. Toward the centers, the lattice dimension switched to 3x11s and at the center to 3x10s, where the load would be least.

Lewandoski explained that the classic Town Lattice truss is a strong and relatively simple construction, a redundant support system with repetitions of diagonal members in compression and tension. The chords do more work at the center of the span and the lattice does more work at either end, and all is held together by large-diameter wooden pins in shear.

By Wednesday, the first layer of lattice was toenailed in position and the crew divided into three teams. One team made the tailcuts on both ends of the lattice, another laid out the second layer and the third made clamps to hold the joints together for boring and pegging.

By Thursday, it was clear that a second delivery of timber would be needed to complete both trusses, so work was concentrated to attempt completion of all latticework, chords and pinning on truss number one.

By Friday at 1:30 when the crew split up and headed for home, Knight Ide, Don Estes, Rick Moyer and Paul Ide had been hard-riding drills for over a day's time in the intense sun. Canadian Lou Federokow had spent most of her day right behind them driving pins. Over 80 percent of the first truss was pinned as we all left with the tremendous feeling of accomplishment and the more doubtful feeling of the season's first sunburn. We left the remainder of the truss work to Jan and the Vermont crew who would return for a second week, and to Peter Doucette (Paris, Ontario) who would assist and prepare the site in the following two weeks.

Scott Murray appeared regularly at the site as overall project man-



Photos © Russell F. Ley 1992

The six-member Bridge Club included old philosopher Joel McCarty, RFD, designer of the bridge and clerk of the works, and the five others pictured.



Jonathan Orpin, boss of the volunteers, project treasurer and negotiator par excellence, here politely urging his fellows to get on with it.



Ben Brungraber, PhD (with fellow engineer Dave Fischetti, left), engineering advisor, general factotum and joiner of clubs.

ager, coordinating all business for the Guild with Guelph park planner Andy Goldie. At week's end Andy presented us with City of Guelph lapel pins as tokens of appreciation. A volunteer week away from home and businesses was naturally a concern to all and at one point the question "What are we doing here?" was asked outright. Answered Tom Southworth: "We're all just successfully fighting boredom."

JAN LEWANDOSKI and Ken Pitman were among several framers during that second Mayfly week to appear in a *Guelph Mercury* photo story. The newspaper described the bridge thus: "132 feet long . . . about 140,000 pounds . . . trusses made of 400 pieces of 24 foot long Douglas Fir . . . 900 18-inch pins and 600 shorter pins . . . lasting 150-200 years." By the end of the week the two trusses were complete except for a fair number of peg holes deliberately left open until the conference.

Joel McCarty of Alstead, N.H., the man who designed the bridge and produced the drawings, arrived on-site beginning week three to supervise construction through the end of the conference two weeks later. Curtis Milton of Franklin, N.H., and George Nesmith of Berkeley, California, using a borrowed truck-mounted auger, took the lead on drilling and planting the large cross-braced masts (telephone poles, actually) that would serve as derricks. Delivery of the glulam beams for the two approach ramps was late, so there were plenty of framers to guy



Ken Rower

Ontarian Scott Murray, Numero Uno, who managed the project and whose steady good humor was matched by courage when the chips were down.



Photos above and below © David L. Brill 1992

Ed Levin taking a split-second break from his duties as bridge modeller, conference director, seminar presenter and promoter of Russian apprentices.



Bridge builder Jan Lewandoski, who supervised the unfamiliar Town Lattice construction and helped further with raising and rolling, here holds up the bridge single-handed.

and rig the six derricks during the weekend before the conference.

Two different methods for roof truss construction were tested for accuracy and labor time. The decision was then made to give dimensions and performance standards to the roof truss teams and let them be. McCarty remarked of this libertarian decision that during the course of construction, "there seemed to be some insurmountable obstacles, but we chose to ignore them." Nothing was ignored, however, in the engineering of the bridge between our own Ben Brungraber, P.E., Ed Levin (who performed the appropriate computer modeling) and David Trudeau, P.E., of Ontario.

Jake Jacob of Seattle flew back again to Guelph after his first week as a Mayfly to work the weekend before the conference. He called the bridge project "a great equalizer" for Guild members, providing experience not many of them had before. Jake, Tom Bowles (of Montana) and David Crocco (New Jersey) spent much of the day Monday splicing the raw rope and rigging the block and tackle as timber framers from all over North America began to stream into Guelph.

Brothers Tom and Harry Southworth, owners of a water-powered sawmill in Lancaster, N.H., travelled back to Guelph to the very ball field where, years before, they had played for a week as kids while their father, a professor, attended a University of Guelph seminar. With fellow framer Rick Moyer they returned to the conference after their first Mayfly week carrying the strangest load, over a half-ton of 4-in. diameter oak cores from a rotary-cut veneer mill in Newport, Vermont. The freshly-turned and quite pungent oak—still steaming from processing—turned their enclosed van into a 10-hour rolling steam bath.

(No doubt their initial reaction when asked to carry rollers to Guelph was "no sweat.") Certainly without their cargo the bridge could not be rolled into position. Another curious cargo, scores of pointed pikes in three lengths, arrived from Pennsylvania with bridge restorer and lock gate builder Marcus Brandt.

At sunset Monday, June 8, Bruce Kidder and I entered Guelph and drove straight to the bridge site. In the waning light the six towering derricks stood at intervals between the two waiting trusses. We checked in at a University of Guelph dormitory, where we all received our blue hospital-style wrist bands for site admittance and our own individual signature peg to sink into the last truss before raising. In town at the Albion Hotel (the preferred after-work meeting place) a small crew discussed plans for the next day.

Tuesday morning, the first day of the Guild's Eighth Annual Conference, work continued on the bridge as most Guild members attended workshops and meetings until the scheduled truss-raising session. At 3pm over 300 timber framers bearing hospital wristbands and oaken billy-clubs swarmed out of the university, intent to drive those pegs home and lift those trusses into the air. Everyone drove a peg as the rigging crew trimmed the block and tackle and crews raced to secure the special steel bed timbers to the ends of both trusses. (Steel bed timbers were required in this otherwise exclusively wooden bridge because the two concrete piers, engineered—by others—for a typical steel bridge, were too narrow to provide enough bearing surface to prevent even the hardest wood from crushing. And the steel would rest on roller bearings rather than the customary bearing blocks.)

Scott Murray then instructed teams of pullers (on the ropes) and lifters (who would eventually use pike poles) in the procedure for raising the first truss. At Scott's command "Yo, Heave!" the pullers and the lifters began work simultaneously. The truss began to rise. Nearing the point of maximum lift by hand, lifters broke away to grab the shortest of the pike poles and send the sharp ends into the top chord as the truss steadily rose. The riggers kept up a constant lifting tension as more lifters peeled off to grab the longer poles and push up the truss. Surprisingly quickly the truss was vertical. The necessary pull, leverage and push had been well-calculated. A cheer went up from the watching crowd and then from the framers themselves.

After a crew of riggers transferred the rigging to the other side of the derricks while most framers were served supper at the site, the second truss went up successfully (although many thought it was a more difficult lift than the first), and both trusses were made fast to the poles for the evening. In the golden glow of the setting sun, with the derrick masts sticking out above, the rigging and the welcome banner under full sail, the camber took on the look of an inverted keel line and the overhangs at the ends a Viking boat's bow and stern. Every skeletal line implied a vessel for the water. We took our own waters at the Albion in a manner befitting our mid-term accomplishment.

As the conference continued Wednesday, crews worked at the site all day preparing floor joists, approach ramps and stairs and removing the derricks. The *Guelph Mercury* ran a front-page photo story of the previous day's hand-raising. The issue quickly sold out around town, leaving many a busy framer without a souvenir copy, but the paper had over 400 copies to donate to the Guild that were otherwise destined for the recycler because of imperfections in the color photo registration—easily remedied by a simple focal adjustment achieved with a few Canadian beers or a sentimental tear in the eye.

The derricks were removed on Wednesday leaving the two large trusses standing cross-braced to each other as a floor joist team began the work of custom-fitting notched joists and wedging them up in their positions against the inverted vees of opposite lattice openings. Meanwhile other crews began working the cedar lumber for the flooring, siding and approach ramp railings, the last featuring a handsome diamond grid fencing to repeat the truss lattice pattern.

PERHAPS the most challenging task in the critical path of construction was the plan for 37 individual truss-building teams to cut and test-join their custom-fitted roof trusses in three hours, eat dinner and then install the systems through the upper chords of the main trusses before nightfall.

Under the general supervision of Nancy Wilkins of Montana, the teams were led by "trussheads" previously briefed in the details of the roof construction. Our original Mayfly team naturally fell back in together under trusshead Doug Lukian. Dinnertime came and most trusses were still not complete as framers took dinnershift rides in busses back and forth to the dining hall at the university. By nightfall Thursday one lone roof truss stood in position atop the lattice trusses as the day's game was called on account of darkness. Nancy Wilkins' scorecard showed the visiting team down at the top of the ninth. For the first time the project was behind schedule with no room for error or even bad weather. The pressure was on.

Early Friday, the teams returned to install their roof trusses, and as the day went on, augmented by more workers now that the conference was over, specialized teams formed to deliver timbers and others travelled down the roofline installing truss after truss. By mid-morning the heat was intense and everyone had a palmful of those wonderful Douglas fir splinters. Most of the collar beams of the roof trusses, which had to pass through the lattices before being joined to their rafters and struts, simply didn't fit—another consequence of "the lumber from hell," as Ed Levin called it. It was in the midst of this tremendous effort, complicated by the incorrectly sawn lumber, that a team of jackers who



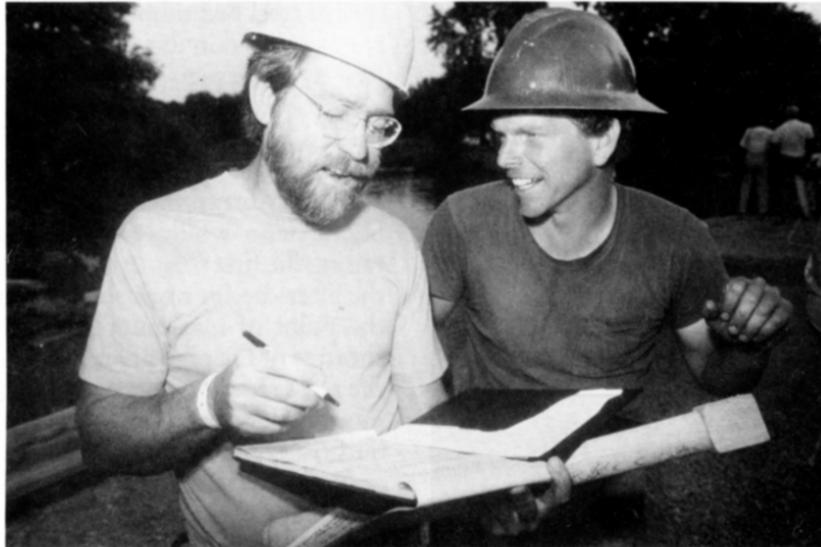
Joe Toomey safely chops a collar mortise in a rafter while Bruce Gardner supervises. Roof truss cutting and installing proved slower than planned on.



Photos © Russell F. Ley 1992

Mike Goldberg, who endeared himself to all by carrying and dispensing water during the hottest hours. He was later sent to St. Petersburg.

were lowering one end of the bridge onto rollers lost control and one corner of the incomplete structure dropped several inches before landing on cribbing below. (Report, page 16.) The unexpected movement sent workers inside the bridge and on the trusstops scrambling off the structure. The error was corrected and the work resumed calmly. By afternoon some people took refuge under the tent at one end of the site, collapsing in the welcome breeze there. Finally the roof trusses were completed and strapping went on lickety-split. Bundles of cedar shakes instantly appeared aloft and by nightfall the project was nearly back on schedule. Completion was within reach in the next 24 hours.



Marcus Brandt (right), in antic mood, with Karl Manzer composing the Speed River Covered Bridge Song, performed at the party after the dedication.

THE actual rolling of the bridge by hand out over the river and into position for two cranes to carry it the rest of the way was accomplished in several moves over Friday and Saturday. The block and tackle used to hoist the trusses was re-rigged to allow lines of framers to pull away from the river and roll the bridge the other way. The timbers used for the framing ways now became a two-rail track under the bridge, aimed at the piers. The oak rollers lay across the double-width rails, the lead roller at the front (and the last roller at the trailing end of the bridge), taking the brunt of the weight because of the arch of the camber. After each roller in the leading set was freed to the rear, it was sent forward again to become the next rolling axle.

The blocks compounded the pull at a 6:1 ratio with an estimated net advantage of 4.5:1. Each time the bridge actually rolled, it took every one of the hundreds of people on hand pushing directly and pulling indirectly. As the bridge neared the anchor points of the pulley systems, the entire Guild switched to pushing the bridge, many from underneath, almost completely hidden from view. Poised against the floor joists at face level, scores of framers under that bridge floor strained at the "Yo, Heave!" command and slowly the movement began. At that moment, we went a lot farther back than the 19th century of the bridge design. We felt distinctly Roman—or Egyptian.

Under powerful lights and to the hoarse shouts of roofing boss Randy Joseph, shinglers worked until 10:30 Friday night and resumed work early Saturday morning, pushing to finish the roofing and siding before the scheduled lift. The local radio news announced that 300 "farmers" had raised a wooden bridge by traditional methods, thus by inadvertence perhaps paying homage to forbears of our craft. As the morning

advanced, the week-long sunny sky continued, but the wind began to pick up slightly. The crane operators expressed anxiety about lifting the bridge in the afternoon, and so the decision was made to move up the final push. For the final time timber framers lined up to roll the bridge, now with one end suspended in a cradle on the cable of a 450-ton crane. Machines were beginning to replace humans as the bridge rolled toward its final pick point.

As the crane engineers rigged the cable on a second, 250-ton crane for the final double-hoist, it suddenly became apparent that there were no timber framers touching the bridge. The work was literally leaving our hands and the

feeling of loss was palpable. In other minds there was relief. "Now it's their problem," said Jan Lewandoski.

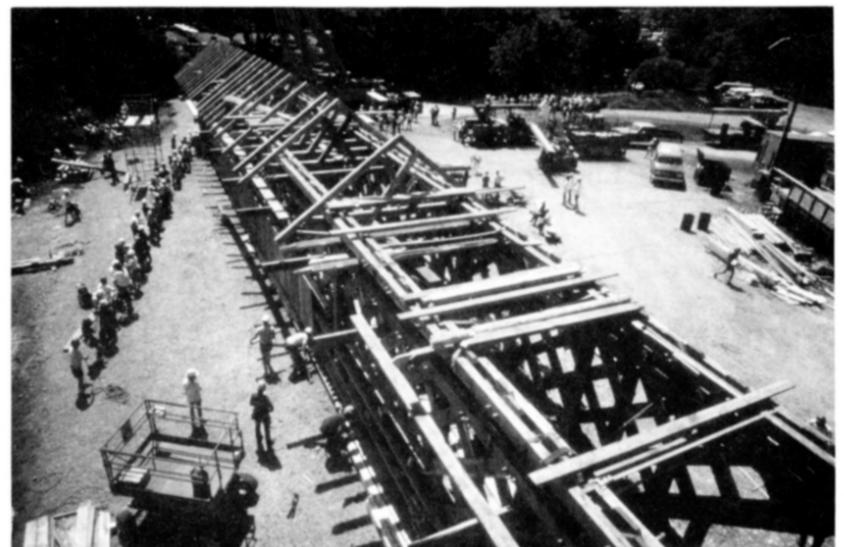
The bridge swayed slightly in its cradles while workers at the piers fastened special cylinder bearings designed to carry the concentrated weight and allow for lengthwise movement. The delicate tandem movements of the two cranes, linked by automatic controls, were so subtle that they held everyone in suspense. There was never one precise moment when the crowd watching could see that the bridge actually assumed its final position on the piers. Crowds of locals in boats, standing on the banks or cooling knee-deep in the river, cheered at one point, but it was not the unified and exultant group celebration that had greeted the hand-raising of the trusses three days earlier. The feeling was now serene pride and private congratulation between the framers and the people of Guelph surrounding them. Secretly, perhaps everyone was slightly sad that this great experience would soon end.

THE people of Guelph were extremely gracious, friendly and proud of their city. Several even found their way into construction at the bridge site. I will fondly remember Harry Palm and Molly Kurvink, neighbors down the street from the bridge who not only helped raise the trusses on Tuesday but also helped raise the roof of the Albion Hotel with their band in celebration Tuesday night. Three encores and dancing in the limestone building left the mortar needing repointing.

And when the time came finally to open the bridge to its owners, the people of Guelph swiftly packed the bridge to capacity. "To load the bridge any more, they would have needed pockets of pennies, piggy-back riders and a snowstorm," said one happy framer. The people of

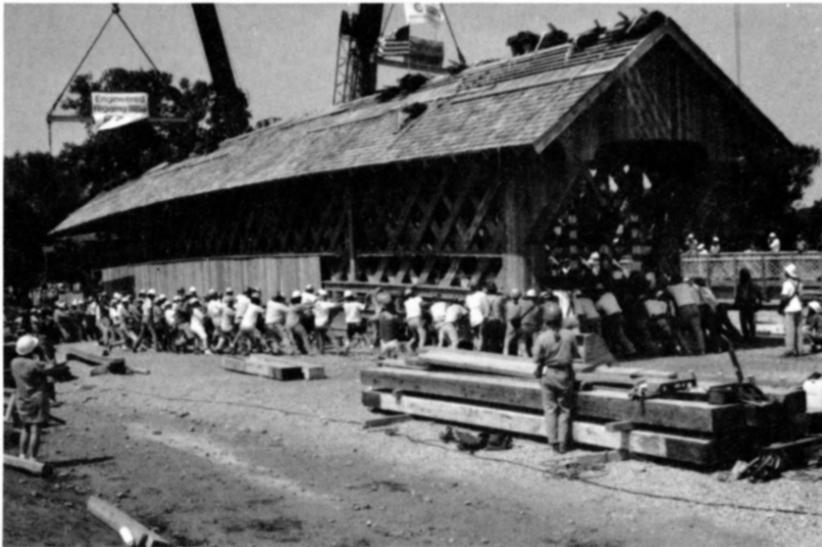


Friendly dynamo Terry Clark (left), straightening the tackle, and Gordon Miller, ever-helpful despite speech and hearing disabilities.



Photos © David L. Brill 1992

Work on the roof framing was interrupted more than once to roll the Very Long Object toward the river to meet an early crane date.



Ken Rower

All hands on the job to pull on the tackle and push on the bridge to send it rolling toward the waiting and self-promoting riggers' cradle.



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The bridge leaves the hands of the timber framers and floats free—a post-partum moment of sorts. Here seen from the other bank.

Guelph also helped inaugurate the bridge as speeches were made on the steps. Scott Murray cracked a bottle of champagne just below the TFG logo carved subtly in the gable-end siding, and a marriage almost immediately graced the eastern portal of the bridge.

Jim LeRoy, known (despite his name) as framers around the country as the Prince of Panels, married his princess Vickie Jones on the steps of the new bridge as the presiding minister declared the structure the province's newest chapel. The couple walked down a 500-ft. aisle of timber framers and well-wishers that culminated in an arcade of pike poles adorned with white streamers. Tim Chauvin, still Texas's premier singing timber framer, sang the wedding ode. "It didn't happen that we said, 'We have 3,000 people together, let's get married,'" said Jim, never at a loss for words. "But I'm honored to have Guelph watch." The *Guelph Mercury* covered the story on Sunday's front page calling the event "a fitting end to a chapter in Guelph's history that touched an emotional nerve in the city."

JONATHAN ORPIN remarked that he never felt so close to an effort and to so many people. "I've got all new friends now," he said. Several framers observed how visible the Guelph project would remain, compared to the obscurity of the two Guild-Habitat dwellings after their construction in 1989. Newly-elected Guild director Jake Jacob said, "Someday I'll return to Guelph and show my son what I helped build." There was a feeling that the Guild was making a monumental leap by spanning that Canadian river, that future public works will be influ-



Ken Rower

The citizens of Guelph flow through the bridge in both directions, immediately justifying its existence and taking obvious pride and pleasure in their newest amenity.

Bridge Statistics

Clear span	120 ft.
Lattice truss length	132 ft. bottom, 144 ft. top
Length at ridge x width x height	148 x 12 x 22 ft.
Weight (dead load)	147,000 pounds
Ramp length	47 ft. 3 in. each
Framing species and board footage	Douglas fir (B.C.), 50,000 bf
Siding, roofing, flooring species	Western red cedar
Number of white oak pegs	2,000 1¾-in., 1,000 1-in.
Squares of cedar shakes	41½
Modelled live load deflection	1 in.
Full design load @ 100 psf	136,400 pounds
Actual elastic deflection, full pedestrian load	5/16 in.
Cranes used to set bridge	Krupp 250-ton and 450-ton
Cost of one-day crane rental and gravel pad	\$ 85,000 CAN
Cost of piers and abutments complete	\$176,000
Cost of bridge and ramps save materials	\$137,500
Cost of bridge and ramp timber	\$ 96,000
Estimated total project cost	\$542,500
Total number of Guild members on project	350
Estimated man-hours	18,320
Beer served at Albion Hotel June 8-14	42 kegs, 285 cases

—Mike Koness

enced by the Guelph demonstration. The children of Guelph thanked the Guild with this poem:

*For Canada's birthday, out of
timber and wood,
You've built a bridge for our
neighbourhood.
We'll have it forever for all to
enjoy,
Our heritage gift for each girl
and boy.*

The sun set over the Guild's Saturday night celebration dinner. Red and white checkered cloths covered a field of tables as groups of framers and their families sat down to dinner, watched fireworks and listened to the band. Before retiring, my wife Patricia and our three-year-old son Liam took a walk through the now huge and strangely empty work yard and across the bridge, still active with people walking and pausing to look out over the river, at the moon or its reflection in the peaceful water.

As we approached the center of the bridge we found a group of people clustered and talking excitedly. In the center was Ben Brungraber, speaking (quietly) and holding a stick like an icon. As distant lights filtered through the lattice, I realized that all were gathered about the stick that told the elastic deflection of the bridge when the Guelph citizens poured on to it, filling it to capacity. The small band celebrating around that stick shared a very archaic and pure moment. The measure of the bridge had been taken. It amounted to five-sixteenths of an inch.

—WILLIAM COLLINS

Bill Collins offers architectural, timber framing, landscape design and graphic services in Point Pleasant, Pennsylvania.



Ken Rower

Timber framers and friends sit down to supper. The catered feast was followed by a rock band and fireworks.



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Jim LeRoy and Vickie Jones tie the knot in "Ontario's newest chapel," while a pensive Sharon Bosies holds the bouquet.