TIMBER FRAMING

JOURNAL OF THE TIMBER FRAMERS GUILD

Number 132, June 2019

Remote Framing in BC

TIMBER FRAMING

JOURNAL OF THE TIMBER FRAMERS GUILD

NUMBER 132 JUNE 2019

CONTENTS

On the front cover, moving building materials by barge and helicopter to a remote site on the Sunshine Coast, BC. Photo by Dave Petrina. On the back cover, finished interior of a rammed earth building. Photo by Emily Blackman.

1106 Harris Avenue, Suite 303, Bellingham, WA 98225
360-746-6571 or 855-598-1803
info@tfguild.org

Editorial Correspondence
Please email journal@tfguild.org or send your mail inquiries to the Guild office at the address above.

Editors Michael Cuba, Adam Miller

Editor Emeritus Kenneth Rower

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

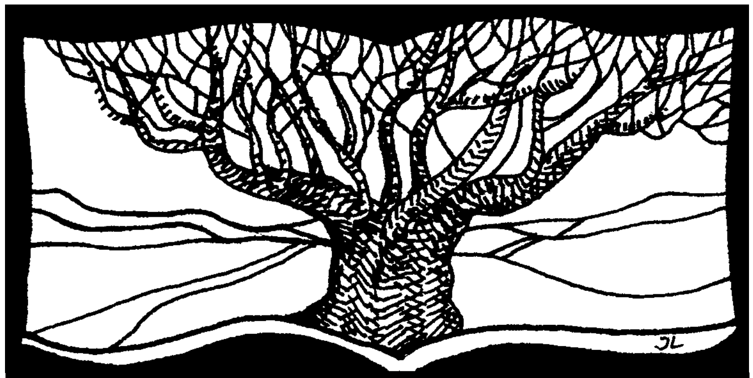
Layout/Design Erin Moore

Printed on Anthem Plus, an FSC® certified paper

TIMBER FRAMING (ISSN 1061-98ww60) is published quarterly by the Timber Framers Guild, 1106 Harris Avenue, Suite 303, Bellingham, WA 98225. Subscription $50 annually or by membership in the Guild. Periodicals postage paid at Becket, MA 01223 and additional mailing offices. POSTMASTER: Send address changes to Timber Framers Guild, 1106 Harris Avenue, Suite 303, Bellingham, WA 98225.

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

1985



Books

Essential Rammed Earth Construction

Essential Rammed Earth Construction: The Complete Step-by-Step Guide. Tim J. Krahn, P.Eng. Gabriola Island, BC: New Society Publishers, 2019. 8½ x 11 in., 160 pp., illustrated. Softcover, $40.

TIM Krahn's organized and methodical approach to introducing and exploring rammed earth construction reflects his engineer's eye and serves to provide the reader with a compelling and comprehensive argument in favor of its use. The book effectively bridges analysis of big-picture issues like climate impact, to the structural, thermal, and moisture dynamics of rammed earth enclosure systems, to specific construction and design techniques.

In his introduction, Krahn is explicit that the design and application of rammed earth covered in this book is related to North American climates, and accordingly the cold and wet climates of Canada in addition to the more arid or humid hot climates of the southern United States. While this may impact the universal application of certain details, the nature of the materials, approach to design, and techniques for construction are applicable in all contexts and serve as a valuable resource to anyone interested in working with rammed earth.

Krahn writes, "While it is not the purpose of this volume to go into detail regarding engineering design, it bears stating that my current engineering design methodology follows the Canadian Masonry Design Code—CSA S304.1." He goes on to present a case study, navigating through restrictive building codes to successfully bring compliant buildings into existence. This degree of detail not only serves as a practical nugget of administrative maneuvering but exposes rigor to reinforce the reader's confidence. There is no question as to the strength of Krahn's arguments from a technical vantage point. His commitment to working proactively within a code-regulated environment is insightfully reprised later in the book.

It can be difficult to introduce alternative building systems into the marketplace of ideas or products. There is a lot of risk and cost involved, and the more we learn, the more we realize the complexity behind the physics of heat and moisture as they relate to our walls. Krahn's explanation of thermal and moisture performance characteristics of rammed earth walls aids those of us in the building science community through a relatable context of the four control layers of the enclosure. This establishes a logic that can then be applied to a range of design decisions, from finish selection to additive and stabilizer types, to fenestration detail. Krahn does the important job of connecting the building science principles of a rammed earth wall assembly to real-world decisions, honoring his intention to make this a book useful to those who intend to build using the information provided. He does a good job of laying out the fundamental building physics in a clear and concise manner.

In a chapter titled "Rammed Earth's Dirty Secret," Krahn writes two remarkable paragraphs, candidly revealing that, in researching the book, he calculated that rammed earth carries a significant embodied carbon emissions load, in large part due to commonly used polystyrene foam insulation:

> I find this truth hard to swallow, but it is the truth nonetheless. I am not saying that rammed earth cannot be built sustainably in northern climates, but I do not believe that the majority of the North American rammed earth building that has been done to date can claim to be carbon neutral—which, in the light of global climate change, really needs to be a key criteria for building design.
>
> I am not saying that rammed earth construction the way it is being done is worse than conventional concrete construction, but it is hard to say that it's anything other than less bad. And less bad does not meet the long-term goals that our built environment needs to reach.

This passage is striking for a few reasons. For one, Krahn cares enough to look at the carbon numbers—this is far from a given, as quantifying the climate impact of our buildings' life cycles is still a nascent, albeit growing, practice even among sustainability-minded professionals. For another, he is completely, even disarmingly, honest about his realization of the climate impact of the assembly. Rather than trying to rationalize or distract from the results of his analysis, he turns the reader's focus to potential solutions of the impact of materials commonly used for insulation or stabilizers. The depth and integrity revealed in this approach instills a greater degree of confidence in the author and, in a way, binds the reader and author with a common goal of improving the global warming potential of rammed earth assemblies.

For material nerds such as myself, this book was a delight. Krahn gives his readers a lot of credit for their ability to reference technical information, while crafting his language to ensure a clear and simple description of the materials. This balance allows a range of audiences to relate to the content on a level they can access. Krahn clearly loves materials, and shares that by offering the best technical description of the applied physics of earthen construction that I have seen. By presenting the physical characteristic of the material, the method by which it is tested and evaluated, and relating the results of the testing to the physical properties of the material, the reader is offered a context in which to understand not just what the properties of a given material might be, but why it has those properties, and how you can apply that knowledge to improve the quality of your design.

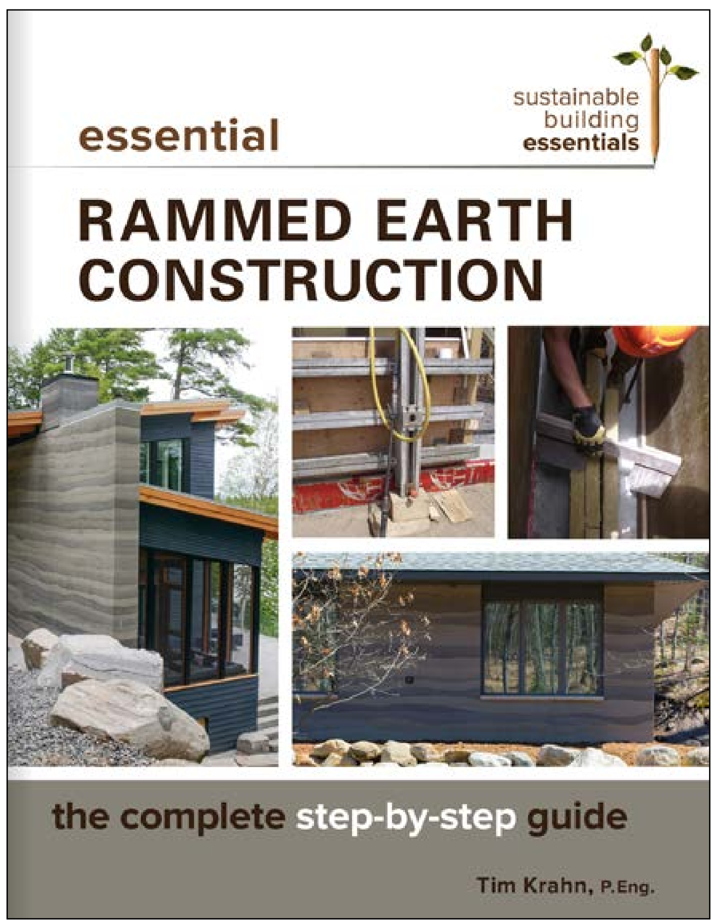
Krahn offers a comprehensive review of different material options for the whole of a rammed earth mix, referencing some of the most cutting-edge and emerging technologies. He explains the process of selecting the material from the gravel yard, evaluating it, designing a mix, and related testing from methodologies through field and lab work. He provides enough description of the many types of structural and moisture testing regimes to enable any resourceful and motivated person to conduct some basic material engineering evaluation. This approach transcends technical resourcefulness, and offers a degree of empowerment, skill development, and competence that separates a truly valuable educational resource from a good reference.

This book offers several chapters dedicated to fabrication. Krahn lays out a range of different approaches to the actual construction of the rammed earth wall systems, from mixing to loading to tamping. He strikes a good balance of providing detailed, experience-rich perspective for the qualified builder without going so far as to attempt a remedial instruction manual. Krahn offers a cautionary tale of an under-supervised volunteer project and the results of a poorly managed construction process as a counterbalance to the technically rich contents of the book. He extends his eye for detail all the way to a clear description of electrical box layout, and various aesthetic features that can be incorporated into rammed earth walls, as well as a solid treatment of window installation and flashing details.

This book stands out in its value to anyone considering, let alone actively working with, rammed earth wall systems. Further, it serves as a wealth of information ranging from structural analysis, cost estimation, fundamental building science, and a systems-based approach to the design and construction process that would benefit any project. Earthen construction clearly isn't just for the desert anymore, and in this book, Tim Krahn helps us understand not just why, but how.

—Jacob Deva Racusin

Jacob Deva Racusin is co-owner of New Frameworks Natural Design/Build. Jacob is co-author (with Ace McArleton) of The Natural Building Companion: A Comprehensive Guide to Integrative Design and Construction*. White River Junction, Vt.: Chelsea Green, 2012.*



Timber Framers of the Future

BEING the spouse of a timber framer has its pluses and minuses—much like being the spouse of a Waldorf teacher. Most of this falls into the plus category equally. On the teacher side of the equation, the children in the family get to have a Waldorf education. Having a timber framer for a spouse has had the perks of sets for class plays in addition to cubbies, platforms, stepping stools, and plant hangers. Among the best of these benefits was the third-grade housebuilding blocks of teaching. For those not familiar with Waldorf education: the class teacher ideally stays with the same class for grades one through eight, the teaching is focused in blocks of three or four weeks of a single subject. Part of the third-grade curriculum includes housebuilding.

We have heard numerous reports of building timber frames with youngsters but none so young as nine years old. I had taught one class through all eight grades and then again with another class to teach grades one through five. Both groups of students built and raised a timber frame in their four-week housebuilding blocks in grade three when all, in both classes, were nine years old. Over four weeks were devoted to completing each of the timber-framed garden sheds. One shed, measuring 12 ft. by 16 ft., was permanently set up at the school as a functional garden shed. The second shed, measuring 10 ft. by 12 ft., was raised, auctioned off, dismantled, and reassembled for the winning bidder on her property (by, you guessed it, the timber framer and a crew of young adults interested in the project). Proceeds from the winning bid were contributed by the class for the building of a new wing at the school.

The first class had 15 students and the second class had 28, many with various learning differences—from blindness to Tourette's to autism spectrum disorders to severe emotional challenges, to prodigy-like capacities, among other issues. So, the planning was important in both cases, but more so in the second case from the sheer number of students and challenges involved.

All photos: Patrice Maynard

Lifting the first bent, with David coaching from the left.

Enthusiasm was immediate for this project from many vantage points. We, as a couple of differing professionals, were happy to share such a project together. The satisfaction of sharing the thrill of timber framing with the very young was strong for us both. Asking youngsters to visualize a finished house and build on that imagination was another point of mutual satisfaction. The parents of the third graders found it astonishing that we could undertake such a large and impressive project. The greatest enthusiasm came from the little hearts and hands, eager to try out real tools, real materials and to work with real craftspeople.

The Plan

We began by planning a modest-sized garden shed (quite large to the young) with David specifying the materials to be used. He sketched out the garden shed and drafted a lumber list. I approached a local lumber yard and was able to have the wood donated. The owner of the lumber yard, Herrington's Lumber, in Hillsdale, New York, got a big kick out of the whole idea and was pleased to help. Mr. Herrington is a man who supports many educational projects in our area whenever he can.

For the school's new garden shed, we planned on building a stone foundation, 12 inches high, dry laid with some invisible mortar. A parent in this class is a stone mason—a maker of houses, walls and sheds of stone. He was happy to do the necessary excavation work and build us a foundation for the shed. This generous parent had his crew come to school over a period of five days, in preparation for the actual hands-on house building. The crew let the children help in small ways to mix the mortar and to dig a bit. We all watched with keen interest as the crew prepared the ingredients needed for the mixture and handled the stones for the foundation. This was made of field stone and dry laid in its appearance, but the builder used minimal mortar as was his habit in building. After excavation, crushed stone was placed before the field stones were laid. It was a substantial foundation for a small garden shed but gave the father a chance to show his skills to his son's class and offered the children a chance to understand the placement of a foundation and the mixing of concrete.

David had figured out how many chisels, mallets, and other tools would be needed for the aspiring young framers to have their turns without unreasonable wait times. He limited the number of tools to keep costs down and to reduce the risks involved. Much of the equipment used was David's own. Because of the scope of the projects and the age of the youngsters, his daily preparation was fairly substantial.

David did most of the layout on his own. He used some of the simpler tasks of measuring to give the children a sense of the process. He understood that if work stopped completely with the end of each school day, the projects would not be completed in the weeks we had. David used power tools after school to rough out some of the pieces and keep our project moving steadily. None of the children ever saw or used any power tools.

Pegging into offset holes—important lesson in understanding!

David helps young Martin pound a peg with a parent watching.

The Instruction

We strategized about how to approach the class and the work they would do. With both classes, there were two days of classroom orientations. The first class worked as a unit with all 30 little hands working in unison. For the second class, I explained that the group would be divided into four different working teams to accomplish the various tasks. David joined the class for these orientation days. His task was to explain to the children how sharp and heavy the tools are, how strict we all had to be about following the rules, and the importance of attentiveness to his instructions. A somber silence fell upon the children as they watched a real joiner shave a patch of hair off his own arm to demonstrate the sharpness of the chisels. Children were then able to handle the tools in the classroom, to feel their heft and to practice as I coached them about handling the chisels and mallets. There were bursts of enthusiastic chatter when some of the bigger slicks and mallets came out. One young girl grew remarkably wide-eyed when she got to hold the biggest slick. David explained how each tool would help to accomplish the various tasks of the project. He did this with both classes, and there were similarities in both projects. For this article I will focus on the second class's story as this was the more demanding of the two.

On the second day of classroom instruction, the lumber yard delivered the necessary wood—all eastern white pine (*Pinus strobus*). This was a colossal stimulant to the children's increasing excitement about what they were getting ready to dig into. This enthusiasm sparked instant engagement with the task at hand but created challenges as well—excited children are not always the most self-controlled. We had planned for this and created rules that we agreed together were clear and consistent in aiding our burgeoning timber framers to keep it together and to avoid accidental disasters small and large.

The Action

The first hands-on task then became David's, giving orders to budding timber framers about the correct way to handle timber in a confined space so as to not knock anyone over and to be mindful of the proper stacking and organizing of the wood. There was one young fellow, Sjaak, who showed an uncanny ability, even at age nine, for this comprehension of moving large objects around, and he became David's right-hand man in all things involving the carrying and setting up of the timbers. Sjaak was quick to correct classmates and avert potential disasters when he saw others handling materials incorrectly.

David set up four stations of wood working so that different divisions of labor could allow all children to experience chiseling mortises and tenons. He borrowed a boring machine from a friend for a drilling station. The plan was to have lines of seven children at each chiseling station. The preparation is all well and good and imaginatively pleasing, but once the timbers are set up, the chiseling starts and quickly begins to feel like work!

This big class of little friends was particularly vulnerable to giving up too quickly when serious effort was required (with a few noteworthy exceptions). One of the hidden gifts of a project like this is that the thrill of it all propels the children further than the ordinary tasks of life. Educating the will of growing children is one of the defined goals of Waldorf education and this project was chosen for this very reason. David often laments when he gets a young assistant in one project or another and realizes after a few days that no one has ever taught the aspiring adult how to work! This whole endeavor was a primer for just this sort of learning.

Diligence was in the air and concentration ran high. Work requiring the greatest focus was done in the morning in the first hour and a half of the main lesson and continued throughout the day in 45-minute increments when the children had lessons with the class teacher. It was possible to see the children beginning to understand how hard the work is, the care needed to square corners in the mortises, and delighting in small tricks of the trade which David shared in mini lessons along the way.

The Discipline

This blissful harmony lasted for about eight days, straight through the weekend. Clearly, after the weekend, some attention had waned. On the eighth day, the unraveling became evident. The noise level was higher, and the concentration diminished. Two children got nicked enough to bleed and required bandages. Because of this, David halted activity and explained to everyone that these small accidents were symptoms of the decline in attention and adherence to correct procedures. He stopped the work for that morning. This was a real shock to the class. They were uncharacteristically quiet and murmured about whether they had blown it completely. They wondered if the project was off for good. Secretly, I felt this was a good worry for these youngsters to have. Some of them were marvelous, rascally rule-benders at heart. Some were out-and-out natural comics. Consequences connected to the work were sobering for them.

That night, we reviewed the progress to date and the hazards involved in continuing as planned. David realized that he could not hold focus on the project, with the needed instruction at different times, and act as the disciplinarian. So, we decided that the class would be split into two. One group would work in class on main lesson books, recording their experiences and timber framing facts through drawing and writing, while the second group worked on the frame. After forty-five minutes in the main lesson, the groups would switch. David remained with the framers and I led the rest of the group in the classroom. This significantly reduced the children's time spent waiting in line.

David changed his approach and structured side tasks of material handling and site cleanup to keep everyone busier on the work site. This event caused David to rethink the approach he was taking. He refocused his attention on the work more energetically, pointing out work well done more frequently and noting where more attention could be paid to improving the chiseling work.

With this plan in place, we made it clear to the class that any goofing around or loss of focus would cause anyone working on site to be sent into the classroom for main lesson book work (oh, dreaded exclusion!). The threat of lost time from working proved enough: David never had to send anyone inside and there were no additional needs for bandages. After this temporary shut down and shift in approach, a mood of real commitment and hard work settled in.

The days were a little brisk with the remaining cold of winter in the Northeast. It was just warm enough during the days to make it glorious to be outside. To see the children working as hard as they did was moving. For both projects, the weather was a cooperative partner with scarcely a drop of rain. Everyone had a turn with the boring machine at least once with varying levels of success and needs for assistance. Each child was able to try their hands at a few mortises, tenons, material handling tasks and site clean-up each day. By the end of three weeks we were feeling like professional woodworkers. Children could be heard coaching each other and calling cautions to each other when they saw potential dangers lurking. It was impressive. With the rhythm and determination established among the children, David was able to relax a little. Raising day was fast approaching, and his intuitive and increasing focus became a leading example for the young apprentices to imitate.

After the children were done working each day, David spent time examining, squaring mortises, and trimming tenons where necessary to keep the cuts accurate and the project on schedule. The project naturally caught the attention of the whole school and the third graders were feeling very important as high schoolers admired the work and declared the project to be "really cool." Big brothers and sisters were especially taken with the complexity of the plan and the fine work of their little siblings. During the project, volunteers would stop by—parents, fellow craftspeople, timber framers, and one leather craftsman (who loaned us the boring machine) to see the children work. Some helped David with organization, ensuring the success of the following day. David poured all his skill and determination into this work. With their new awareness, the children could feel this, and it helped them rise to the work in a wonderful way.

The Raising

By week four, we had planned the assembly and raising processes. Now, as with all good raisings, the crowds anticipated coming to watch and help. David's usual concentration before any raising set in. Preoccupation with thinking through the details and logistics took on a new kind of intensity in this case. Leading up to the big days of raising work, we had many short, intense conversations, prioritizing safety and the goal of assuring that the experience was the children's and not the work of intervening parents or older children.

David had gathered all of us outside, where we sat on the timber we had prepared, and listened to his explanation of the assembly and hand raising process with a bit of history on the evolution of raising practices mixed in. The youngsters listened with full attention as the step-by-step approach to assembly and raising was laid out. David taught the children all that was needed for ensuring safety and protecting their good work when handling the timbers. A quiet buzz

Third grade students handing pieces to waiting assemblers.

Handing up the rafters.

filled our class for these orientation days. It really was thrilling. Just think of the imagination building in these young souls of what the results of their work would be!

I had arranged for the third graders to be allowed to miss classes for two days, so that full days could be spent on assembly and raising. The faculty were beginning to share anticipation of seeing the little building go up. With the children excused from classes, all faculty were able to attend the raising.

Construction commenced, as planned, on Wednesday of the fourth week. The pieces of the two bents for the small frame were assembled. Sjaak had been established as second-in-command to David for moving the timbers into position. Some of the young engineers were fascinated with the draw boring process. Watching intently, they offered sounds of awe when they saw how this pulled things more tightly together as the peg is driven. It wasn't a mistake that the holes were offset! A great deal of earnest concentration went into raising the bents and finding out how the pieces were all held together. There was eager scrambling to use the largest beetle. To watch as third graders tried to aim a beetle to drive pegs and tighten joints was quite entertaining. We had a few dedicated parents of children in the class whose help was invaluable. We had no glitches or late-discovered errors at all, which was grand!

Adults took the lead in setting the rafters as young timber framers helped to carry and hoist them up. Once the frame was set and the roof completed, the whetting bush, the tree of life, was nailed into position by David. One by one, each third grader climbed the ladder at the end of the timber frame and balanced their way, joist by joist, to the opposite end for the final picture of all participating craftspersons.

The depth of satisfaction, as all the children found their daring place on the frame for the culminating picture, was palpable. We still hear from students about the wonderful memories they have of the timber framing process. With the first frame, children placed new pennies in each mortise to note the year of the project. They can still show which mortise holds their penny. With the second shed, no pennies were placed since the frame was to come down again in anticipation of its fundraising potential.

The understanding that comes to children through an experience like this is significant. To be included in work like this is important for young children to experience. This is a time in a child's life when realization comes that there is no Santa Claus or Tooth Fairy and the magic of their early childhood consciousness fades away. Here they had the chance to participate in making the magic—and there are few things more magical than a timber frame!

The Closing of the Circle

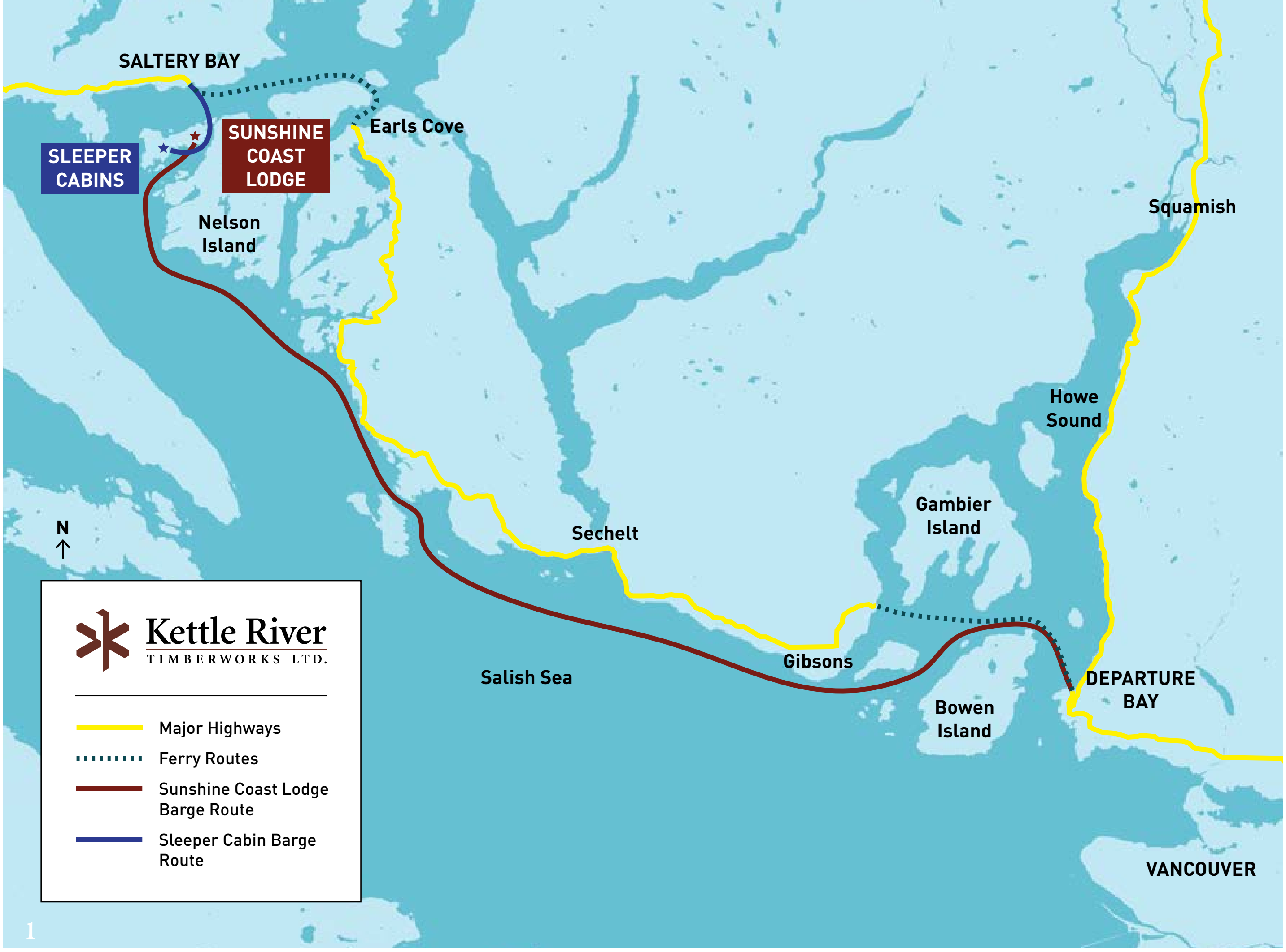
One small footnote is that some years later Sjaak hand cut a gorgeous wooden bench, with a scene carved on the back rest, for his twelfth grade project (required of each twelfth grader in a Waldorf school). After the project presentations of the class were complete, David went to congratulate these students on their accomplishments. He had just been asked to cut a timber frame for the local biodynamic health food store, to provide an outdoor, three-season pavilion for its patrons. While admiring the handsome wood carving work on the bench, David asked Sjaak if he'd like a summer job as assistant to cut the frame for this pavilion. Sjaak agreed and both men, young and older, spent a happy, almost silent summer sharing the work together and reliving the first and second in command experience of grade three.

—Patrice and David Maynard

David, a Guild member for over thirty years, began learning the craft of timber framing in 1987. He's been at it ever since. Patrice holds an M.Ed. from Antioch University New England. They live with their three children in Ghent, New York, in a timber frame built by David.

The third graders on the frame with Patrice to the left.

Patrice and David in Dingle, Ireland, September 2018.



Paula Heal

Into the Wild: Timber Framing in Remote Locations

THE last ice age left the coast of British Columbia carved up into a myriad of fjords and islets accessible only by boat or float plane. Over the last ten years, my company has had the opportunity to design and build more than a dozen timber frame homes along these remote waterways. These projects have ranged from elegant 260-sq.-ft. sleeper cabins to luxurious 4,000-sq.-ft. lodges. Remote timber framing projects are both extremely satisfying and challenging to complete, and over years of accumulated experience on these jobs I have learned many unexpected lessons.

The word "remote" has different meanings to different people. My definition describes a location that is: (1) inaccessible by a paved road; (2) unreachable by a regularly scheduled ferry; (3) sparsely populated with few, if any, neighbors apart from otters and eagles; (4) "off the grid," which in BC means no guaranteed access to the services that we take for granted in more urban areas, such as electricity, Wi-Fi, running water, sewage, coffee shops, or even cell phone service. While this last is slowly expanding up the coast, it is unlikely to ever reach the most sparsely populated areas. "Remote" also means no lumber yards or neighborhood hardware stores around the corner, which highlights the need for thorough advance planning.

For a homeowner, the appeal of a remote location is the tremendous beauty as well as the privacy. However, getting to these sites is often a multi-hour, multi-step voyage involving a ferry from Vancouver to the Sunshine Coast, driving up to Earls Cove or Saltery Bay and then taking a water taxi to the site itself. Most of these remote sites are located on the water, which makes for moderately easy access by boat or water taxi, although the shoreline and topographic features can make landing materials a challenge. Seasons, weather and currents are also necessary considerations

1 The map shows the location of the Sunshine Coast Lodge and the Sleeper Cabins relative to Vancouver, home of Kettle River Timberworks, Ltd. Materials for the Sunshine Coast Remote Lodge were trucked to Horseshoe Bay in Greater Vancouver. The trucks were then loaded directly onto the barge. The barge trip from Horseshoe Bay (shown in red) was six to seven hours but cost less than sending all the trucks up the coast on ferries. Materials for the sleeper cabins were trucked and ferried from Vancouver and nearby Squamish to Saltery Bay followed by a short one-hour barge trip (shown in blue) to the island. The yellow lines are roads; the dashed lines are the regularly scheduled ferry routes.

for accessing the site. A map showing the locations of two selected projects is shown in Figure 1, along with the crew and barge routes.

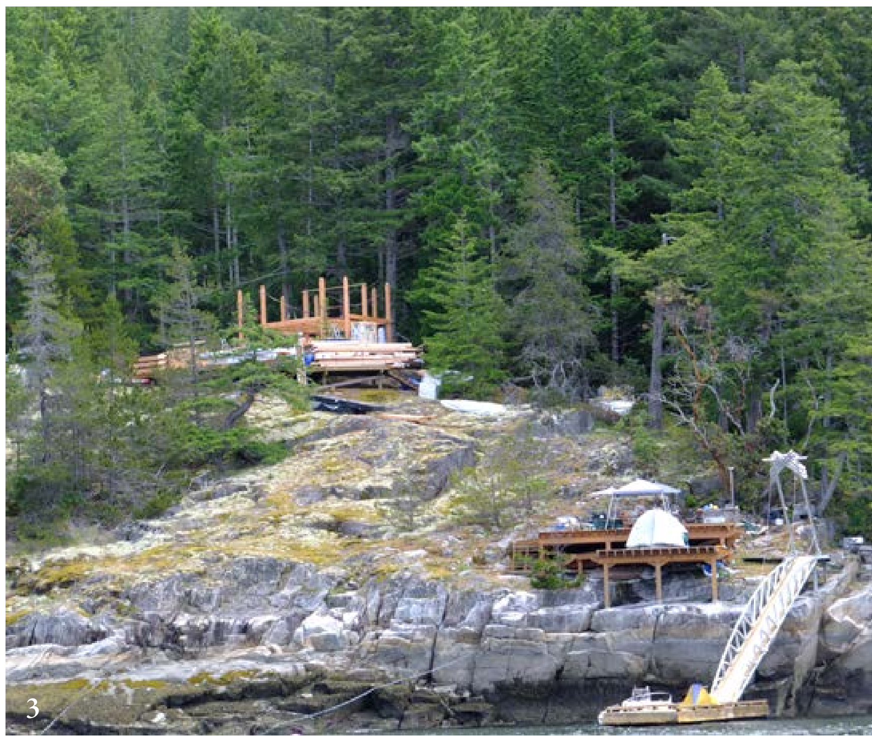
Our timber frame projects are typically initiated when clients approach us with a vision for what they want to build on their personal piece of paradise. After initial discussions, a project really kicks off with a site visit. This visit usually takes place shortly after the client engages us and before design starts, approximately eight to twelve months before the actual construction begins. Because of the amount of time and effort it takes to get to these remote building sites, we usually only make one pre-construction site visit. This means that we need to obtain and determine all the necessary information at once, such as site topography, the best place to build the house, and the best locations for material landing and storage (Fig. 2). We always take a lot of site photos, from as many angles as possible, which we refer to repeatedly during the planning and design process. Sometimes we use aerial photos of the property that were taken for real estate purposes, which has inspired us to think about using drones to capture images of the property from all angles. At this point we also try to determine crew accommodation and logistics.

Other first site visit considerations involve finding and identifying fresh water sources, the distance to the nearest transportation hub (for the crew's days off and in case of emergency), and any water hazards or tricky currents. Although many of the homes we build rely on rainwater collection, the residents of one island reportedly used a dowser to successfully identify an appropriate well site. Armed with this bundle of information, impressions, and photographs, we make the long trip home again to Vancouver to start the planning and design process.

A critical part of the initial site visit is to plan the landing site. This involves assessing the coastline to identify obstacles both above and below the waterline, which will determine how close a barge can get to the site. We need to determine if vehicles and equipment can be unloaded directly and where the material will be landed and stored. As most of the landing sites are very small (beaches are rare on BC's inner coast), we need to anticipate how much material is required and how to store it securely above the tideline. A key consideration is the range of the barge crane: if the distance between the barge and the landing site is too great, air support (i.e., a helicopter) may be required. In some cases, if the terrain is irregular or very steep, we may need to construct a platform in advance of the barge arrival so that we have a level place to land materials (Fig. 3).


2

All photos: Dave Petrina, except where noted


3


4

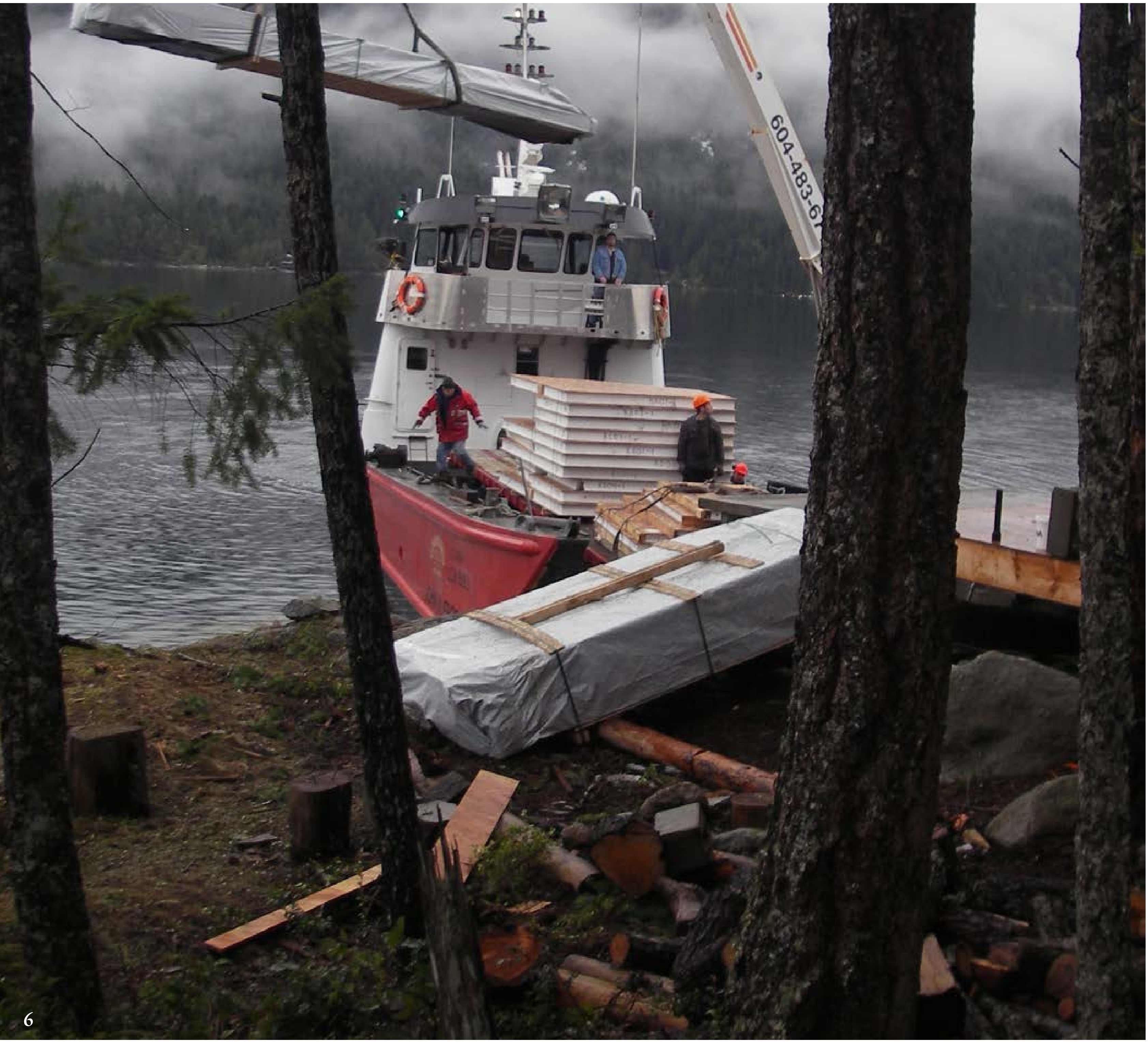
2 To capture information during site visits, we've purchased our own survey equipment to conduct a proper topographic survey of the site.

3 A sloping and irregular landing site requires careful planning for unloading and storage needs.

4 Pier construction for a house. When the site is irregular or sloped, temporary landing sites and living spaces also need to be fabricated.

5 Loading a barge. Each barge trip can cost up to $10,000 CAD per trip, including barge and the trucks. Larger projects can take about three to five barge trips to transport everything to the site.

6 Unloading the barge using a crane. When unloading the barge for the Sunshine Coast Lodge project, the crane swung a load too wide and the barge started to roll. This could have been a disaster. Fortunately the quick-thinking operator spooled the load down and dropped it into the sea (aka "salt chuck"). The load of timbers did not sink and the operator was able to drag the load in the water and then re-lift with better positioning.



Design considerations for remote homes Design plays a critical role in a successful remote build. Important elements to consider include foundations, framing strategies, and off-grid necessities. Sometimes an outside architect is brought in to support our team during the design phase, but for most projects all the design is conducted in-house. Our company has done both turn-key projects and others where only the frame and SIPs are supplied.

The first fact of life (or nature) is that most coastal building surfaces are not flat. Since many of the province's islands are made of smooth, solid granite, excavation is usually not desirable or even feasible. Most sites require some hand digging to reach the bedrock, and mechanical excavation is not financially or logistically practical. To minimize the use of concrete and blasting, many remote houses involve pier construction, or the use of concrete piers pinned to the rock as opposed to a full foundation (Fig. 4). Pier construction creates a nice dry storage space underneath the structure that critters are often drawn to.

Appropriate frame design influences the transportation and ease of raising a project and can also have a major impact on project costs. For remote sites, we favor a common rafter frame design that allows the house to be built piece by piece. Raising a bent or wall-style frame requires a crane, which is rarely a realistic option on remote sites.

Off-grid design involves incorporating both low- and high-tech solutions to make our clients' homes as comfortable and sustainable as possible. Many remote homes incorporate rainwater collection and low-tech gravity-fed water systems such as a water tank or reservoir located up a hill or on a raised platform. Other houses use solar power to pump water from a well to the holding tank; this ensures good water pressure even when the solar isn't available. Some clients recycle graywater from bathing for flush toilets while others use composting toilets. Typically, propane is

7 Unloading a barge with a helicopter. Helicopter lift capacity increases as the fuel is burned off, so the lightest loads are carried first with the heavier ones left for last.

8 Lifting without a crane. Here, four material lifts are being used to raise timbers.

used to power the stove, refrigerators and freezers, while the oven can be propane or wood-fired. Passive solar hot water heating can be used to supplement propane on-demand hot water heating systems. Although high-tech solar panels and battery systems can support lighting, they are insufficient to warm the house during the cold, wet West Coast winters which make wood stoves a necessity. Fortunately, there are several good wood stoves on the market that have an oven compartment, making them ideal for both heating and cooking. Even the remote coastline of BC is not a utopia, and these remote homes are vulnerable to intruders. We've had clients install remote cameras. One client had us design removable floorboards on a stair landing to conceal a secret vault. Another had us chopper in an 8x8 shipping container to serve as a remote Fort Knox for storing valuables such as boat motors, chainsaws, fishing gear, and fine Scotch when the home was vacant.

It's all about the planning: transportation and material logistics

Unlike standard building projects, we source and consolidate all of the equipment and hardware before the project begins so that it can be packed and barged to the site. Having completed more than a dozen of these projects, we have developed extensive checklists of the tools, building materials, generators, fuel, food, survival items, and first aid gear that we will need. Every hammer, chisel, and battery is included. Planning wisely and packing well minimizes the number of barge trips required and reduces the need for unexpected (and expensive) trips back to the mainland to pick up what we forgot.

Barge transport provides some additional interesting challenges. Most jobs have a narrow delivery window that is influenced by the currents and tides that appear at a different time and depth each day. If we don't come and go within the specific window, the current may be too powerful to navigate or else the barge may be grounded by the diminishing tide. Usually the barge driver will advise us about the best time to land, and we will schedule our day around that (Fig. 5).

Some of the islands, including Sidney and Gambier Islands, have rural roads but no vehicle ferries, so we can place loaded vehicles directly on the barge to transport the equipment to the property on their rural roads. This is often easier and faster than unloading directly from a barge but may require our truck drivers to do what few in the business are comfortable with. There is no room for error when truck drivers are required to back a tandem trailer onto a crowded open barge with a foot of grace or navigate kilometers of overgrown island roads with barely a place to turn around.

Finally, to add to the complexity, we have learned the hard way to be prepared to accommodate local culture. The BC coast has traditionally attracted colorful characters, some of whom have a pirate mentality. For example, we once had all materials and the whole crew ready and waiting for a barge that never showed up. We were unable to contact the operator that entire day and only later learned that he had decided to drop us for a more lucrative government contract relocating a herd of elk from an urban area to a more appropriate wilderness location.

9 A Roustabout in action.

10 Converted aerial work platform being used to lift materials.

11 While not our preferred method on remote sites, telehandlers can be used to lift beams.

12 Crew accommodations on site can include sailboats, tents, yurts, and old cabins. With sailboats, we need to be aware of the weather. On one job we had to leave a site at 2AM to avoid getting smashed on the rocks.

Landing the material on site presents its own set of challenges. We typically use the barge crane to lift materials directly from the barge to the landing site (Fig. 6), but other methods may be necessary if the landing site is far from the worksite. This may include moving the materials bucket brigade style from the barge up a bank to the worksite, though this manual approach can exhaust and demoralize a crew. Alternatively, on several occasions we have used a helicopter to shuttle everything from the barge up to the site in just a few hours. On one such project, a helicopter with an approximate 2200-pound lift capacity moved 25 tons of building materials in just 27 lifts. While this was accomplished in just an hour and a half, with one load hustled from the barge to the landing site every two and a half minutes, this approach requires even more planning: before barging, we had to decide what would be included in each helicopter load based on weight, materials were packaged appropriately, each load was numbered, and the drop location for each load was mapped. Still, we felt it was $8,000 CAD well spent (Fig. 7).

Building without a crane

The key factor that distinguishes remote timber framing raisings from many more typical building jobs is that we don't have the luxury of a crane. Although cranes are standard equipment on modern sites, it's helpful to remember that prior to the advent of the crane timber framing was done with many hands and pike poles and maybe the help of a gin pole. Today, there are a number of portable machines that can be used on remote job sites:

- ***Material lift.*** These can be rented from building supply stores. While their individual vertical lift capacity is limited, material lifts can be used in combination to lift heavier loads up to 2,000 lbs (Fig. 8).
- ***Roustabout.*** A Roustabout can lift up to roughly 1,500 lbs., which is greater in capacity than a single material lift (Fig. 9).
- ***Aerial work platform.*** A small lift can be transported to a remote location and adapted to a flexible lifting machine capable of lifting about 400 lbs. (Fig. 10).
- ***Chain fall.*** Chain falls and comealongs can be used for hoisting.
- ***Telehandler.*** A telehandler is a four-wheel drive, telescoping-boom forklift, ideal for both material handling and as a lifting device (Fig. 11).

13 Crew transport involves boats, water taxis, and on rare occasions, seaplanes.

Our preferred method is to use either a Roustabout or a material lift as these are compact, versatile, inexpensive, and can be packed to a jobsite fairly easily by just a few crew members. The lift can also be removed from a jobsite with a rugged boat such as a water taxi—no barge required. By contrast, a telehandler requires very good landing and worksites to drive the machine around. It's also an expensive piece of equipment to rent, can damage the site and requires a barge at the end of the project to transport it off site.

Unique labor force challenges: selecting the right crew and keeping them safe and happy

One the biggest success factors for remote construction projects is hiring the right group of people. You need to ensure that potential crew members fully understand what they are getting into—this isn't shop work! The rustic lifestyle doesn't work for everyone and I've had crew members decide, after only a few days, that this isn't the right scenario for them. In those cases, I returned them to the nearest transportation hub, settled their paycheck, and thanked them for giving the project a go.

THE CRITICAL SUCCESS ELEMENT FOR REMOTE BUILDS IS HIRING A CREW WHO THRIVE IN THE OUTDOORS.

Tips for adaptation to a remote building location:

- Wear the same clothes every day.
- Get used to being off social media.
- Rainwear is everyday wear.

For those who thrive in the outdoors, enjoy spending time in stunning natural locations, like being near water, and love camping, these projects can be a dream come true. Jobsite accommodations vary—we may sleep in tents, sailboats, yurts, crummy rented cabins, or rustic accommodations that we've built on site (Fig. 12). Since we build year-round, this sometimes means camping in the snow. While the ideal crew number varies with the scope of the project, we typically find that four or five members are ideal for an efficient team.

Expectation management about the crew schedule is important. Typically, on these jobs we work 12 hours per day, ten days at a stretch, followed by four days off. While we ideally try to leave the site at the end of day ten, the West Coast weather can be very unpredictable and sometimes it is necessary to spend another night on the site to wait out a storm.

In these remote locations, taking good care of the crew includes feeding them well. Everyone needs a good meal at the end of the day, but no one has the energy or patience to prepare a meal after 12 hours on the job. We plan out the full ten-day menu ahead of time and bring everything with us on site. We make sure that most meals are ready to go, requiring only minimal preparation, and we have many meals pre-made for us. Small things go a long way in keeping a remote crew happy: a couple of cold beers after a long day or some good quality chocolate can be a real morale booster. We replenish all the meal supplies when we return to Vancouver at the end of each ten-day work blast.

In addition to great meals, we try to provide our crew with other benefits. Depending on the specific site and client, we have hosted a family weekend on site in the summer time, where each crew member was invited to bring their family; we provided all the food as well as entertainment.

Dom Koric

14 Sunshine Coast Lodge.

Working out the details of crew transport and payment

As already emphasized, getting to and from a remote site can be challenging. In the past we were fortunate to have a sailor on the crew and were able to sail to the island on his boat. We have also had clients lend us boats for the duration of the project and on some of the jobs we have flown in with a seaplane, although this is the most expensive mode of transport by far (Fig. 13). One of the best options is a water taxi—having a professional captain in a seaworthy boat removes an element of risk. The downside of relying on a water taxi is that once you and the crew are dropped on the island, you need to be fully self-sufficient: no runs to the nearest marina for provisions!

It is important to be clear with your crew about payment for travel time. For example, the crew may have to spend a day in limbo waiting for water taxis and ferries on their trips to and from the job site. It helps to be clear upfront how they will be paid for their travel time: our practice has always been to pay people 50 percent of their standard working rate.

Safety considerations: dealing with the unexpected

"Remote" also means that access to medical services is limited, and planning for the unexpected can make or break the project. First and foremost, it is necessary to have an emergency evacuation plan in place in case of a serious accident. The evacuation plan needs to include knowing who to call: the ambulance, the Coast Guard, or private transport (water taxi). The evacuation plan also needs to include a viable method of contact: if you don't have cell service, you need to have VHF radio, including a valid VHF Operator's Licence, to call for help if necessary.

Although our hope would be that help could arrive in a short period of time, we need to be able to deal with any serious injuries and know how to stabilize someone for the 24 hours it may potentially take for a water taxi or the Coast Guard to arrive, especially if the weather is poor. In addition to a level-three first aid kit, spine-board, and oxygen, we always have at least one level-three first aid person on the crew, as per requirements of our regional workers' safety agency.

15 Completed sleeper cabins.

The big payoff: a completed timber frame home

Although the long days working on remote timber framing projects are hard, they bring many rewards. Apart from spending time outside and working as a team, one of the biggest rewards for the crew is the satisfaction of creating something unique, enduring and beautiful that we are truly proud of.

Although we are proud of every timber frame home we've built, a couple of our favorites are described below.

Sunshine Coast Lodge

The Sunshine Coast Lodge is a 2,900-sq.-ft. timber frame designed by Guild member Andrew Preston and engineered by Fire Tower Engineered Timber. It features structural insulated panel walls, a conventional roof, and operates completely off the grid. Between solar power and diesel backup generators, this has all the comforts of home. It has wood stove heat with baseboard backup, propane hot water, stove, and fridge, and even a central vacuum system. The project required 3,100 workhours on site (Fig. 14).

Sleeper cabins

On a small, half-acre island adjacent to the Sunshine Coast Lodge are two 400-sq.-ft. sleeper cabins. We designed the timber frame with engineering by ISL Engineering. With structural insulated panel roof and walls, these 20x20-ft. boxes were designed to have a large open space to accommodate the bedroom and living room. On the other side of a dividing wall is a bathroom and kitchenette. These required 450 workhours on site and took a crew of four only two weeks to complete (Fig. 15).

Demobilization and a return to civilization

Our clients choose their remote properties because of their unspoiled beauty, so it is our job to ensure that the job site is as pristine as possible when we leave. The first thing we do is to get our tools, gear, and waste materials off the island. Fortunately, with these timber frame homes being prefabricated, there is minimal construction waste. Some of the wood waste can be burned when permitted, but the rest has to be hauled off, usually by water taxi. We typically don't require a barge to exit a job unless we brought in a telehandler or a vehicle. We usually complete the projects with a big debrief to identify improvements for the next project and refinements of our extensive project checklists.

There is always a big sense of relief when we wrap up projects, as there is a lot of opportunity for things to go sideways during a remote build. The crew is usually pretty worn out after these projects

MEMORABLE MOMENTS (GOOD AND BAD) FROM WORKING ON REMOTE SITES.

1. Night swims in phosphorescent algae off Nelson Island on the Sunshine Coast.
2. June 15, 2011, the historic date when the Vancouver Canucks played the seventh game of the Stanley Cup while our crew was on a build on Sidney Island. We managed to jury-rig a satellite dish so that we could watch the Canucks be defeated.
3. Waking up at 2AM to the sounds of a passing pod of orcas off Hardy Island.
4. The clients who showed up on their boat, unexpectedly, to serve us a steak dinner, complete with fine wine, by candlelight.
5. Sailing to Nelson Island in absolute pitch dark with Matthew (a crew member) on his boat. While he sailed, I had to stand on the bow of the sailboat with a flashlight and didn't see the bluffs of the island until we were about 10 feet away. Another great memory is racing across the water at nine to ten knots on his sailboat at the end of a build.
6. Finding petroglyphs on a client's site (Fig. 16).
7. Unloading a 3000-lb. load of timber from a barge to Nelson Island and having the crane cable snap and drop the load in front of a very shocked crew of guys. We were very lucky that no one was injured.
8. Receiving a text from a new hire on his first night on the job. He wrote that he was very tired, that "he missed me" and that "he loved me." He thought he was texting his girlfriend. We had a good chuckle.

and will often take a few extra days to recover before starting on the next project. I'm grateful that I've had the opportunity to work with such a great crew over the last few years. Their hard work and friendship have made everything worthwhile.

—DAVE PETRINA

Dave Petrina founded Kettle River Timberworks Ltd. in 2004 after a successful career as a mechanical engineer in the high technology industry (Fuel Cell Vehicle sector). Dave lives in Vancouver, BC, and spends his spare time with his family, riding his mountain bike through the woods, and planning dance parties for his friends.

This article is based on a presentation delivered at the Timber Framers Guild 2018 Western Conference, at Timberline Lodge, Mt. Hood, Oregon.

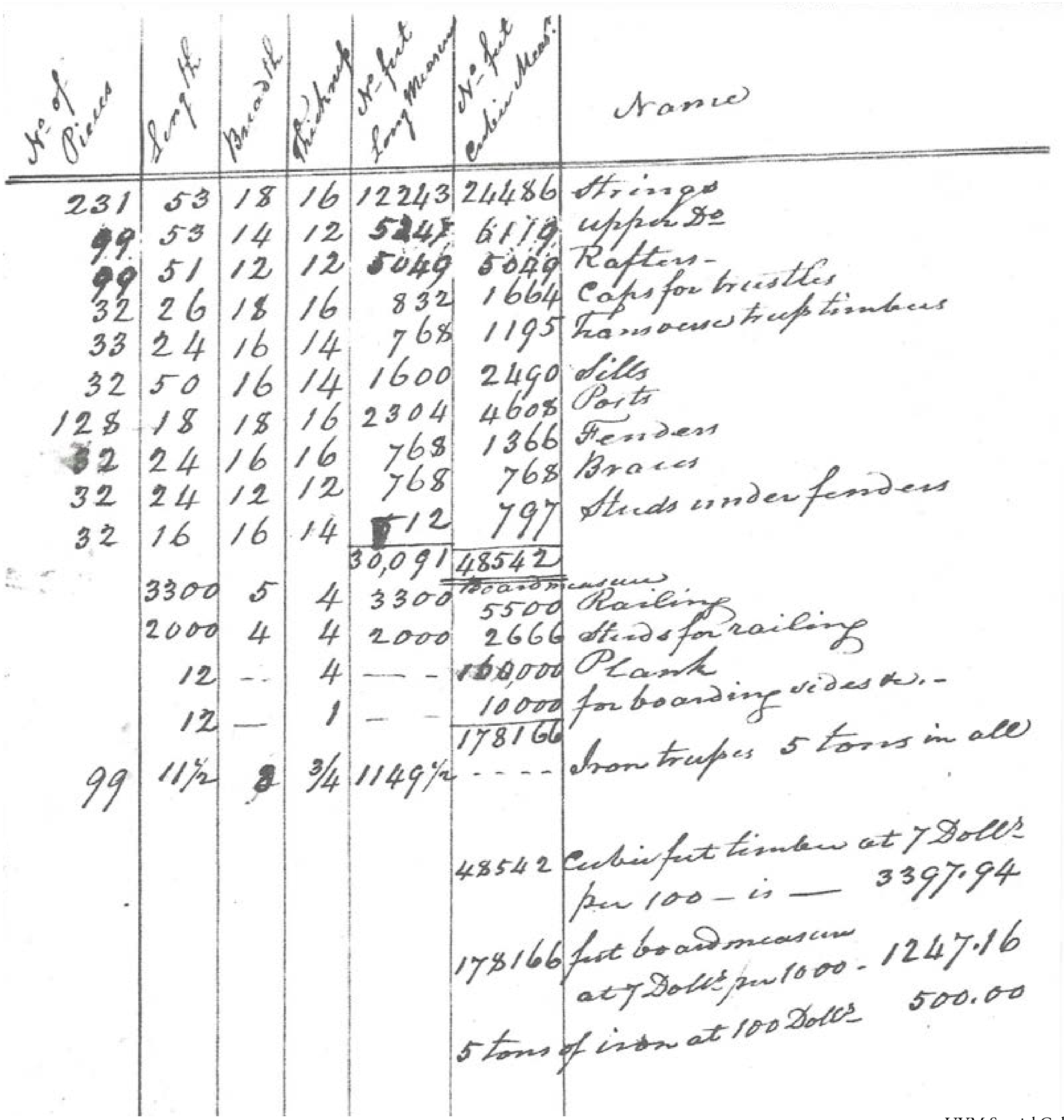
Acknowledgments: The author wishes to thank Chrystal Palaty for writing support, Jan Palaty (reader), and Amy Mair (editor) for helpful edits and comments.

16 Petroglyphs below the high tide line on a client's property.

John Johnson and the Bridge at St. Johns, Quebec

THE lumber list in Fig. 1, obviously from the heroic period of lumber tallying, is by the hand of John Johnson of Burlington, Vermont. On the reverse is the title: "Bill of Bridge Timber, St. Johns." It is undated, but likely from the early to mid 1820s, since the bridge in question, the Pont Jones between Iberville and St.-Jean-sur-Richelieu, Quebec, was completed in 1826–27. At the time, under the English Regime since 1759, these towns were called Christieville and St. Johns, about 50 miles north of Johnson's home. In the period 1790 to about 1830, the Province of Quebec, the St. Lawrence River, and the cities of Montreal and Quebec were far more economically important to northern Vermont than were Boston or New York.

The document is from the extensive John Johnson Archive at the University of Vermont Special Collections, and is identical in form and appearance to a great many other lumber lists for bridges, courthouses, churches, college buildings, jails, and mills designed and sometimes built by Johnson between the 1790s and his death in 1842. Whether this list was a proposal solicited by Robert Jones,



No. of Pieces	Length	Breadth	Thickness	No. feet long measure	No. feet cubic meas.	Name
231	53	18	16	12243	24486	Strings
99	53	14	12	5247	6119	upper Do
99	51	12	12	5049	5049	Rafters-
32	26	18	16	832	1664	Caps for trestles
33	24	16	14	768	1195	Transverse truss timbers
32	50	16	14	1600	2490	Sills
128	18	18	16	2304	4608	Posts
32	24	16	16	768	1366	Fenders
32	24	12	12	768	768	Braces
32	16	16	14	512	797	Studs under fenders
				30,091	48542	
					board measure	
	3300	5	4	3300	5500	Railing
	2000	4	4	2000	2666	Studs for railing
	12	--	4	— -	160,000	Plank
	12	—	1	— —	10000	for boarding sides &c.-
					178166	
99	11½	3	¾	1149½	----	Iron trusses 5 tons in all

48542 Cubic feet timber at 7 Dolls per 100 – is — 3397.94

178166 feet board measure at 7 Dolls per 1000 - 1247.16

5 tons of iron at 100 Dolls 500.00

UVM Special Collections

1 John Johnson, "Bill of Bridge Timber, St. Johns," c. 1825.

Author's collection

2 W. H. Bartlett, "St. John's—Richlieu River." Colored engraving (1838).

a land developer in Bedford, Quebec, at the time, or from an actual initial design for the Pont Jones, I can't establish at this time, and I don't know who could. However, I do know that the length is identical, the location correct, and the appearance very similar to the Pont Jones, a bridge that lasted until 1917 as a wooden truss structure (Fig. 2).

John Johnson (1771–1842) first appeared in these pages in Timber Framers News 10, November 1988, in an article I authored based on a diary the 28-year-old Johnson kept while building a "grist mill, saw mill, and floom" in Enosburgh Falls, Vermont, in 1799. At that date, Enosburgh was barely settled and Johnson was expected to make almost everything, including much of the milling machinery, from trees standing near the site. He went on to become the most distinguished framer we know of in early northern Vermont, building many of the first college buildings at the University of Vermont between 1801–1830, the 1802 Burlington Court House, the Orleans County Courthouse and Jail in 1815, an 1811 meetinghouse in Burlington, and a great number of long-span wooden bridges throughout the region, generally in the kingpost or kingrod truss and the Burr Arch forms. By the 1820s, he spent much of his time designing grist- and sawmills and their machinery in Vermont and both Lower and Upper Canada (Quebec and Ontario), as well as supplying them with millstones and iron parts from a forge he partly owned in Keeseville, New York. A great lover of mathematics, Johnson was eventually appointed Surveyor General of Vermont, and was employed by the US and Canadian governments to make the official survey of the border between New Brunswick and Maine. This interest shows up in many of his working drawings, such as for roof trusses and steeples, using a decimal system taken sometimes to 1/10,000th of a foot (not inches and their fractions, nor the metric system), which must have amused his carpenters, who probably changed the decimals back to eighths and sixteenths in their heads.

I have been fascinated by this lumber list since first seeing it in the 1980s and recently decided to try and delineate the bridge structure from the document. I did this before imagining I would ever identify the bridge itself. While I can discern every item on the list and its position in the bridge, it would have been difficult to do so without having looked at much of the Johnson Archive, particularly where it relates to bridges. Almost all elements of the St. Johns Bridge can be found drawn and described in the plans for a four-span structure joining Colchester and Burlington, Vermont, built in 1816 (Fig. 3). This bridge uses timber kingposts, but another sketch for a similar, unidentified, bridge by the same hand uses kingrods (Fig. 4). Johnson calls these "rafter trusses," referring to the sloping members supporting the kingposts or kingrods as rafters, rather than main braces, or top chords. Even the term *kingrod* needs clarification, since on the bridge at St. Johns, he uses rectangular strap iron rather than round or octagonal rod.

The timber can all be assumed to be white pine (*Pinus strobus*), old growth and of a quality we will never see again. All of John Johnson's structural work was in white pine unless otherwise specified as oak or yellow pine, which Zadock Thompson's *History of Vermont* (1842) tells us, on page 215, was another name for red, or Norway, pine (*Pinus resinosa*) at the time. Red pine and oak were treated as interchangeable in Johnson's specifications, wherever greater strength was needed, which I don't think any framer or engineer would assume today. On an 1827 Johnson lumber list for a bridge on the "Brewster Plan" (a repetitive series of kingpost trusses named after the agent for Colchester and Burlington during the construction of Johnson's 1816 bridge between the communities) the "Centre Posts, round, to be sawn" are specified as "P. Pine," which probably means pitch pine (*Pinus rigida*), a species Thompson (*History*, p. 216) finds "for architectural purposes less valuable than either (red or white [pine])." On that same 1827 lumber list Johnson also specifies "white oak" for "keys and treenails."

Taking the lumber list item by item

Item 1: *(231) 53 ft. x 18 in. x 16 in. Strings.*

Bottom chords are sometimes called strings, but in this case these are sub-chords and longitudinal joists, or stringers. This is clarified by Item 2 and a different lumber list for a similar truss. It will later become apparent that there are seven of these per span.

Item 2: *(99) 53 ft. x 14 in. x 12 in. Upper Ditto.*

In another Johnson lumber list, for the 1816 Colchester kingpost truss bridge, we are given not just "Name" but "Name and Description" (Fig. 5). The first item on the Colchester list is "Strings for the floor of the Bridge." The second is "Ditto to lie above the plank and receive the Rafters." This is accompanied by a drawing of the Colchester kingpost design that makes this clear (Fig. 3). In both bridges seven full-length 16 x 18s are laid across the span and planked transversely with 4-in. flooring. While these timbers could likely clear span what might be 48 ft. (at St. Johns) or 57 ft. (at Colchester) between piers without breaking, they would probably sag. I suspect, during construction, they were propped up at one point near mid-span, which would be sufficient to assure a slight deck camber in the completed structure. This stage completed, you have not only the final bridge floor but a false bridge and working platform as well—obviously an experienced and clever framer at work.

Now the framer places these 99 bottom chords on top of the deck. Ninety-nine divides evenly by three, so I begin to suspect a double-barreled bridge with three trusses per span, for 33 spans. Thirty-three spans of 53-ft. bottom chords gives 1749 ft. of bridge. J.-P. Coupal, in *Une Histoire de St. Jean*, cites a length of 1754 ft. for this bridge. In spite of the exceptional width of the Richelieu, the Pont Jones was built on this site because the water was shallow, making work on piers easier.

Item 3: *(99) 51 ft. x 12 in. x 12 in. Rafters.*

Cut in half to 25 ft. 6 in., these give all the rafters (top chords) you need. This shorter length allows for 3–4 ft. of relish at the ends of the 53-ft. bottom chords, as indicated in the Colchester drawing. The immense double chord-depth eliminates the fear of shear, or even localized bending, where the rafters bear slightly inboard from the piers or abutments.

Item 4: *(32) 26 ft. x 18 in. x 16 in. Caps for Trustles.*

Trustles [*sic*] are the trestles, bents, or piers that divide and support the span. For 33 spans there would be 32 trestles, plus the two land abutments. The caps are slightly wider than the bridge floor. These caps transfer the load of the bridge to the piers.

In the 1838 engraving, the St. Jean-side abutment appears to be a log crib filled with earth (Fig. 2).

Item 5: *(33) 24 ft. x 16 in. x 14 in. Transverse truss timbers.*

These run, one at the middle of each span, beneath the seven strings (including the three double chords), supported by the kingrods.

Item 6: *(32) 50 ft. x 16 in. x 14 in. Sills.*

These sills sit on the bottom of the river at the base of the trestles, as illustrated in the Colchester kingpost drawings (Fig. 3).

Item 7: *(128) 18 ft. x 18 in. x 16 in. Posts.*

These are the trestle posts: four at each position for St. Johns, five at Colchester.

Item 8: *(32) 24 ft. x 16 in. x 16 in. Fenders.*

Fenders, in this case, are long timbers sloping down from the upstream trestle posts to the underwater sills. They serve to fend off ice, debris, log rafts, and generally divert floating objects from damaging the bridge.

Item 9: *(32) 24 ft. x 12 in. x 12 in. Braces.*

Cut to shorter lengths, and at a steeper angle than the fenders, these rise from the sill to the downstream trestle posts, bracing them against the pressure of the river, and its ice and flotsam.

Item 10: *(32) 16 ft. x 16 in. x 14 in. Studs under fenders.*

These are cut to various lengths to help the fenders sustain the blows directed against them by river traffic and debris.

The above items are the structural timber for this bridge which Johnson calculates as "30,091 ft. Long Measure" and "48,542 ft. Cubic Measure," which we might refer to as 582,504 bd. ft. He calculates a price for this timber at $7 per 100 cubic ft., amounting to $3397.94 for all this large and long stuff. This is approximately .58 cents per bd. ft. or $5.80 per M (thousand board feet).

Structural timber, however, is not the end of the significant information about this immense, although repetitive, bridge. The list goes on (using long and board measure rather than long and cubic measure) for this smaller stuff:

Item 11: *3300 linear ft. x 5 in. x 4 in. Railing.*

If the total length of the timber bridge is 33 spans of 53 ft. each (1749 ft.), 3300 ft. is almost enough to rail the two outside edges of the entire bridge, suggesting it is an open, not covered, structure of some sort. The reason for the length discrepancy is likely that the railings are interrupted by the rafters, or top chords, of the outer trusses. As above, Coupal cites the Pont Jones bridge as 1754 ft. in length.

Item 12: *2000 linear ft. x 4 in. x 4 in. Studs for railing.*

These are relatively few in number because the railing acquires most of its lateral stiffness from its intersections with the large sloping truss rafters.

Item 13: *12 ft. lengths of 4-in. plank, amounting to 160,000 bd. ft.*

Widths unspecified, but this is the volume needed to floor the deck. Not specified as oak, this planking is likely white pine as well.

Item 14: *12 ft. lengths of 1-in. board, amounting to 10,000 bd. ft. For boarding sides.*

At first view this seems like a lot of lumber, and I assumed the trusses might be cased and coped with boarding as they often are on an uncovered bridge, particularly on rafter trusses where the truss, not being rectangular, doesn't provide a frame for the wall. However, assuming three lines of 33 triangular trusses 12 ft. tall, over nearly 1,800 ft. of length, the specified quantity of boarding wouldn't start to cover it, while it might just cover one side of the railing and the outside of the double bottom chords below it.

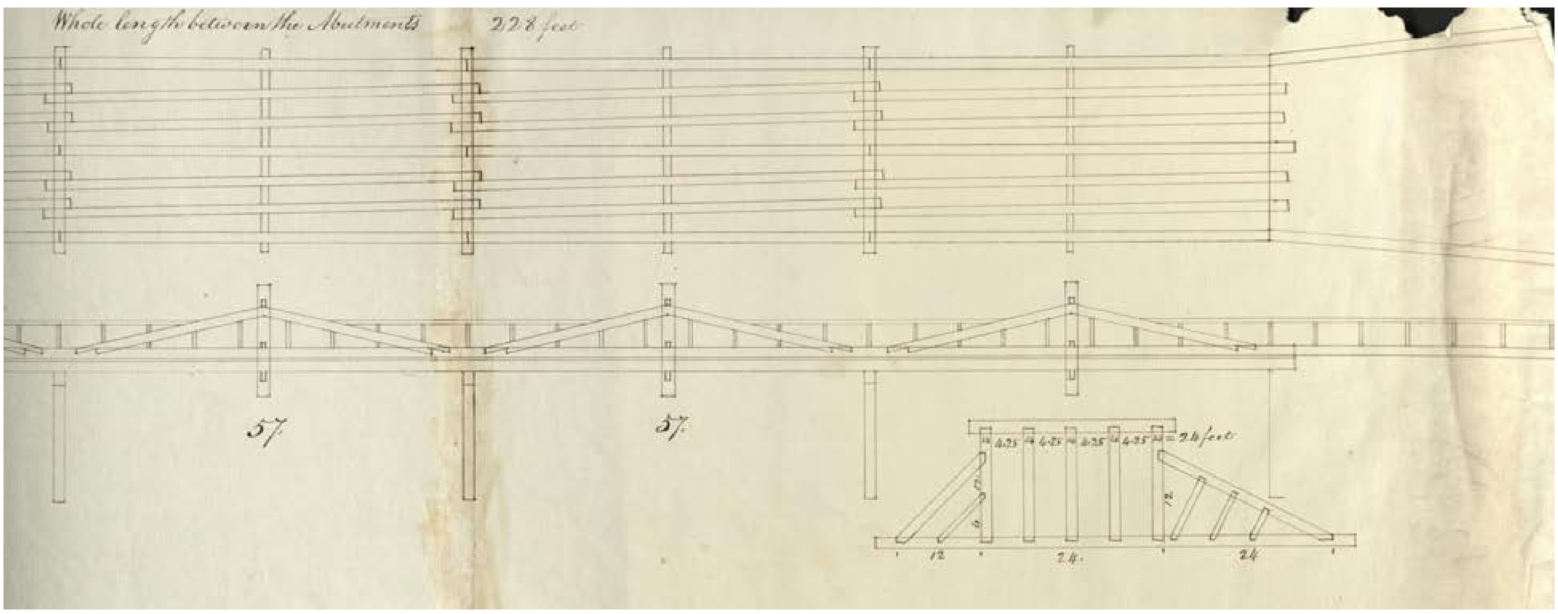
Items 11–14 amount to 178,166 bd. ft. of lumber at .7 cents per bd. ft., $1247.16 in total, i.e., less than $10 per M.

Item 15: *(99) 11½ ft. x [illegible breadth] x ¾ in. thickness. Iron trusses 5 tons in all.*

This last item, for the kingrods, provides us with the height of the truss and an easy confirmation of the rafter lengths. The kingrods actually don't appear to be round rods but rather ¾ in.-straps passing through mortises in the chords. Calculating wrought iron at approximately 480 lbs. per cubic foot, the width of the strap would be around 3 inches (which is what the illegible write-over looks like).

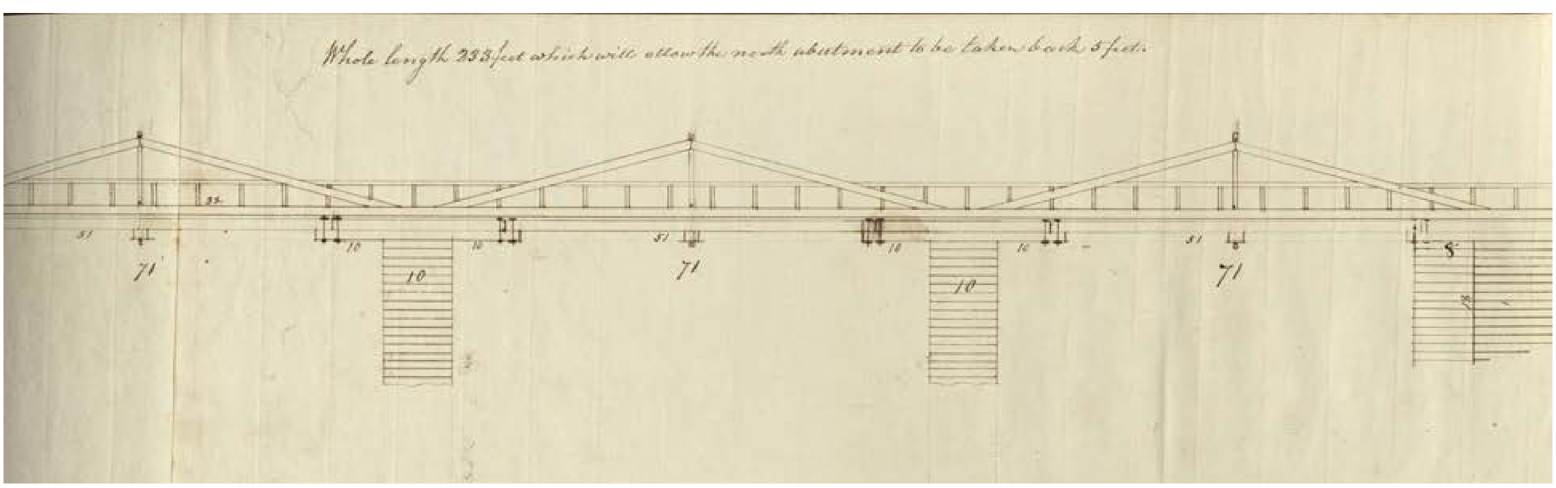
The Pont Jones: Was it built this way?

We can be confident that John Johnson's bill of timber for a bridge at St. Johns, Quebec, refers to the Pont Jones, built in 1826–27. It was the first bridge to span the Richelieu River, is the right length, and would look like what was actually built. What we don't know is if Johnson was employed to build or supervise the construction of this bridge, or even if his design specifications were used. I have searched all of John Johnson's business and miscellaneous correspondence at the University of Vermont Special Collections, but there are no letters preserved to or from Robert Jones, the property developer who caused this bridge to be built. Archives Canada has numerous documents relative to Robert Jones and the Pont Jones, but no correspondence with John Johnson of Vermont, nor with any other builders or designers. Searching for and through all the Jones Family papers, with their extensive business interests in Upper and Lower Canada, in many different archives, would be a research project far beyond the reach of this article, but perhaps someone either



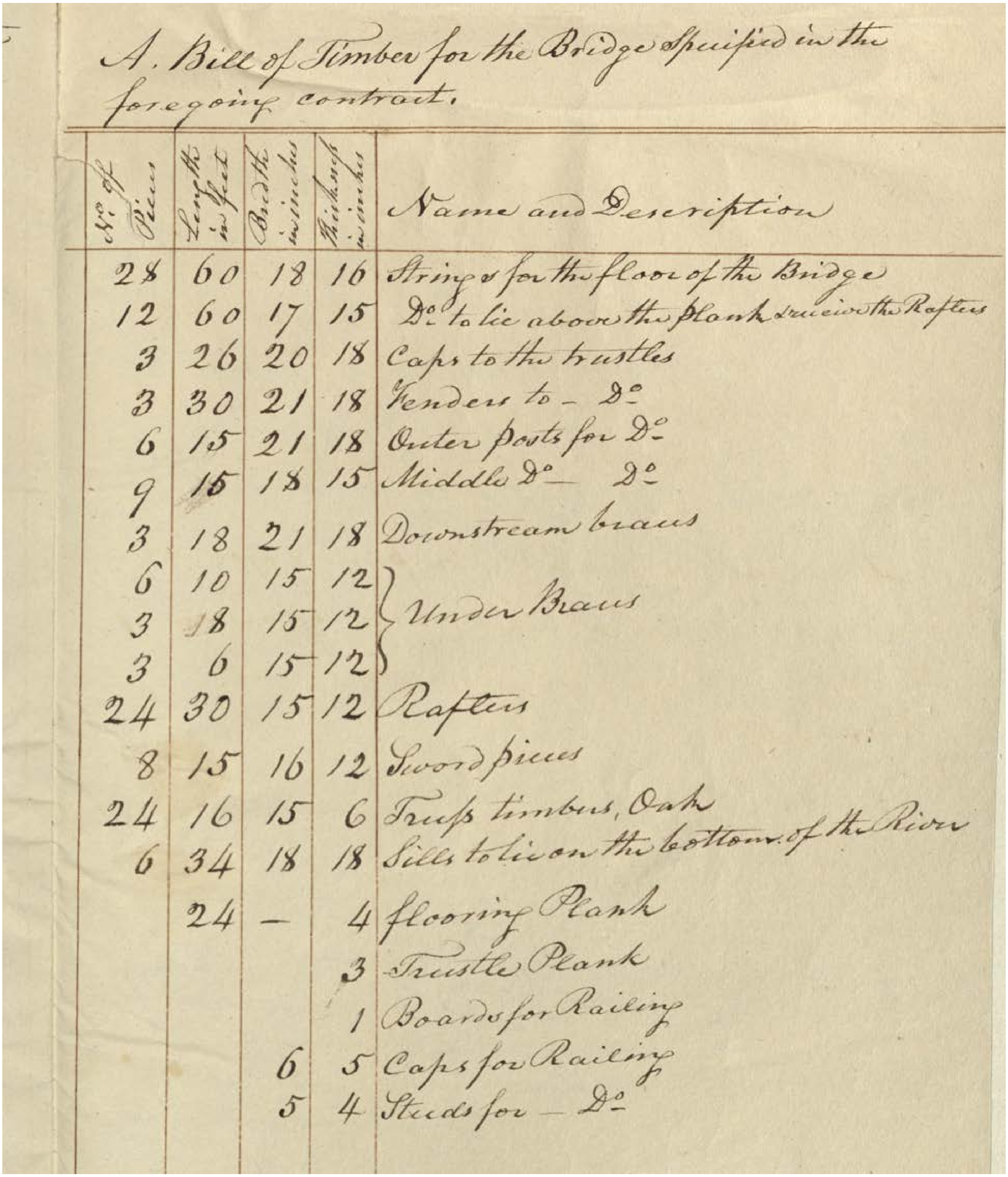
UVM Special Collections

3 John Johnson, design for a bridge between Colchester and Burlington, Vt., 1816. Elevations of trusses and trestle, as well as a floor framing plan.



UVM Special Collections

4 John Johnson, elevations of kingrod trusses for an unknown location.



A. Bill of Timber for the Bridge Specified in the foregoing contract.

No. of Pieces	Length in feet	Bredth in inches	Thickness in inches	Name and Description
28	60	18	16	Strings for the floor of the Bridge
12	60	17	15	Do. to lie above the plank receive the Rafters
3	26	20	18	Caps to the trestles
3	30	21	18	Fenders to – Do.
6	15	21	18	Outer posts for Do.
9	15	18	15	Middle Do. – Do.
3	18	21	18	Downstream braces
6	10	15	12	Under Braces
3	18	15	12	
3	6	15	12	
24	30	15	12	Rafters
8	15	16	12	Sword pieces
24	16	15	6	Truss timbers, Oak
6	34	18	18	Sills to lie on the bottom of the River
	24	–	4	flooring Plank
			3	Trestle Plank
			1	Boards for Railing
		6	5	Caps for Railing
		5	4	Studs for – Do.

UVM Special Collections

5 John Johnson, lumber list with names and descriptions, for the 1816 Colchester to Burlington, Vermont, bridge.

6 **The Pont Jones as queenpost trusses after the 1878 rebuild. Photo circa 1880, republished in *Le Canada Français*, St. Jean, Quebec, April 16, 1975.**

Collections of Gaetan Forest and Gerald Arbour

knows something or will be encouraged to look. That Jones and Johnson were both in the business of establishing mills may provide a connection. We do have an interesting quote from "l'historienne bien connue d'Iberville" (the well-known historian of Iberville), Yvonne A. Labelle, in the newspaper *Le Canada Français* for April 16, 1975, that the 1826 Pont Jones was "construit par les Frères Howe d'Angleterre qui s'établiront a High Brooke, Mass." (constructed by the Howe Brothers of England who have established themselves at High Brooke, Mass.). It would not have been unusual for Johnson, or some other framer or engineer, to design a bridge and for the owner to have it built by others, but the Howe Brothers, and even High Brooke, Mass., are so far eluding identification.

What do we know about the Pont Jones in the 19th century? We have an 1838 colored engraving by W. H. Bartlett, in *Canadian Scenery Illustrated* (1840), entitled "St. John's—Richlieu River," which is mostly a picture of the Pont Jones (Fig. 2). The work of art is romanticized: the bridge is only 11 years old at the time but its structure and that of the tollhouse appear weather-beaten and on their way to becoming an old ruin. Numerous peasants are engaged in humble activities on and around the water. It is clear, however, that it is a double-lane bridge supported by a long sequence of kingrod trusses. Many of the trusses are omitted at the closer end, but I believe this is to allow the artist to portray the lively traffic of humanity and animals crossing the span.

We also know that if Johnson designed it, the Bill of Bridge Timber we have is preliminary, because a special law passed by the Province of Lower Canada (*Statuts Provinciaux du Bas-Canada*, 1826, ch. 29, s. 1) set some conditions on the bridge design to accommodate other users of the river: "The Act authorizes Robert Jones to build a toll bridge on the Richelieu River at St. Johns, near the rapids . . . at his own expense and including a lift bridge solid and sufficient over said river."

7 **Colorized photo postcard of the Pont Jones with utility lines, after 1880.**

Collections of Gaetan Forest and Gerald Arbour

Wikimedia Commons

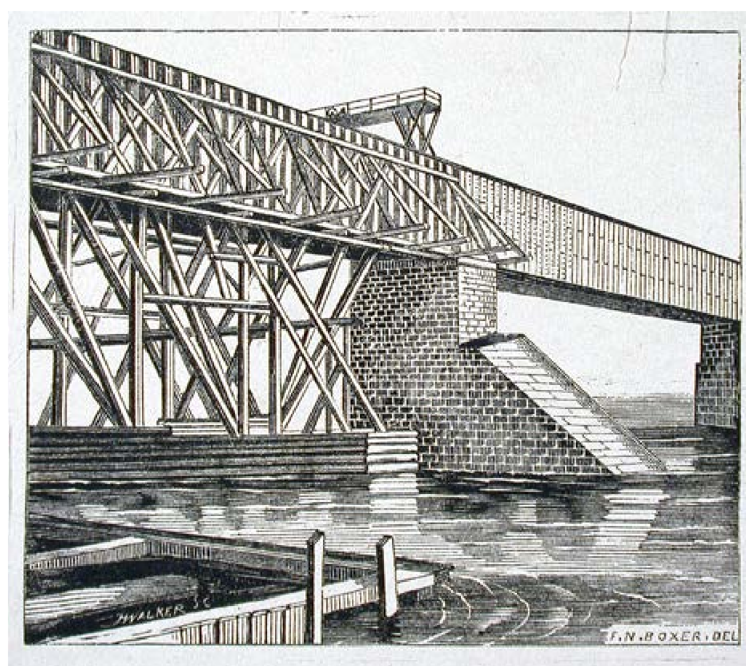
8 Wooden bridge over the Elbe at Hartenfels Castle, Torgau, Germany. Detail of a painting by Lucas Cranach the Younger, *Stag Hunt of the Elector Johann Friedrich*, 1544.

Shortly afterwards, in the same year (March 29, 1826), this statute was amended to provide for "one opening of at least 90 ft. of width between its piers, for the passage of boats, barges and rafts." Since 1797, rafts of timber descending from Lake Champlain were the major traffic on this river. The lift bridge (*pont-levis*) was to accommodate vessels with fixed masts.

Three images provided to me by Quebecois historic wooden bridge researchers Gerald Arbour and Gaetan Forest show the Pont Jones in later life, after 1878 when it was rebuilt, most likely to a queenpost or queenrod form (Fig. 6). Evidence of this was again provided by Gaetan Forest with two items from the newspaper *Le Franco Canadien* for July 9 and August 16, 1878, announcing: "The repairs to the Pont Jones are complete. The bridge was almost completely rebuilt, virtually a new bridge, and put in a state of solidity capable of passing any test."

Fortunately for comparison, all the post-1878 images are from nearly the same perspective, looking from the St. Jean side, near the tollbooth, toward a unique church spire in Iberville. Two of these are photographs and the third an 1884 oil painting. In all three the Pont Jones has become a series of queenpost or queenrod trusses, with both the trusses and the trestles cased in boards and planks. In the earlier photo (Fig. 6) (judged so by the lack of utility poles and lines), the trusses are buttressed externally against lateral movement, with the exception of a giant set of queen-type trusses near the St. Jean end, likely the 90 ft. span required by law, and so tall as to be able to incorporate overhead gallows frame bracing. In the later photo (Fig. 7) and 1884 painting, the lift bridge is there, metal in the painting. Utility poles and lines are obvious in the painting and the later photo, but the giant queen-type trusses only suggested in the photo, and at a reduced scale (perhaps lost in vigorous retouching during colorizing); timber barges using the adjacent Chambly Canal have replaced log rafts, and travel in both directions. This second Pont Jones was demolished in 1917, replaced by a modern steel and concrete structure: the Pont Gouin.

Once again, I am writing here of extinct, historic timber construction on a scale rarely contemplated today, where most timber framing is devoted to expensive homes (although the Guild itself continues this legacy of public works, including large bridges, in its projects). Other than the unanswered question of whether Johnson's design was actually used, we might ask why, in a period



McCord Museum, M930.50.7.263

9 The wrought-iron Victoria Bridge (1859) under construction across the St. Lawrence. John Henry Walker, *Victoria Bridge, Montreal, QC*, wood engraving.

when long-span wooden truss bridges, of 200–250 ft. in the clear, were common (Johnson was regularly spanning 100–180 ft. with Burr Arch types in Vermont) was an ancient type of bridge built, i.e., a long series of short spans made of gigantic timber (Fig. 8). I speculate that the shallow depth and hard bottom of the Richelieu rapids at the location of maximum traffic made this option more affordable, as well as being the conservative choice.

Twenty years later, in 1846, the Pont Yule was constructed downstream at a narrow and deeper section of the Richelieu: a series of between five and seven wooden-truss spans of unknown type across approximately 900 ft., and these high enough to avoid all river traffic. Only one photo of this bridge is known to exist, and that of a rather glamorous portal and a small section of boarded wall, seen from the side. The Pont Yule, probably an impressive covered bridge, burned in 1891.

Thirty-three years after the Pont Jones, in 1859, the Victoria Bridge (Fig. 9) was put across the St. Lawrence River at Montreal, about 30 miles from the Pont Jones. Composed of wrought-iron plates fabricated in England, assembled into a tubular structure on site, this was the longest railroad bridge in existence at the time and "the eighth wonder of the world." These two traditions, craft-based timber framing and highly engineered, capital-intensive metal construction, continued to coexist for another 50 years at least, with evidence of the Boston and Maine's series of double lattice truss wooden railway bridges across northern New England being built as late as 1908 (the still extant Fisher Bridge in Wolcott, Vt., Fig. 10). With typical clear spans of 100 ft., it was possible to get 175 tons on the wooden railway bridge at one time, and numerous times a day. Several of these still exist and carried rail traffic until the 1960s.

Some wooden bridges can survive for hundreds of years, but only if they are covered and the roof and walls well maintained. The 1826 Pont Jones was uncovered, even the trusses not cased in boarding until its second life as queenrod or queenpost truss spans, beginning in 1878. It may seem unusual, and perhaps again archaic, that an immensely expensive 33-span bridge almost 1800 ft. long would be exposed to the elements, thus having an expected lifespan of only 20 to 40 years. Johnson himself covered many of his large clear-span trusses in Vermont, for example the 1825 Burr Arch at Hubbel's Falls and another Burr Arch planned to be built at Berkshire (undated).

Jan Lewandoski

10 Fisher Bridge (1908), Wolcott, Vermont. Double lattice truss of 100-ft. span. Central pier added in 1960s. Ventilating monitor to evacuate locomotive smoke. Note worker in dark red jacket for scale.

There may be two reasons for leaving the trusses and floor unprotected. First, the size of the river and the large amounts of ice it carried perhaps led to no expectation of long life for any span at that site. Consequently, why go to the vast expense of making it a covered bridge at all since it would involve 120,000 bd. ft. of boarding, not to mention plates, rafters, nailers, 630 squares of coverage by wood shingles, and a lot of labor, when you might lose it at any time? Secondly, leaving wooden bridges uncovered was likely more common than we think from antiquity up to the mid-20th century—we only have the covered ones to look at today because the uncovered don't last. Historically, most short spans (under 40 ft.) were uncovered, merely rebuilt as necessary by the multitude of skilled framers who formed the manpower of the wood construction industry in the past. No less an authority than Squire Whipple, in his influential *A Work on Bridge Building* (1847), suggests that roofing and siding a bridge increases the weight and invites wind damage. Whipple argues that "If a bridge costing $1000 without covering, will last nine years, an additional investment of $1818 at five per cent compound interest, will provide the means of renewal as often as necessary" (p. 117). He goes on to debate the possibility that, as span increases, the economic calculus may shift in favor of protection (p. 117–18). Whipple also mentions that "Many bridges are annually swept away in this country by floods and freshets. Where the permanence of the structure is doubtful, prudence would rather dictate the structure be made as cheap as possible, consistent with strength and safety" (p. 118).

Similar arguments concerning the amortization of uncovered wooden bridges versus building longer-lasting wrought-iron structures across the Erie Canal at Rome, N.Y., are found in the John Johnson papers toward the end of his life, when Johnson's son worked as an engineer of canals and bridges in New York state. A letter dated August 23, 1841, from an engineer named J. Dana Allen, contends that "carrying the investment with an interest account forward for a term of 50 years, deemed to be the life of the Iron structure, and considering that 3 wooden structures to be sufficient for that term, and the result exhibits nothing in favor of the Iron" (UVM John Johnson Collection, 3–34).

The initial kingrod Pont Jones survived for 52 years (1826–1878). However, its epitaph was being written some years earlier by an elephant named John Nathans, as told in this article from the *Montreal Star* written between July 24, 1869 (the date of the incident) and August 5, 1869, when reprinted in the *Waterloo Advertiser and Eastern Townships Advocate*:

> **An Elephant Inspects a Bridge**
> The *Montreal Star* says the well known sagacity of the Elephant had a somewhat remarkable exemplification, at St. John, in the Province of Quebec, on Saturday morning last, in which the immense Ceylon elephant, belonging to Campbell's Menagerie and circus, which was to exhibit in Montreal, was the hero. We will premise our statement with the fact that, a few weeks since, while travelling from Waterbury to Northfield, in the State of Vermont, this elephant in crossing a bridge, over a creek, crushed the floor with his enormous weight, and fell partly through, his

forequarters only remaining on the bridge. By this accident he was lamed for several days, but not sufficiently to prevent him from travelling. When he was brought to the Long Bridge, over the Richelieu River, at St. Johns, he evidently retained a vivid recollection of this mishap, and neither coaxing, threats, persuasion, nor force, could induce him to budge an inch on the, to him, perilous structure. Nor does it appear that his apprehensions were unfounded—for the proprietors of the bridge notified the Menagerie managers that they were dubious of the capacity of the bridge to bear the weight of the elephant, and that if they crossed him they must do so at their own risk. The morning was rather chilly, and as they did not wish to risk his health by swimming, they concluded to make the venture. The band chariot and an enormous den of performing lions were started on ahead of him in order to give him confidence, and when he saw that they went safely over, he was induced to follow which he did very slowly, testing each plank and timber with this fore feet and trunk as he progressed. Whenever he discovered any of the timbers to be defective he would cross over the division to the opposite roadway, and would so progress until he came to another doubtful place, when he would cross back again. He worked along in this way until he had come more than half way over, when he became suspicious that neither road was safe, and started rapidly back, driving back the long den of cages that were following and clearing the bridge for a space of ten or more rods. At this juncture a flock of sheep came running past him, and he vented his spleen by picking them up one by one with this trunk and throwing them into the river until he had disposed of seven in this way. He was finally induced to go on, and after having been more than two hours in crossing arrived safely over. The scene was witnessed by over two thousand people, and the utmost excitement prevailed.

—Jan Lewandoski

Research for this article was generously assisted by the knowledge and efforts of Gerald Arbour and Gaetan Forest, experts on the historic wooden bridges of Quebec. Translations from French by the author.

References

Bartlett, W. H. and N. P. Will. *Canadian Scenery Illustrated.* London: Geo. Virtue, 1840.

Coupal, J.-P. *Une Histoire de St. Jean-sur-Richelieu.* 2014. http://www.jeanpaulcoupal.blogspot.com/2014.

John Johnson Collection. University of Vermont Special Collections.

Labelle, Yvonne A. *Monographie d'Iberville.* Iberville, Quebec: 1958.

Noel, Francois. "Gabrielle Christie's Seigneuries." PhD dissertation. Montreal: McGill University, 1985.

Statuts Provinciaux du Bas-Canada, 1826, ch. 29, s. 1.

Thompson, Zadock. *History of Vermont, Natural, Civil and Statistical.* Burlington, Vt.: 1842.

Whipple, Squire. *A Work on Bridge Building.* Utica, N.Y.: 1847.

Visionary Partners

Members of the Timber Framers Guild
are craftsmen. Pioneers. Historians. Artists.

And some are visionaries.

Many thanks to our Visionary Partners, who support the future of timber framing by supporting the Timber Framers Guild at the highest level.

Level 3

Bensonwood
Timber Home Living
Trillium Dell Timberworks

Level 2

Fire Tower Engineered Timber
FraserWood Industries
Harmony Timberworks
Heritage Natural Finishes
New Energy Works
Tamarack Grove Engineering

Level 1

Carolina Timberworks
Cascade Joinery
Dorval Timber
Enercept
Hardwick Post and Beam
Hochstetler Timbers, Ltd.
MoreSun Custom Woodworking
Rothoblaas
Sauter Timber, LLC
Texas Timber Frames

PUBLISHED BY
THE TIMBER FRAMERS GUILD
1106 HARRIS AVENUE, SUITE 303
BELLINGHAM, WA 98225