The Building of a Bridge

2015

Getting started

The re-building of the bridge idea started at the beginning of the garden project in 2011 but was not the main priority at the time because the garden itself was the focus of our energy. Knowing full well that the garden construction would take a toll on the bridge because of the transport of materials to and from the island, it seemed to be better to do so over the old bridge and not disturb a new bridge.

Another part of the equation was that we had the ability and approval to take on the garden but had no credibility with the City to ask for the materials and support needed to build a bridge.

As time went on we got to a point where the credibility was established and serious discussions with City representatives about the need for a new bridge began. We had the bridge reviewed and inspected by PC Engineering and requested the City Planning Department to visit the bridge and tell us about permits and offer general advice. During this time I researched other bridges and materials to determine if there was a better way to approach the project. One thing that became clear was that to replace the bridge with the most basic permit and red tape, we would need to utilize the same design as the original bridge and we would have to bring it to current code and standards.

During this time I had visited the Japanese Garden in Spokane Washington, that has a beautiful bridge that I had asked the head gardener about and thinking that it was fairly new I found out that it was built in the early 1070's, it had no wear and tear and was a pleasant gray color with brass finials. The wood was purple heart and the cost of that bridge was $100,000.00.

Our bridge would be twice as long and a bit wider than the Spokane bridge and finding a vendor for the materials was a challenge in itself since it is an exotic hardwood that comes from Brazil. The wood was finally found at Moxon Hardwoods and the board feet need to fulfill the project was available. The materials were held for us so that we could arrange payment. Not only the wood and its handling and machining would continue to be researched but how to glue it and fasten it would also become priorities. At this time everything fell into place for materials since it turned out that the best glue to use was the best glue available and the best hardware was going to be stainless steel and all machine tools were going to be carbide.

Getting ready

There are two ways to build something out of wood, you can purchase raw materials and make the dimensional materials, shape it and assemble it or you can go to the lumberyard and purchase the pre-cut materials and shape them and assemble them. Because of the availability and cost of materials to be pre-dimensioned like 2x4's and 2x6's, we would now we needed a source for machining of the materials and to disassemble the old bridge and build the new bridge, it was suggested by the City Planning Department that we communicate with the ACE Academy. After many months and several meeting and a choice by the school to take on the project, it was determined that the school was not capable of doing any of the project.

Now what do we do was the question. It seemed that there were too many complications for the City do build it with City labor and or funds and we needed to remember that the City had already provided 75% of the materials, all of the wood. So with that we decided to reach out to the local high schools and see if it could become a wood shop project. By now it was spring and the school year was gone for new project and with school being out soon it would be fall of 2013 before we would get started. We quickly found out that most of the high schools in east county had shut down the wood shop programs and those that had a program had limited class time and few 3rd and 4th year students that would be

capable of performance. The only school that had a program that was able to provide a program, students and machinery that was big enough was Reynolds HS. Before school let out I was able to communicate with the staff at the woodshop and determined that they could work on the project machining but did not have a construction class that could take on the assembly of the new bridge, with that we would take on the removal and assembly of the bridge project. During the time of discussions at any of the schools l stressed the fact that this was a once in a lifetime project, because of the bridge, the wood and the experiences that would accompany the project. With some unknowns about the upcoming school year we established a plan and were set to proceed in September2014 until the teacher at Reynolds decided to take another position at another school and there was not a replacement. Once the school year started and a month went by a temporary teacher was placed and we did get started until he was terminated...now what do we do?

With our choice of options running out and the real start of the bridge further away than ever more discussions took place with the Parks Department to determine a direction that we needed to take, for me it seemed logical for the garden volunteers to take on the project since we had the knowledge and most of the machinery available for processing the wood and the removal and assembly of the components. With that we still needed someone that could provide equipment and/or time to machine some of the bigger materials, just because the raw materials were so big and heavy and we needed space. We reached out to wood working clubs and other woodworking organizations and explored connections to people that used to be in the industry and were retired or were extreme hobbyists; none came to the plate. Finally one day in late December 2014, a longtime friend of mine suggested that I contact a fellow by the name of Doug Mullins at Quality Woodworking. He had a big shop and might be of assistance. The same day that I called I met with Doug and we worked out a plan to utilize his industrialized shop, equipment and expertise if needed. Everything that we needed to process the materials in his shop, we purchased to fit his equipment. We just needed to sync our schedules.

Things are finally moving

By now I had begun to process some of the components in my own shop and most of which were repetitive in nature. All through the winter material was moved to my shop and large sections were cut into smaller sizes and shapes getting ready for further preparation and assembly. We also cut most of the deck boards to length and pre-drilled the boards for the screws that would hold them to the beams of the bridge, this process continued until about March 2014 when we set up teams of volunteers to process the wood in my shop while I would be gone on an overseas trip. The volunteers started around the first of April and continued to the first of May 2014, cutting, sawing, sanding, gluing and clamping the wood to produce the 80 plus cubes needed as spacers between beams of the bridge. When I returned the cubes were done and the shop was clean and minimal scrap had been produced.

After the return from my trip I dedicated the first week of May to organization and coordinating with Quality Woodworking and organizing the work parties that would move the material to QW and assist with the processes required.

Deck boards

About the second week in May we began cutting material on Doug's 5 HP table saw. The first boards that we took on were the 8 quarter or 2-inch boards that needed to be cut to 8 foot lengths and then processed again through the table saw to 6-inches wide. All narrower sections were glued to others to make another 6-inch or wider board that would become a full board. Now that all of the 110 deck boards were ripped to length and width, we ran them through the planer to make them all the same thickness and to remove any major flaws. With the boards being all the same length the boards would be run through a industrial sander with a 24 grit sanding belt that would put a grain finish on the walking surface of the board to assist with foot traction.

Now that the boards are done and we have our stainless steel fasteners we are ready to begin with the disassembly of the old bridge and removal of the old deck

boards. The objective was to leave as much of the old railing intact as possible to assist with safety for our volunteers, we would also close off the bridge access with fencing. The removal of the old bridge began on June 1, 2015, leaving as much of the railing as possible and still have access to the deck boards that needed to be removed. Once we began to work directly on the deck, which was June 6th, we set up teams of individuals and they would; move the boards from the barn to the work site, remove old boards from the bridge, clean the beam surface, attach the weather protection material to the beam, walk an old board to a holding area, walk a new board to the boards position, place the board and screw it down. That process continued for 4 hours until 60 boards had been removed and replaced with new boards. The next Saturday we did exactly the same process and finished the deck on that Saturday, June 13th. The feeling of the decks stability and strength was immediate.

Machining continues

Now with this phase was complete efforts to continue with the machining of the railing beams began, except this time instead of using 8 quarter wood were would be using 4 quarter wood and again with variations in width and length of the boards. The boards were sorted to allow for the quality of the pieces to be the best for the 55-foot lengths that would eventually be assembled, the remainder would be used for other sections of the bridge. This process started at the table saw and each board was ripped to a 7-inch width and planed so that they were all the same thickness and each board had the ends squared off with the miter saw and no sanding would take place on these boards since they were going to be used in a different fashion and traction was not an issue. Once the boards were ripped, planed and squared off they were machined at each end to form a half lap joint that would allow the boards to be connected end to end forming the 12 foot boards to a total of 60 feet. This process took the efforts of at least 4 people to move the materials and feed them through the radial arm saw the was fitted with a "dado" blade, each board end had multiple cuts to complete the 6-inch lap joint.

Completed and ready for fit and assembly the 80 boards were moved back to the park and the barn so that they could be set up in the storage yard using a series of 55-gallon drums as tables. Boards were placed end to end, fitted, glued with a two-part epoxy and clamped. After the epoxy had set each lap was drilled while using a jig for a series of 4 dowels per joint, the 1/2-inch dowels were of mahogany. The main purpose of these dowels being added was to insure the strength of the joint while the sections were being moved and we were successful with no boards breaking at the joints.

A work station was set up near the entrance of the park and the long boards were moved using 6 to 10 volunteers, they were carried via a pre-determined route through the park and positioned on saw horses for further work. The further work consisted of laying out the position of the holes for the threaded rod to pass through, to allow for the ease of positioning the boards over the rods we made the holes about 3/4-inch with a bit and then using a router we made a slot at each intended opening. We are now ready to move the boards onto the bridge and begin building the beams

Now the hard part

Once the deck was done the rest of the old railing needed to be removed, as well as the railing hardware would be replaced, the replacement would be new stainless steel all-thread that the City purchased along with new washers and nuts. The railing is supported and held to the large glulam beams with 3/4-inch rod that goes from the bottom of the main beams to the top beam of the railing at 6 location and middle beams are connected to each other in the same manner. This removal became much more difficult than imagined because of the way the hardware had been installed the first time the bridge was built, not so much the removal as was the installation of the new hardware and the fact that the holes were not straight and different diameters. This exercise took 3 to 4 days getting the rod through the beams and up through the deck boards to be drilled to allow access. The stainless steel rod had to be purchased in 12 foot lengths and also had to be brought in from Tacoma WA.

Now that the rod is up through the deck boards and new angled support blocks for the bottom of the main beams are in place, we installed the feet that had been previously produced during the winter. Each of these was pre-drilled for the rod access and two holes for the stainless steel lag screws. Once in position the screws were installed and the first 55-foot long boards could be positioned onto the feet. Each board was glued to the foot below it with Tite Bond 3 and held into position with a nut and washer at each of the 22 positions.

Building the beams

The new railing would require the new codes to be integrated into the design, the old railings were made of solid beams and spacer blocks between the beams. Because of the arch of the bridge and the shorter lengths of board used there were saw slots that were added to the beams so that they could bend. Our beams, although taller than the old ones, would be laminated with 1-inch think boards that were 55 feet long and would bend to the proper degree just with gravity.

The spacer blocks on the original bridge were about 8-inches tall and our new blocks would need to be 1/16th short of 4-inches for the new code, the old ones would be solid and the new ones would be hollow to afford ease of installation and we spent less money on materials.

The old bridge with the solid spacers required the beams to have pockets for the heads of the bolts and the nuts and one can imagine that the pocket had no cosmetic appeal and eventually over the years the pockets were filled with caulk to help disguise the assembly. With the new railing we took the advantage to use all-thread that would allow us to add a washer and a nut at any point that we wanted and this also allowed us to hide the hardware inside the beams and spacers since they were hollow, we would pull the beam down from the bottom of the beam instead of pushing it down from the top of the beam.

With the first board being in place on top of the feet, we can now begin building the walls of the beams. The 1-inch think boards were cut into inch and a half

widths and were all planned to the same thickness so they could go into the wall structure of the beam at any place at any time and we would maintain the same height throughout the assembly process. The process included taking the narrow strips with a 45 degree angle on them and laying them on top of the first 55 foot long board end to end, applying glue and anchoring them into place with 18 gauge nails and a pneumatic nailing gun, the main reason for the nails was to hold the boards into place until the glue dried. Each layer of the narrow strips would overlap the joints below to allow for maximum strength. We continued building the wall of the beam until we reached the thickness of the beam that we were looking for. Since all of the material was the same thickness, both sides of the bridge beams would be the same height. With the wall of the beam being complete the top of the beam would be put into place, another 55 foot long board would be positioned on top and it would be secured with the glue, nails and the nut and washer assembly.

Because the spacer blocks alternate we would have to secure or sandwich the blocks between the beams using shorter sections of the all-thread rod since there are only 3 on each railing that run from bottom to the top of the rail. Again because of the beams and spacers being hollow we were able to anchor the two beams together with the spacer in between, we drilled a hole in the bottom beams top and tapped it with a 3/4-10 thread, with the purple heart being so dense and strong the threads hold nicely as they did in the testing of the application.

The handrail

In order to build the handrails we employed the same principal as we did with the beams to connect the shorter sections of wood to produce a 55-foot long section. These section were now going to be 1-inch thick and 3-inches wide, once connected and dowelled we laid them on the deck to obtain the same arch as the railing beams. The next step would be to apply the second board and the third board with glue, the result is a 3"x3"x55' curved section of wood and it will stay that way. Allowing it to dry and set for a day, the section was moved onto

supports and placed on its side and with a router we began making cuts on the outside edges of the section taking away about 1/4-inch at a time. We started with a 1/2-inch round over bit and graduated up to a one and a half router bit and setting latter shallow for several passes until we removed enough material at the corners until the board was round, 3-inches in diameter. Hand sanding was necessary to remove imperfections and rough spots, much of which was accomplished once it was set into place on the bridge.

The hand rail rests on nests that were also produced during the winter and each one was cut to correspond to the pitch of the railing were it was positioned. The nests were made with 2-inch thick stock and are anchored to the top beam with stainless steel lag screws and the handrail is held into the nest with a horizontal lag that connects the two ears of the nest and through the handrail.

The posts

Some of the old posts had been replaced over the years and they were not all the same diameter and they were fitted with metal post caps since the finials no longer existed. We chose to make the posts out of Douglas fir and they would be made with a diameter of 9-inches and would be about 60 inches long so that they could be cut to the proper length taking imperfections into account. The posts were purchased from a log cabin manufacturer in Kalama WA and all four were identical. Once cleaned up and sanded some of the shrink cracks were filled with epoxy to stabilize them and the bottom ends needed to be reduced in size to fit into the steel sleeve that was an original aspect of the first bridge. The top of each post would be squared off and dressed with a wax solution to prevent water from entering into the end grain of the wood and just prior to this a 3/4-inch hole was drilled into the middle of each post about 3-inched deep, so that a stainless steel threaded rod could be epoxy into it for mounting the finial. Now that these adaptations were made the post were sent off to the wood carver to carver the kanji symbols into the chosen face of each post, when carving was complete the symbols were finished with a black ink.

The Finials (Gaboshi)

A standard for bridges in Japan is to have a finial on each post called a Gaboshi. In order to get it right I had asked Tad to go to the Portland Japanese Garden and measure the finials on the bridge in that garden. He did so and took pictures as reference and proceeded to produce a detailed drawing of the unit with dimensions and radiuses of the transition points.

Now the drawing was used to build up sections of the purple heart wood so that they could be machined on a lathe to the specifications noted on the drawing. We were fortunate to have Todd Nelson offer to machine 2 sets of finials to the specifications. Todd not only has the expertise but also has the equipment to provide such pieces of art. The finials measure about 6-inches in diameter at the largest section and are about 12-inches tall. I drilled and tapped a hole in the center of each bottom so that they would mount onto the posts and would be centered on each post. To prevent them from being removed we drilled a angular hole through the finial and into the post about 3-inches with a keyed screw to lock it into place.