



Dominion Traditional Building Group

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Date: Jun 9, 2022

Scott Harris
224 Washington Street
Fredericksburg, VA 24405

Re: Belmont stair rebuild methodology

Scott,

Enclosed is a summary of our methodology for the Belmont stair rebuild project. The methodology was completed by Hunter Shackelford, and we hope that it encompasses all information relevant to the work we performed. If you have any suggestions for additions, we will be happy to edit as required.

Thank you again for the opportunity to complete this project for Gari Melchers Home and Studio and the University of Mary Washington.

If you have any questions, please let me know.

Respectfully,

Sam Biggers
Director of Preservation Services



Belmont Stairs Rebuild: Methodology and Materials

Written by Hunter Shackelford; mason for Dominion Traditional Building Group and Historic Preservation alumnus from the University of Mary Washington.

The restoration of the masonry stairs at Gari Melchers' Belmont provided our team at Dominion Traditional Building Group a unique opportunity to mix traditional building techniques with modern procedures in order to create a stable and long-lasting structure. At first glance, this porch appeared to be constructed primarily of Aquia sandstone that had been significantly degraded due to elemental exposure over time.

The overarching goal for our company was to create a finished product that will be true to the original porch and last for years to come. Our specific goals were to:

- Disassemble the existing staircase in a systematic manner
- Construct a stable footing on which the porch could be rebuilt
- Repair or recreate the stone components that were damaged
- Rebuild the porch in a safe and efficient manner while constantly considering the reinstallation of the iron railing along the edge of the porch
- Clean the structure and utilize lime-based mortar repointing

Before any work could begin to disassemble the porch in the existing condition, each stone and component of the structure were documented in order to preserve as much of the original integrity as possible. This ensured that each stone that was determined to be structurally sound would be reinstalled exactly where it was removed. During this process, benchmark measurements were established, utilizing an optical level measuring tool, in order to determine exactly where the original stones were located. This process allowed for those stones to be reset and repositioned accurately during the rebuild process. These benchmarks, in conjunction with measurements and measured drawings, created a footprint of the existing structure. Each stone was documented twice in order to ensure accuracy. Detail and context photos were taken of the porch components during this process. Following photographic documentation, each stone was assigned an alphabetic and numeric designator. This designator was attached to the stones via physical tagging and annotated digitally on photos. If the physical tag was lost or destroyed, the digital photos could be used as a backup to establish the location of the desired stone. The final portion of the documentation process came through the production of measured drawings. These drawings were used in conjunction with the benchmarks and the photo documentation to create an accurate depiction of the old porch.

Following a thorough documentation process, disassembly of the porch began. Before any of the stair treads could be removed, the bed joints beneath the treads that were filled with Portland cement needed to be broken. This allowed for straps to be wrapped around each stone,



which were used to lift them free of the porch via an excavator. The bedding mortar was broken primarily through the use of plugging chisels, as the mortar was “lipsticked” in place. This meant it was only applied in a thin layer on the exterior of the stone, and not fully bedded underneath the treads. Once the bed joints had been broken, each stone tread was carefully lifted with a mini-excavator and stored on pallets adjacent to the porch for cleaning and repair. With the removal of the treads, the masons onsite determined that there was no kind of footing supporting the porch in any form. In this exposed state, the craftsmen on site observed that at an undermined earlier date, the center portion of the porch had concrete poured into existing gaps to create the illusion of a stable structure. Approximately half of the treads had protruding “tabs” chiseled onto their ends that sat under the cheek walls. These tabs created a semi-supported base for the porch and mechanically tied the stone treads into the cheek walls. This construction feature caused the exposed end of the treads to become dramatically out of level and cant upwards as the cheek walls settled. Various previous repairs were observed with the stair treads removed. Approximately ten total courses of brick had been laid along the front of the porch under the treads, the bottom nine in a running bond with the final course being laid in a header pattern. These bricks were laid on each side of the center mass in a Portland cement-based mortar, indicating they were an approximate 20th century addition to the porch. On top of the brickwork sat sandstone carved in a radius that mimicked the curvature of the staircase. The stones on the left side, when viewing the staircase towards the building, were all re-laid in Portland cement, indicating that they all had been removed and relaid at some point. However, the stones on the right side were merely repointed with a Portland cement-based mortar. This demonstrated that this right-side portion of the porch had never been completely removed and rebuilt, but only repaired (with the exception of one stone). The bottom left stone of the right side had been removed at an undetermined point in the past and replaced with brick that had been parged with mortar to mimic the look of sandstone. These disguised bricks, along with one other stone that was broken on the left side of the staircase, were replaced with sandstone provided by staff at Gari Melchers’ Belmont. The replacement sandstone pieces were hand-carved by members of Dominion Traditional Building Group to mimic the existing stone.

Before any of the treads on the porch could be reset, the cheek walls first had to be stabilized. This task had to be accomplished in order to arrest further settlement of the wall. At the time of the porch disassembly, the cheek wall had settled approximately five inches into the ground. This stabilization of the cheek walls would also provide a solid footing for the stair treads upon their reinstallation. For each tread on the right side of the porch, small footers were dug out under the cheek wall and filled with concrete. Old brick and other debris were then positioned between the cheek wall and the newly poured footer. The cheek wall on the left side of the porch was much more stable. Therefore, small footers were poured on that side to support the newly set treads. These small footers were supplemented with a larger concrete footer that followed the inner curve of the porch to the center mass supporting the landing. On top of this footer, eight-inch CMU blocks were laid, stepped back with the height of each stair tread.



Masonry wall ties were installed every other course in the CMU wall to secure the new brickwork and provide a stable finished product. The CMU blocks, combined with the concrete footers, provided a much more stable base than had existed in the prior to our work. With the construction now on a solid footing, the treads were systematically brought back to the porch for reinstallation. Each tread would be re-laid, leveled, plumbed, and then very slightly tilted forward and inboard to allow each step to shed water away from the porch. The benchmark measurements shot prior to the disassembly of the stairs, in conjunction with the measured drawings, were crucial to resetting the stones in a way that allowed for the rebuilt porch to be as accurate to the original structure as possible. As each tread was set, #57 gravel was poured into the gap between the footers on each tread and Type S mortar was utilized to bed beneath the stone. This created a solid base for the next stone to set. While gravel, concrete, and Portland cement-based mortars are not traditional building materials, the use of contemporary building materials in areas that would never be viewed by the public eye allowed for our craftsmen to create a system that would be more likely to last for a long period of time without causing harm to the structure that was being created. With the stone treads all re-installed, the brickwork was then rebuilt.

The existing bricks removed from the porch were in poor condition, and had excessive Portland cement mortar attached to every face, This rendered them unsalvageable. As the bricks were not the focal point of the porch, modern modular bricks were utilized to replace those that had been removed during the demolition of the porch. The new bricks used were extremely close in size and color to the original. The mason conducting the reconstruction laid the brick in a lime-based mortar and did not strike the joints flush, but instead smeared them. This finish gave texture to the brickwork similar to what was in place at the beginning of the project. Above the brickwork, original curved sandstone pieces were reinstalled, all laid in lime mortar. As stated above, there were two pieces of sandstone that were carved by DTBG masons.

In conjunction with the reinstallation of the brickwork, the outer handrail pieces on the cheek walls were removed and relaid in lime mortar. The stone newel pieces, located at the ground-level of the cheek wall, were noticeably out-of-plumb. DTBG dug out around the bases of these stones, re-set the stones to be plumb, and poured a footing to ensure they are stable and supported. Following completion of the work at the newels and the handrail pieces, all mortar joints on the cheek walls were cut out and repointed using lime mortar.

At the top of the landing, marble pavers were removed and re-set in lime mortar. During the removal, one piece of marble was discovered to be broken. The DTBG masons received a replacement marble piece from the staff at Belmont to replace this piece. Prior to setting the marble pavers, stable fill was used to ensure that the marble pavers would be stable and remain in place after reinstallation. This fill was a mixture of concrete and gravel.

One of the challenges behind this project was justifying our work with the stone elements that were left in place. As stated earlier, the outer cheek walls were left in their original positions.



Additionally, the entire middle mass of masonry supporting the landing (with the exception of the top border stones at the landing) were left in their original position, as well as the bottom treads that are embedded in the ground. This presented challenges, some foreseen, some unforeseen at the start of the project. As stated earlier, when reinstalling the stone treads, considerations when placing the stones included the radius of the curve, the height, the level of plumb, and necessary slight slope to shed water. One challenge that we encountered during the project was the joint below the top border stone on the front face of the landing. When that stone was reinstalled to be level and plumb, we understood how much the masonry mass below had settled to the left. This settling manifested itself in a joint between the top stone and the masonry mass that widened as it moved toward the south (left) end. To visually remedy this, we installed Jahn to the top of the masonry mass below the joint. The thickness of the Jahn grew as it approached the south edge. We matched the color and texture of the stone, so that our repair is not readily noticeable. Similarly, we completed Jahn repairs on other stones, where chunks of stone were missing. Where stones were broken in pieces, we used Akemi Akepx 2010 epoxy and stainless steel pins to reattach the stone pieces.