Darnell's Chance—"Lost in Time"

by Stephen A. Johanson

Have you ever felt a sense of excitement and mystery going inside an old building or exploring the contents of a forgotten trunk, a sense of being lost in time in an obscure corner of an attic? If so, it is probably because the materials and features observed resonate with the spirit of the past, of people and events.

Imagine, then, the excitement of unearthing an 18th century burial vault in your own backyard that was lost in time for more than 150 years. The vault was uncovered in 1990, and workers identified two holes in the ceiling where the vault had been abandoned and filled with rubble. For safety reasons, the brick remaining between the two holes was removed, resulting in a void in the ceiling 17 ft long x 3 ft wide. The vault was then enclosed in a greenhouse to protect it from the weather (see photo).

Excavations in the interior of the vault revealed that it was completely filled with earth and brick rubble. Once the fill was removed, a masonry subcrypt was discovered in the southwest corner of the vault, where remains represented all age groups that could be expected to occupy a large 18th century household. The remains are being analyzed by the Smithsonian Institution and will be reburied in the vault following its restoration.

Thousands of 18th century artifacts were recovered from the rubble fill in the interior of the vault. An analysis of historic ceramics recovered from layers containing human remains suggests that the vault was filled during the first quarter of the 19th century (approximately 1815).

Project Scope

The goal of the project was to restore the brick masonry burial vault to its 18th century appearance by conserving, restoring, and rebuilding the vaulted ceiling, stairway, subcrypt, and parging of the exterior roof vault. Historic research recommended rebuilding an accurate stairway door and iron gate, reflecting the architectural design of the period.

A group of historic research specialists was assembled to document, research, and analyze the character and traditional design of the 18th century burial vaults. This team of specialists consisted of a historical architect, a conservator, material restoration scientists, a historic mason, and a specialty restoration contractor.

Pre-Excavation

Several investigative processes led to the restoration of the burial vault. Identifying, retaining, and preserving the form and detailing of the architectural materials and features were crucial to define and maintain the vault's historic character. Good preservation required the need for meticulous planning prior to restoring this irreplaceable cultural resource. The process for the architectural and structural evaluation was comprised of the following six initiatives:

1. Determine the feasibility of retrofitting the structures to accommodate a repair scheme for the deteriorating materials;
2. Evaluate the repair recommendation, which limits the changing of the appearance of the structures;
3. Determine the structural adequacy and integrity of various structures' elected elements and architectural features;
4. Evaluate the structural problems or distress resulting from unusual loading or exposure conditions, inadequate design, or poor construction practices;

Figure 1

5. Determine the feasibility of modifying the existing structure to conform to current historical codes and standards; and
6. Perform restoration and repair services in accordance with the United States Secretary of the Interior's Standards for Treatment of Historic Properties.

Mortar Analysis

Vault mortar samples were obtained for visual, analytical, and laboratory analysis. Comparing them visually in the field with a hand lens determined that the mortar was fairly consistent in composition throughout, ranging from pieces quite hard in the vault ceiling to some soft as clay near the floor in water-soaked areas. The color varied slightly from piece to piece, an overall gray tinged with pink, yellow, or tan. One could easily see many large pieces of aggregate that appeared to be oyster shell. Notice the gray and white pieces of shell as well as numerous lime blebs (all bubbles) and mostly medium-to-fine-grade sand.

The samples were gently crushed with a wooden roller and poured into a stack of sieves (No. 8, 16, 30, 50, 100, 200, and pan). After a minute of shaking and tapping, the pieces on the No. 8 sieve were placed in a bowl and gently crushed with a wooden dowel. The goal was to break apart the larger pieces of shell and rock from the sand and binder. This process was repeated several times with each sieve size. The mortar was also gently rubbed against the screen of each sieve to further separate pieces of aggregate form the calcium carbonate binder. The amount retained on each sieve was weighed before it was recombined and placed in dilute hydrochloric acid (HCl) and water to remove all of the acid-soluble portions. When dissolution in HCl was complete, a great deal of silt and clay dissolved in the water. This is what gave the original mortar such a strong gray color.

It was proposed to tint the replica mortar with more stable iron-oxide pigments in place of the original silts and clays. The binder of the existing mortar was pure lime. Therefore, a rich calcium-lime hydrate with a high surface area was used along with a pozzolan. The pozzolan was a clean (not a manufactured by-product such as fly ash), high-temperature-fired kaolin clay containing high alumina and silicate content. In the presence of finely ground hydrated lime, the pozzolan causes a catalytic reaction to produce a calcium-alumina-silicate cement in part of the material while allowing the remaining calcium hydroxide to carbonate slowly in the normal manner of lime mortars. The reason for adding a pozzolan is to achieve an earlier set and higher strength. This was particularly important for the parging over the top of the vault to ensure proper setting, even in the lower damp locations.

Documentation

Prior to proceeding with the vault restoration, a careful inventory of the masonry was undertaken. Masonry units were numbered and photographed so dimensional documentation occurred. Accurate completion of this log assures the proper replacement and setting of all units when disturbance occurs either deliberately or accidentally.

Stabilization

Initially, emerging stabilization of the compression dome was installed to ensure the structure did not continue to deteriorate and to ensure the safety of current investigators and historians. This work included the installation of a temporary housing enclosure, shoring of the compression arch, and diversion of ground water.

Masonry

Study of the historic brickwork provided information about the masonry units' method of production and construction. The color, size, shape, and texture of the brick revealed the masonry bricks were hand-molded and traditionally fired in a clamp with hardwoods. Similarly, the principal component of the masonry mortar was lime. Mortar samples were obtained for analysis. It is essential, in good historic research, to understand the properties of the original mortar. Throughout the ages, different masons made mortar differently. So the intent here is fivefold:

1. The replacement mortar must be a good mortar match;
2. The replacement mortar must have similar mechanical and chemical properties of the original mortar;
3. A good, visual microscopic material identification needs to occur;
4. Identifying the correct matching aggregate source of supply is critical; and
5. Mixing dosages and proportions needs to be field tested to create the proper aggregate packing arrangement.

These items are all critical in developing a replacement mortar that exhibits proper strength and durability. Essentially, one needs to keep in mind that as mortar weathers, the color of the mortar comes from the aggregate within.

Repointing

Preparation for repointing entailed the removal of the old mortar to a depth of 1 to 1-1/2 in. This ensured an adequate bond between the new mortar and existing masonry. In areas where the joint width was 3/8 in. or less, only a 1/2 in. routed joint was obtained. In either case, removing deteriorated mortar to sound substrate was essential. In most cases, this was accomplished with hammer and chisel. Power tools were avoided due to the

age of the masonry. Bricks tended to be very soft with a brittle face. Replacement mortar was installed in multiple lifts and, at times, packing tools were used to pack mortar into tight areas uniformly. The majority of the routed cavities were repointed with unpigmented new mortar. Only the last 1/2 in. or so of pointed joints were colored with the iron-oxide pigments.

Restoration

Repairs to the masonry vault mimicked construction techniques of the 18th century. Deviations to these practices were only allowed when underpinning of the stairway masonry walls was undertaken.

Tread and riser brick units were removed, numbered, and stored. No more than three steps were removed at any one time to permit installation of a new concrete footer beneath the stair wall. The concrete stair was reinforced with No. 4 epoxy-coated reinforcing steel and poured as an inclined one-way solid slab. The underside form was the existing soil, excavated to the proper depth. The top riser and tread formwork was installed to provide a foundation, which would permit the reinstallation of existing masonry, at the original tread/riser height and depth.

Historic reproduction bricks were not necessary. Replacement bricks were located at other 18th and 19th century restoration projects. In most cases, the masonry units were reinstalled in the stair at the same location they were placed originally.

Inspection of the vault dome roof indicated it was constructed on centering wooden ribs, composed in unison with supporting linear planks. The brick in the compression arch was laid on top, bedded in mortar. Hand saw planks were used to replicate the original form markings.

Masonry units were laid according to their original set pattern. No reinforcing was installed. Several inches of a lime-rich mortar was installed as a topping slab over the dome. Cure time for these materials was 4 to 7 days. Once set, they provided an excellent waterproofing barrier. This completed the reconstruction, and the historic vault is now set to receive the remains.

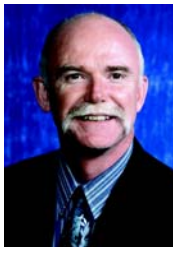

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Figure 2

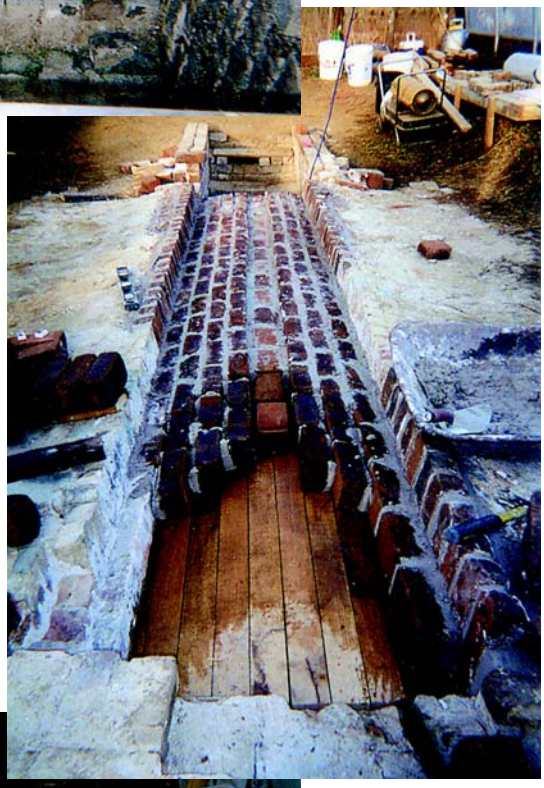

Figure 3

Figure 4