

3.1 MASONRY SMALL STRUCTURES

Historical Overview

There are no known masonry arched culverts or bridges in Maryland that date to the seventeenth or eighteenth centuries (Spero 1995: 50). There are however, masonry arched structures that date from the first half of the nineteenth century. Perhaps the most well known masonry structures are those along the National Road in western Maryland. In fact, records indicate that in the 1830s, engineers for the Federal government recommended constructing bridges on the National Road out of timber, a “necessity growing out of cost” but this was not allowed because an Act of the General Assembly had mandated stone bridges (Searight 1971: 58). Other early masonry structures were built along the turnpike connecting Baltimore by way of Frederick to the National Road at Cumberland (today’s US 40 and US Alt. 40) and along other major pikes leading out of Baltimore. Masonry structures were also built in association with Maryland’s nineteenth century canals and railroads.

At the end of the nineteenth century, the 1899 Report of the Maryland Geological Survey (Geological Survey) stated that bridges that had been built over the past decade were of wood, iron and stone (Johnson 1899: 205). A 1902 report of the Geological Survey stated that stone was also utilized for retaining walls and to protect the ends of drains (Reid 1902: 139). That same report described masonry culverts as follows:

The walls of brick culverts shall not be less than 8 inches thick. The bricks are to be laid in cement mortar composed of one part Portland cement and two parts clean sharp sand . . . the brick are to be solid hard building-brick. The covering stones may be of good quality granite or gneiss or equally strong rock not less than 10 inches thick at any point . . . the bottom of the brick culverts is to be filled to the depth of 4 inches with coarse clean stone not over 4 inches in size, or other hard broken material of a proper size. The slope of the bottom of the culvert shall be 3 inches in 20 feet (Reid 1902: 77).

The Geological Survey’s report of the following year mentioned that discussion of an arched stone culvert had been considered. Its construction cost was estimated between \$400 and \$500 (Johnson 1903: 179).

During the first half of the twentieth century, small stone arches were built but the use of masonry construction had been superseded by concrete construction. Local builders probably continued to use arched masonry construction for reasons such as lack of knowledge of the new concrete technology or easy access to high-quality stone. During the Great Depression, public work’s projects may have included construction of small stone arches. In more recent years, stone arched construction has been rare but may have been used for small structures in parks or other areas where aesthetics was a primary consideration. (Most often, masonry is used today only as facing on modern concrete structures for aesthetic considerations. See Section 3.2).

Description

In Maryland, both brick and stone were used for the construction of small arched structures. They were also used for construction of abutments and, from around the

mid-twentieth century, as facing on concrete abutments and headwalls. Arched masonry small structures in Maryland are generally single-arched and can be brick, stone or a combination of both.

Stone as a building material possesses compressive strength and since arch design relies on compression, stone is a suitable building material for small structures (and bridges). The arch acts in compression, distributing stresses from live loads along the arch downward and outward into the abutments. In a masonry arch, the arch carries the weight of the load as the stones press together in an overlapping pattern. Stone arches have an arch ring that has radiating stones called “voussoirs” -- the central voussoir is the keystone. The spandrel walls abutting the edges of the arch serve only to retain the fill under the roadbed (Figure 3.1).

Brick was also used for building arched structures. Brick arched structures have the same structural components as the stone arches and function in the same manner.

Three basic arch shapes were used for arched roadway structures: semi-circular, segmental and elliptical (Figure 3.2). There are also three basic types of stone used for arched construction: rubble, ashlar and squared (dressed). (See Figure 3.3.)

The distribution of masonry construction was dictated by the local availability of materials such as stone, particularly in the nineteenth century. Brick arches appear to be rare on Maryland's State Highway System today but the Geological Survey reports of the early 1900s discuss construction of brick culverts (Reid 1902: 77). Stone arches are more common but their numbers are still small and few retain their historic structural integrity. Many of the extant stone arched small structures are in Washington County. Extant examples of small masonry arches, as included in the SHA Office of Bridge Development's ongoing Small Structures Inventory, are in Allegany, Baltimore, Cecil, Frederick, Garrett, Howard, Montgomery and Washington Counties, all in the Piedmont or Appalachian regions of the state. The county roads of Howard County include two small rubble culverts and the county roads of Cecil County include a post-1860 stone arch (CE3005), a ca. 1831 brick arch with stone abutments (CE1008) and a ca. 1925 timber structure with rubble stone abutments (Dominick 1997).

A recent review of selected small structure inspection files at the SHA Office of Bridge Development indicates that many of the masonry arched structures have undergone substantial alterations. Many have been widened one or more times with the addition of more modern structures on one or both sides. The original arches encased within several of these structures are not readily visible. The structures have also lost defining details such as parapets and wingwalls and some are sheathed in gunite.¹

¹ Gunite is a material used for surface repairs of roadway structures. Its use is mentioned for repair of bridges as early as the 1943-44 Report of the Maryland State Roads Commission (Maryland State Roads Commission 1945: 49).

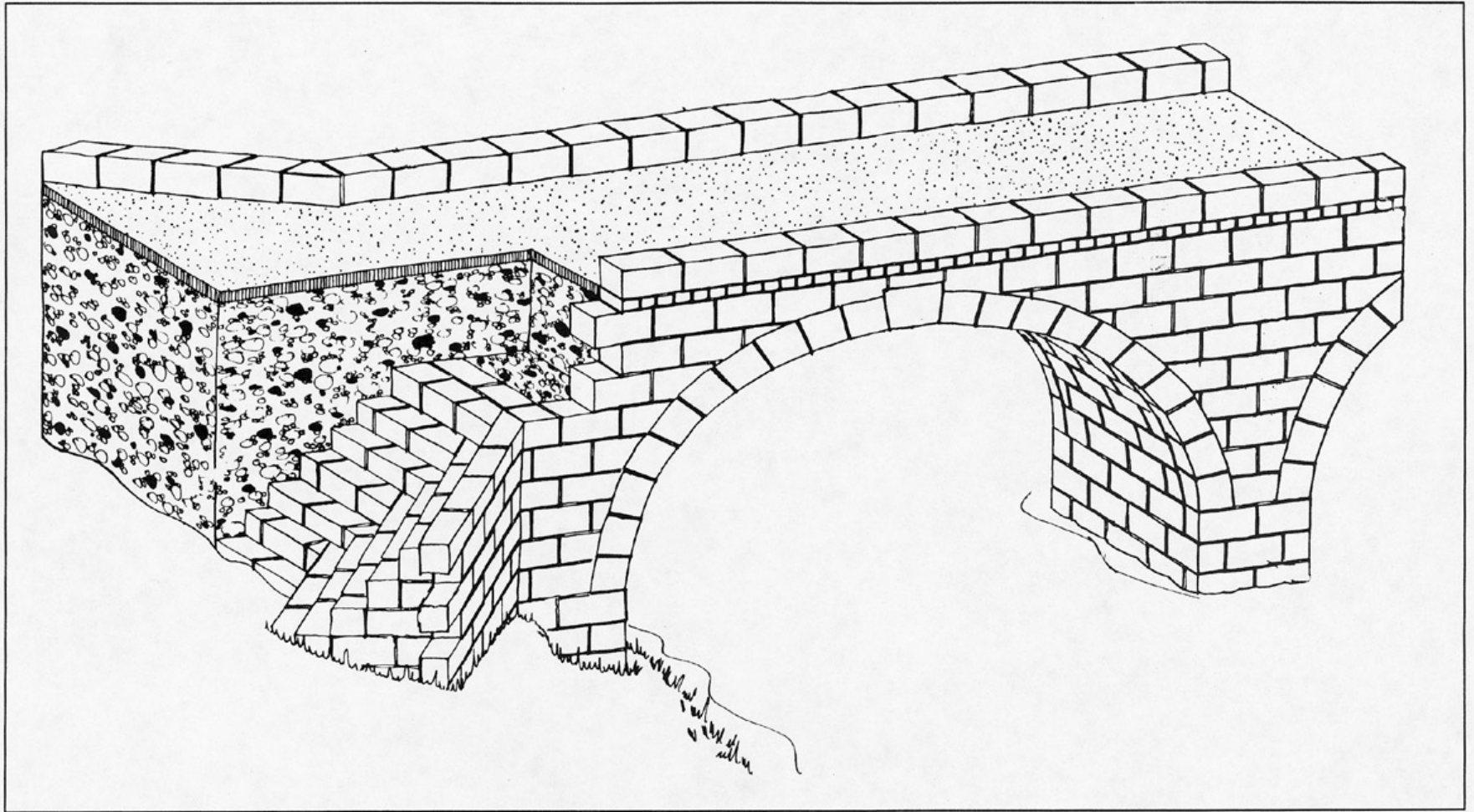


Figure 3.1. Isometric view of masonry arched structure (Source: Pennsylvania Historical and Museum Commission and Pennsylvania Department of Transportation 1986).

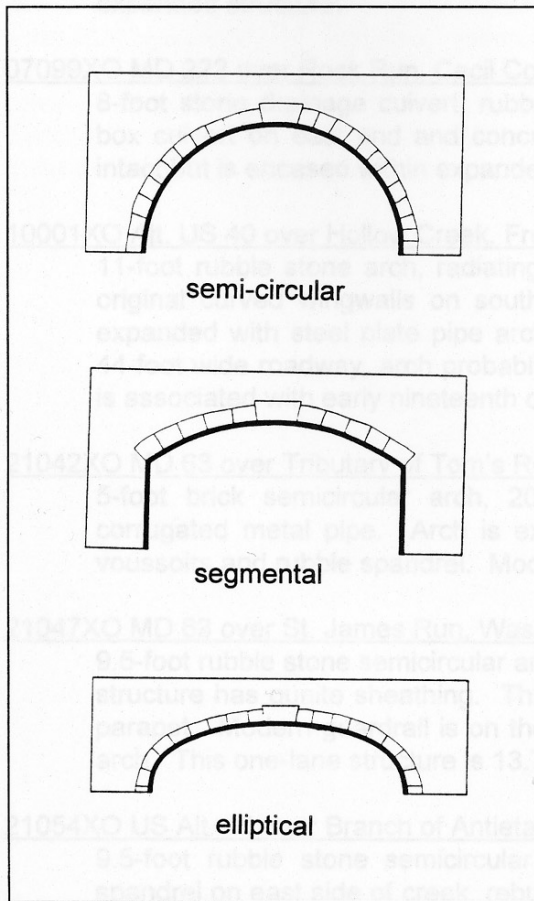


Figure 3.2. Types of masonry arches (Source: Pennsylvania Historical and Commission and Pennsylvania Department of Transportation 1986).

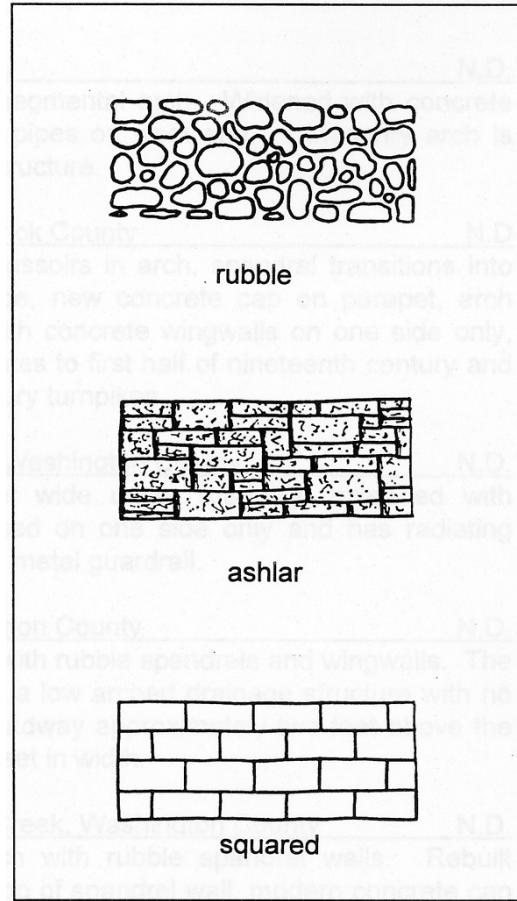


Figure 3.3. Types of stone-laying techniques (Source: Pennsylvania Museum Historical and Museum Commission and Pennsylvania Department of Transportation 1986).

Below are descriptions of selected extant masonry arched structures²:

03304XO MD 150 over Tributary of Back River, Baltimore County N.D.³

15-foot long rubble stone semi-circular arch abutting 44-foot wide brick arch on stone foundation walls, extended on each outer side with concrete box culverts and a structural plate pipe. Masonry arches are intact but encased within expanded structure.

07099XO MD 222 over Rock Run, Cecil County N.D.

8-foot stone drainage culvert, rubble, segmental arch. Widened with concrete box culvert on east end and concrete pipes on west end. Masonry arch is intact but is encased within expanded structure.

10001XO Alt. US 40 over Hollow Creek, Frederick County N.D.

11-foot rubble stone arch, radiating voussoirs in arch, spandrel transitions into original curved wingwalls on south side, new concrete cap on parapet, arch expanded with steel plate pipe arch with concrete wingwalls on one side only, 44-foot wide roadway, arch probably dates to first half of nineteenth century and is associated with early nineteenth century turnpikes.

21042XO MD 63 over Tributary of Tom's Run, Washington County N.D.

5-foot brick semicircular arch, 20-foot wide under roadway, extended with corrugated metal pipe. Arch is exposed on one side only and has radiating voussoirs and rubble spandrel. Modern metal guardrail.

21047XO MD 63 over St. James Run, Washington County N.D.

9.5-foot rubble stone semicircular arch with rubble spandrels and wingwalls. The structure has gunite sheathing. This is a low arched drainage structure with no parapet. Modern guardrail is on the roadway approximately two feet above the arch. This one-lane structure is 13.75 feet in width.

21054XO US Alt. 40 over Branch of Antietam Creek, Washington County N.D.

9.5-foot rubble stone semicircular arch with rubble spandrel walls. Rebuilt spandrel on east side of creek, rebuilt top of spandrel wall, modern concrete cap atop spandrel. Widened with concrete box culvert. Arch sheathed in gunite.

² The numbers are those assigned by either the state, county or city to small structures within their jurisdiction. Structures included in the State Highway Administration Office of Bridge Development's Small Structures Inventory have numbers ending in XO. Structures on city/county roadways have the county/city abbreviation in their structure number (e.g. "CE" Cecil County, "BC" Baltimore City) and are included in the inventory of the respective city/county road departments.

³ N.D.=Date unknown/indeterminable

Tips for Dating Masonry Small Structures

Many of the extant masonry arched drainage and other small structures date to the first half of the nineteenth century. These structures are found along the National Road and other early turnpikes in the state. In particular, a conscious effort has been made to preserve the stone arched structures along the National Road that are mainly of rubble stone arched construction. Other small masonry structures may date to the City Beautiful Movement of the late nineteenth and early twentieth centuries in such locations as on parkways and in planned subdivisions. Small stone arches may also have been built during the 1930s through federal work relief programs such as the Civilian Conservation Corps and the WPA. More modern stone arches are generally in most cases a stone veneer applied to a concrete structure.