

3.2.4 CONCRETE ARCHES AND ARCHED CULVERTS

Historical Overview

The 1902-03 Geological Survey Report discussed the construction of an arched concrete culvert, four feet wide and five feet high and designed to span a narrow waterway (Johnson 1903: 183). A photograph accompanies the text and depicts a barrel-arched concrete culvert with a concrete headwall and wingwalls (Figure 3.10). Several feet of fill are between the top of the arch and the roadway (Johnson 1903: Plate XI, Figure 2).

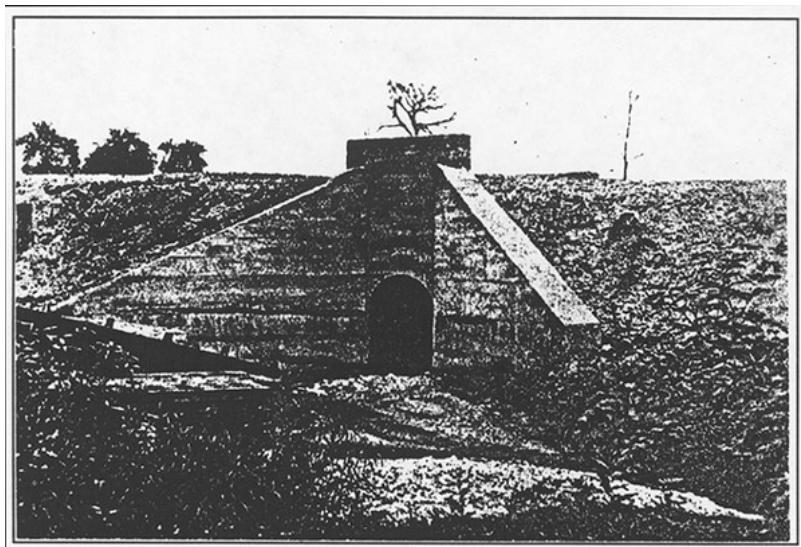


Figure 3.10. 1903 arched concrete culvert (Source: Maryland Geological Survey 1903: Plate XI, Figure 2).

The 1905-06 Geological Survey Report included before and after photographs of a culvert that had been improved (Crosby 1906: Plate II, Figures 1 and 2). The before photograph shows what appears to be a primitive and deteriorated false (corbelled) rubble arch. The replacement culvert is concrete with a semicircular arch, concrete wingwalls and a concrete headwall with a concrete cap rail. The report noted that in 1906, one single arched concrete structure was constructed in Washington County, the location of many early nineteenth century stone structures. This may have been a small structure. Over the next three years, other concrete arches were built in Washington County by the same company (Spero 1995: 176, 178).

Arched designs for small structures (and bridges) were not included in the state's Standard Plans issued between 1912 and 1933. Preliminary research indicates that the arched design was not widely used for small structures. According to Spero, "an examination of the data on the extant concrete bridges on Maryland's state roads indicates the growth of the standardized beam and slab at the expense of the arch" (Spero 1995:101). Arched concrete construction is rarely, if ever, used for small structure construction today.

Description

The small structures classified in the SHA Office of Bridge Development's partially completed Small Structures Inventory include both arched drainage-type culverts and arched structures spanning narrow waterways. Preliminary research indicates that the concrete arched small structures and culverts are of the closed spandrel type (Figure 3.11). The culverts include a solid concrete barrel arch with vertical sidewalls. The culverts may or may not feature a paved invert (stream bottom). The other type of reinforced concrete arched structures has a circular or parabolic arch with the arch continuing into the sidewalls; these arches generally have a low rise-to-span ratio. The cavity formed by the arch and the walls of both arches and arched culverts is filled with earth or other available materials up to the level of the driving surface. Like masonry arches, concrete arches often feature a parapet. Some twentieth century concrete arches are faced in masonry.

Preliminary research indicates that few concrete arches or arched culverts remain. Many of the extant structures have been altered through the addition of a slab to one or both sides of the arch.

Some examples of arched structures extant in Maryland are:

15002XO MD 80 over Fahmey Branch, Montgomery County N.D.
16.5-foot concrete arch widened with concrete slab. Three-panel incised parapet on both arch and slab sides of structure, similar to pre-1928 Standard Plan parapet rail design.

16064XO MS 212 over Drainage Ditch, Prince George's County N.D.
4.5-foot concrete arch. Ashlar spandrel walls, modern metal guardrail, 39-foot wide roadway.

15040XO MD 195 over Long Branch, Montgomery County N.D.
8-foot concrete arch widened with concrete slab. Concrete parapet and modern metal guardrail, rubble spandrel and wingwalls, 32-foot wide roadway.

15049XO MD 28 over Monocacy River, Montgomery County N.D.
6-foot concrete arch with 4 feet of fill between arch and roadway. Concrete headwall with attached modern metal guardrail, 24-foot wide roadway.

B00151 Thistle Road over unnamed stream, Baltimore County 1920
13.75-foot concrete arch, widened with concrete arch in 1949. Solid parapet rail has hexagonal cut-outs, 18.9-foot wide roadway.

Tips for Dating Concrete Arches and Arched Culverts

In the early years of the twentieth century, arched culverts with either vertical sidewalls or wingwalls were constructed. The arched culvert design was generally superseded by the box culvert design with the introduction of the 1912 Standard Plans.

Most small concrete arched structures (besides culverts) date between the second decade of the twentieth century and World War II. After the war, concrete arched

construction was rarely used for small structures. Pipes, pipe arches or structural plate pipes were used in lieu of the concrete arch.

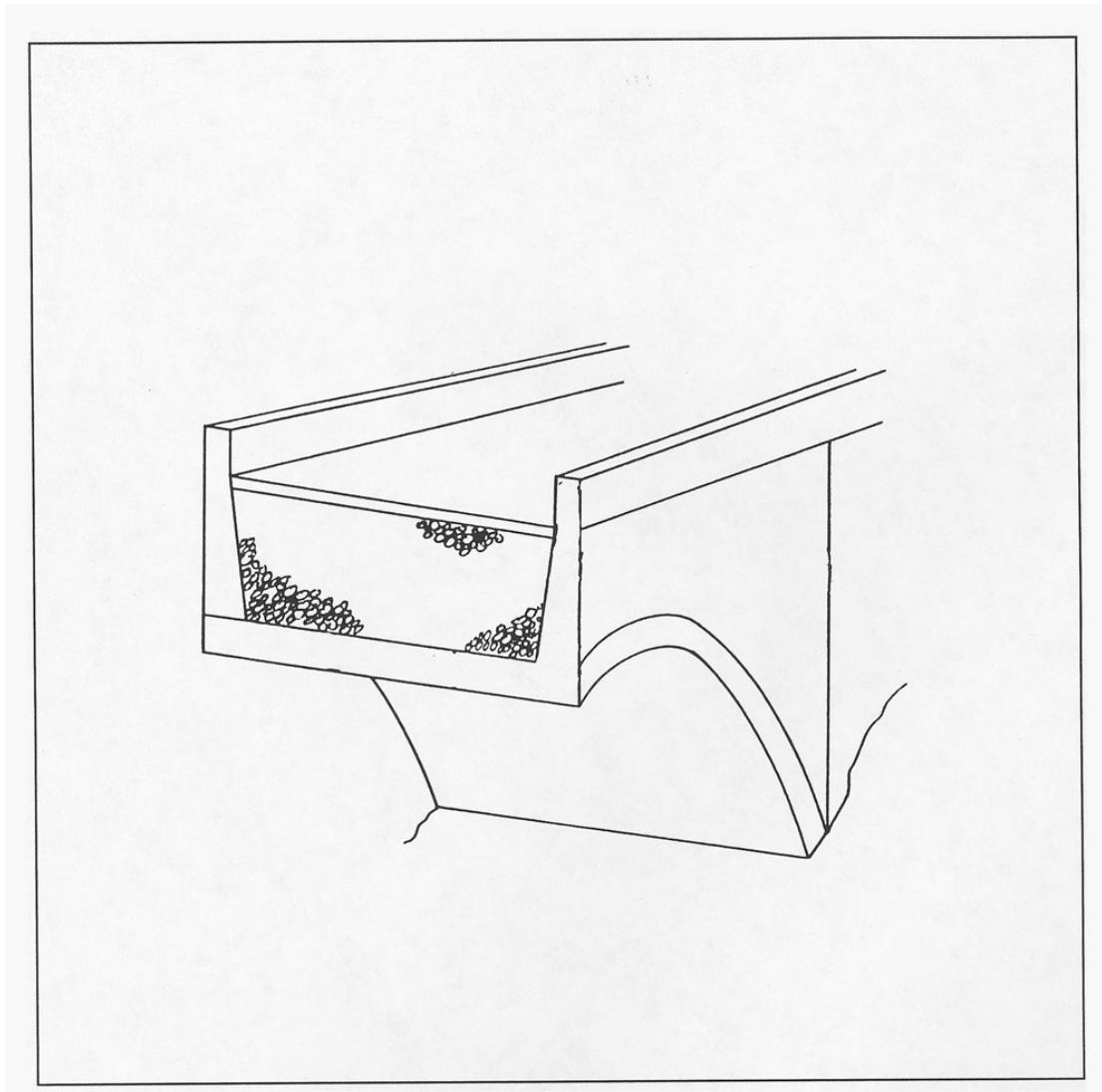


Figure 3.11. Section of closed spandrel concrete arch (Adapted from: FHWA 1991: 9-17).