

## 3.2 CONCRETE SMALL STRUCTURES

### Historical Overview

After 1900, concrete came into common use throughout the United States and in Maryland as a construction material for bridges and small structures. Reinforced concrete technology grew steadily through the first three decades of the twentieth century and became the most widely used material for bridges and small structures. Concrete provided a more maintenance-free and long-lived alternative to the small timber structures of the nineteenth century.

The growing sentiment for the use of concrete for transportation structures during that era is well illustrated in an early twentieth century report of the Virginia State Highway Commission, subtitled *Highway Bridges and Culverts*:

*. . . timber bridges must be discarded except for locations where lumber is abnormally cheap and traffic is abnormally light. Steel beam bridges of short span with their perishable timber floors are recommended only where the erection gangs are too ignorant to handle reinforced concrete in the right way. Reinforced concrete must be accepted as the economic solution of the problem of the short highway span bridge up to spans of twenty feet. For strength, for durability, for true economy these bridges excel all others* (Miller 1996: 13).

During the first years of the twentieth century, the Geological Survey's Reports on the Highways of Maryland are full of references to replacing old wooden structures with "permanent" concrete structures. The Baltimore County Roads Engineer reported to the Geological Survey in 1903 that the Sherwood Bridge, the first reinforced concrete bridge in the state, had been completed. According to his report:

*What is known as the steel concrete form of construction was adopted, which used reinforced concrete beams instead of simple steel or wooden beams as in other forms of construction; this is the first example of its type in the state. Steel rods are imbedded in the concrete beams to enable them to withstand heavy loads . . . This bridge has a clear span of 25 feet* (Johnson 1903: 169).

Also in the 1903 report are numerous mentions of concrete culverts, including a photograph of an arched concrete culvert with concrete wingwalls and abutments. According to the caption under the photograph, the culvert was built at the foot of Wilson's Hill in Prince George's County. Under the two photographs on that page, in bold, is the caption "roads built under plans and specifications of the Geological Survey" (Johnson 1903: Plate IX). The accompanying text states that the concrete for the culvert was made from sand and gravel in the vicinity (Johnson 1903: 183).

Walter Wilson Crosby, Chief Engineer of the Geological Society, in discussing the county roads being improved under the Shoemaker Act, reported in 1906 that:

*The reconstruction of practically every wooden bridge has been a necessity in order that it might support the steam roller or the traffic . . . The general plan has been to replace these with pipe culverts or concrete bridges and thus forever do away with the maintenance of expensive and dangerous wooden structures (Crosby 1906: 378-79).*

By 1912, the newly-formed State Roads Commission joined a growing number of state highway departments in developing standardized plans for their bridges and small structures. Maryland's Standard Plans included designs for concrete culverts and concrete box, slab and girder structures. The small structure designs were for spans in increments of 2 feet from 6 feet to 18 feet in length. The 6-foot to 16-foot spans were slab structures while the 18-foot length was a girder type structure. The 1912 Standard Plans specified both reinforced and plain concrete and provide ratios for mixing the concrete. A plain parapet rail was shown on the plans.

Revised Standard Plans came out in 1919 and had a separate plan sheet for the slab and girder designs. Again, the 18-foot length was a girder. These Standard Plans include an incised parapet rail in which the number of incised panels increased with the length of the structure. No designs for box bridges or culverts were shown in the 1919 plans.

In 1924, the State Standard Plans included designs for slab bridges from 6 feet to 20 feet in increments of two feet. Girders were no longer included in the Standard Plans for small structures. Like the 1919 plans, the designs included an incised parapet rail with the number of panels increasing with the size of the span. The 1924 plans also included a standard design for slab abutments that featured horizontal scoring in the concrete abutments and wingwalls.

In 1928, the State Roads Commission developed an open rail balustrade called the "standard open handrail." In 1930, standard small structure plans utilized the open balustrade for the 6-foot to 18-foot slab structures. The plans include an isometric view of a slab structure with the standard open handrail and abutments with horizontal scoring. The 1933 Standard Plans for small concrete structures specified concrete slab designs for structures from 6 feet to 18 feet in length, horizontally incised abutments and wingwalls and the open balustrade design that was introduced in the Standard Plans of 1928.

Between 1935 and 1945, the Reports of the State Roads Commission contained several mentions of the use of stone for facing on concrete structures either to simulate the "old stone bridges" of the early nineteenth century or to enhance the appearance of a modern structure in a visually sensitive location. The 1935-36 State Roads Commission Report mentioned one bridge project where "it was considered desirable to face the exterior surfaces of the bridge with granite, resembling the appearance of a masonry arch" (Maryland State Roads Commission 1937: 52). A decade later, references to the importance of the appearance of a structure and its "architectural fitness" to its location were discussed in the project to relocate the Frederick-Hagerstown Highway. Masonry structures were deemed fit because stone was in the character of the early National Road structures and because it blended with the natural rock outcroppings of the area (Maryland State Roads Commission 1947: 56).

The concrete slab structure, along with some girder structures and box culverts, was widely used on state highways throughout Maryland (and most assuredly on roadways of cities and counties) up through World War II. State Roads Commission reports of the pre-World War II era repeatedly mention the use of slab construction for small structures.

The concrete rigid frame, another type occasionally used for construction of small structures, was developed after World War I but was not widely used in Maryland until after World War II (little road building occurred during World War II, except for construction of access roads for defense facilities). Preliminary research indicates that Maryland has some rigid frame small structures. The State also has a few concrete arches extant but that type was apparently not widely used for small structures. Types of known small concrete structures in Maryland, which are discussed individually on the following pages, include<sup>1</sup>:

1. Concrete Slab
2. Concrete Box Culvert
3. Concrete Girder (beam)
4. Concrete Arches and Arched Culverts
5. Concrete Rigid Frame

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<sup>1</sup> Concrete pipes are discussed in the "Pipes" section of this chapter.