SMALL STRUCTURES ON MARYLAND'S ROADWAYS

HISTORIC CONTEXT REPORT

Prepared For

Maryland State Highway Administration
Maryland Department of Transportation
Baltimore, Maryland

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ABSTRACT

This report was prepared by Cultural Resource Specialist Margaret Slater and Planner Nancy Skinner of Parsons Brinckerhoff Quade and Douglas (PB) at the request of the Maryland State Highway Administration Office of Planning and Preliminary Engineering. John Wisniewski, PB Structural Engineer, assisted in the preparation of the report.

The purpose of the report is to present a historical context for small structures on Maryland's roadway system; small structures are those with a total length of less than 20 feet. The context was developed to provide materials to assist in the assessment of the eligibility of small structures for the National Register of Historic Places and will facilitate Section 106 consultation regarding these structures. The report contains: 1) historical overview of the development of Maryland's roadway system focusing, when possible, on small structures; 2) discussion of the types of small structures found on Maryland's roadways; and 3) guidance for assessing the state's small structures for National Register eligibility.

The report identifies two significant historical contexts for small structures: the first halves of both the nineteenth and twentieth centuries.

Within the two defined periods of significance, only certain types of small structures are potentially individually eligible for the National Register. Masonry arched structures built during the first half of the nineteenth century could be eligible for the National Register under Criterion A for their association with development of the state's early turnpikes and the National Road and under Criterion C as examples of masonry arched construction. The structures must possess sufficient integrity to convey their period of significance. Surviving examples of masonry construction from this era are few in number. (Although there is no current evidence of the existence of such structures, pre-1800 structures could be eligible for the National Register under Criterion C as examples of early Maryland roadway structures and possibly under Criterion D for the information that could be gleaned from them concerning pre-1800 construction techniques of roadway structures.)

Selected concrete structures built in the first half of the twentieth century could be eligible for the National Register. These include early twentieth century arches and arched culverts as well as concrete structures built according to the Standard Plans adopted by the State Roads Commission between 1912 and 1933. The concrete arches and arched culverts built during the first decade of the twentieth century are examples of experimentation with concrete for roadway structures, a development significant in structural engineering, and they could be eligible if they retain a high level of integrity. Certain concrete structures built according to the Standard Plans are also potentially eligible for the National Register under Criterion C, as examples of the trend to standardize designs for small structures. Structures such as Standard Plan concrete slabs and girders, if they possess a high degree of integrity, could be eligible for the National Register. The box culvert, another concrete Standard Plan structure, is not eligible for the National Register because there are thousands of extant examples and because they are essentially non-descript and very hard to date. Although not individually eligible for the National Register, a box culvert could be a contributing component of a historic district if it retains sufficient integrity to convey the district's period of significance.

Both timber and metal beam structures were included in the 1933 Standard Plans. If timber or metal beam structures are identified that were built according to the Standard Plans, they could be individually eligible for the National Register. Both timber and metal beam structures could be considered contributing elements of a historic district if they possess sufficient integrity and date within the district's period of significance.

Other types of small structures discussed in this report are not individually eligible for the National Register because they do not fit within the significant historic contexts identified for small structures. These are the concrete rigid frame structure which, although not individually eligible, could be a contributing element of a historic district and pipes. Pipes are perhaps the most widely used small structure on Maryland's roadways and would neither be individually eligible for the National Register or eligible as a contributing element within a historic district because they are ubiquitous and possess no technological significance.

1.0 INTRODUCTION

Purpose

The purpose of this report is to present a historical context for small structures on Maryland's roadway system. The context will provide sufficient materials to assist in the assessment of the eligibility of small structures for the National Register of Historic Places and will facilitate Section 106 consultation regarding these structures. The report contains: 1) historical overview of the development of Maryland's roadway system focusing, when possible, on small structures; 2) discussion of the types of small structures found on Maryland's roadways; and 3) guidance for assessing the state's small structures for National Register eligibility.

A 1995 report prepared for the State Highway Administration (SHA) entitled *Historic Highway Bridges in Maryland: 1631-1960: Historic Context Report* (Spero 1995) provides a context for the state's historic bridges. The Spero report provides an excellent context that relates the history of transportation in Maryland to bridge construction. The report does not, however, address small structures as a group and consequently provides insufficient data to assist in Section 106 consultation regarding small structures.[1]

What is a Small Structure?

The small structures addressed in this report are those with lengths of less than 20 feet. In Maryland today, roadway structures under 20 feet in length are often referred to as "culverts" whether they are subsurface drains or simply small bridge structures that span narrow waterways. Historically, however, culverts referred only to subsurface road drainage systems. Culverts were distinct from small structures that functioned as bridges, carrying traffic loads and having a clear, open span above a waterway.

In the nineteenth century, references in various governmental reports were made to culvert construction and repair on the National Road in western Maryland. A road inspector in 1833 wrote concerning the National Road that "the culverts are too few and small . . . culverts 2' x 3' should be constructed at convenient distances to carry off water" (Searight 1971: 70). These early small drainage structures were probably built of stone (Figure 1.1).

In the first decade of the twentieth century, the Maryland Geological Survey (Geological Survey), which evolved into the SHA, promoted replacement of old wooden structures with "permanent bridges and culverts" (Crosby 1905-06: 346). Their first published annual report provided an estimate of the money that had been spent on bridges; the estimate included the cost for "culverts and smaller drains" (Johnson 1899: 205). The report also described culverts as tile pipes laid across and under the roadway (cross drains) with a headwall at each end (Johnson 1899: 274). In the 1905-06 report of the Geological Survey on highways in the state, Highway Engineer A. N. Johnson reported on plans to replace the old wooden structures "with pipe culverts or concrete bridges

[1] For more information on transportation history in Maryland and on the State's bridges, refer to the Spero report, which is on file at the Maryland State Highway Administration and the Maryland Historical Trust. Relevant portions of the report are summarized and referenced in this report.

and thus forever do away with further expense for the maintenance of expensive and dangerous wooden structures" (Crosby 1907: 379).

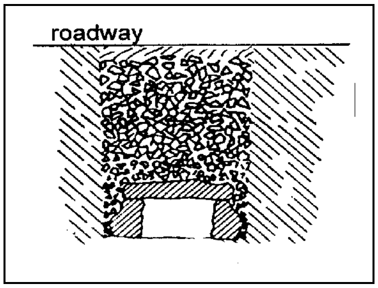

Figure 1.1. Drawing of stone culvert (Adapted from Johnson 1899: 275, Figure 10).

Following the trend of other states, during the first decade of the twentieth century Maryland began development of standardized bridge and culvert plans for newly-built or replacement structures along the state's roadways. The first plans (Standard Plans) were issued in 1912 by the Maryland State Roads Commission. In the Standard Plans issued between 1912 and 1933, culverts were subsurface drainage structures that did not directly carry traffic loads. Examples are the reinforced concrete box structures such as the "steel-concrete culvert" of 1912 and the "box culvert" of 1931. The structures in the Standard Plans that did directly support traffic loads and featured a clear open span above a waterway were called "bridges," even for those spans as short as six feet. Figures 1.2 and 1.3 illustrate, respectively, a subsurface pipe culvert that does not directly carry traffic loads[2] and a small bridge over a waterway that does directly carry traffic loads.

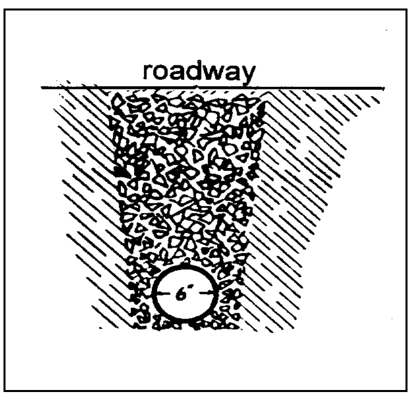

Figure 1.2. Drawing of a culvert (Adapted from Johnson 1899: 275)

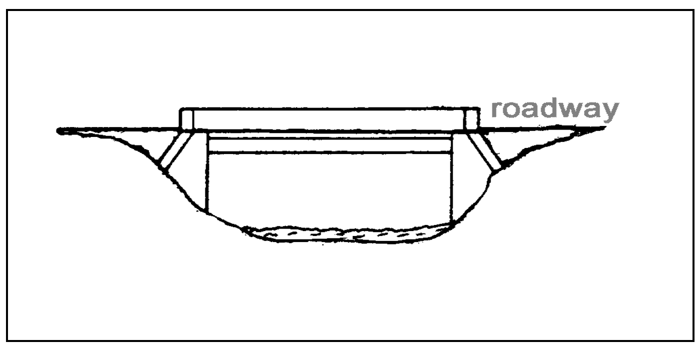

Figure 1.3. Drawing of a small bridge.

[2] The fill, between the top of the structure and the road, helps support and distribute the load.

The general perception of culverts as subsurface drainage structures that do not directly carry traffic loads and of bridges as structures that provide a clear open span (or spans) above a waterway and have load-carrying decks at or just below the road-level persisted until the late 1970s. In 1979, the Federal Highway Administration (FHWA) adopted the 20-foot or greater parameter in its bridge definition for the National Bridge Inspection Standards.[3] Structures less than 20 feet in length were often considered "culverts" regardless of whether they were subsurface road structures or small "bridges." The 1979 Federal Highway Administration *Bridge Inspector's Training Manual* defines culverts as:

> *A small bridge constructed entirely below the elevation of the roadway surface and having no part or portion integral therewith. Structures over 20 feet in span parallel to the roadway are usually called bridges, rather than culverts; structures less than 20 feet in span are called culverts even through they support traffic loads directly* (US Department of Transportation 1979: G-13).

This definition left a structure with a 20-foot span defined as neither a bridge or a culvert. In 1983, the 20-foot structure was addressed by the American Association of State Highway and Transportation Officials (AASHTO) who defined culverts in their *Transportation Glossary* as "any structure under the roadway with a clear opening of twenty feet or less measured along the center of the roadway" (AASHTO 1983: 19). (The 1991 *Bridge Inspector's Training Manual* again defined a bridge as a structure "having an opening of more than 20 feet" [USDOT 1991:A-1]).

Although AASHTO considers structures with total lengths of 20 feet to be culverts, for the purposes of this report, all structures on Maryland's roadways that are less than 20 feet in length are considered "small structures" and structures 20 feet or over are considered "bridges." This parameter is used because the state uses the 20-foot and over parameter to define bridges in their state-wide bridge inventory. In the historical discussions contained in this report, however, the term "bridge" is often used even for structures under 20 feet. The term "bridge" in these cases is included according to its historic usage. A good example of this is the State Roads Commission references to slab structures with spans as short as 6 feet in the Standard Plans as "bridges."

The small structures on Maryland's state highways are enumerated in the SHA Office of Bridge Development's Small Structures Inventory, currently about 90 percent complete.[4] County and city bridges that are not on the state highway system are not included in the state's inventory; instead, each county maintains its own inventory and follows the

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[3] Only bridges are eligible for FHWA bridge replacement funds. These bridges must be inspected and made part of the National Bridge Inspection Inventory. Structures having a span of less than 20 feet may be included on a state's bridge inventory but they are not eligible for FHWA bridge replacement funds. Consequently, state highway departments often inventory and address structures that are less than 20 feet (small structures) separately, as does Maryland's State Highway Administration.

[4] Other structures that do not meet the definition of "culverts," such as retaining and noise walls, are also included in the state's Small Structure Inventory. At the instruction of the SHA, these other structures are not discussed in this report.

state's lead of classifying all structures 20 feet and over as bridges and those under 20 feet as small structures.

2.0 HISTORICAL OVERVIEW: SMALL STRUCTURES ON MARYLAND'S ROADWAYS

Introduction

P.A.C. Spero's 1995 report, *Historic Highway Bridges in Maryland: 1631-1960: Historic Context Report* (Spero 1995) prepared for the Maryland State Highway Administration (SHA), includes a detailed discussion of the development of Maryland's roadway network and the history of the state's bridge building activities. This chapter builds upon the discussions contained in that report, to focus on the development of small structures on Maryland's roadways. While many of the existing significant bridges discussed in the Spero report are complex in design and were built almost entirely by the State of Maryland, the remaining smaller bridge structures covered by this report are uncomplicated and could have been constructed by relatively unskilled labor using locally available materials.

Historically, as people needed to cross streams and rivers for commercial or personal endeavors, they devised some type of bridge according to the materials and skills at hand. The earliest bridges were probably crude and simple spans over the narrowest stretch of water. These early bridges most likely consisted of trees cut to fall across streams or stone or wood slabs laid across piles of rocks. As technology improved, bridge design and construction became more sophisticated, longer spans were feasible, and crossings were placed in more convenient locations for travelers. The second half of the nineteenth century and the and early twentieth century saw tremendous advances in the technology of bridge building, with the evolution of more durable materials, the development of standard plans for simple spans, and the growth of a cadre of specialized bridge engineers and highway departments at both the state and local level.

The design of small structures has benefited from the technological advances of the nineteenth and early twentieth centuries, in particular the introduction of reinforced concrete. Early in the twentieth century, Maryland's State Roads Commission developed a series of standardized designs (Standard Plans) for small structures such as box culverts and concrete slabs for use on state highways. These plans were also available to counties and cities for their use, and there are examples of small structures based on the Standard Plans found on roads throughout the state. Up through the end of the 1940s, however, the design and construction of small structures on county and local roads continued to be less regimented than those on state road projects. In general, county and city road departments were constrained by limited budgets, which in turn affected the designs and types of materials that could be used for the structures. The State Roads Commission Report for 1947 and 1948 noted that "in the design of county road projects, the aforementioned policies and desirable standards are tempered with good judgment in order to arrive at a structure within the budget of the county and which will be consistent with the traffic expected to use the facility" (Maryland State Roads Commission 1949: 62).

The significance of roadway structures, in particular small structures, is not in what they are, but in what they do. They are a part of an extensive transportation network that permits people to move between home, jobs, school, medical and social activities and myriad other purposes. They may be described as "work horse" structures, with the materials or design rarely deviating from the common practice, thus saving time and money. They are not “large expensive sculptures erected primarily for aesthetic purposes, [rather] they are important because of their usefulness within larger systems that support social, cultural and economic development. At the root, bridges . . . are built to serve practical utilitarian functions, and usefulness is the essence of their existence” (Jackson 1988: Preface).

This chapter examines several historical themes in the development of the road system and the role of small structures in Maryland from the colonial era to the immediate post-World War II era, when the state geared up for a massive overhaul of its roads and bridges. The influence of the state’s geography and topography are briefly reviewed, followed by an examination of the historical development of the road system with particular emphasis on small structures. Topics discussed are the influences of colonial and state legislation affecting road building; the era of internal improvements and the Good Roads Movement, the rise of state-level highway organizations in the 1890s and early twentieth century, the influence of standard plans and the use of relief and prison labor for construction of state and local road projects.

Geography and Topography

Maryland’s diverse geography has played a significant role in the development of the state’s transportation network. The state extends from the Delmarva Peninsula on the Eastern Shore to the Appalachian Mountains in the west. It can be divided into three physiographic regions: the Coastal Plain, the Piedmont Plateau and the Appalachian Region (Figure 2.1). Within the Coastal Plain are two major divisions: the Eastern Shore and the Western Shore. The Eastern Shore is characterized by flat terrain and wide river channels that drain into the extensive marshes of the Chesapeake Bay. The Western Shore features sharp variations in terrain, ranging between 100 and 280 feet, with deep stream channels and sharp divides. The major watersheds draining the Western Shore are the Potomac, Patuxent, Patapsco and Gunpowder Rivers with their tributary streams. The traditional course of highway construction on the Western Shore, at least to the early part of the twentieth century, was along the major divides of the watersheds in order to minimize construction grading.

The Piedmont Plateau, extending from the Coastal Plain to the beginning of the Appalachian Mountains, is divided by Parr’s Ridge, which is the nominal headwaters of the Gunpowder, Patapsco and Patuxent Rivers. East of Parr’s Ridge, these swift rivers cut through broad, fertile valleys. The Monocacy River Valley dominates the western division of the plateau region. Roads in the Piedmont have traditionally been influenced by the topography of the region. In the eastern division, roads traditionally ran along the divides, through the broad valleys and at the bottom of the river channels. Roads in the western division either followed the divide or cut across the valley.

The Appalachian Region, in the westernmost portion of the state, consists of a series of parallel mountain ranges with deep valleys, bisected by the Potomac River. The mountain ranges, running in essentially a north-south direction, have affected the location of transportation routes. Most of the important early land routes followed the

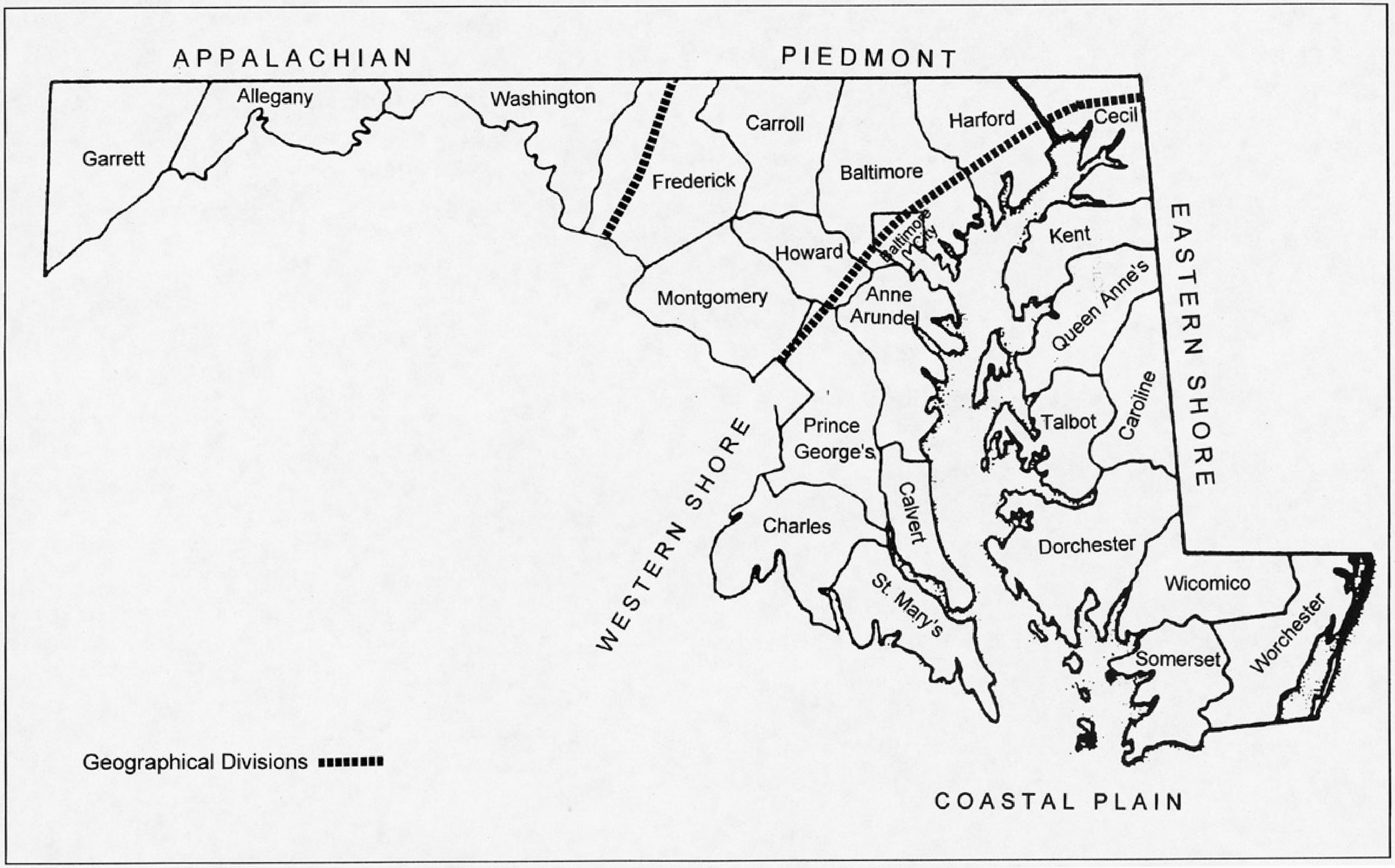

Figure 2.1. Map of Maryland showing geographical divisions and counties.

river valleys, thus in a north-south direction. The National Road, however, was built to serve as an east-west connector, running across the mountain ridges and into the western portion of the state. Other, less important, east-west roads crossed the mountains through the low divides or along the major waterways that flowed through the Appalachian Mountains of Maryland.

Maryland's landscape is dissected by countless small streams and rivers and, since the colonial period of settlement, this feature has necessitated the construction of numerous large and small structures to facilitate overland travel. In general, the geography and topography of each section of the state has historically influenced the choice of materials used for the foundations and superstructures of bridges and small structures: stone structures with foundations on rock were more prevalent in the Appalachian and Piedmont divisions, while timber structures with predominately timber piles were typical on the Coastal Plain (Spero 1995: 8). Since the early years of the twentieth century, however, with the advent of modern materials such as reinforced concrete and steel and the implementation of standard plans for small structures, geography has been less of an influence on types of construction and appearances of small structures.

For more detailed discussions of the topography and geology of the state and its relation to road-building activity, please refer to P.A.C. *Spero's Historic Highway Bridges of Maryland: 1631-1960, Historic Context Report* (Spero 1995: 3-8), and to the essay by Arthur Johnson in the *Report of the Highways of Maryland*, produced by the Maryland Geological Survey in 1899 (Johnson 1899: 192-196).

Early Transportation Networks 1631 to 1800

The earliest routes of travel in Maryland followed the courses of least topographic resistance. The many navigable rivers and streams of the vast Chesapeake watershed were known to the native Americans prior to European settlement and constituted the primary means of access into most parts of Maryland below the fall line during the settlement and early colonial eras (Spero 1995: 8). Indian trails for overland travel between the heads of streams and rivers were also used by early settlers, and have formed the basis of several modern transportation routes.

The earliest European settlements in Maryland were along the Atlantic coastal areas and the settlers, like the Indians before them, depended upon horses and canoes for travel. This initial dependence on waterborne transportation prevented the immediate development of crossroads settlements. Horse-drawn wheeled vehicles came to prominence once colonists began to settle away from the water's edge. The transition from packhorses to wheeled vehicles necessitated the construction of permanent river and stream crossings in the form of ferries and bridges.

Early Road Acts

As early as 1637, Maryland's Colonial Assembly acted to facilitate transportation among the many farms and towns, beginning with an act for public ports, that Lord Baltimore refused to approve (Spero 1995: 9). Most of the earliest transportation acts related to ferries and waterborne transportation, but while navigation remained an important aspect of travel in Maryland, the patterns of settlement increased the need for official regulation of road-building activity. The Colonial Assembly passed Maryland's first comprehensive general road law in 1666. This act delegated to the County Courts or Commissioners the responsibility to lay out a highway system that would make the heads of rivers and creeks "passable for horse and foot." The Act also provided for the appointment of overseers by each county to build and maintain the roads, a tax against the colonial inhabitants that could be paid in tobacco or in labor, fines for non-performance and a system of marking the roads. Thus, Maryland's road law of 1666 established the policy of the individual counties being responsible for building and maintaining all roads within their borders, a policy that generally continued to the early twentieth century. A system of roads paid for entirely by the state was not developed until after the establishment of the State Roads Commission in 1908 (Leviness 1958: 2-3).

A new general road law was passed in 1696. In addition to setting up a province-wide system of road marking and requiring for the first time that public roads be cleared and grubbed to a 20-foot wide travelway, the 1696 colonial law required that "good and substantial bridges" be constructed over the heads of rivers, creeks, branches and swamps, at the discretion of the county justices of the peace (Spero 1995: 9-10). This law, repassed in 1704 and subsequently amended, became the basic road act of colonial and early post-colonial Maryland. Leviness, author of the *1958 History of Road Building in Maryland* noted that this law appeared not to consider travel by wheeled vehicles as a viable mode at that time (Leviness 1958: 3).

There is little evidence of the construction methods or materials of these "good and substantial" bridges, although it seems safe to assume that most were of timber. Strong evidence concerning the prevalence of simple timber beam bridges in early eighteenth century Maryland comes from a 1724 colonial Maryland law that gave the county road overseers the right to use any suitable trees on adjacent lands in order to build or repair any bridge maintained at a public or county expense; the use of trees fit for making clapboards or cooper's timber was, however, excluded (Souissat 1899: 121). The Act noted that "the several bridges that have been heretofore over the heads of rivers, creeks, branches, swamps, and other low and miry places, are very much broken and out of repair, and several new bridges are still wanting" (Spero 1995: 11). The heads of such waterways were generally the narrowest location at which a crossing could be made, thus, it can be assumed that many of these bridges were probably small structures. Not until 1795 did the State of Maryland agree to provide compensation to the adjacent land owners for the confiscation of timber used in building and repairing public bridges.

In 1794, the General Assembly of the new state of Maryland revised the general road law of the state, leaving most of the road work in the hands of the counties, but setting up a system of County Levy Courts to govern specifically the construction of public roads and bridges. According to this law, bridge repairs were to be performed by laborers hired by the courts, except in cases involving "framed or arched bridges exceeding fifteen feet in length" (Kilty 1808: November 1794 Session, Chapter 25). Spero observes that this legislation is an early recognition that the construction and maintenance of longer or more complicated bridges might involve more expertise than the average laborer would possess (Spero 1995: 15). The average laborers at this time consisted of both free men and slaves. It can be implied from the wording of the law that small structures under 15 feet were generally built using laborers hired by the county courts. The wording also seems to imply that many structures were fairly small, 15 feet or less in length.

The 1794 act also permitted County Levy Court justices to raise taxes for new bridge construction (up to 100 pounds) or repair (up to 30 pounds annually for a single bridge). The law also required cooperation between adjoining counties for building or repairing bridges over county lines; such bridge work was to be contracted out to workmen through a process of bidding and receipt of proposals (Spero 1995: 15).

Other legislation pertaining to Maryland's transportation network at the end of the eighteenth century consisted of legislative chartering of private bridge companies and canals. Over the course of the century personal and commercial travel modes in Maryland had evolved from primarily horses and foot travel prior to the Revolutionary War to include substantial volumes of wheeled traffic after the war. The need for improved avenues of travel was apparent.

Transportation Improvements in the Nineteenth Century

In the post-colonial era, a wider variety of travel modes and routes helped to open up the new country. Spero has described the primary themes in the transformation of travel in the nineteenth century and their affect on bridge building in Maryland: private toll roads or turnpikes, the National Road, canals and railroads, and the Good Roads Movement.

Turnpikes

Turnpikes were quite simply roads on which a toll was required for passage; the term comes from the bar or gate that was suspended over the road. Durrenberger observed that the feature that differentiated turnpikes from other roads was the directness between destinations (Durrenberger 1931: 84-85). Spero explains that "turnpiking" a road meant either straightening, rebedding or resurfacing an old dirt road with some combination of gravel or stone or surveying and laying out a new road in order to take advantage of the terrain (Spero 1995: 16). The innovative practices of stone surfacing and road drainage, as developed by British engineers Thomas Telford and James McAdam, were first applied in this country to the construction of turnpikes (Spero 1995: 16).

Leviness explained in his 1958 *History of Road Building in Maryland* that the turnpikes filled a void at the time when stone roads were needed to promote commerce in the new nation but the citizens were not yet ready to appropriate the money needed to build high quality roads (Leviness 1958: 29). Thus various state legislatures chartered a number of private companies to build hard roads and maintain them by charging tolls. The charters often specified how the road was to be laid out, specifying, for example, that no bridges and culverts should be less than 20 feet wide. The companies were directed to build "good and sufficient bridges" where necessary on the turnpikes (Durrenberger 1931: 85, 91). In 1818 Maryland's Governor Goldsborough prepared a progress report on the status of the turnpikes chartered by the Maryland General Assembly, which provides some insights into the types of bridges that were built. Spero notes that the governor's report documented the use of simple timber beam structures as well as stone arch bridges (Spero 1995: 18). The stone bridges were built primarily in the

Appalachian and Piedmont regions, reflecting "a growing popular demand in those areas for sturdy structures able to withstand the pressures of frequent wagon traffic as well as the force of water, ice, and flood debris along streams and rivers with moderate or high slopes" (Spero 1995: 19). Conversely, the preferred building material for turnpike bridges in the Coastal Plain was timber. The geographical preference for building material was based on the availability of local materials and environmental factors (i.e. stone was readily available in the western areas of the state where the soils were thin and rocks were near the surface, and timber was preferable in the east where the clay soils were very thick and wet).

National Road

The National Road was the first federally built highway in the United States. Its original purpose was to connect Cumberland, Maryland with the new state of Ohio, although the State of Maryland encouraged the construction of turnpikes to link the National Road with Baltimore via Hagerstown and Frederick. The National Road was originally built between 1811 and 1818, under the supervision of US Army topographic engineers (the Corps of Engineers), and was maintained by the Federal government from 1818 to 1835, when the State of Maryland assumed control over its portion of the road in 1835. By 1878, when the Legislature transferred ownership over to Allegany and Garrett Counties, the National Road had been relegated to a secondary transportation route because of its poor condition and the increasing role of the railroad for commercial traffic.

Spero notes that the preferred bridge types on the National Road were semicircular stone masonry arches and culverts (Spero 1995: 20). This supports the observation above that stone bridges were most common in the Appalachian and Piedmont sections of the state.

Canals and Railroads

In the early nineteenth century two new transportation modes came to prominence in Maryland: canals and railroads. Although neither mode carried highway traffic, their use of civil engineers and innovative construction methods and materials influenced the improvements in construction methods for highway bridges and small structures in the late nineteenth and early twentieth centuries. Canals were constructed in the 1820s to serve as artificial commercial water routes; private canal companies were chartered by the state to construct and maintain the canals. The Chesapeake and Ohio (C&O) Canal connected Washington D.C. and Cumberland in the western portion of Maryland, and the Chesapeake and Delaware (C&D) Canal linked the Chesapeake and Delaware Bays in the eastern portion of the state. Bridges were integral parts of the canal system, but as Spero explains, the types differed for the two canals as a result of their geographic locations. Along the C&O, the canal was "spanned by dressed stone masonry arch bridges and was occasionally carried (as at the Monocacy River) by stone aqueducts" (Spero 1995: 21-22). Some surviving small bridges associated with lock complexes have been documented and recorded, although it is unlikely that these would fall under the definition of a small structure because of the canal width required for commercial water traffic. Along the C&D in the eastern part of the state, covered timber bridges spanned the canal. Probably few, if any, of the C&D bridges were small structures because of the wide river channels and estuaries in that part of the state.

In the 1830s railroads began to challenge canals for commercial traffic, and quickly outpaced them. The railroads provided a training ground for American civil engineers and led the way in the application of new bridge types and standard plans, and in the use of modern materials (metal) for bridge construction. Spero notes the Baltimore and Ohio Railroad demonstrated to the public that stone viaducts and then iron truss bridges would work if properly engineered (Spero 1995: 22).

State Oversight of Road Building

Throughout the 1800s, Maryland's General Assembly passed a variety of legislation affecting public and private roads and bridges, but the power and responsibility of public roads remained primarily with the counties. In 1818, the county courts were authorized to appoint on a regular basis three-person panels of viewers to inspect potential or proposed road and bridge locations and to examine whether "the public convenience requires it" (Sioussat 1899: 154). That law, amended and revised several times between 1853 and 1888, governed the counties' administration of public roads and bridges through the end of the century.

Although railroads dominated inter-regional and national travel and transportation through the end of the nineteenth century, Spero notes that the state's basic system of public county roads and private roads built to access farms or factory sites slowly expanded during the century under the patronage of the Legislature and county officials (Spero 1995: 25). By the end of the century, however, despite the advances made in materials and trained engineers, the majority of county roads in Maryland were largely unimproved dirt routes, which meant mud in wet weather and dust in dry weather, and most county bridges were one-lane wide and in need of repair (Leviness 1958: 39).

The Good Roads Movement

The last decade of the nineteenth century was a time of transportation reform efforts throughout the nation. The national Good Roads Movement, beginning in the 1890s, was an effort to improve the condition of local roads. It began essentially as a grass roots movement in rural areas of the country, where farmers and their families desired better roads for getting their products to market and for social interaction in general. The popularity of bicycling gave further impetus to the Good Roads Movement, as bicycling aficionados joined with the farmers in an unlikely alliance to demand smooth, all-weather roads.

The Maryland Road League (Road League), one of the numerous blue ribbon panels of civic leaders established during the reform period at the end of the nineteenth century, advocated for good roads and bridges in the state. Spero notes that the Road League recommended the establishment of a state engineering department that would assist the counties with the intention that each county eventually establish an engineer's office of its own to handle road and bridge matters (Spero 1995: 26). Along with the extraordinary coalition of farmers and bicyclists, the Road League lobbied the General Assembly for a study on the economic value of good roads.

The Maryland General Assembly had established in 1896 a small agency, the Maryland Geological Survey (Geological Survey), to investigate and report on the various types of geological material found in the state. With the demands of the Road League and the proponents of the Good Roads Movement, in 1898 the General Assembly instructed the Geological Survey to investigate and report back on "the question of road construction in this State" (Leviness 1958: 42). Thus the Geological Survey was designated as the agency responsible for state supervision of road-building activity. A Highway Division within the Geological Survey was created, and the office of Highway Engineer was established. The first State Highway Engineer was Arthur N. Johnson, who was previously on the staff of the Board of Highway Commissioners for Massachusetts and later became the dean of the School of Engineering at the University of Maryland (Leviness 1958: 42).

Pursuant to the 1898 legislative order, the Geological Society prepared and published in December 1899 the *Report of the Highways of Maryland*. This seminal report contained a comprehensive survey of road conditions in the state (by county) and a discussion of the relationship of topography, climate and geology to road building in the state. The portion of the report that was authored by Arthur Johnson provided insight into the method of construction and condition of the state's small structures. His report explained that "under the head of bridges is included not only bridges proper, but also culverts and smaller drains" (Johnson 1899: 205). He noted that bridges:

> *may be divided into three classes---wooden, iron and stone. The majority of the small bridges, with spans of up to 30 feet, culverts and drains are of wood. The shortest spans are a simple beam to which is nailed the flooring and rails. For spans from 10 to 30 feet, a simple triangular frame with a central tension rod or post forms the supporting truss [king-post or queen-post]. They are in various stages of repair varying from newly-built to those over which it is unsafe to ride* (Johnson 1899: 205-206).

According to Johnson's report, short iron bridges were rapidly replacing wooden spans, "some of which are of a flimsy construction" and that there were comparatively few I-beam bridges, which were "one of the cheapest and best forms for spans less than 25 to 30 feet" (Johnson 1899: 206). The report recommended as the most durable method of construction for small spans "the combination of masonry and I-beams, between which are transverse arches of brick, the whole covered with concrete, over which is laid the roadway" (Johnson 1899: 206). Spero observed that this recommendation constitutes the state's first official endorsement of concrete in bridge building, although there are no extant examples of the unreinforced concrete, composite arch and beam bridge as recommended in the 1899 report (Spero 1995: 26-27).

In addition to producing the report on road conditions as requested by the proponents of the Good Roads Movement, the Highway Division of the Geological Survey instituted a campaign to instruct county road supervisors in the fundamentals of proper grading and drainage and hammered hard at the economic advantages of good roads. The Geological Survey recommended a ten-year program of building all-weather roads, with the cost to be shared equally by the state and the counties. It also recommended the creation of a state highway commission as a mechanism to supervise the program (Leviness 1958: 44-46). Maryland did not adopt the concept of a state highway commission until 1908, and for the ten years between 1898 and 1908, the Geological Survey's Highway Division conducted a "considerable amount of testing and demonstration work and offered the services of a highway engineering organization to counties, cities and towns" (Maryland State Roads Commission 1930a: 10). Leviness asserted that the Geological Survey's main value was educational; through studies, press releases and building of model roads, it conducted a vigorous public relations campaign to promote good roads (Leviness 1958: 49).

Modern Transportation 1900-1948

Several trends in the first half of the twentieth century resulted in a dramatic improvement of Maryland's roads by the mid-century mark. The Geological Society and its successor, the State Roads Commission, promoted the concept of all-weather roads, a system of state-maintained roads, standardization of structural plans and roadway design and method of construction, and increasing specialization and professionalization of state and county road engineers. During this period, old roads and structures along the routes were widened and upgraded, and new roads, bridges and culverts were constructed.

The Good Roads Movement continued in Maryland into the early decades of the twentieth century. In 1904, the General Assembly passed the first significant statute that provided for financial aid and state supervision of road- and bridge-building activities. The Maryland State Aid for Highways Act is commonly referred to as the Shoemaker Act, in honor of Samuel M. Shoemaker of Baltimore County, who was instrumental in leading the march to "get Maryland out of the mud" (Leviness 1958: 46-47). The statute established an annual appropriation of $200,000 to build and upgrade county roads in order to create a system of modern macadam roads across the state. Counties would receive a share of the total appropriation in proportion to their public road mileage provided that they matched the state money on a fifty-fifty basis. This law thus doubled the amount of money each county could spend on road repairs without any additional tax levy for county residents.

Under the Shoemaker Act, each county selected the roads to be improved subject to the approval of the Geological Survey. Upon approval, the Highway Division conducted surveys, drew up plans and specifications, advertised for bids, awarded the contract to the lowest bidder and supervised the construction work. Upon satisfactory completion the road was accepted by the County Commission as a county road and the County Commissioners were required to maintain it in good repair. This is a significant step in the movement toward direct state supervision of roads in Maryland, but the counties continued to be the principal authority for building and maintaining the roadway network in Maryland. In 1906, however, the General Assembly enacted a law providing for the building of a state road, independently of the counties, the Baltimore-Washington Highway (State Road 1); this measure reflected a growing sentiment that some main thoroughfares in the state should be built by the state alone, while the counties could continue to build the less important roads (Crosby 1908: 33).

In the 1906 report on the State Highway Construction Program, Chief Highway Engineer Walter Crosby reported that the bridges on the roads that were being improved under the Shoemaker Act were found "in most cases to be in a very unsatisfactory condition" (Crosby 1906: 378). He explained that practically every wooden bridge had to be reconstructed so that it could safely support not only regular traffic but the steam roller used to improve the road. According to Crosby, the general plan was to do away with these "unsatisfactory and expensively maintained wooden structures" and replace them with pipe culverts or concrete bridges so as to reduce future expenses for maintenance. He noted that the Highway Division preferred these materials, although it had on two occasions approved the use of a steel bridge with wooden floors (Crosby 1906: 379).

State Roads System and the State Roads Commission

The proponents of the Good Roads Movement maintained the pressure for creation of a state highway commission that would have greater powers over roads and bridges. In 1908, Governor Austin L. Crothers, who has been called the father of the Maryland state roads system, came into office on a Good Roads platform. In that year, under his supervision, the General Assembly passed the State Road Act, providing for the selection of a comprehensive state-wide system of roads connecting all of the county seats, to be built and maintained at the sole expense of the state. The law also created the State Roads Commission to select the state road system and administer a $5 million, seven-year improvement program to construct and maintain the system (Leviness 1958: 51). This program marked the beginning of the shift in responsibility for road building from the counties to the state. The State Roads Commission and the Maryland Geological Survey operated in tandem for two years, from 1908 to 1910, at which time all highway functions of the Geological Survey were transferred entirely to the State Roads Commission.

The State Roads Commission assumed the charge toward greater professionalism in the design and construction of roads and structures in Maryland. In 1912, the State Roads Commission implemented the practice of placing district engineer offices in eight subdivisions or “residencies” across the state. A District Engineer was appointed to live at a central point within each district and to be responsible for overseeing the state road and bridge work in that district (Leviness 1958: 60). Throughout the first half of the twentieth century the State Roads Commission and its various divisions evolved to fulfill the purpose of creating a modern road system in Maryland. While the state’s system of roads was evolving, county road departments continued to bear substantial responsibility for building, repairing and maintaining roads, bridges and culverts on the local roads, which comprised the majority of the mileage in the state.

By 1915 the state road system envisioned in 1908 was completed, with a system of 1,304 miles of hard surfaced roads that were passable twelve months of the year and connected all county seats. This system was comprised of newly constructed roads as well as previously constructed county roads and former toll roads or turnpikes (Maryland State Roads Commission 1930a: 11-12). Then came World War I, during which the heavy-load traffic passing through the state to the numerous shipbuilding yards, proving grounds and military centers on the East Coast caused substantial damage to the state’s roads and bridges.

Standard Plans

By 1912, the concept of standard plans for bridges and culverts had taken hold in Maryland. At that time the Department of Surveys under the State Roads Commission prepared standard plans for bridges with spans up to 36 feet in length. The theory was that the District Engineer would investigate the proposed bridge location, then refer to the standard plans and select the type of foundation that would fit the location and conditions. Plans were developed for box culverts and for bridges as small as a 6-foot span, and for spans increasing in size by two-foot increments up to 36 feet. These standardized plans greatly simplified the work of engineers on smaller roadway structures (Maryland State Roads Commission 1916: 79).

The standard plans were revised in 1919, 1924, 1928, 1930, 1931 and 1933, each with notable differences such as the width of the roadway and the type of rail. (The 1912-1933 Standard Plans for small structures are in the Appendix to this report). No further standard plans were developed after 1933. There is no evidence, however, to indicate that the latest plans were not used through the 1940s, by either the state or the counties for small structures, particularly during the war years when skilled labor and structural materials (e.g. steel) were scarce.

By the end of the 1940s, the design of county road projects continued to be less regimented than state road projects. The State Roads Commission's biennial report for 1947-48 admonished that the application of the standards and policies promoted and used by the state highway department to individual county road projects must consider the county's available funding and the volume and type of traffic expected to use the facility. Although more modern materials had been proven more efficient and durable, the report noted that timber structures continued to be widely used in bridges on purely county or local highways (Maryland State Roads Commission 1949: 46).

State Programs of the 1920s and 1930s

Following World War I, the state proceeded vigorously to rebuild the roads and structures that had been damaged by defense-related traffic. A general re-appraisal of Maryland's bridge system found most bridges and small structures, like most roads at the time, to be too narrow and weak for the increasing traffic resulting from the greater availability of personal vehicles. To respond to those problems, the State Roads Commission developed a long-range program of bridge replacement and reconstruction. This program was carried out through the 1920s and 1930s.

A separate Bridge Division within the State Roads Commission was established in 1920 to oversee the expanded bridge program. One of the top priorities was the replacement of the many narrow, timber structures built in the nineteenth century; these single-lane bridges and small structures were so narrow that vehicles could not pass each other on them (Leviness 1958: 129-132). Among the "one-way and dangerous bridges" that the State Roads Commission reported as being replaced during the period from 1924 to 1926 was a 9-foot reinforced concrete slab bridge over Ballenger Creek on Jefferson Pike in Frederick County (Maryland State Roads Commission 1927: 61). It was through this program that many of the state's pre-twentieth century small structures and culverts were either torn down and replaced or repaired beyond recognition of their original form. An explanation of the state's policy toward the older structures was provided in the 1927-1930 Report as follows:

> *Until recently it has been the natural and appropriate policy of the State Roads Commission to embody the old bridges [on former county roads] as part of the State Roads System, as these bridges were, until recent years, fully adequate for the needs of traffic. With the rapid increase in automobile traffic and the increasing loading of trucks and buses, a*

> *number of these bridges each year have become inadequate for the present day traffic* (Maryland State Roads Commission 1930a: 61).

In 1933, the General Assembly passed the County Road Act, which gave counties the option to maintain their roads from local tax levies or to turn over such roads to the State Roads Commission for maintenance (Maryland State Roads Commission 1934: 68). Twenty of the state's 23 counties opted to take advantage of this opportunity to reduce their local tax rates. In the first two years of the County Roads Maintenance Program, "several hundred wooden structures, both bridges and culverts," were rebuilt or replaced at state expense; other roadway activities conducted under this program were the replacement of small wooden bridges by corrugated metal pipes, ordinary repairs and maintenance to bridges, clearing inlet and outlet ditches, construction of drainage structures and the scraping and painting of steel bridges (Maryland State Roads Commission 1934: 68-72).

Included in the activities reported by the State Roads Commission during the 1937-38 period were the construction of several county bridges in Frederick and Allegany County using steel beams and timber floors, and design of numerous small slab bridges and box culverts of varying sizes on the state roadway system (Maryland State Roads Commission 1939: 84). Since the final set of Standard Plans were issued only four years earlier in 1933, it is quite likely that the bridges and small structures referenced in the 1937-38 Report were constructed according to the Standard Plans. One configuration in the 1933 Standard Plans for structures up to 20 feet in length specified a timber structure for secondary roads only, which included most county roads. The discussion on the County Road Maintenance Program in the 1937-38 State Roads Commission Report also notes that the program has been one of the commission's most unsatisfactory functions, because of the method of allocating the funding to the several counties and the fact that the public frequently criticized the work, often comparing what was done in one county to what has been done in another (Maryland State Roads Commission 1939: 22).

<u>Labor Sources for Road Building</u>

In the 1930s and 1940s, two somewhat unusual sources of labor were used for road-building activities in Maryland: convicts and relief workers. Projects undertaken by these laborers included relatively simple tasks such as widening and paving, clearing out ditches and most likely construction of culverts and other small structures. These two sources of labor are discussed below.

Convict Labor

During World War I, because of a shortage of labor, the State of Maryland revived briefly an eighteenth century tradition of using convict labor to perform construction and maintenance activities on public roads and bridges. Although it is difficult, if not impossible, to determine which roadway structures were built by convict labor, it can be assumed that some small structures were included in the construction and maintenance activities. Prisoners were put to work on road maintenance activities that required little skill, in particular oiling the macadam road surfaces. After the war, this system of labor was abandoned.

In the late 1930s, however, the use of prison labor was reinstituted as a means of relieving "idleness of inmates in the Penal institutions of the State" while helping with highway housekeeping (Maryland State Roads Commission 1943: 57). In 1937, the State Roads Commission was authorized to spend $100,000 a year to employ prisoners on reconstruction and maintenance of road facilities. This pool of generally unskilled labor was put to work on such jobs as stabilizing shoulders, installing and lengthening drainage culverts, widening cuts and fills, building earth shoulders and cleaning out ditches. Subsequent General Assemblies through 1948 continued and even increased the authorization (Maryland State Roads Commission 1949: 17).

During and immediately after World War II, prison labor was used extensively for maintenance activities on state and county roads, while federally subsidized relief labor (discussed below) was used to construct new defense access highways. In some instances prison camps were constructed to house the male prisoners in the areas too far removed from the penal institutions to permit daily transportation. The 1947-48 State Roads Commission Report stated that a prison camp was "recently" established in Montgomery County to make penal labor available for work in Montgomery and adjacent counties: "These counties, due to their proximity to Washington and the high wages paid by private industries, have been unable to secure labor requirements for maintenance operations. As a consequence, roads in these areas have suffered from lack of maintenance" (Maryland State Roads Commission 1949: 20). That report also noted that prison camps formerly located at Leonardtown and Elkton had been abandoned.

Relief Labor

During the 1930s, Federal emergency funds were available for the relief of unemployment resulting from the Great Depression. Many states took advantage of these sources of funding to help with road construction during a time when there was pressure to reprogram state road user revenues for other purposes.

The Public Works Administration (PWA), a New Deal agency created in 1933, distributed nearly $6 billion for construction of roads, bridges, tunnels, dams, public buildings, municipal water and sewage systems and railroad equipment and facilities upgrading throughout the nation during the 1930s. Its primary purpose was to provide jobs for unemployed persons and stimulate an economic recovery during the Great Depression. The Works Progress Administration, created in 1935 and renamed the Works Projects Administration (WPA) in 1939, assumed many of the functions of the PWA. Between 1935 and 1943, WPA-funded projects nationwide employed more than 3.3 million people. As employment opportunities increased within the private sector with the onset of World War II, WPA projects withered, and the program was liquidated in 1943 (Olson 1985: 398-399; 548-551).

In Maryland, the relief labor provided by the WPA was used by the State Roads Commission and the various counties to improve county and state roads, including a Farm-to-Market Roads Program to improve county roads, implemented in the 1935-36 reporting period (Maryland State Roads Commission 1937: 5). Prior to World War II, the WPA laborers were used for such tasks as constructing shoulders, grading and surfacing roads, constructing concrete pipe drainage and installing erosion control. These were tasks that were relatively simple, requiring minimal oversight. The 1939-40

State Roads Commission Report noted that "this type of work has been particularly active in the western counties and on the Eastern Shore, where a large mileage of county roads have been improved by this method" (Maryland State Roads Commission 1940: 65). The 1941-42 State Roads Commission Report listed, by county, projects conducted with WPA labor, including among others the construction of a timber bridge over Jenkins Creek in Somerset County and the installation of 472 linear feet of concrete pipe at Cardiff (Maryland State Roads Commission 1943: 52-53). Most likely, the construction of drainage culverts was one of the uses the state and counties had for WPA workers.

The value of the WPA labor program to the state is summed up by the following statement: "While labor furnished for these projects by the W.P.A. is not considered 100% efficient, the utilization of these men in the construction of the above projects has resulted in a considerable saving to the State over their cost had they been constructed under contract or by our regular maintenance forces" (Maryland State Roads Commission 1940: 68).

With the onset of World War II, WPA labor was used almost exclusively on highway construction and other state improvement projects leading to Army Posts while convict labor was used to maintain state and county roads less critical to the war effort (Maryland State Roads Commission 1943: 3).

Road Programs During and After World War II

During World War II, the State Roads Commission attempted to continue its program of upgrading state and county roads, but found it necessary to eliminate as much as possible the use of materials that were critical to the war effort, which meant that steel would not be used as the main structural component in new or repaired structures. According to the 1940-42 State Roads Commission Report, timber and reinforced concrete construction were used in many locations where structural steel would ordinarily have been used. In the case of reinforced concrete construction, "the members have been so proportioned that the amount of reinforcing steel has been kept to a minimum" (Maryland State Roads Commission 1943: 42).

As an emergency wartime measure, the state halted new construction of county roads in 1943 (Maryland State Roads Commission 1945: 3). The use of prison labor on general maintenance work and urgently needed improvements helped to relieve to some extent the critical labor shortage. Most of the work related to small structures and culverts during the war years was for repair and maintenance, the type of work that could be performed by the available, untrained laborers, using materials at hand such as timber, stone, brick and concrete. The use of less sophisticated materials continued to be used in the period immediately after the war, especially on less strategic roads. The 1947-48 State Roads Commission Report claimed that timber structures continued to be built on purely county or local highways (Maryland State Roads Commission 1949: 63).

As early as 1940, the Bridge Division of the State Roads Commission began developing designs and plans for an extensive construction and repair program for the post-war years. The 1943-44 State Roads Commission Report noted that existing bridges had experienced rapid deterioration during the war years because of the lack of maintenance (Maryland State Roads Commission 1943: 46, 49). Wartime restrictions, scarcity of materials and a dearth of skilled laborers and engineers resulted in an extensive backlog of road and bridge projects by the late 1940s. Up through 1947, the extensive plans prepared during the war years for the improvement of the state's roads and structures remained on the shelf, awaiting the availability once more of construction materials and skilled labor and engineers.

Leviness reported in his *History of Road Building in Maryland* that 1948 marked the launch of the state's greatest road-building program, which "laid the groundwork for the major construction of the Fifties" (Leviness 1958: 157). Thus 1948 was a watershed year for Maryland's transportation history. Beginning in 1948 and extending over the next four years, the State Roads Commission implemented a plan to build or rebuild 757 miles of state roads, planned and commenced construction of the state's expressway system and initiated work on the Chesapeake Bay Bridge (Leviness 1958: 157).

Summary

The historical context for Maryland's small structures parallels that of the state's bridges. Both types of structures fit within the larger context of the development of the state's roadways. Two specific periods, however, are significant in the specific historical context of small structures:

1. The first half of the nineteenth century (ca. 1800 to 1850), and

2. The first half of the twentieth century (ca. 1900 to 1947).

The earlier period of significance, generally between 1800 and 1850, relates to the extensive road-building activity in the state during the early nineteenth century, in particular the construction of the National Road and the numerous turnpikes or toll roads. There are no known small structures that date to an earlier period than this.

The later period of significance for small structures is generally between 1900 and 1947. It may actually be further divided into two periods. The first is the period between 1900 and 1911, when concrete was promoted as a "permanent" construction material for small structures and reinforced concrete was introduced (around 1903). The second era extends from 1912 to 1947, during which time the state issued and promoted extensively the use of Standard Plans for small structures (and bridges).

Small structures on Maryland's roadways are also associated with other historical contexts that are interesting (e.g. the Good Roads Movement, rise of state-level highway organizations, influence of professional engineers, and labor sources). Such contexts, however, are not particularly significant for small structures. For example, structures that fit within the context of "Labor Sources for Road Building" are generally associated with roadway maintenance activities. These structures would be hard to identify and would be, as a rule, pipes and box culverts that are unimportant from an engineering standpoint. For the traditional contexts such as significant engineering technologies and historical events, larger structures (i.e. bridges) generally provide better representative examples than do small structures.

3.0 TYPES OF SMALL STRUCTURES ON MARYLAND'S ROADWAYS

Introduction

Several types of small structures are present on Maryland's roadways. These structures date from around the first quarter of the nineteenth century to the present. Some structure types were generally used only for small structures (shorter crossings, cross drains, culverts), while other types are also utilized for bridges (longer crossings of 20 feet and over).
For inspection purposes the State Highway Administration (SHA) Office of Bridge Development is now developing an inventory of small structures on Maryland's state highways. The inventory, which is approximately 90 percent complete, includes the following small structure types:

<u>Masonry</u>
- arches

<u>Concrete</u>
- slab
- box culvert
- girder/beam
- arch
- rigid frame

<u>Metal</u>
- beam
- arch

<u>Timber</u>
- beam

<u>Pipes</u>
- pipes and pipe arches

County and city-owned small structures are not included on the SHA's bridge inspection inventory but instead are inventoried and maintained by the county and municipal governments. Communications with county and city road departments concerning small structures have not revealed any small structure types beyond those listed above.
This chapter presents a brief background history/chronology of the use of the different types of structural designs for small structures. A more complete history of bridge development, by structural type, is included in Spero's *Historic Highway Bridges in Maryland 1631-1960*. The majority of the bridge development chronology presented in that report also relates to small structures since many bridge structural types were also used for small structures (e.g. stone arches and concrete girders). Some structural types were predominantly used for small structures (e.g. slab and box culvert).

This chapter also describes and illustrates each structural type. Reports of the State Roads Commission throughout the first half of the twentieth century discuss the types of small structures built and the materials used. Materials used in the early twentieth century included stone, timber, steel and concrete. The State Roads Commission

Report of 1939-40 indicates that structures continued to be built of concrete, steel and timber, and I-beam, timber beam and "several types of reinforced concrete" construction were used (Maryland State Roads Commission 1940: 54). One of the early post-World War II reports claimed that "improvements in metallurgy, structural steel, steel reinforcement and other similar components and in cement for concrete as a structural material and in timber has given the designer broader fields of application" (Maryland State Roads Commission 1947: 53).

Standard Plans

The State Roads Commission's standard plans (Standard Plans, hereafter) issued between 1912 and 1933 are also excellent illustrations of the types of small structures built in the first half of the twentieth century. During this period, the State built many "work horse" structures that rarely deviated from the designs presented in the Standard Plans.

The 1912 plans, published on a single sheet, applied to box culverts, box bridges and slab and girder structures, all of concrete. These plans feature a roadway width of 22 feet. The 1919 designs feature a roadway width of 24 feet and had a separate sheet for the concrete slab and girder designs. Comparison of the plans shows that by 1919, the diameter of the reinforcing bars was reduced as well as the space between the bars, therefore increasing the number of reinforcing bars but decreasing their size and weight (Spero 1995: 180).

In the 1920-23 Report of the State Roads Commission, the author noted that "new Standard Plans have been prepared for slab and girder spans" (Maryland State Roads Commission 1924b: 58). Dated 1924, these plans featured a 24-foot roadway. Concrete slab bridges were specified for small structures up to 18 feet in span. By that date, girder structures were no longer specified in the Standard Plans for use on small structures. With the exception of a standard open handrail design introduced in 1928, the 1924 plans continued in use until 1930 when the standard roadway width was increased to 27 feet.

In 1931, a series of Standard Plans were developed for concrete box culverts. No standard roadway width is included in the plans. The 1933 plans increased the roadway width to 30 feet. Changes were again made to the reinforcing bars of the slab structure which were moved closer together to increase the load-carrying capacity. The 1933 Standard Plans also included designs for timber and steel beam structures, both for use on secondary roads only.

Table 3.1 outlines the types and sizes of Standard Plans for small structures that were prepared by the State Roads Commission. Illustrations from these plans are interspersed within the text of this chapter. Excerpts from the plans in a reduced format are included in the appendix to this report. The original plans are on file in the SHA's Office of Bridge Development in Baltimore.

Table 3.1

Standard Plans for Small Structures issued by the Maryland State Roads Commission

Year	Description	Span Length/Structure Size	Road Width	Details	Other
1912	Standard Steel-Concrete Culvert	6' or 8'	24'	Solid Parapet Rail	
	Concrete Box Culverts	18"x18", 24"x18", 24"x24",			
		36"x24", 36"x36", 4'x2', 4'x3'			
		4'x4', 5'x3', 5'x4', 5'x5'			
	Standard Box Bridges	10' to 16'	24'		
	Standard Slab Bridges	6', 8', 10', 12', 14', 15', 16'	24'		
	Standard Girder Bridges	18'	24'		
	Detail of Coping--Culverts & Bridges				
1919	Details for Standard Slab Bridges	6', 8', 10', 12', 14', 16'	24'	Solid Parapet Rail	
	Standard Girder Bridges-Plan/Details	18'	24'	Paneled Parapet Rail	
1924	Standard Bridge Abutment-Slab Bridge	6', 8', 10', 12', 14', 16', 18'			
	Standard Slab Bridge	6', 8', 10', 12', 14', 16', 18'	24'	Paneled Parapet Rail Single panel up to 14", then three panel	Individual plans-each size
1928	Standard Open Handrail				
1930	Standard Slab Bridge-Superstructure Details	6', 8', 10', 12', 14', 16', 18'	27'	Open Rail	Individual plans-each size
	Standard Slab Bridge-Isometric View			Open Rail	
	Standard Bridge Abutments-Slab Bridge	6', 8', 10', 12', 14', 16', 18'		Horizontal scoring	
1931	Standard Box Culvert	2x2, 3x2, 3x3, 4x2, 4x3, 4x4, 5x4, 5x5, 6x6		No fill has incised parapet	Individual plans-each size Individual plans for: no fill, 5-foot max. fill & 10' max. fill
1933	Standard Slab Bridge-Superstructure Details	6', 8', 10', 12', 14', 16', 18'	30'	Open Rail	Individual plans-each size
	Standard Balustrade Details			Open Rail	
	Standard Abutments for Concrete Slab Spans	6', 8', 10', 12', 14', 16', 18'		Horizontal Scoring	
	Standard Timber bridges for secondary roads	10, 12, 14, 16, 18			H-10 load, Note: to be used only on infrequently used roads
	Standard Timber Bridges for Secondary Roads	10, 12, 14, 16, 18			H-15 load
	Standard Steel Beam Bridges for Secondary Roads	10-14', 15-19'			H-15 load

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).

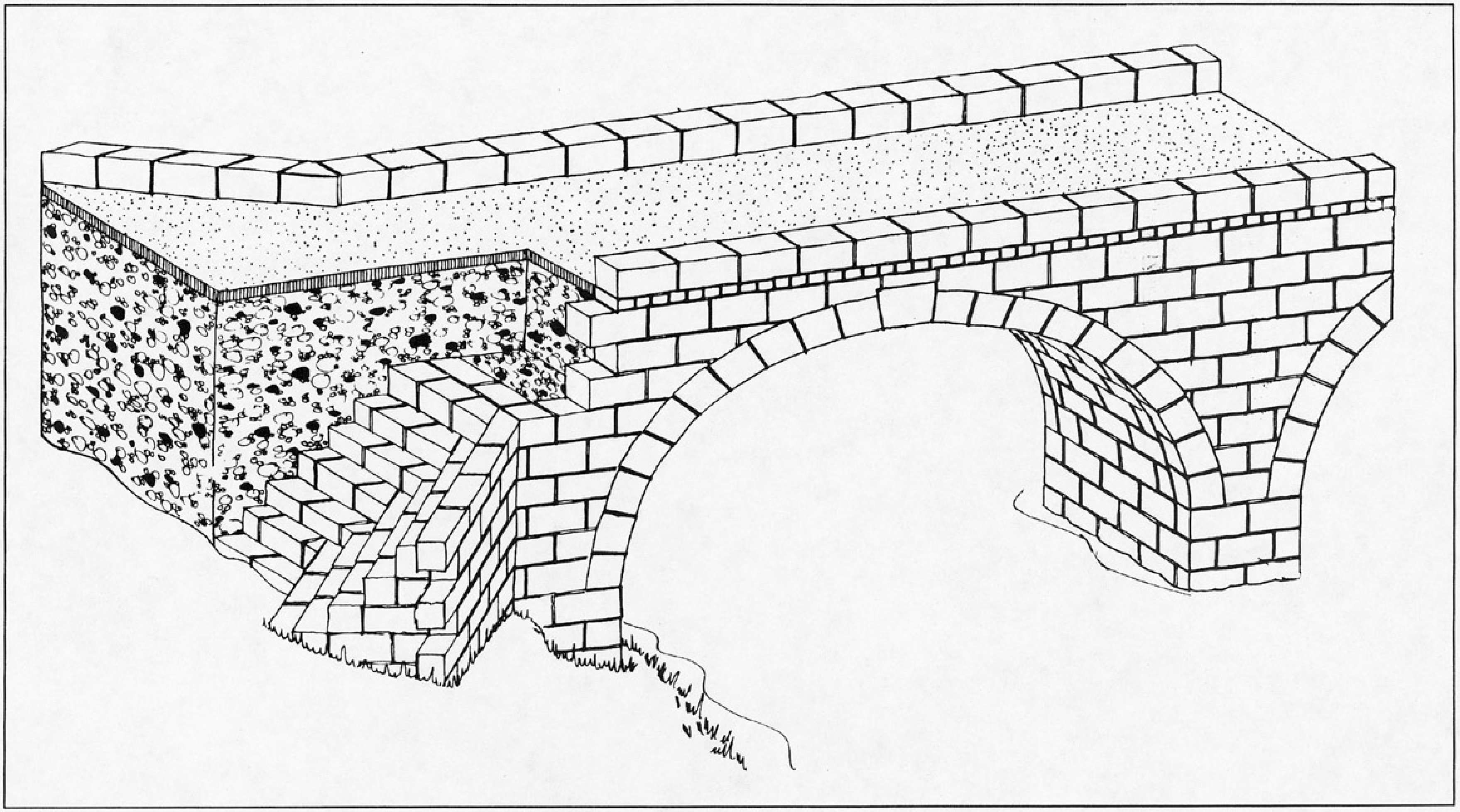

Figure 3.1. Isometric view of masonry arched structure (Source: Pennsylvania Historical and Museum Commission and Pennsylvania Department of Transportation 1986).

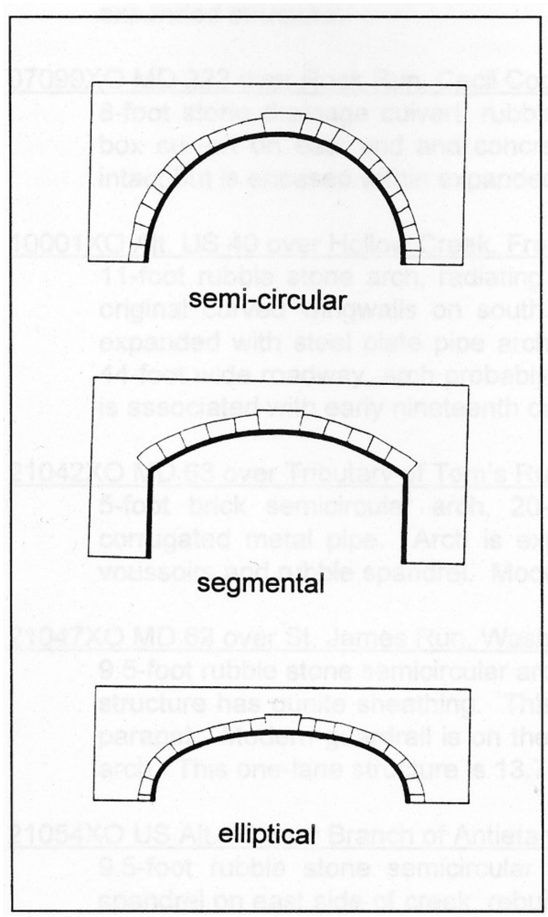

Figure 3.2. Types of masonry arches (Source: Pennsylvania Historical and Commission and Pennsylvania Department of Transportation 1986).

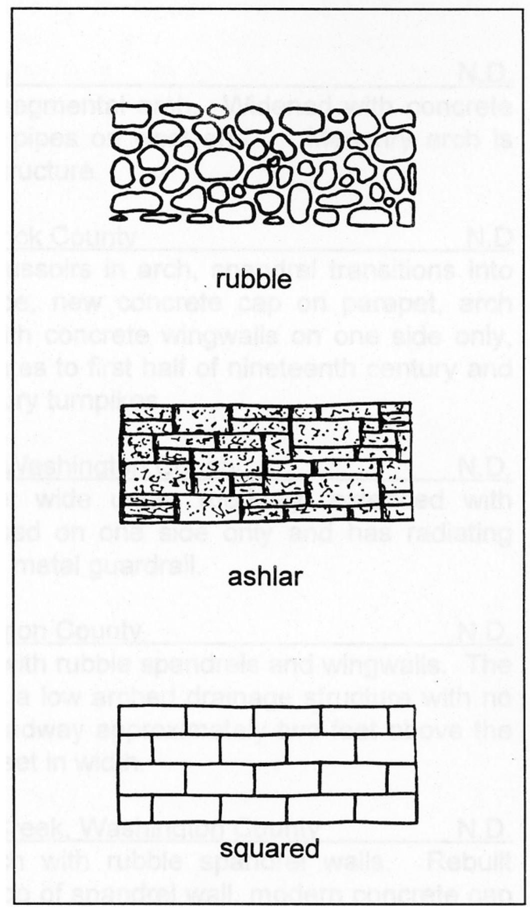

Figure 3.3. Types of stone-laying techniques (Source: Pennsylvania Museum Historical and Museum Commission and Pennsylvania Department of Transportation 1986).

Below are descriptions of selected extant masonry arched structures[2]:

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-feet 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.

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[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.

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 though 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[1]:

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

[1] Concrete pipes are discussed in the "Pipes" section of this chapter.

3.2.1 CONCRETE SLAB

Historical Overview

It is not known when the first slab small structure was erected in Maryland, however, the first reinforced concrete bridge in the state dates to 1903. Consequently, small slab structures were most assuredly built in the first decade of the twentieth century. By 1912, the State included the reinforced concrete slab in their Standard Plans for structures from 6 feet to 16 feet in length. The 1912-15 Report of the State Roads Commission refers to the construction of three "small slab structures" for a cost of $2,128.70 (Maryland State Roads Commission 1916: 59).

Between 1912 and World War II, the concrete slab was specified as Maryland's standard structure type for small spans from 6 feet to 18 feet. Consequently, many of these small slab workhorse structures were built on the state's roadways.

The early slab structures had solid parapet rails. The 1919 and 1924 Standard Plans showed incised rectangular design in the solid rail. The 1924-26 State Roads Commission Report mentions one small (9-foot) reinforced concrete slab structure (Maryland State Roads Commission 1927: 61). In 1928, an open balustrade was introduced in the Standard Plans and this type of rail design was continued in the Standard Plans issued in 1930 and in 1933.

The 1930 and 1933 Standard Plans for the slab bridge show horizontal scoring on the abutments and wingwalls. The 1937-38 Report of the State Roads Commission discussed the design of a number of small slab bridges of varying sizes in connection with replacement or reconstruction of existing highways (Maryland State Roads Commission 1939: 84). The Standard Plans were also available to the counties and municipalities for use on their roadways. It can be assumed the local governments took advantage of the offer of prepared plans in some instances, but in other cases they probably built site-specific simple slab structures that were not according to Standard Plans.

Description

As a small structure, the concrete slab is a single span, composed of a reinforced concrete "part", commonly referred to as a slab, and generally constructed as a single unit (or less commonly as a series of narrow slabs) placed parallel with the roadway and spanning the space between the supporting abutments. The slab serves as the deck as well as the structural member carrying the stresses between abutments (Figures 3.4 and 3.5). Slab structures are generally fabricated and constructed on-site. Recommended for small structures up to about 20 feet, the slab structure was easily widened and relatively simple to construct. In the earliest phases of development of the slab structure, its use was confined to small structures.

Preliminary research indicates that many small slab structures built according to the Standard Plans are extant on Maryland's roadways today. This same research indicates that many early slab structures have been altered by the addition of slabs or box culverts for widening and through the replacement of the original rails, abutments or wingwalls. Preliminary research also indicates that slab structures also remain on city and county roads; some appear to have been built according to the state's Standard Plans.

Some examples of small slab structures on Maryland's roadways are:

15171XO MD 117 over Branch of Seneca Creek, Montgomery County N.D.

4.8-foot concrete slab, 9 feet wide, extended with 10-foot wide box culvert. No parapet, guardrail or wingwalls.

04019XO MD 262 over Chew Creek, Calvert County ca. 1924

19.5-foot concrete slab built according to 1924 Standard Plan for 18 foot slab. Three-paneled parapet rail is identical to Standard Plan, also 24-foot roadway width and other dimensions.

03344XO MD 25 over Black Rock Run, Baltimore County 1927

17.5-foot concrete slab built according to 1924 Standard Plan for 18-foot slab. Three-paneled parapet rail, 24-foot roadway and other dimensions are identical to Standard Plan.

10034XO MD 140 over Branch of Cattail Creek, Frederick County ca. 1930-40

6-foot concrete slab built according to 1930 Standard Plan for 6-foot slab. Open handrail is identical to Standard Plan as is horizontal scoring on wingwalls.

C0014 Stoakley Road over Mill Creek, Calvert County ca. 1930

15.5-foot concrete slab built according to 1930 Standard Plan for 16-foot slab bridge. Open handrail is identical to Standard Plan.

CE2007 Lombard Road in Cecil County 1931

concrete slab with solid parapet rail. According to builder's plaque, this structure was built by Cecil County in 1931.

Tips for Dating Concrete Slab Small Structures

There are numerous known concrete slab small structures on Maryland's roadways today. It is known that many small slab structures were constructed between the first decade of the twentieth century and the present. During the period 1912 to 1933, when Standard Plans were issued by the State, this may have been the most widely used small structure (along with pipes and box culverts) on the State Highway System. (Standard Plans for slab structures are in Appendix A, pages A-2, A-4, A-8-13, A-19-26, and A33-40.)

Two visible elements can assist in dating slab structures: the parapet/rail and the substructure (wingwalls, abutments). For example, the open rail design (Appendix A, A-15) was not introduced into the Standard Plans until 1928. Although an open rail may have been used prior to that time, it was rarely used before 1920. On the other hand, solid parapet rails with incised designs are also known to have been used on bridges dating after the introduction of the open rail in 1928. Another feature useful in dating slab structures is the horizontal scoring on the abutments and wingwalls that was introduced in the Standard Plans of 1930.

The width of the roadway can also be an indicator of construction dates. The standard width of state highways was 22 feet in 1912, 24 feet from 1919 to 1929 and 27 feet from 1930 to 1932; in the 1993 Standard Plans, the roadway width was increased to 30 feet.

Another indicator of age is the size and spacing of the reinforcing bars on a structure. If the bars are exposed, the dimensions can be compared to the Standard Plans.

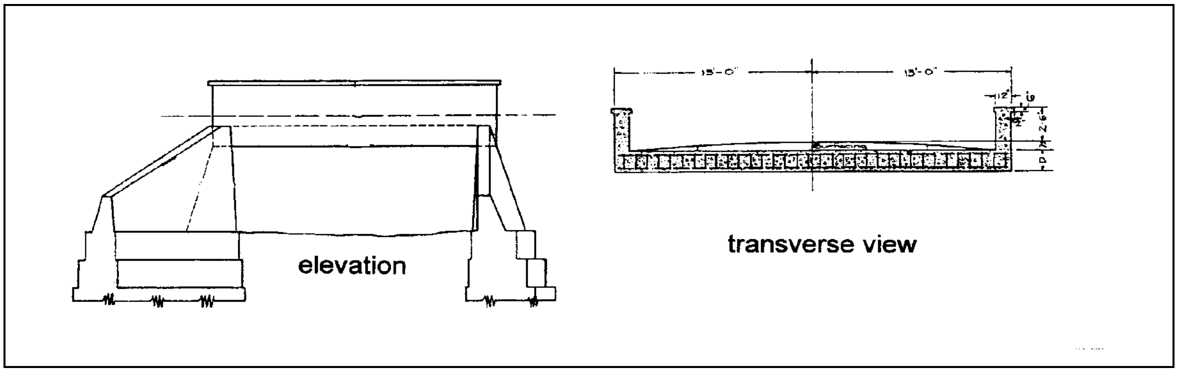

Figure 3.4. Elevation and transverse view of typical slab structure (Source: Maryland State Roads Commission, 1919 Standard Plans).

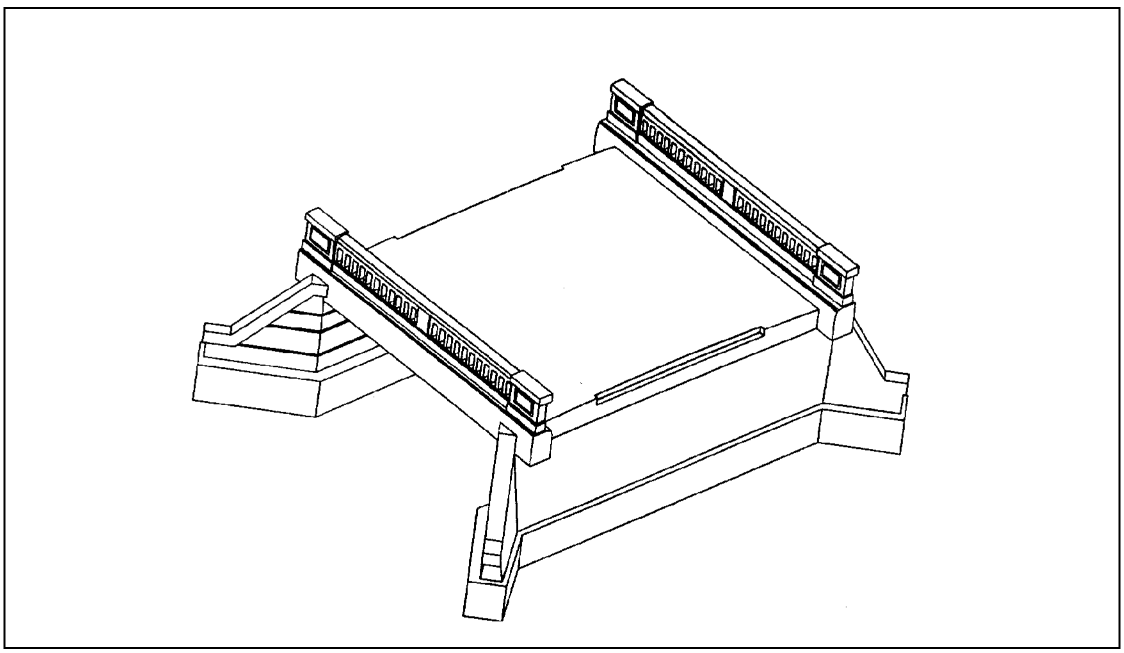

Figure 3.5. Isometric view of slab structure (Source: Maryland State Roads Commission, 1930 Standard Plans).

3.2.2 CONCRETE BOX CULVERT

Historical Overview

An early mention of box culverts is contained in the 1900-01 Geological Survey Report. The author reported that "after a number of attempts the contractor abandoned the construction of a box culvert at this point and substituted 30-inch pipe" (Reid 1902: 133). This statement illustrates that box culverts were known to contractors in Maryland during the first few years of the twentieth century.

When the State Roads Commission issued the first Standard Plans for roadway structures in 1912, they included designs for both "box culverts" and "box bridges." The plans contained four designs for "steel-concrete" (reinforced concrete) culverts and one design for a "box bridge." The culverts ranged from 18 inches x 18 inches to 6 feet x 8 feet and specified plain concrete on the sides and bottom of the box and reinforced concrete on the top. The box bridge design was for spans from 10 feet to 16 feet and included reinforced concrete on all four sides of the box.

These designs may have continued in use until the State Roads Commission issued revised box culvert designs in 1931. The size of the culvert designs in 1931 ranged from a 2-foot x 2-foot box to a 6-foot x 6-foot box. Designs were included for eight sizes of box culverts and each size culvert had a separate design for no-fill, 5-foot maximum fill and 10-foot maximum fill. The no-fill designs had a parapet rail with an incised rectangular design.

The State Roads Commission Reports between 1935 and 1945 contain numerous references to the construction of box culverts on state roadways. For example, from 1938 to 1940, 31 box culverts were built. Over the next two-year period, 32 box culverts were constructed (Maryland State Roads Commission 1940: 54 and 1943: 42). The reports in the immediate post-World War II period continued to reference the construction of box culverts. Reinforced concrete box culvert construction is still used today.

Description

A box culvert is generally a four-sided drainage structure with a square or rectangular opening (Figures 3.6 and 3.7). A box culvert can carry the roadway on top of the box or the structure can be built well below the roadway with earth fill between the structure and the road. As a small structure, a box culvert can have one or more openings (boxes). Some or all sides of the structure may be reinforced.

Some examples of concrete boxed culverts in Maryland are:

<u>BC3455 Belvedere Avenue over Chinquapin Run, Baltimore City 1936</u>

19-foot long box culvert with two box openings. Incised parapet rail, wingwalls and 36-foot wide roadway.

<u>07044XO US 40 over Branch of North East River, Cecil County 1938</u>

12-foot by 9-foot concrete box with 8 feet of fill between top of box and roadway. Modern metal guardrail, concrete wingwalls.

07011XO US 40 over Branch of Perch Creek, Cecil County 1938

Two, 4-foot by 3-foot concrete boxes with 2 feet of fill between top of boxes and roadway. Modern metal guardrail, concrete wingwalls.

05012XO MD 577 over North Davis Millpond Road, Caroline County ca. 1941

Two, 7-foot by 9-foot boxes with no fill between top of box and roadway. Modern guardrail installed on top of slab, 22-foot wide roadway.

Tips for Dating Concrete Box Culverts

Concrete box culverts are ubiquitous; they have been in use from the earliest years of this century and are still used today. There are few useful tools for dating box culverts. Some of the earlier no-fill culverts had solid parapet rails such as those shown in the 1912 and 1931 Standard Plans (Appendix A, pages A-2, A-28-30).

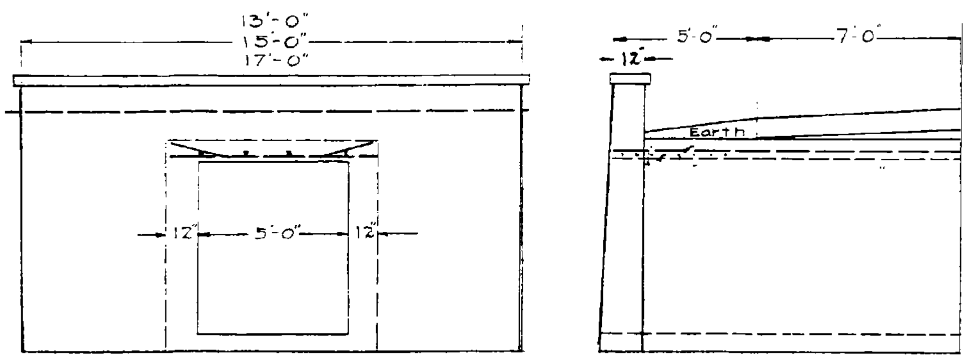

Figure 3.6. "Steel-concrete" box culvert, 1912 Standard Plans (Source: Maryland State Roads Commission 1912).

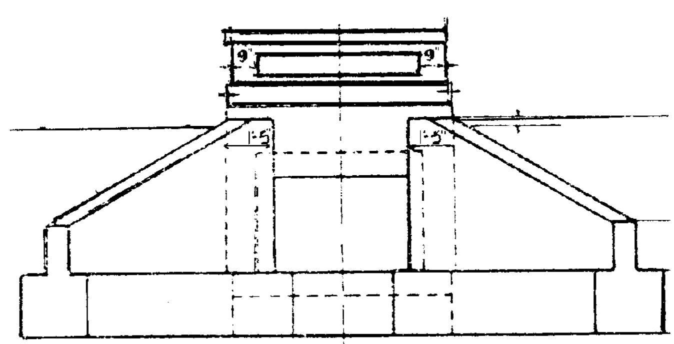

Figure 3.7. Box culvert from 1931 Standard Plans (Maryland State Roads Commission 1931). Note incised parapet.

3.2.3 CONCRETE GIRDER

Historical Overview

The first reinforced concrete girder (beam) bridge was built in 1903 but the design was apparently never widely used for small structures. The State Roads Commission's Standard Plans of 1912 and 1919 specified the use of the girder for the largest of small structures, the 18-foot span. By 1924, the girder had been supplanted by the slab for small structures. Girders were recommended only for structures 20 feet and over. Like the Standard Plans for the slab, the girder plans included solid parapet rails in 1912 and a solid parapet rail with an incised rectangular design in 1919. Concrete girders are rarely, if ever, used for small structure construction today.

Description

In a small structure, a concrete girder is a span composed of a reinforced concrete slab combined with two or more stringers (girders). The stringers or girders are longitudinal structural members, usually rectangular in shape, that are installed under the bridge deck and support the deck between abutments (Figures 3.8 and 3.9). There are several types of girders. Perhaps the most commonly used on small structures is the T-beam girder, which has an integral slab and stringers.

The concrete girder was not widely used for small structures on Maryland's roadways but there are extant girders under 20 feet in length. Some examples are:

13067XO MD 144 over Branch of Middle Patuxent River, Howard County 1919

18-foot concrete girder with solid parapet rail, concrete wingwalls, 24-foot roadway. Resembles 1919 Standard Plan which specified an 18-foot girder structure. Parapet rail and roadway width are consistent with Standard Plans.

21095XO US 40 over Tributary of Potomac River, Washington County N.D.

14-foot concrete girder widened with box culvert in 1964. Unornamented solid parapet and wingwalls, 36-foot roadway width.

21096XO US 40 over Tributary of Potomac River, Washington County N.D.

11-foot concrete girder widened with box culvert in 1964. Unornamented solid parapet with modern guardrail attached to top, 24-foot roadway widened to 36 feet.

Tips for Dating Concrete Girder Small Structures

Most concrete girder small structures pre-date World War II. As stated above, after the adoption of the 1919 Standard Plans, girders were never again included as the standard design for small structures in the state's Standard Plans. A structure 18 feet in length with a 24-foot wide roadway and a solid parapet rail could be an example of a girder built according to the Standard Plans. Standard Plans for small, girder structures are in Appendix A, pages A-2 and A-5-6.)

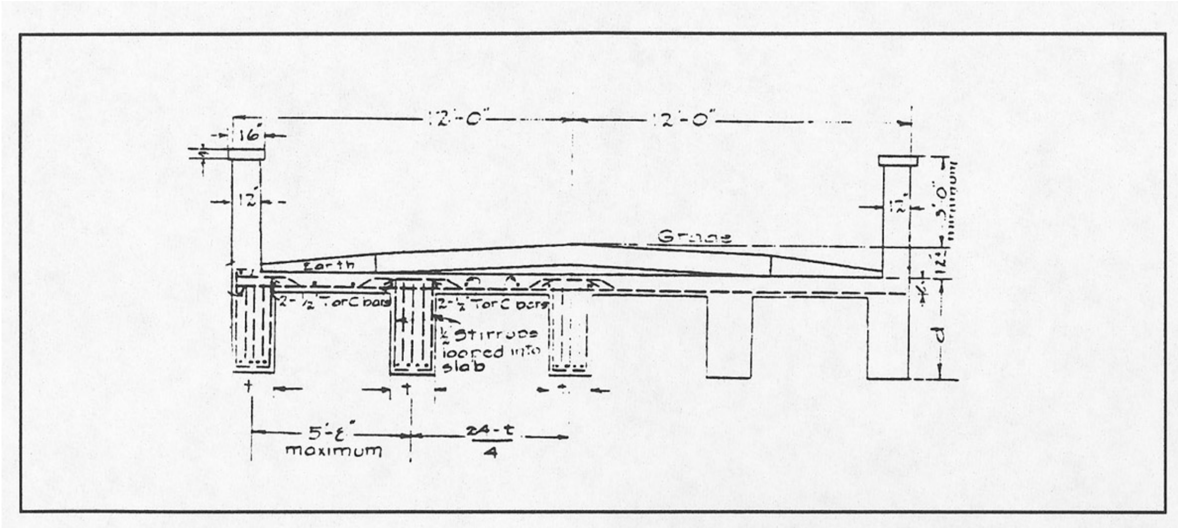

Figure 3.8. Girder Section from 1912 Standard Plans (Source: Maryland State Roads Commission 1912).

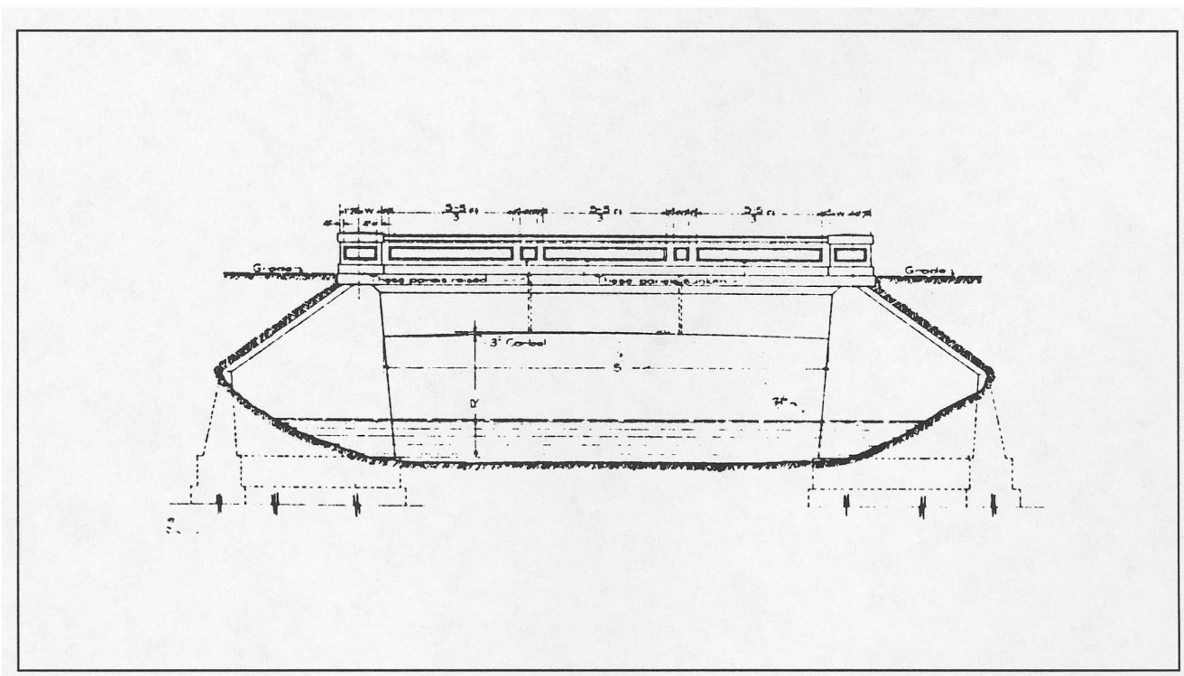

Figure 3.9. "Standard Girder Bridges, General Plan" from 1919 Standard Plans (Source: Maryland State Roads Commission 1919).

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).

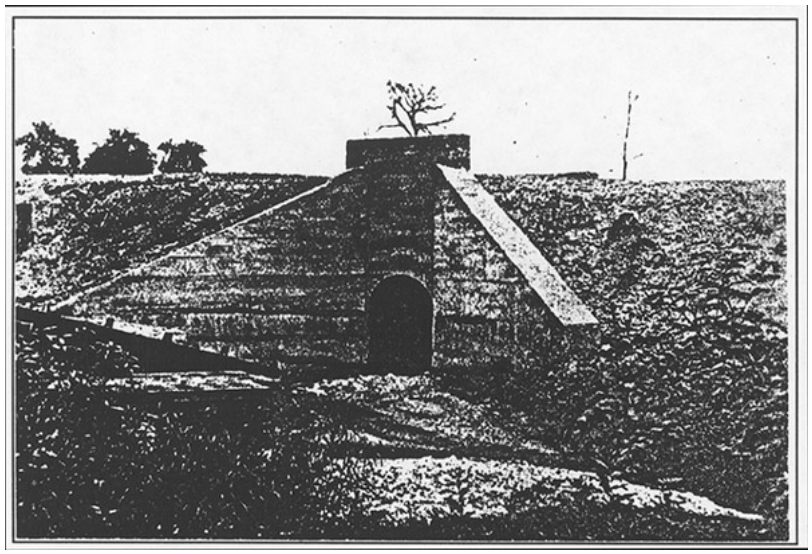

Figure 3.10. 1903 arched concrete culvert (Source: Maryland Geological Survey 1903: Plate XI, Figure 2).

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:

<u>15002XO MD 80 over Fahmey Branch, Montgomery County N.D.</u>

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.

<u>16064XO MS 212 over Drainage Ditch, Prince George's County N.D.</u>

4.5-foot concrete arch. Ashlar spandrel walls, modern metal guardrail, 39-foot wide roadway.

<u>15040XO MD 195 over Long Branch, Montgomery County N.D.</u>

8-foot concrete arch widened with concrete slab. Concrete parapet and modern metal guardrail, rubble spandrel and wingwalls, 32-foot wide roadway.

<u>15049XO MD 28 over Monocacy River, Montgomery County N.D.</u>

6-foot concrete arch with 4 feet of fill between arch and roadway. Concrete headwall with attached modern metal guardrail, 24-foot wide roadway.

<u>B00151 Thistle Road over unnamed stream, Baltimore County 1920</u>

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.

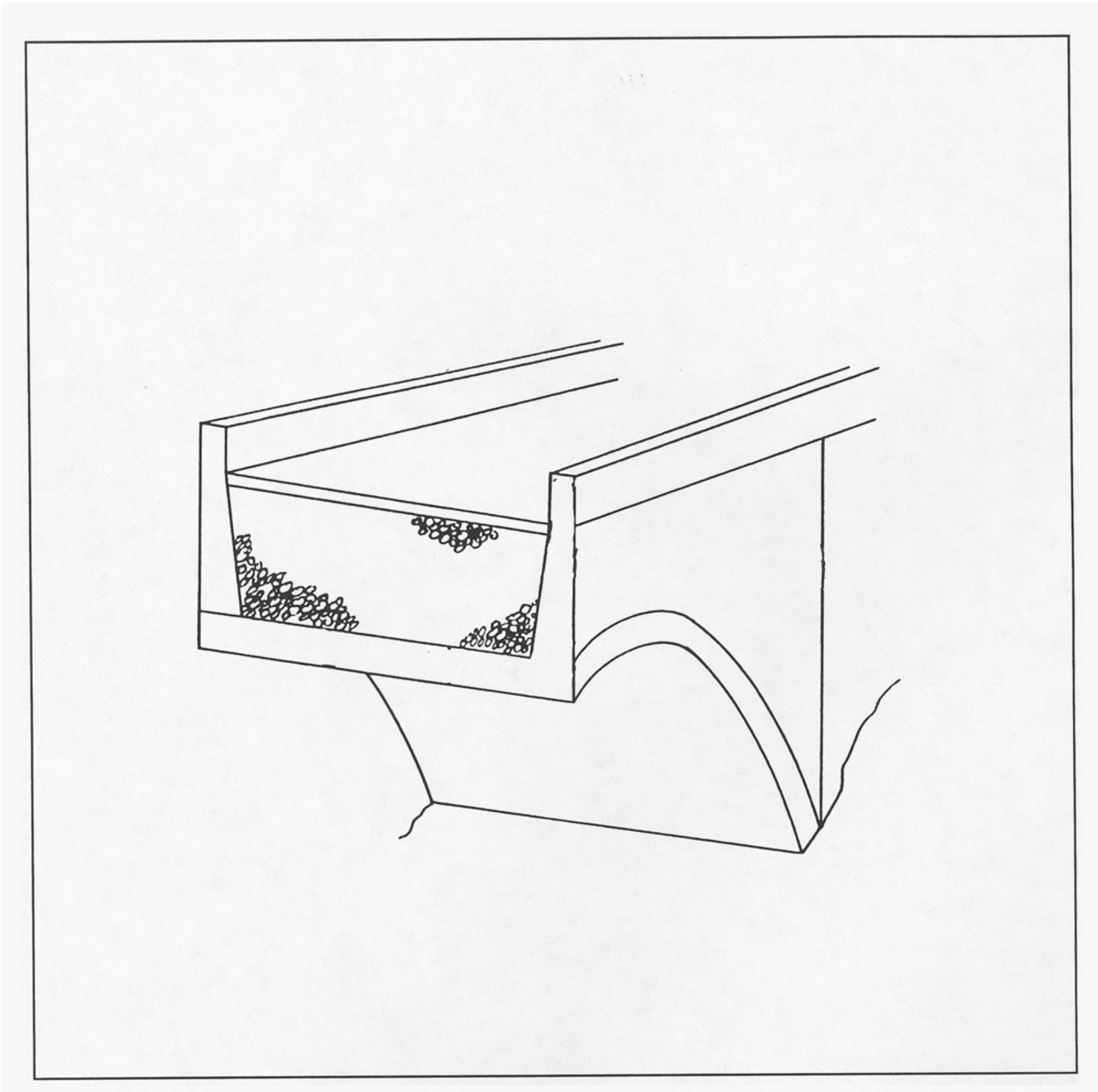

Figure 3.11. Section of closed spandrel concrete arch (Adapted from: FHWA 1991: 9-17).

3.2.5 CONCRETE RIGID FRAME

Historical Overview

The earliest known extant rigid frame bridge in Maryland was built in 1934. It is assumed that the earliest rigid frame small structures would date to the same era. The usage of the rigid frame structure, however, grew more rapidly after World War II. A post-war report of the State Roads Commission discussed the importance of the “contribution of the rigid frame structure” to the field of concrete structure design (Maryland State Roads Commission 1947: 53). Since that time, its importance has been nationally recognized (Condit 1961: 213). Rigid frame construction is still used for small structures today, particularly in areas where environmental concerns preclude the use of a paved invert.

Description

A rigid frame structure is cast in place and may or may not be poured monolithically, resulting in walls that support the deck slabs as continuous bents. This type of construction produces a structure of “great stability” (Miller 1996: 20). Rigid frame small structures are generally non-arched in Maryland (Figure 3.12). They can be drainage structures built well below the roadway surface with earth fill between the structure and roadway, or they can be at-grade structures with the roadway directly on top of the deck slab. Some at-grade structures have solid parapets with incised rectangular designs.

Rigid frame structures feature positive and negative moment[1] throughout the structure due to the interaction of the “legs” (walls) and beams (slab). In slab beam frame construction, the primary reinforcement is tension steel.

A review of the partially completed SHA Office of Bridge Development’s Small Structures Inventory indicates that there are few rigid frame small structures on the state’s roadways. Some extant examples of the rigid frame small structure are:

<u>03069XO MD 146 over Tributary of Little Gunpowder Falls, Baltimore County N.D.</u>
6-foot concrete rigid frame with 4.5 feet of fill between top of structure and roadway. Solid concrete parapet with incised rectangular design on west side only of structure, 29-foot wide roadway, concrete abutments, no wingwalls.

<u>03173XO MD 146 over Merryman Branch, Baltimore County N.D.</u>
11.5-foot concrete rigid frame with 12 feet of fill between top of structure and roadway. Concrete wingwalls, 9-foot wide roadway.

<u>08020XO MD 224 over Branch of Mallows Bay, Charles County N.D</u>.
9.75-foot concrete rigid frame with 8 feet of fill between top of structure and roadway. Concrete wingwalls, 20-foot wide roadway.

Tips for Dating Rigid Frame Small Structures

Most rigid frame small structures in Maryland generally date after World War II but a small number of extant structures appear to pre-date the war. Rigid frame structures would date no earlier than 1930. Research reveals that some pre-World War II, at-grade, rigid frame small structures have solid parapet rails.

[1] Bending forces in bridge members are caused by “moment.” A moment is commonly developed by a transverse loading which causes a member to bend (USDOT 1991: 3-12).

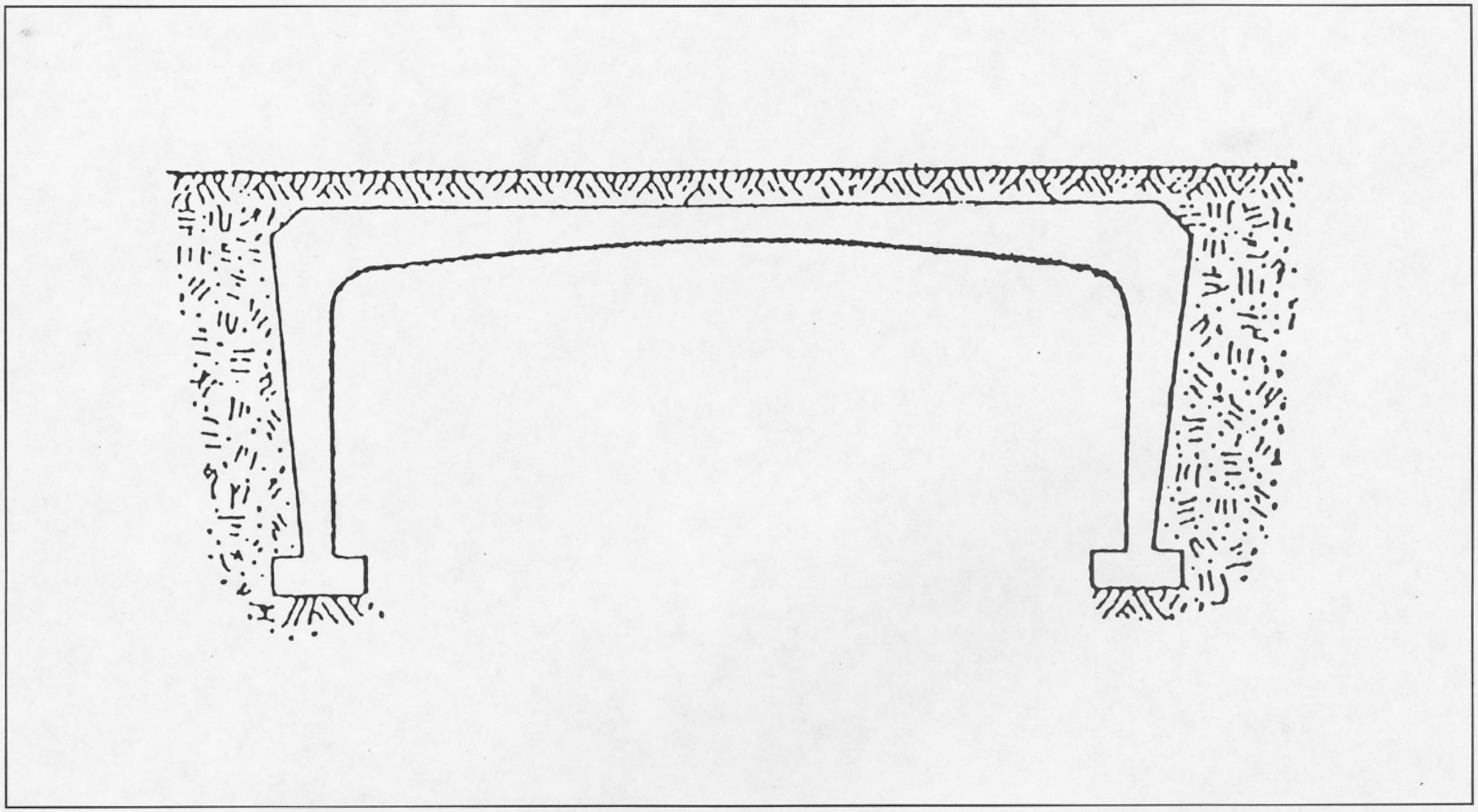

Figure 3.12 Rigid frame structure (Source: Spero 1995: 171).

3.3 METAL SMALL STRUCTURES

Historical Overview

It is likely that the earliest metal beam (or girder) bridges in Maryland were built for the railroads (Spero 1995: 126). Spero noted that because girder bridge construction technology was not difficult and became readily standardized, few descriptions of nineteenth century girder construction in Maryland have been located (Spero 1995: 126).

The 1899 Report of the Maryland Geological Survey noted that "there are comparatively few I-beam bridges, one of the cheapest and best forms for spans less than 25 or 30 feet" (Johnson 1899: 206). That same report stated that repairs were underway to county roads and that "some of the small wooden bridges have been replaced by steel-beam bridges with wooden flooring" (Johnson 1899: 253). In 1906, Walter Crosby, Chief Engineer of the Highway Division, discussed eliminating wood structures and replacing them with concrete. He added that "in but two instances has the State approved the use of other materials. There the conditions required the approval of the use of a steel bridge with a wooden floor" (Crosby 1906: 379). This statement indicates, that at least on the state level, concrete was favored over steel, although steel was still used for bridge construction.

Between 1900 and 1930 concrete-encased, rolled I-beam structures were commonly built. According to Spero, numerous steel beam, steel girder and steel stringer and girder varieties were constructed on state and local roads between 1900 and 1930, including steel culverts (Spero 1995: 127). Spero also surmised that "metal girder bridges in Maryland between 1900 and 1930 were second in popularity only to reinforced concrete bridges" (Spero 1995: 127). The earliest extant datable girder bridge in the SHA bridge inventory dates to 1909. In the 1920s, the use of metal girders appears to have increased but the structure was not among the designs recommended for small structures in the state's Standard Plans of that decade.

The 1933 State Standard Plans included a design for "steel beam bridges," for structures ranging from 10 feet to 59 feet in length. For small structures, specifications were provided for lengths of 10 feet to 14 feet and 15 feet to 19 feet. These steel beam structures were specified for an H-15 load[6] and for use on "secondary roads".

According to Spero, until World War II interrupted major bridge building, steel spans continued to be built in Maryland under county, municipal and state auspices" (Spero 1995: 128). The shortage of critical materials, such as metals, during the war often resulted in the use of concrete as opposed to steel for new construction. Some small steel beam structures continue to be built today in Maryland.

Description

There are several types of metal structures.[7] Generally, the type of metal structure utilized for small structures is the I-beam. The I-beam is comprised of longitudinal metal

6 An H-15 load carrying capacity assigned to a structure means it is capable of supporting a 15-ton truck; an H-20 load capacity can support a 20-ton truck.

7 Metal pipes are discussed in Section 3.5.

beams (stringers) that span the area between the abutments. Atop the beams is a wood deck or concrete slab deck (Figures 3.13 and 3.14). Through girders or deck girders are rarely, if ever, used for small structures. These structures feature a deck supported by floor beams running perpendicular to the roadway; the girders frame into the main longitudinal girders along the structure's outer edges.

Another type of metal small structure is the metal arch or the structural plate arch, composed of sheets of metal welded together (Refer to Figure 3.18 for drawing of structural plate arch). Although this type is listed on the SHA Office of Bridge Development's Small Structures Inventory as a small structure type, there are no extant examples in the 90% complete inventory. Most of these structures would date to 1960 or after.

There are few metal beam structures listed in the SHA's Small Structures Inventory. Examples of metal beam construction of small structures on state and county roadways are:

<u>B0051 Windsor Mill Road over Unnamed Stream, Baltimore County 1930</u>

single span, steel beam bridge with concrete deck.

<u>CD394B Grand Valley Road over Unnamed Stream, Carroll County ca. 1940</u>

13.5-foot single span, steel beam with concrete deck and part stone and part concrete abutments.[8]

<u>15040XO MD 195 over Long Branch, Montgomery County N.D.</u>

14.75-foot single span, steel beam, extended with concrete slab.

<u>16043XO MD 382 over County Line Creek, Prince George's County 1963</u>

19.75 foot single span, steel beam on 18-foot wide roadway.

<u>15008 MD 124 over Branch of Goshen Branch, Montgomery County 1989</u>

12-foot single span, steel beam on 23-foot wide roadway.

Tips for Dating Metal Beam Small Structures

Preliminary research has not revealed any extant metal beam small structures that date to the first quarter of the century. By 1930, the state's Standard Plans included a steel beam structure for use on secondary roads (Figure 3.14 and Appendix A, page A-42). A comparison of extant steel structures to the Standard Plans could provide dating assistance. Some elements that can be compared to the Standard Plans are the size of the beams and diaphragms (compare structure length to table on plans) and the size and spacing of the posts of the bridge rail (i.e. 6-inch by 8-inch posts spaced 5 feet center to center).

8 Often, replacement structures were built using the old abutments. That appears to be the case with this structure.

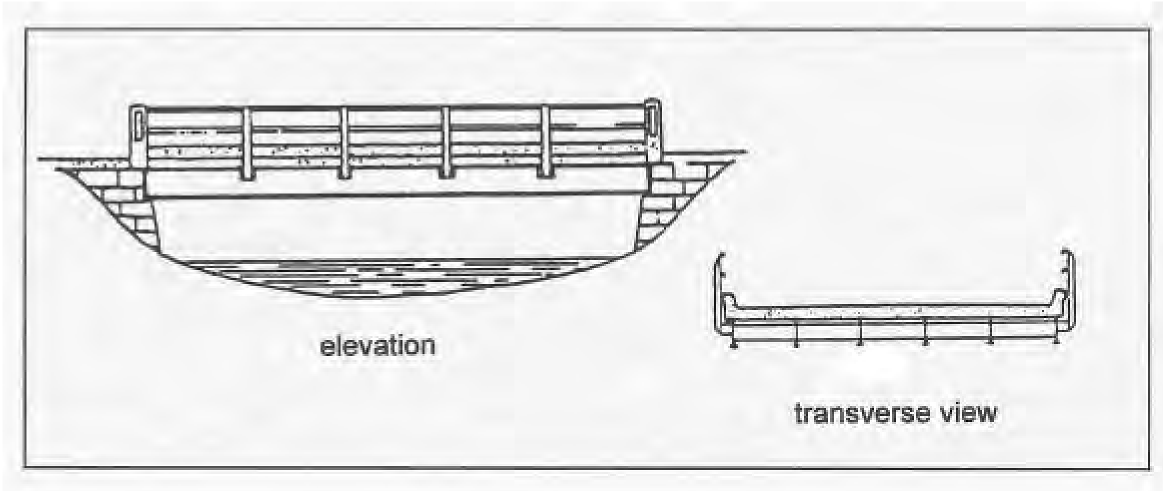

Figure 3.13 Steel beam, elevation and transverse view (Source: Carver N.D.).

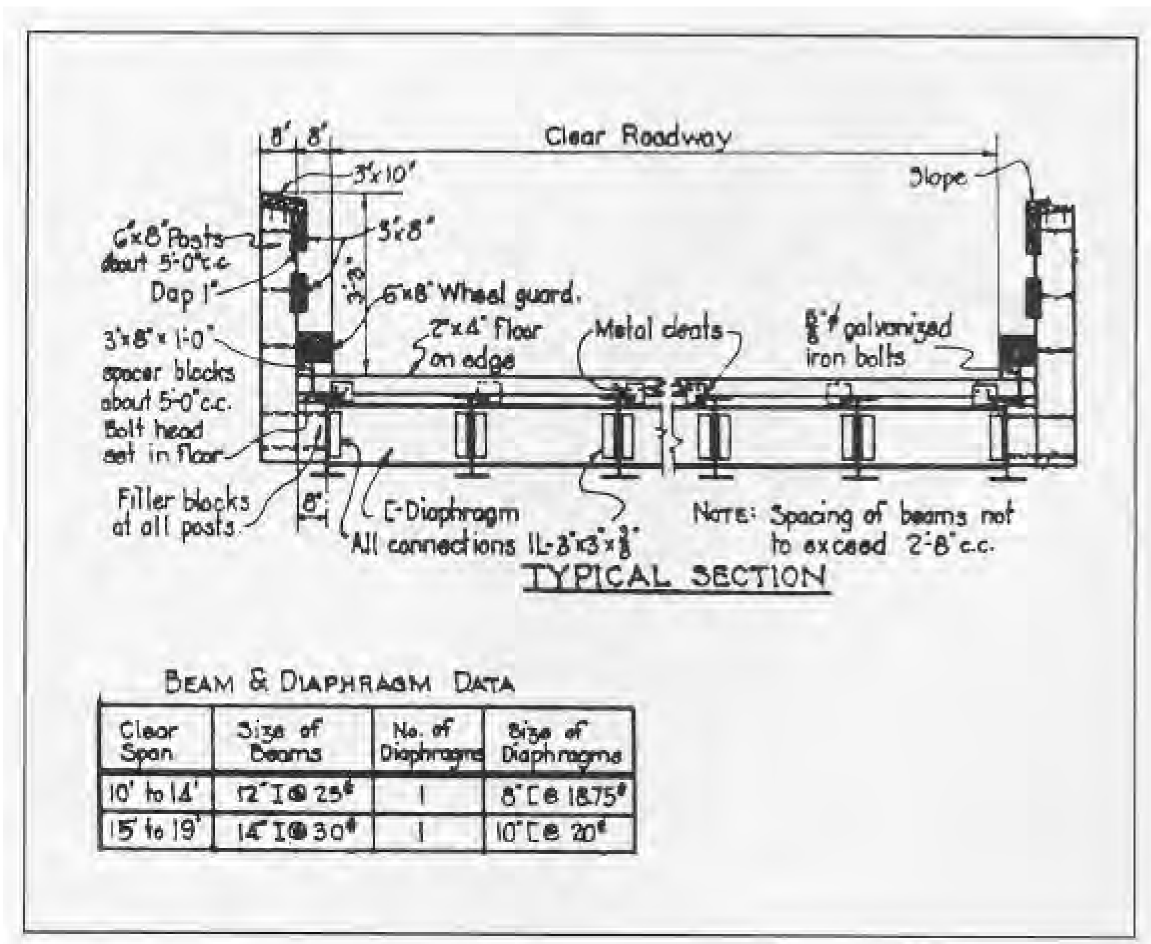

Figure 3.14. Standard Steel Beam Bridges for Secondary Roads from 1933 Standard Plans (Source Maryland State Roads Commission 1933).

3.4 TIMBER SMALL STRUCTURES

Historical Overview

Although written documentation is not readily accessible, the majority of early small structures were most assuredly of timber construction. This is because timber was often easily available and a small span would be relatively easy to construct. These small structures were probably simple timber beams (stringers) spanning the crossing with plank decks atop the beams. There may also have been small king or queen post timber truss structures since these too were relatively easy to construct.[9]

The 1899 Geological Survey Report on the Highways of Maryland contained the following reference to early eighteenth century timber bridge construction:

> *The overseers of the highways were frequently hindered in repairing bridges by the refusal of the owners of the adjacent lands to permit them to cut trees for that purpose. Therefore, in 1724, the overseers were authorized, by a law [chap xiv] supplementary to that of 1704, to make use of any trees except those fit for clapboards or cooper's timber, for building or repairing any bridge maintained at a public or county expense; i.e. for which appropriations were made distinct from those for highways* (Sioussat 1899: 121).

In the engineers' reports of the 1830s concerning construction and maintenance of the National Road in western Maryland, engineers expressed the desire to erect structures with stone abutments and wingwalls and wooden superstructures rather than the stone arch-type structures specified for use on the National Road (Searight 1971: 71). This method was proposed as a cost-saving measure. The 1835 report from the Commissioners of the State of Maryland to the Senate and US Congress concerning the National Road indicates that some wood structures were built on the National Road. The Commissioners reported that "the floors of the wooden bridges must be removed every two or three years and the whole structure of the bridges themselves must be built every twenty or twenty-five years" (Searight 1971: 35).

A statewide survey of highway bridges conducted by the Geological Survey in 1899 revealed that:

> *. . . a majority of the small bridges with spans up to 30 feet, culverts and drains are of wood. The shortest spans are a simple beam to which is nailed the flooring and rails. For spans from 10 to 30 feet, a simple triangular frame with a central tension rod or post forms the supporting truss* (Johnson 1899: 205-206).

The triangular frame structures were probably king or queen post trusses. The 1899 Geological Survey's Report also noted that "some of the small wooden bridges have been replaced by steel beam-bridges with wooden flooring" (Johnson 1899: 253).[10]

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9 There are no known extant small structures of timber truss construction.

10 Carroll County reported that an "A-frame" timber structure stood on an abandoned roadway until a few years ago (Butler 1997).

In the first decade of the twentieth century, Walter Wilson Crosby, Chief Engineer of the Geological Survey's Highway Division, advocated for reconstructing every wood bridge and forever doing away with "further expense for the maintenance of expensive and dangerous structures" (Crosby 1906: 379).

Despite the general sentiment in the early part of the twentieth century to replace wood structures with concrete, timber structures continued to be built. They were low in cost and relatively easy to construct and for areas of the Eastern Shore, timber structures were the most suitable structure for the environment (e.g. salt, sand, water, flat terrain). They are not included in the Standard Plans of the first three decades of the twentieth century. As late as 1933, however, the State Roads Commission included two designs for small timber beam structures in the Standard Plans. These designs were both for use only on secondary roads. One design was for a timber beam structure from 10 feet to 18 feet in length and for an H-10 load. A note on this design stated that the structures were "to be used only on infrequently traveled roads with the approval of the Chief Engineer" (Maryland State Roads Commission 1933: Standard Plans). The second design was for the same size timber beam structure but with a higher (H-15) load capacity. The State Roads Commission Report of 1934 stated that "several hundred wooden structures, both bridges and culverts, have been rebuilt or replaced" (Maryland State Roads Commission 1934: 72). That same report also mentioned the use of "creosoted timber" (Maryland State Roads Commission 1934: 44).

In the late 1930s composite timber and concrete structures came into use "in the flat terrain of the Tidewater region" (Spero 1995: 44) These structures, however, were generally bridges as opposed to small structures. The 1946-47 Report of the State Roads Commission stated that "structures in the tidal tributaries will find a considerable use of timber especially in the substructure and should the crossing be near a community where it is desirable to construct a bridge of pleasing appearance, this can be accomplished through the medium of a combination of timber and concrete" (Maryland State Roads Commission 1947: 56). The next State Roads Commission Report claimed that timber structures were still widely constructed on county or local highways (Maryland State Roads Commission 1949: 63). Timber construction is still used today for small structures in the state, mainly on the Eastern Shore.

Description

Timber beam small structures are comprised of timber beams (stringers) supported by either timber, masonry or concrete abutments (Figure 3.15). The railings and floor are generally of wood.

Few timber structures are listed in the SHA Office of Bridge Development's partially completed Small Structures Inventory for state highways. Timber structures may be much more prevalent on the county roadways. For example, Cecil County reported at least three small timber structures on county roadways (Dominick 1997).

Examples of timber construction of small structures on Maryland's roadways are:

CE3013 Stevens Road, Cecil County — ca. 1925

Timber beam on rubble stone abutments with wood handrail.

18048XO MD 472 over Branch of Patuxent River, St. Mary's County N.D.

12.75-foot timber beam with timber bulkhead abutments and timber wingwalls, 20-foot wide roadway.

22022XO MD 54 over Mockingbird Creek, Wicomico County 1940

17.75-foot timber beam with timber bulkhead abutments, 18-foot wide roadway.

Tips for Dating Timber Small Structures

Older wooden structures (unless covered) had relatively short life spans because of the effect of both traffic and weathering on the wood. In addition, many of the early twentieth century timber structures were eradicated before World War II by the efforts of the state and counties to upgrade their roads. Because of these two factors, it would be unlikely to find an early timber structure dating prior to 1920.

In 1933, the state's Standard Plans included a timber structure for use of secondary roads (Appendix A, pages A-43-44). A comparison of extant timber structures to these plans could assist in dating. Some structural elements that can be compared to the Standard Plans are the size and spacing of the stringers (shown in a table on the plans), the configuration of the superstructure and the size and spacing of the bridge rail posts(6 inch by 8 inch posts spaced five feet center to center).

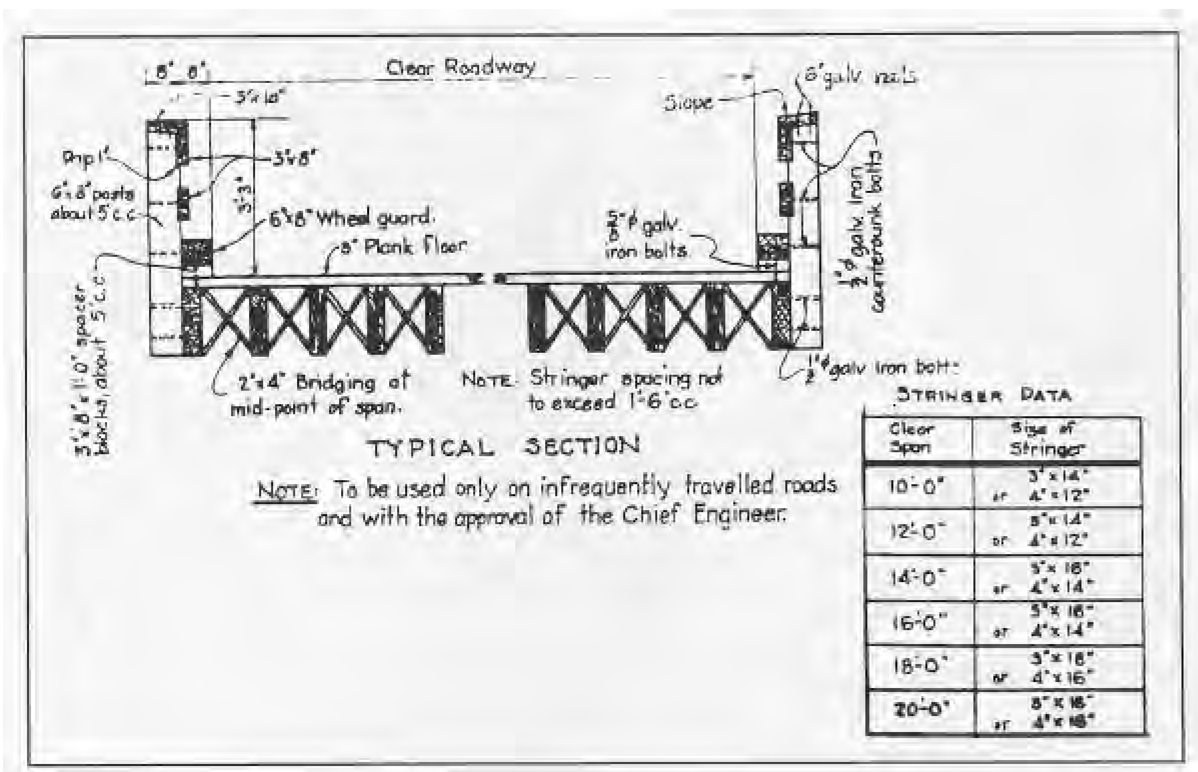


Figure 3.15. Timber Bridge from Standard Plans of 1933 (Source: Maryland State Roads Commission 1933).

3.5 PIPES AND PIPE ARCHES

Historical Overview

It is not known when pipes came into use as small structures on Maryland's roadways. In the first report of the Maryland Geological Survey in 1899, there are several references to pipes as well as illustrations of the construction methods for pipe culverts (Johnson 1899: 273, 275). (See Figure 3.16.) For example, it was reported in Kent County that:

> *Much attention has . . . been paid to building substantial culverts in all parts of the County. They are made of tile drains [pipes] with ends well protected by neat brick walls carried two or three feet above the level of the roadway* (Johnson 1899: 240).

The report states that stone was also used to protect the ends of tile pipe cross drains.

The next report of the Geological Survey contains a reference to a 30-inch pipe (built because of a failed effort to construct a concrete box culvert) but the composition of the pipe is not stated (Reid 1902: 133). Subsequent reports include references to both terra cotta and iron pipes (Johnson 1906: 286). The 1905-06 report stated that "either iron or vitrified clay pipes may be used for culverts up to 24 inches in diameter, the ends being in all cases protected by stone masonry. The larger culverts may be built of concrete" (Crosby 1906: 375). That same report discussed replacing the dangerous wooden structures with pipe culverts or concrete bridges (Crosby 1906: 379). The next year, the state's Chief Highway Engineer advocated rebuilding the existing roadways and replacing small bridges with pipes (Crosby 1908: 71).

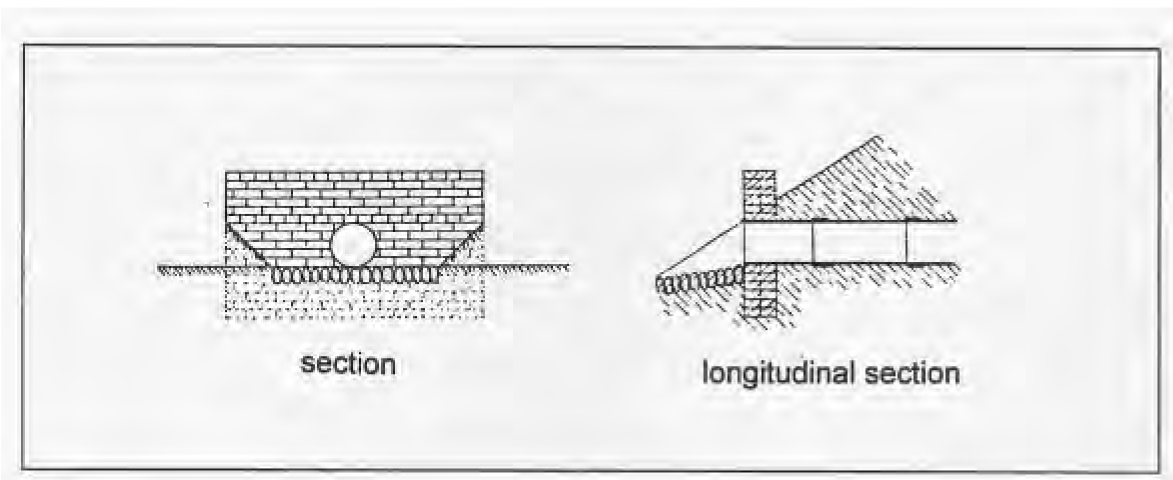


Figure 3.16. End elevation and longitudinal section of a pipe culvert under an embankment (Johnson 1899: 273, Fig. 8).

Pipe culverts are mentioned in the State Roads Commission's Report of 1916. The 1932 Report contains at least two references to replacing wooden bridges with corrugated metal pipe (Maryland State Roads Commission 1934: 72). The types of pipes listed in the Materials Section of the report include: cast iron, reinforced concrete pipe, vitrified pipe and tile, and corrugated metal pipe (Maryland State Roads Commission 1934: 53). In the 1937-38 Report, it was noted that 6,276 feet of corrugated metal pipe culvert ranging in size from 12 inches in diameter to 60 inches was laid in order to "provide for better drainage" (Maryland State Roads Commission 1939: 124).

Pipes are ubiquitous and have continued in use through this century up to the present for either drainage under roadways or to conduct small waterways under the roadway. The use of the iron and tile pipes of the early part of this century has been superseded by concrete and corrugated metal pipes. Pipe arches came into use after World War II.

Description

As small structures on Maryland's roadways, pipes are generally cross drainage structures situated well below the roadway surface. These are often referred to as pipe culverts. Earthen fill is placed to the sides of the pipe and between the pipe and the roadway. The pipe is generally a round structure but can be elliptical or arched. As stated above, pipe culverts can be of cast iron, tile, corrugated metal or concrete.

In metal pipes, the pipe is generally made of a single plate, formed and welded. A variation of this is the pipe arch that generally consists of an arched section of pipe. Figures 3.17, 3.18 and 3.19 are illustrations of types of pipes. Some examples of pipes and pipe arches on Maryland's roadways are:

<u>10048XO MD 550 over Branch of Hunting Creek, Frederick County 1930</u>

3-foot x 2-foot cast iron pipe, concrete headwall, 2-foot fill between top of pipe and roadway, 24-foot wide roadway.

<u>18044XO MD 245 over Cockold Creek, St. Mary's County 1936</u>

15-foot wide corrugated pipe arch, concrete foundation, headwalls and wingwalls, 5-foot fill between top of structure and roadway, 22-foot wide roadway

<u>02048XO MD 270 over Branch of Furnace Creek, Anne Arundel County ND</u>

8-foot x 6-foot elliptical corrugated metal pipe, concrete headwall, 10 feet of fill between top of structure and roadway.

<u>21178XO MD 67 over Tributary of Israel Creek, Washington County 1970</u>

6-foot structural plate pipe, concrete headwall and wingwalls, 21-foot wide roadway.

<u>08048XO MD 227 over Ponmonkey Mill Swamp, Charles County ND</u>

3.1-foot corrugated metal pipe, no wingwalls or headwalls, 2-foot fill between top of structure and roadway, 26-foot wide roadway.

Tips for Dating Pipes

Wrought iron is no longer used for pipes; most iron pipes would pre-date World War I. Concrete has been used throughout this century and would be very difficult to date. Extant corrugated metal pipes are known to date to the 1930s as are corrugated metal pipe arches. Pipe arches date generally from the 1930s to the present; many of these are associated with modern Interstate construction.

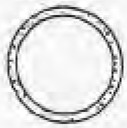
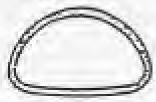
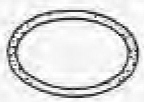
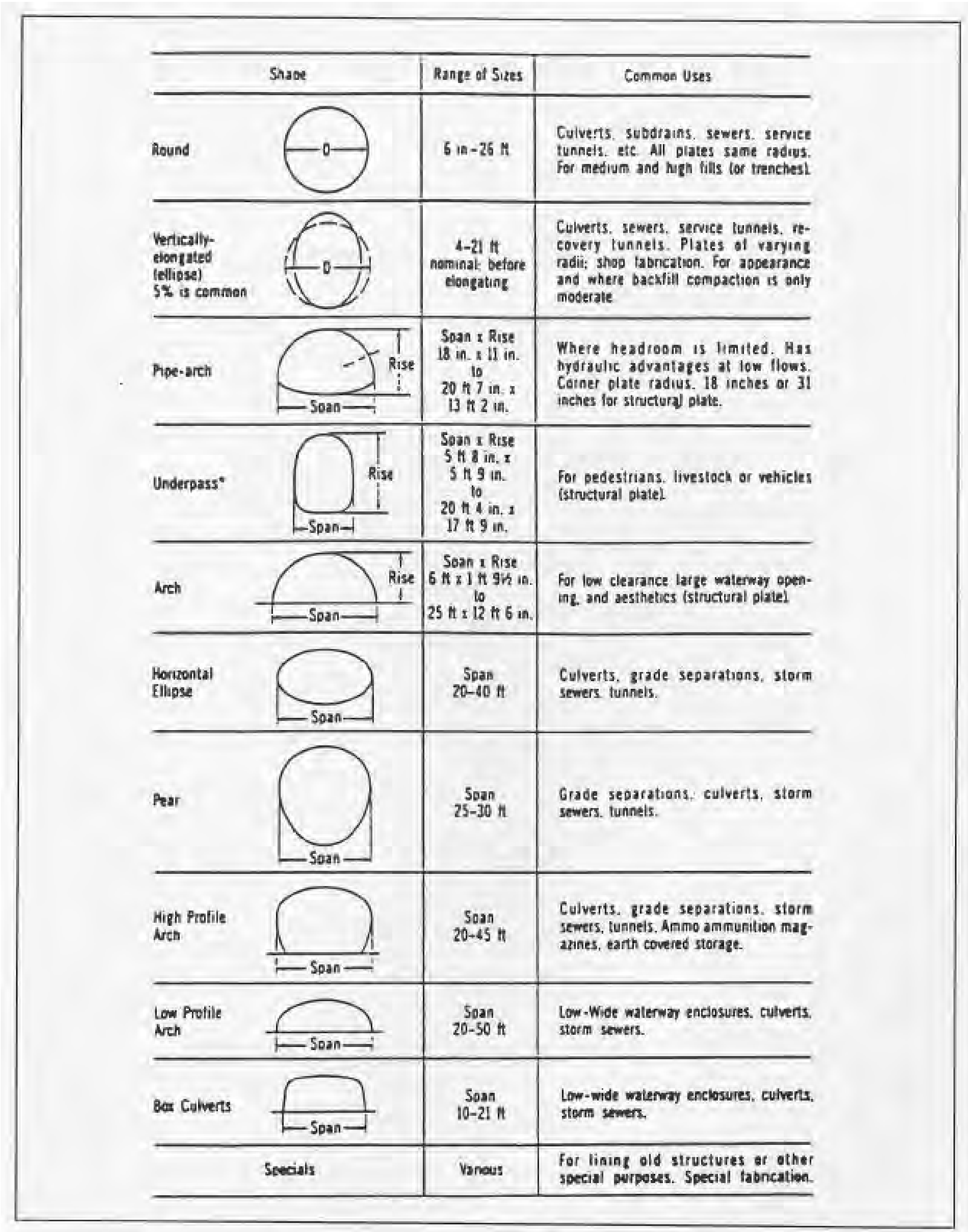
SHAPE	RANGE OF SIZES	COMMON USES
CIRCULAR 	12 to 180 inches reinforced 4 to 36 inches non-reinforced	Culverts, storm drains, and sewers.
PIPE ARCH 	15 to 132 inches equivalent diameter	Culverts, storm drains, and sewers. Used where head is limited.
HORIZONTAL ELLIPSE 	Span x Rise 18 to 144 inches equivalent diameter	Culverts, storm drains, and sewers. Used where head is limited.
VERTICAL ELLIPSE 	Span x Rise 36 to 144 inches equivalent diameter	Culverts, storm drains, and sewers. Used where lateral clearance is limited.
RECTANGULAR (box sections) 	Span 3ft to 12ft	Culverts, storm drains, and sewers. Used for wide openings with limited head.
ARCH 	Span 24 ft to 41 ft	Culvert and storm drains. For low, wide waterway enclosures.

Figure 3.17. Concrete pipe shapes (Source: FHWA 1991:19-4).



Shape	Range of Sizes	Common Uses
Round	6 in–26 ft	Culverts, subdrains, sewers, service tunnels, etc. All plates same radius. For medium and high fills (or trenches).
Vertically-elongated (ellipse) 5% is common	4–21 ft nominal; before elongating	Culverts, sewers, service tunnels, recovery tunnels. Plates of varying radii; shop fabrication. For appearance and where backfill compaction is only moderate.
Pipe-arch	Span x Rise 18 in. x 11 in. to 20 ft 7 in. x 13 ft 2 in.	Where headroom is limited. Has hydraulic advantages at low flows. Corner plate radius, 18 inches or 31 inches for structural plate.
Underpass*	Span x Rise 5 ft 8 in. x 5 ft 9 in. to 20 ft 4 in. x 17 ft 9 in.	For pedestrians, livestock or vehicles (structural plate).
Arch	Span x Rise 6 ft x 1 ft 9½ in. to 25 ft x 12 ft 6 in.	For low clearance large waterway opening, and aesthetics (structural plate).
Horizontal Ellipse	Span 20–40 ft	Culverts, grade separations, storm sewers, tunnels.
Pear	Span 25–30 ft	Grade separations, culverts, storm sewers, tunnels.
High Profile Arch	Span 20–45 ft	Culverts, grade separations, storm sewers, tunnels, Ammo ammunition magazines, earth covered storage.
Low Profile Arch	Span 20–50 ft	Low-Wide waterway enclosures, culverts, storm sewers.
Box Culverts	Span 10–21 ft	Low-wide waterway enclosures, culverts, storm sewers.
Specials	Various	For lining old structures or other special purposes. Special fabrication.

Figure 3.18. Standard corrugated steel culvert shapes (Source: FHWA 1991: 19-5).

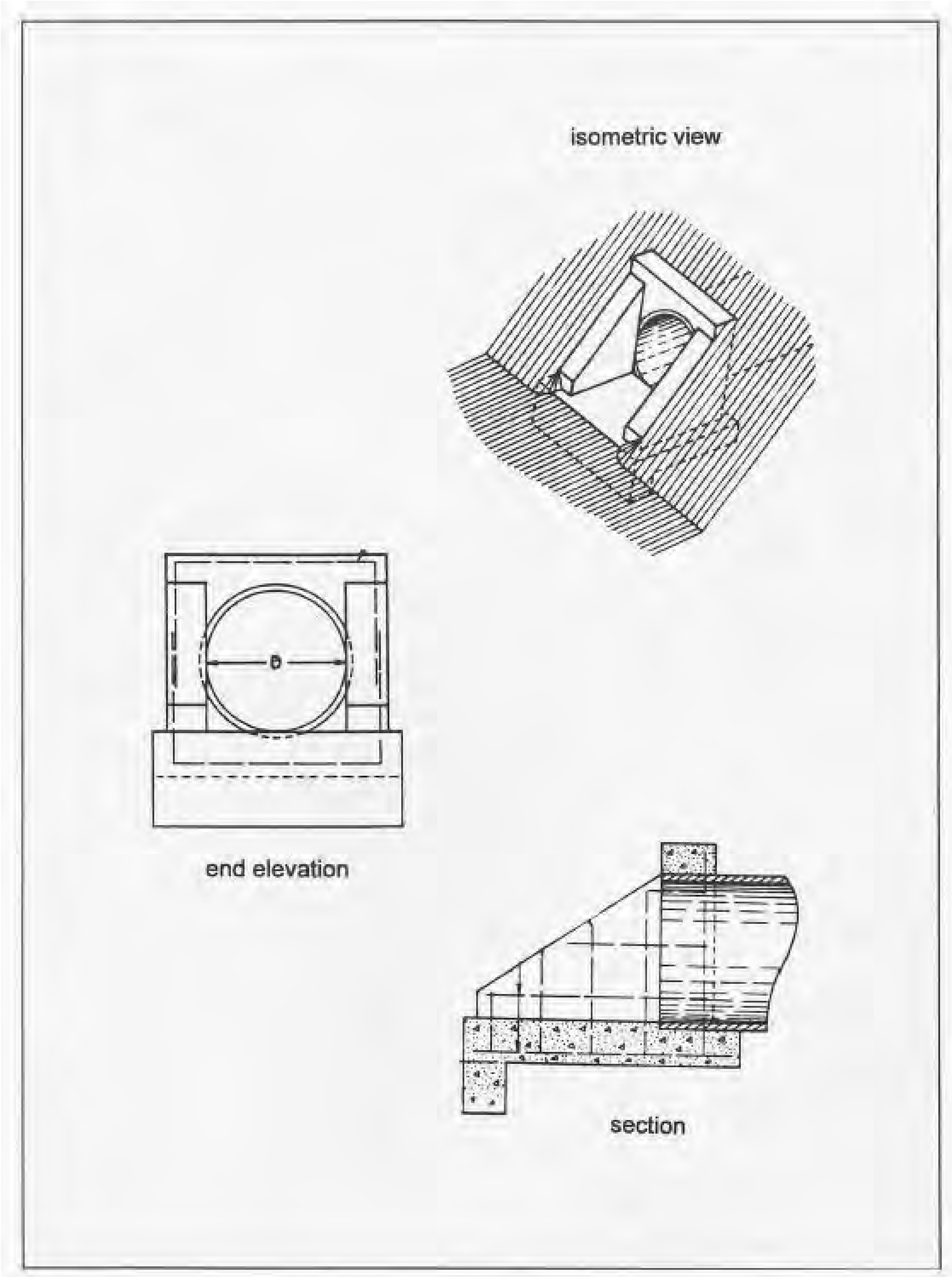


Figure 3.19. Details, standard metal or concrete pipe (Source: Maryland State Highway Administration 1986: MD-360.01).

4.0 EVALUATING MARYLAND'S SMALL STRUCTURES

Introduction

The historic context presented in Sections 2.0 and 3.0 of this report provides important background information that can be used to assess the National Register eligibility of small structures on Maryland's roadways. In order to do this, the questions below must first be answered:

1. Is the structure associated with an important historic context?

2. How does the context relate to the criteria of eligibility for the National Register as set forth in 36 CFR 60.6?

3. Does the structure possess integrity--does it retain those features necessary to convey its historic significance?

These three questions are addressed below. This section concludes with a discussion of the potential National Register eligibility of each of the small structure types described in Section 3.0.

4.1 Significant Contexts

Is the structure associated with an important historic context?

Historically, small structures, along with bridges, fit within the larger context of Maryland transportation history and the development of the state's roadway system. Within their own context, small structures do possess importance during certain, limited periods of the development of the state's road system.

Since all known extant small structures date to the nineteenth and twentieth centuries, a small structure dating earlier could possess significance as a sole or rare surviving example of pre-nineteenth century small structures in Maryland. It could also provide information on the construction techniques of the state's early small structures.

In the first half of the nineteenth century, two events are significant in the development of small structures: the construction of the National Road and the "turnpiking" of roads throughout the state. Structures from this era could possess engineering significance as examples of traditional building technologies such as masonry arched construction. They could also possess significance for their association with important roadway networks such as the National Road, a resource of both state and national significance.

In the twentieth century, there are two significant contexts under which small structures should be evaluated. The first is the ca. 1900-1911 period which witnessed the promotion of concrete as a "permanent" construction material for small structures (and bridges) and the introduction of reinforced concrete around 1903. This was an experimental period and concrete structures such as arches or arched culverts dating from this early period could be significant for this association.

The second significant period of the twentieth century is between 1912, when the first Standard Plans for small structures (and bridges) were issued by the State, to 1948 when major changes in roadway planning and technology occurred. Certain concrete small structures built according to the Standard Plans and unaltered could be significant.

Small structures are associated with other historical contexts (e.g. prison labor, the WPA) are interesting but are not particularly significant to small structures. In addition, often large structures (i.e. bridges) better represent many of the areas and periods of significance, particularly those relating to significant engineering technologies and historic events.

4.2 National Register Criteria of Eligibility

How does the historic context relate to the criteria of eligibility for the National Register as set forth in 36 CFR 60.6?

The historic context for small structures possesses limited areas and periods of significance. Although in some ways the context is identical to that of bridges, there are also major differences. For example, bridges can possess significance for their association with crossings important in the development and growth of the state, as examples of a solution to a difficult engineering challenge, as examples of the work of prominent engineers or for their architectural or artistic distinction. Small structures would rarely possess such significance.

Small structures do fit into the same significant contexts as bridges when their association with the development and advancement of Maryland's roadway system is considered. In this instance they can be considered as either integral elements of a larger system or as individual examples of a technology specific to an important time in the development of roadway structures in Maryland.

Below is a discussion of the application of the National Register Criteria of Eligibility to small structures. This discussion focuses on individual eligibility but also provides guidance for evaluating small structures within the context of a historic district. In all instances of potential National Register eligibility discussed below, the issue of integrity must also be considered.

Criterion A--*A small structure associated with events that have made a significant contribution to the broad pattern of our history*.

There may be cases where a small structure could be eligible for the National Register under Criterion A for its association with a significant historical event such as a military battle. Although the occurrences would be very limited, a small structure could also be individually eligible for the National Register under Criterion A if it stands on a roadway highly significant in the early growth and development of the state (or United States) and if it dates to the period of the development of the roadway. For example, a nineteenth century masonry arched small structure on the National Road could be individually eligible for the National Register for its association with this highly significant road. A factor that increases the significance of these early nineteenth century masonry arched structures is their limited surviving numbers. Other very early nineteenth century structures associated with the major turnpikes could also be significant under this criterion. (Many of these structures would also be eligible under Criterion C.)

Some twentieth century roadways are significant but it would be very rare for a small structure on these roads to be individually eligible. Most assuredly, there are many extant examples of the small structures associated with these twentieth century roads, thus reducing the significance of an individual small structure.

Criterion B--*A small structure associated with the lives of persons significant in our past.*

A small structure would generally not possess significance under this criterion because construction of individual small structures is rarely, if ever, linked to significant individuals.

Criterion C--*A small structure that embodies the distinctive characteristics of a type, period, or method of construction, or represents the work of a master or possesses high artistic values.*

Small structures would most likely qualify for individual listing in the National Register under this criterion. Structures eligible under this criterion would generally relate to the significant historical contexts summarized above in Section 4.1.

Although the pre-1800 period is not amongst the two significant historical contexts for small structures, a surviving small structure dating from the Colonial period up to around 1800 could be individually eligible as an example of a structure that embodies the distinctive characteristics of an era or method of construction, particular to the early centuries of the state's history. There are, however, no known extant small structures from this era.

Masonry arched structures built in the first half of the nineteenth century are illustrative of the early development of the state's roadway system. They are also significant for their method of construction which is rarely used today, and as examples of craftsmanship in the individuality of some of the structures. Both brick and stone arches are examples of structures that could be individually eligible. The numbers of surviving small masonry arches are limited, a factor that increases their significance.

Concrete and reinforced concrete small structures such as arches and arched concrete culverts built in the first decade of the twentieth century (up through 1911) are illustrative of a period significant in the history of small structures (and bridges). During this period, concrete was introduced and heavily promoted as a "permanent" building material for roadway structures. Apparently, there were failed efforts at concrete construction during this early period, indicating that the new type of construction required the assistance of builders with some knowledge of the new structural building material. There are no known concrete small structures dating to this period. A small structure datable to this period could be eligible for the National Register as a rare surviving example of early twentieth century concrete construction of small roadway structures.

Other small structures could be individually eligible as examples of structures built according to the Standard Plans issued by the State Roads Commission in 1912, 1919, 1924, 1928, 1930, 1931 and 1933. Several structure types and construction materials were included in the Standard Plans but not all types would be considered eligible. For example, the early Standard Plan slab and girder structures were considered significant because they promoted a ”new” technology, while the timber and metal Standard Plan structures were simply carryovers from the nineteenth century. There are surviving examples of Standard Plan structures on the state's roadways. An unaltered example of selected Standard Plan structures could be significant under this criterion.

Criterion D--*A small structure that has yielded, or may be likely to yield, important information in history or prehistory.*

Although the occurrence would be rare, a small structure, such as a masonry culvert that is datable to the Colonial period, could be individually eligible for the information it could provide on construction methods of that era.

Evaluating small structures that are not individually eligible

There are instances in which small structures may not be individually eligible for the National Register but may be considered contributing components of a historic "district." In this case, "district" can be defined in two ways. The first is what we commonly think of as a district, that is a grouping of buildings historically united by plan or physical development. A historic roadway, however, can also be considered a historic "district."

In order for a small structure to be a contributing component of a historic district that is comprised of a grouping of buildings and other resources, it would need to be determined whether the small structure was built and/or upgraded within the district's period of significance and whether it still retained sufficient appearance to represent the period of significance.

Thinking of a historic roadway as a "district" works in the same way. Its period or periods of significance and whether the small structure fits within that period would both need to be determined. One roadway, the Baltimore-Washington Parkway, is the only roadway in the state currently individually listed in the National Register. The National Road is highly significant and portions of the roadway could be National Register-eligible. Other roads may be eligible as a "district" but no historic context for these resources has been developed. Spero's report contains a good outline of some roads thought to be significant in the state's development (Spero 1995: 29-31). Besides the National Road and the Baltimore-Washington Parkway, two examples of other roadways that may possess significance are the Rock Creek Potomac Parkway and the Crain Highway (ca. 1920s-35). The latter, the first major new road constructed on entirely new location by the State Roads Commission, could be considered partly or wholly eligible as a "district" because it reflects the early twentieth century trend toward standardized road and structural design (including culverts).

If a pre-1948 small structure is proposed for renovation or replacement and its small structural type is not individually eligible, a determination should be made of whether the structure is within a listed or potentially eligible historic district, including linear roadway districts. A determination would then be made as to whether the structure fits within the district's period of significance. Alterations or changes to a structure during the period of significance of the district may be significant. An example is a renovated structure, possessing integrity, whose changes reflect a historic trend that characterizes the district.

4.3 Integrity

Does the structure possess integrity--does it retain those features necessary to convey its historic significance?

To be individually listed in the National Register, a resource must not only meet one or more of the Criteria of Eligibility but it must also have integrity. In a small structure, integrity would be related mainly to design, materials and workmanship but, of course, integrity elements such as location and feeling also would apply. To determine if a structure possesses integrity, it needs to be ascertained whether the structure retains the elements of design and the materials necessary to convey the period in which it was constructed. Integrity applies to the structure's appearance as opposed to its state of repair or functional adequacy.

There are also different levels of integrity required for different types of bridges. Issues such as the rarity of a structure that fits within a significant historic context and whether it is eligible under only one or more than one of the National Register criteria must be considered. For example, a masonry culvert surviving from the Colonial era and buried within other modern structures (e.g. slab or box extensions) could be eligible although its integrity has been compromised by the addition of modern structures to both outer edges. It could be significant under both Criterion C for its design as a rare surviving example of an Colonial-era culvert and under Criterion D for its information potential. Another example is a small structure on the National Road. Because of the high significance of the road, the structure could incur some changes and still possess sufficient integrity to be eligible for the National Register. This is because there is only a small surviving number of these resources and they possess two areas of significance: historical (Criterion A) and engineering (Criterion C).

The small structures of the twentieth century must be evaluated differently because they are generally only eligible under Criterion C and because they are substantially more common and are less significant than the previously discussed structural types. In order to be considered eligible for the National Register, twentieth century small structures should be unaltered--in essence, they should retain all of their character-defining elements. For example, a slab structure built in 1920 according to the 1919 Standard Plans must retain its incised parapet rail, the structural dimensions as illustrated in the plans, its 24-foot wide roadway and its concrete abutments and/or wingwalls. A 1933 slab structure would have to retain its open rail, its structural dimensions as illustrated in the plans, its 30-foot roadway and its incised concrete abutments and/or wingwalls. In both instances, the roadway surface could be modern because that is not a character-defining element of the structure.

4.4 Potential Eligibility of Small Structure Types

The structural types discussed in this section are described in detail in Section 3.0. This section addresses the potential individual National Register-eligibility of each of the following small structure types.

- Masonry--arch
- Concrete--slab, box culvert, girder/beam, arch and arched culvert, rigid frame

- Metal--beam and arches
- Timber--beam
- Pipes--pipes and pipe arches

As stated earlier in this section, small structures have limited areas and periods of significance. Of the small structures that do fit into the defined significant contextual periods, it is likely that few would possess sufficient integrity to be eligible for the National Register.

Assessing the eligibility of small concrete structures of the twentieth century is a particular challenge. Many of the early state highway department bridge surveys conducted throughout the United States did not address concrete structures and, if they did, concrete arches were often felt to be the only type considered significant. In recent years, some states have updated their original bridge surveys to address the wide range of twentieth century concrete bridges.[1]

Research undertaken for this study has included a review of existing small structure files at the State Highway Administration (SHA), interviews with personnel of the SHA's Office of Bridge Development, technical assistance from bridge engineers in the private sector, a review of Spero's report and the bridge surveys of numerous other states, correspondence with county and city highway departments and development of the historic context for small structures in Maryland (Sections 2.0 and 3.0 of this report). This research and analysis provides sufficient background information to determine what small structures could be considered eligible for the National Register. These small structures may be eligible in limited, well-defined areas and periods of significance and must possess medium-high to very high levels of integrity. The research has also provided sufficient information to make a determination that certain types of small structures do not fit into any significant historic context and thus are not eligible for the National Register.[2]

Character-Defining Elements

To assess the integrity of a small structure, the elements composing the structure and their importance to conveying the structure's period of significance must be analyzed. Such elements are referred to as *character-defining elements*. Other elements add to the significance of a structure such as bridge plaques which often play a role in dating a structure and establishing its significance (e.g. builder). Regarding ornamentation, if applied to the structure, it is considered as a separate element. Integral ornamentation such as incised panels on rails or horizontal scoring of wingwalls, however, is assumed under the element itself (e.g. rail, wingwalls) (Spero 1995: C-24). Other elements that

[1] A publication of interest since it relates so closely to the concrete small structures addressed in this study is the *Survey of Non-Arched Historic Concrete Bridges in Virginia Constructed Prior to 1950* prepared for the Virginia Research Council (Miller 1996). The study addresses the National Register eligibility of bridges, not small structures, but many of the types discussed are identical to those of the small structures discussed in this report (e.g. slab, girder, rigid frame). It is interesting to note that of the 1,420 non-arched concrete structures evaluated under National Register criteria during that study, fewer than a dozen were found to be individually eligible (Miller 1996: iii).

[2] Certain contexts such as significant crossings, engineering involvement, and artistic statements are better represented by bridges rather than small structures.

compose a structure are of secondary (moderate) importance or are incidental to the structure's essential characteristics (tertiary).

Concerning structures built according to the Standard Plans, because they were built in large numbers and are not uncommon today, they must possess a very high level of integrity and all of their character-defining elements to be individually considered eligible for the National Register.

The potential for individual eligibility of each structural type is discussed on the following pages. The discussion includes a list of the components of each structure and supplies a rating of the significance of each component in defining the structure's character. The definition of each rating assigned to the structural components is shown below in Table 4.1. This rating system is a simplification of the system presented in Spero's 1995 Historic Bridge Context Report and is designed to be easier to utilize for the target users of this report. The purpose of this report is to assist users in making eligibility determinations for small structures on a *case by case* basis while Spero's report will be used by the historic bridge committee to *comprehensively evaluate* the state's historic bridges.

Table 4.1
Key to Structural Component Importance Rating

CDE	**Character-Defining Element** *Very Important elements--structural components that are key to conveying the structure's period of significance.*
A	**Added Significance** *Elements, beyond CDEs, that add to the significance of a structure. For example, an extant plaque, plate or imprint could increase the significance of a structure and could provide important historical information.*
S	**Secondary (Moderate) Importance** *Less crucial to essential characteristics but can add to structure's historic character.*
T	**Tertiary** *Incidental to the structure's essential characteristics.*

4.4.1 Masonry

Period(s) of Significance	*Pre-1800, First half of nineteenth century*
Potential Applicable National Register Criteria	*Criteria A C, and D*
Integrity Considerations	*Must retain all CDEs under Criterion C. Under Criteria A and D, some alterations may be acceptable.*

There are no known pre-1800 small masonry (stone, brick or a combination) arches or arched culverts. There are, however, extant early nineteenth century structures of this type along the early roads and turnpikes of the state, particularly in the Appalachian and Piedmont regions of the state, where stone was readily available. There may be twentieth century masonry small arches, particularly in areas where aesthetics in design were a major consideration, but it has been much more common in the twentieth century to face concrete structures in masonry for aesthetic appeal rather than to use masonry construction.

Small masonry arches or arched culverts dating up to around 1850 could be eligible for the National Register under Criterion C because they "embody a craftsman tradition derived from Colonial and European sources" (Spero 1996: C-13). These same structures could also be eligible under Criterion A if they are associated with the development of early and significant roadways in the state. A pre-1800 structure such as a masonry culvert could also be significant under Criterion D for the information it could provide on early road drainage construction techniques.

Concerning integrity, because of the limited numbers of surviving pre-1850 small masonry arches and arched culverts, some alterations to the structure may not damage its integrity to a point where it would not be considered eligible, particularly if a structure is also eligible under Criteria A or D. For example, a pre-1800, beautiful arched culvert of squared granite blocks could be eligible under Criterion D even if it has been widened on both sides and is now encased within modern structures. The arched structure would generally have remained intact during the widening and could still be eligible. A stone arch built along the National Road, however, would need to be treated somewhat differently as far as integrity is concerned. Although probably eligible under both A and C, at least one side of the stone arch would need to be exposed since aesthetics were a consideration in the construction of the small stone arches.

A masonry arch or arched culvert could be eligible as a contributing component of a historic district if it fits within the district's period of significance and retains sufficient integrity to represent that period.

Table 4.2 below is a list of the structural components of masonry structures and a rating of their importance.

Table 4.2
Structural Component Importance Rating for Masonry Small Structures

	Structural Element	*Rating*
superstructure	arch ring	CDE
	barrel	CDE
	spandrel wall	CDE
	parapet	CDE
	fill	T
	roadway	T
	applied ornamentation	T
	plaques, plates and imprints	A
substructure	abutments	CDE
	wingwalls	CDE
	applied ornamentation	T
	plaques, plates and imprints	A
	endpost section of parapet, attached to abutment	S

4.4.2 Concrete

Concrete Slab

Period(s) of Significance	*ca. 1900-1911[3], 1912-1947[4]*
Potential Applicable National Register Criteria	*Criterion C*
Integrity Considerations	*All CDEs must be intact*

Small concrete slab structures are found throughout the state. They were built beginning around 1900 and continue to be constructed, although less frequently, on Maryland's roadways today. Standard Plans issued by the State between 1912 and 1933 included a slab design for small structures.

Small slab structures would generally be individually eligible for the National Register under Criterion C. If an unaltered, pre-1912 concrete slab was found, it could be eligible for its association with the introduction of concrete and concrete technology for roadway structures in the state. From 1912 to 1947, a small unaltered concrete slab structure built according to the Standard Plans could be eligible as an example of the state's efforts to standardize the design of small structures (and bridges). In addition, the reinforced concrete slab, promoted widely as a "permanent structure", was a major technological advancement over the timber and metal beam structures of the nineteenth century. Both a pre-1912 slab and a ca. 1912-47 Standard Plan structure would need to retain all CDEs to be individually eligible for the National Register. To be considered a contributing element of a historic district, a small slab structure would need to fit within the district's period of significance and retain sufficient CDEs to represent that period.

Table 4.3 below is a list of the structural components of concrete slab structures and a rating of their importance.

Table 4.3
Structural Component Importance Rating for Concrete Slab Small Structures

	Structural Element	*Rating*
superstructure	slab	CDE
	parapet or railing	CDE
	roadway	T
	applied ornamentation	T
	plaques, plates, imprints	A
substructure	abutments	CDE
	wingwalls	CDE
	applied ornamentation	S
	plaques, plates and imprints	A
	endpost section of parapet, attached to abutment	S

3 Structures dating from this period are associated with the era of experimentation with concrete for use in roadway structures.
4 Structures dating from this period are associated with the efforts of the State to standardize structural design.

Concrete Box Culvert

Period(s) of Significance	*N/A (not applicable)*
Potential Applicable National Register Criteria	*Not individually eligible*
Integrity Considerations	*N/A*

Concrete box culverts are common and have been constructed throughout the state starting around 1900 and continuing through today. The Standard Plans of 1912 and 1931 included designs for various sizes of box culverts.

Although these structures were included in the state's Standard Plans, they are not considered individually eligible for the National Register. Unlike the standard slab bridge, box culverts in both appearance and basic design have changed very little in the nearly 100-year period during which they were constructed and there are numerous extant examples throughout the state. The concrete box culvert is, with the exception of pipes, the small structure most widely used on Maryland's roadways in the twentieth century. These structures are essentially non-descript, are very hard to date and are not significant from a technological standpoint. For these reasons, the concrete box culvert is not individually eligible for the National Register. If, however, a box culvert in a historic district fits within the district's period of significance, it could be considered a contributing component of the district if it possesses sufficient integrity to represent that period of significance.

Table 4.4 below is a list of the structural components of concrete box culverts and a rating of their importance.

Table 4.4
Structural Component Importance Rating for Concrete Box Culverts

Structural Element	*Rating*
box	CDE
fill	T
headwall	CDE
wingwalls (if present)	CDE
roadway	T
railing	CDE*
plaques, plates and imprints	A

* Only the Standard Plan no-fill box culvert designs included a rail design but bridge rails would be similar to those on other concrete structures (e.g.slab and girder) built during the same era (i.e. closed parapet or open rail concrete).

Concrete Girder (Beam)

Period(s) of Significance	*1912-1923*
Potential Applicable National Register Criteria	*Criterion C*
Integrity Considerations	*All CDEs must be intact*

Small concrete girder/beam bridges were not commonly used for construction of small structures. Instead, the type was primarily used for bridges. In the Standard Plans of 1912 and 1919, however, the State did include a girder design for an 18-foot span. There are a limited number of extant small girders on both state and local roadways.

Girder/beam small structures could be eligible for the National Register under Criterion C if they were built according to the Standard Plans of 1912 and 1919. They would exemplify the state's efforts to standardize the design of small structures (and bridges). Concerning integrity, the structures would need to be unaltered, possessing all of their CDEs. In a historic district, a small girder structure could be considered a contributing structure if it fits within the district's period of significance and retains sufficient CDEs to represent the period.

Table 4.5 below is a list of the structural components of concrete girder small structures and a rating of their importance.

Table 4.5
Structural Component Importance Rating for Concrete Girder Small Structures

	Structural Element	*Rating*
superstructure	slab	CDE
	longitudinal beams (on T-beam, slab and beams are integral)	CDE
	concrete parapet or railing	CDE
	roadway	T
	applied ornamentation	T
	plaques, plates, imprints	A
substructure	abutments	CDE
	wingwalls	CDE
	applied ornamentation	S
	plaques, plates and imprints	A
	endpost section of parapet or railing, attached to abutment	S

Concrete Arches and Arched Culverts

Period(s) of Significance	*ca. 1900-1911*
Potential Applicable National Register Criteria	*Criterion C*
Integrity Considerations	*All CDEs must be intact*

Small concrete arches and arched culverts are not common on the state's roadways. Preliminary research indicates that the arch was rarely used for construction of small structures but some filled spandrel arches were built. Arched culverts were built on the state's roadways beginning around 1900 but the design was soon superseded by the box culvert design. Neither arches or arched culvert designs were included in the Standard Plans.

A small concrete arch or arched culvert would be eligible for the National Register only under Criterion C. A structure dating to the first decade of this century could be eligible for its association with the introduction of concrete and concrete technology for use on Maryland's roadway structures.

To be individually eligible for the National Register, a concrete arch or arched culvert would need to retain all of its CDEs. In a historic district, the structure could be considered a contributing resource if it fits within the district's period of significance and retains sufficient integrity to represent that period.

Table 4.6 below is a list of the structural components of concrete arches and arched culverts and a rating of their importance.

Table 4.6
Structural Component Importance Rating for
Small Concrete Arches and Arched Culverts

	Structural Element	*Rating*
superstructure	arch ring	CDE
	barrel	CDE
	concrete parapet or railing	CDE
	spandrel wall	T
	Fill	T
	applied ornamentation	T
	plaques, plates, imprints	A
substructure	abutments	CDE
	wingwalls (if present)	CDE
	applied ornamentation	S
	plaques, plates and imprints	A
	endpost section of parapet or railing, attached to abutment	S

Concrete Rigid Frame

Period(s) of Significance	*N/A*
Potential Applicable National Register Criteria	*Not individually eligible*
Integrity Considerations	*N/A*

The earliest datable rigid frame bridge in the state dates to the early 1930s. This type was not included in the Standard Plans and was apparently not commonly used for construction of small structures before World War II. There are few extant examples of the rigid frame small structure on Maryland's state highways.

Although the rigid frame structural type is significant in bridge technology (Condit 1961: 213), it is not significant in the context of small structures. Its significance is primarily linked to post-World War II advances in bridge technology that led to the design of modern highway bridges, particularly those on the Interstate system. Consequently, rigid frame small structures are not considered individually eligible for the National Register. A rigid frame structure located within a historic district could be considered a contributing component of the district if it was built within the district's period of significance and retains sufficient CDEs to represent the period.

Table 4.7 below is a list of the structural components of concrete rigid frame structures and a rating of their importance.

Table 4.7
Structural Component Importance Rating for
Concrete Rigid Frame Small Structures

	Structural Element	*Rating*
superstructure	rigid frame	CDE
	parapet or railing	CDE
	roadway*	T
	applied ornamentation	T
	plaques, plates, imprints	A
substructure	abutments	CDE
	wingwalls	CDE
	applied ornamentation	S
	plaques, plates and imprints	A
	endpost section of parapet or railing, attached to abutment	S

* There could be substantial fill between top of structure and roadway.

4.4.3 Metal

Period(s) of Significance	*1933-1947*
Potential Applicable National Register Criteria	*Criterion C*
Integrity Considerations	*All CDEs must be intact*

Small metal beam structures have been constructed throughout the state since the second half of the nineteenth century and continue to be built today. A steel beam design was included in the 1933 Standard Plans for use on "secondary roads." Preliminary research indicates that this type was not widely used for construction of small structures in the twentieth century and there are few extant metal beam structures on the state highway system today. (Although metal arches are included as a type on the SHA's list of small structure types, there are presently no known examples of this type. Most would post-date 1947.)

The metal beam structure had its roots in the nineteenth century. When concrete technology was applied to roadway structures around 1900, the popularity of the metal beam structure was superseded by concrete structures. The State included a design for a steel beam structure in its 1933 Standard Plans. This design was intended for use on secondary roads only. Small metal beam structures built according to the Standard Plans and with no alterations to the CDEs could be individually eligible for the National Register. They would exemplify the state's efforts to standardize the design of small structures (and bridges). A metal beam structure that dates within the period of significance of a historic district could be considered a contributing element of the district if it retains sufficient CDEs to represent that period.

Table 4.8 below is a list of the structural components of metal beam small structures and a rating of their importance.

Table 4.8
Structural Component Importance Rating for Metal Beam Small Structures

	Structural Element	*Rating*
superstructure	deck	S
	longitudinal beams (generally rolled I-beams)	CDE
	floor system	S
	railing	CDE
	applied ornamentation	T
	plaques, plates, imprints	A
substructure	abutments, (wingwalls, if present)	CDE
	applied ornamentation	S
	plaques, plates and imprints	A

4.4.4 Timber

Period(s) of Significance	*1933-1947*
Potential Applicable National Register Criteria	*Criterion C*
Integrity Considerations	*All CDEs must be intact*

Timber beam structures have been constructed throughout Maryland's history. A timber beam design was included in the 1933 Standard Plans for use on "secondary roads." There are a small number of extant timber beam structures on the state highway system and also on the county roadways.

When concrete technology was applied to roadway structures around the turn of the century, the popularity of the timber structure was superseded by concrete structures. The State, however, included a design for a timber structure in its 1933 Standard Plans for use on secondary roads only. Small timber structures built according to the Standard Plans of 1933 could be individually eligible for the National Register. They would exemplify the state's efforts to standardize the design of small structures (and bridges). Concerning integrity, the structures would need to be essentially unaltered, possessing all of their CDEs. Added reinforcement to a Standard Plan structure would, in most cases, damage its integrity and render it not eligible for the National Register. A timber structure that dates within the period of significance of a historic district could be considered a contributing element of the district if it retains sufficient CDEs to represent that period.

Table 4.9 below is a list of the structural components of timber beam small structures and a rating of their importance.

Table 4.9
Structural Component Importance Rating for Timber Beam Small Structures

	Structural Element	*Rating*
superstructure	deck	T
	longitudinal beams (stringers)	CDE
	railing	CDE
	floor system	T
	applied ornamentation	T
	plaques, plates, imprints	A
substructure	abutments	CDE
	applied ornamentation	S
	plaques, plates and imprints	A
	endpost section of parapet or railing, attached to abutment	S

4.4.5 Pipes and Pipe Arches

Period of Significance	*N/A*
Potential Applicable National Register Criteria	*Neither individually eligible or eligible in a district*
Integrity Considerations	*N/A*

Pipes have been used in various forms in the state since at least the late nineteenth century. Materials have evolved as technology has advanced but the basic design, use and installation technique of pipes have not changed. Pipes are found in use for under-roadway drainage throughout the state and are perhaps the most widely used small structure on the state's roadways.

Pipes and pipe arches are not important as a standardized structural type and have no technological significance. In addition, they do not fit within the significant contexts developed for small structures. Consequently, these structures are not individually eligible for the National Register nor would they be considered contributing components of historic districts because they are ubiquitous and difficult, if not impossible, to date.

Because pipes and pipe arches are neither individually eligible or eligible as part of a historic district, a table of significant structural components is not provided.

4.5 SUMMARY OF NATIONAL REGISTER ELIGIBILITY

Table 4.10 below is a summary of the potential individual National Register eligibility of each small structure type. It is important to note that although a structural type may not be considered individually eligible, it could be considered a contributing element of a district if it has integrity and fits within the district's period of significance. The only exception is pipes, which because they are so common, hard to date and possess no technological significance are neither individually eligible or eligible within a historic district.

Table 4.10
Summary of Individual National Register Eligibility of Small Structure Types

Small Structure Type	Dates of Significance	Applicable NR[1] Criteria[2]	Integrity Assessment for Individual NR Eligibility
Masonry Arch	pre-1800, ca. 1800-50	A, C, D	Most CDEs must be present[3]
Concrete Slab	ca. 1900-1911 1912-1947	C	All CDEs must be present
Concrete Box Culvert	N/A	Not Eligible	N/A
Concrete Girder	1912-1923	C	All CDEs must be present
Concrete Arch/Arched Culvert	ca. 1900-1911	C	All CDEs must be present
Concrete Rigid Frame	N/A	Not Eligible	N/A
Metal Beam	1933-1947	C	All CDEs must be present
Timber Beam	1933-1947	C	All CDEs must be present
Pipes	N/A	Not Eligible	N/A

[1] NR=National Register.

[2] Note that these criteria are applied in the table only to individual eligibility of small structures.

[3] Some alterations may be acceptable. Refer to Pages 4-9.

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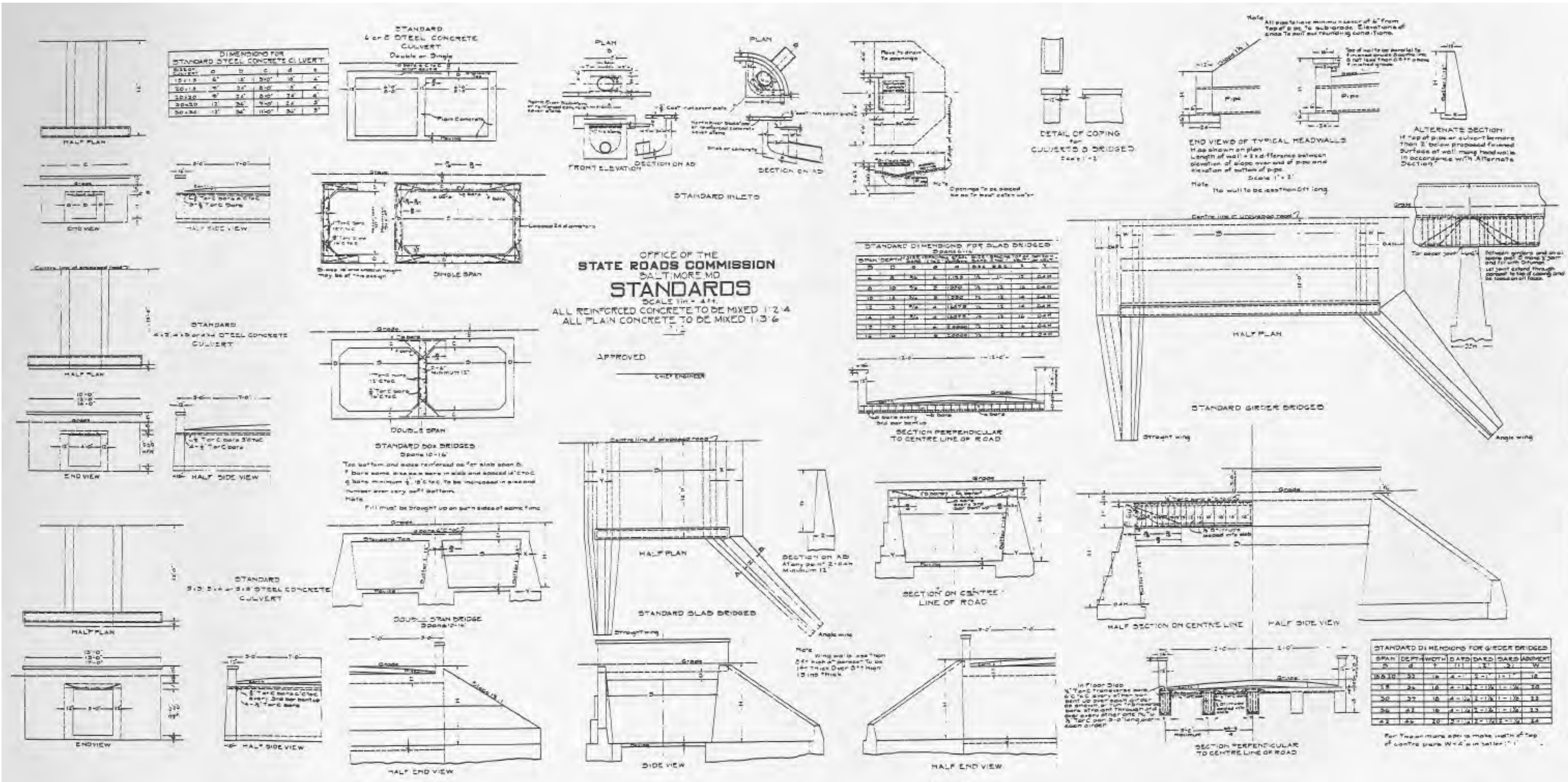
APPENDIX

Standard Plans for Small Structures
Adopted by the Maryland State Roads Commission
1912-1933

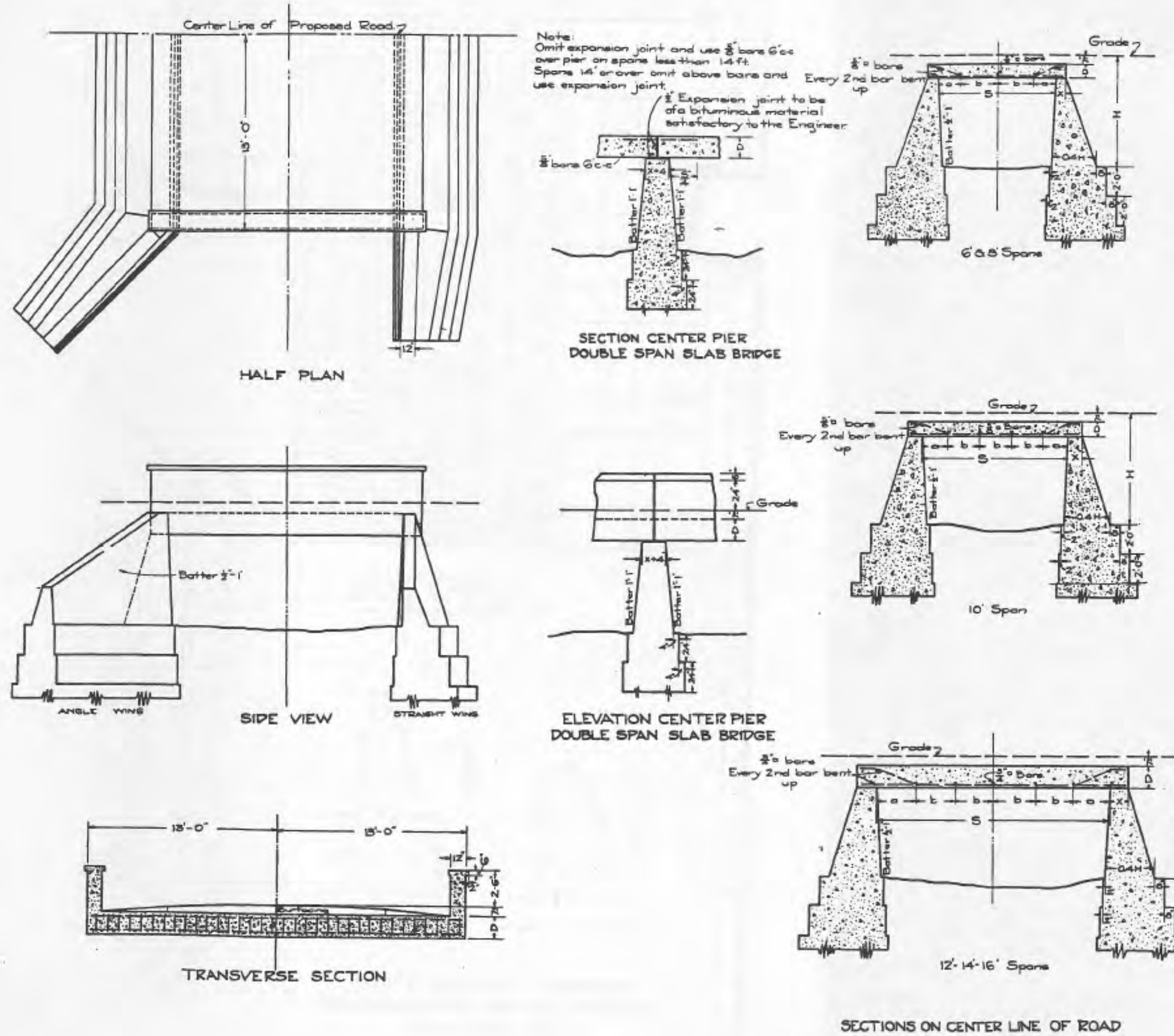
(Originals on file at Maryland State Highway Administration,
Office of Bridge Development, Baltimore, MD)

Contents

1912 Standard Plans


OFFICE OF THE
STATE ROADS COMMISSION
BALTIMORE, MD.
STANDARDS
ALL REINFORCED CONCRETE TO BE MIXED 1:2:4
ALL PLAIN CONCRETE TO BE MIXED 1:3:6
APPROVED
CHIEF ENGINEER
HALF PLAN
END VIEW
HALF SIDE VIEW
STANDARD STEEL CONCRETE CULVERT
SINGLE SPAN
DOUBLE SPAN
STANDARD BOX BRIDGES
DOUBLE SPAN BRIDGE
HALF END VIEW
PLAN
FRONT ELEVATION
SECTION ON AB
STANDARD INLETS
DETAIL OF COPING
CULVERTS & BRIDGES
END VIEWS OF TYPICAL HEADWALLS
ALTERNATE SECTION
STANDARD DIMENSIONS FOR SLAB BRIDGES
SECTION PERPENDICULAR TO CENTRE LINE OF ROAD
STANDARD SLAB BRIDGES
SIDE VIEW
SECTION ON CENTRE LINE OF ROAD
STANDARD GIRDER BRIDGES
Straight wing
Angle wing
HALF SECTION ON CENTRE LINE
STANDARD DIMENSIONS FOR GIRDER BRIDGES

1919 Standard Plans



DIMENSIONS FOR SLAB BRIDGES						
SPAN	DEPTH	SIZE OF BARS □	SPACING LONGITUDINAL BAR C-C	SPACING TRANSVERSE BARS		TOP OF ABUTMENT
S	D			a	b	X
6'	9"	5/8"	6½"	1'-5"	1'-9"	9"
8'	11"	5/8"	5"	1'-6"	2'-6"	10"
10'	12"	5/8"	4½"	1'-9"	2'-2"	12"
12'	14"	3/4"	5½"	2'-0"	2'-0"	14"
14'	16"	3/4"	5"	2'-3"	2'-4½"	15"
16'	18"	3/4"	4½"	2'-6"	2'-9"	16"

Note:
All reinforced concrete to be mixed 1:2:4
All plain concrete to be mixed 1:3:6.

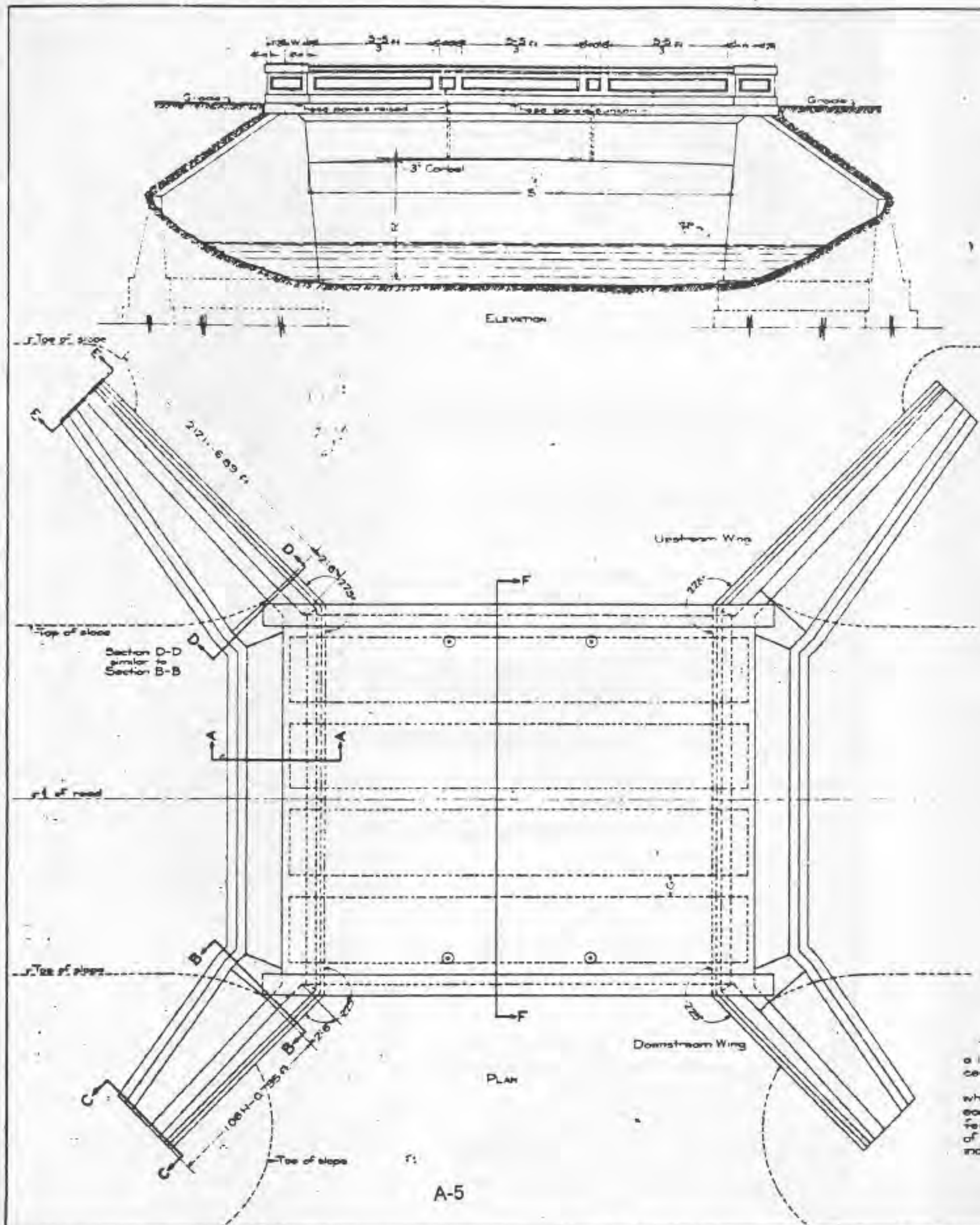
OFFICE OF THE
STATE ROADS COMMISSION
BALTIMORE, MD

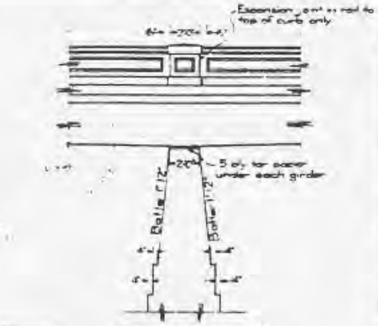
DETAILS FOR
STANDARD SLAB BRIDGES

SCALE 1" = 4'

APPROVED J. N. Mackall
CHIEF ENGINEER

April 17, 1919



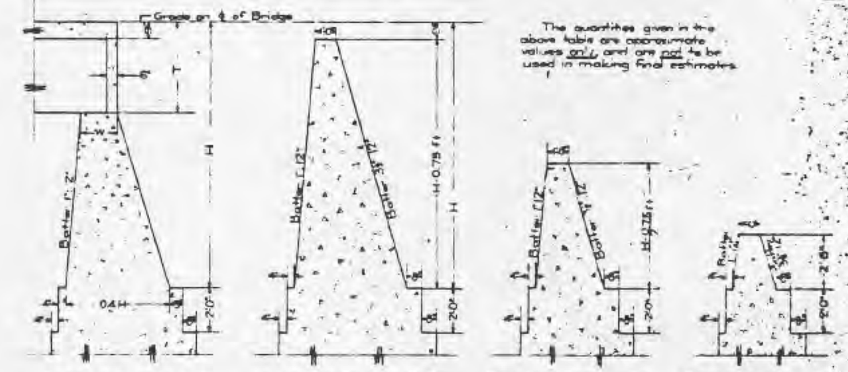


Elevation Center Pier
Double Span

VARIABLE DIMENSIONS			
S	T	G	V
18'-0"	3'-5"	1'-2"	1'-2"
20'-0"	3'-7"	1'-4"	1'-4"
22'-0"	3'-9"	1'-4"	1'-6"
25'-0"	4'-1"	1'-4"	1'-6"
28'-0"	4'-3"	1'-6"	1'-4"
30'-0"	4'-5"	1'-6"	1'-6"
32'-0"	4'-7"	1'-6"	1'-10"

QUANTITIES														
SPAN FEET	R FEET	ABUTMENTS (CUBIC YARDS): ABUTMENTS	FOOTINGS 2 FT	FOOTINGS 4 FT	WINGS (CUBIC YARDS) TWO UPSTREAM: WINGS	FOOTINGS 2 FT	FOOTINGS 4 FT	TWO DOWNSTREAM: WINGS	FOOTINGS 2 FT	FOOTINGS 4 FT	GIRDER (CUBIC YARDS)	SLAB (CUBIC YARDS)	PARAPET (CUBIC YARDS)	TOTAL STEEL (LBS.)
18	2	24	[illegible]	[illegible]	6	45	[illegible]	34	[illegible]	[illegible]	103	158	53	3423
	4	54	[illegible]	332	83	53	[illegible]	[illegible]	56	25				
	5	[illegible]	162	362	119	59	[illegible]	106	[illegible]	143				
	6	276	177	392	155	36	214	140	76	[illegible]				
	8	429	226	434	276	134	296	[illegible]	103	[illegible]				
	10	[illegible]	238	[illegible]	434	[illegible]	381	348	133	241				
	12	865	268	514	642	248	488	515	164	339				
20	2	[illegible]	136	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	178	58	3793
	4	161	[illegible]	[illegible]	88	65	145	80	[illegible]	[illegible]				
	5	222	166	[illegible]	129	62	183	[illegible]	69	[illegible]				
	6	[illegible]	181	400	170	99	[illegible]	[illegible]	80	[illegible]				
	8	[illegible]	[illegible]	461	288	[illegible]	333	228	[illegible]	[illegible]				
	10	634	242	[illegible]	453	180	325	[illegible]	130	[illegible]				
	12	853	272	581	663	[illegible]	436	[illegible]	168	324				
22	2	116	136	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	165	184	63	[illegible]
	4	176	151	340	95	[illegible]	133	86	58	37				
	5	242	166	370	[illegible]	82	158	114	[illegible]	[illegible]				
	6	305	181	400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
	8	494	[illegible]	461	320	140	370	[illegible]	[illegible]	228				
	10	625	242	[illegible]	485	83	401	[illegible]	138	[illegible]				
	12	[illegible]	[illegible]	581	680	230	503	533	[illegible]	300				
25	2	119	140	318	63	53	[illegible]	55	[illegible]	[illegible]	225	218	[illegible]	[illegible]
	4	174	155	348	100	[illegible]	159	90	61	36				
	5	235	[illegible]	378	135	[illegible]	195	[illegible]	72	60				
	6	306	185	408	187	105	234	159	84	155				
	8	468	[illegible]	469	312	[illegible]	378	257	[illegible]	223				
	10	652	245	[illegible]	486	182	[illegible]	385	[illegible]	305				
	12	855	275	589	703	235	[illegible]	543	[illegible]	[illegible]				
28	2	122	144	345	[illegible]	58	151	63	[illegible]	[illegible]	243	241	77	7319
	4	[illegible]	159	355	105	[illegible]	355	94	63	[illegible]				
	5	241	174	385	127	90	[illegible]	128	[illegible]	165				
	6	[illegible]	189	415	176	108	[illegible]	66	56	[illegible]				
	8	274	220	475	324	[illegible]	275	265	[illegible]	227				
	10	610	250	536	459	[illegible]	[illegible]	399	122	[illegible]				
	12	835	[illegible]	596	724	240	523	565	[illegible]	350				
30	2	118	144	325	[illegible]	[illegible]	[illegible]	[illegible]	54	[illegible]	298	259	83	8534
	4	185	159	355	117	75	[illegible]	100	65	[illegible]				
	5	250	174	385	154	93	[illegible]	133	[illegible]	168				
	6	323	189	415	205	[illegible]	[illegible]	[illegible]	158	95				
	8	492	220	476	336	150	332	275	175	243				
	10	685	250	536	514	195	428	408	146	317				
	12	917	280	596	745	244	552	575	180	388				
32	2	133	127	332	82	63	143	[illegible]	32	25	335	277	88	9924
	4	193	162	352	119	79	176	105	66	127				
	5	260	178	393	162	96	214	140	78	173				
	6	334	193	423	214	114	264	181	90	199				
	8	506	223	483	350	154	340	285	118	258				
	10	[illegible]	253	544	531	199	44	422	149	323				
	12	940	283	604	768	248	54	596	183	385				

The quantities given in the above table are approximate values only, and are not to be used in making final estimates.



NOTES

These bridges are designed to carry a live load of an 15 ton truck plus 15 per cent. impact distributed as follows: two-thirds carried by the rear wheels and one-third by the front wheels, each wheel acting over an area three feet square. The trucks have a guage of 5 feet c-c of wheels and a longitudinal length of ten feet.

All bars shall be deformed and shall meet the requirements of paragraph 289 of the specifications.

Slab, girders and parapets shall be of class "A" concrete.

Abutments, wings, and footings shall be of class "C" concrete unless otherwise specified.

APPROVED: J. N. Mackall — MAY 20, 1919 — CHIEF ENGINEER

STATE ROADS COMMISSION
STANDARD GIRDER BRIDGES
GENERAL PLAN

J. N. MACKALL, CHIEF ENGINEER
BALTIMORE, MD., MAY 20, 1919

DESIGNED BY W.J.P.
TRACED BY M.J.K.
CHECKED BY M.J.K.
SHEET NO. 1

- IMPORTANT SCALE NOTE -
THIS PRINT IS A 1/2 REDUCTION OF THE ORIGINAL DRAWING. COMPENSATE FOR REDUCTION WHEN SCALING

5

32-497

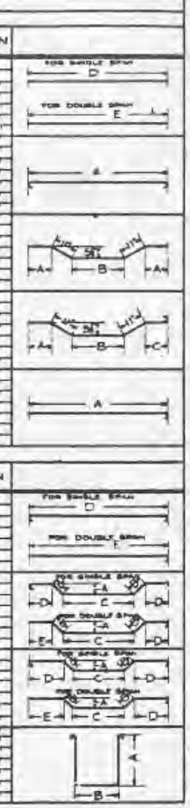
STEEL QUANTITIES

Slab

Span	Notation	A	B	C	D	E	Size	Weight per Foot	Single Span Length	Single Span Number	Single Span Total Length	Single Span Total Weight	Double Span Length	Double Span Number	Double Span Total Length	Double Span Total Weight	Span
18'	a				20'-2"	21'-6"	[illegible]	0.85#	20'-2"	16	323'	275#	21'-6"	32	688'	585#	18'
20'	a				22'-6"	23'-8"	[illegible]	0.85#	22'-6"	16	360'	306#	23'-8"	32	758'	644#	20'
22'	a				24'-10"	25'-10"	[illegible]	0.85#	24'-10"	16	397'	337#	25'-10"	32	827'	703#	22'
25'	a				27'-10"	28'-10"	[illegible]	0.85#	27'-10"	16	445'	378#	28'-10"	32	923'	785#	25'
28'	a				30'-10"	31'-10"	[illegible]	0.85#	30'-10"	16	493'	419#	31'-10"	32	1020'	867#	28'
30'	a				33'-2"	34'-0"	[illegible]	0.85#	33'-2"	16	531'	451#	34'-0"	32	1116'	949#	30'
32'	a				35'-6"	36'-2"	[illegible]	0.85#	35'-6"	16	568'	483#	36'-2"	32	1158'	984#	32'
18'	b	25'-2"					[illegible]	0.85#	25'-10"	20	517'	439#	25'-10"	40	1033'	878#	18'
20'	b	25'-4"					[illegible]	0.85#	26'-0"	22	572'	486#	26'-0"	44	1144'	972#	20'
22'	b	25'-4"					[illegible]	0.85#	26'-0"	24	624'	530#	26'-0"	48	1248'	1061#	22'
25'	b	25'-6"					[illegible]	0.85#	26'-2"	27	707'	601#	26'-2"	54	1413'	1201#	25'
28'	b	25'-6"					[illegible]	0.85#	26'-2"	29	759'	645#	26'-2"	58	1518'	1290#	28'
30'	b	25'-6"					[illegible]	0.85#	26'-2"	32	837'	711#	26'-2"	64	1675'	1424#	30'
32'	b	25'-6"					[illegible]	0.85#	26'-2"	35	916'	779#	26'-2"	70	1832'	1557#	32'
18'	c	2'-9"	3'-3"				[illegible]	0.85#	10'-7"	38	402'	342#	10'-7"	76	804'	683#	18'
20'	c	2'-11"	3'-1"				[illegible]	0.85#	10'-9"	42	452'	384#	10'-9"	84	903'	768#	20'
22'	c	2'-11"	3'-1"				[illegible]	0.85#	10'-9"	48	516'	439#	10'-9"	96	1032'	877#	22'
25'	c	3'-0"	2'-11"				[illegible]	0.85#	10'-9"	54	581'	494#	10'-9"	108	1161'	987#	25'
28'	c	3'-0"	2'-11"				[illegible]	0.85#	10'-9"	60	645'	548#	10'-9"	120	1290'	1097#	28'
30'	c	3'-0"	2'-11"				[illegible]	0.85#	10'-9"	64	688'	585#	10'-9"	128	1376'	1170#	30'
32'	c	3'-0"	2'-11"				[illegible]	0.85#	10'-9"	68	731'	621#	10'-9"	136	1462'	1243#	32'
18'	d	2'-9"	3'-3"	2'-0"			[illegible]	0.85#	10'-2"	38	386'	328#	10'-2"	76	773'	[illegible]	18'
20'	d	2'-11"	3'-1"	2'-1"			[illegible]	0.85#	10'-3"	42	431'	366#	10'-3"	84	861'	732#	20'
22'	d	2'-11"	3'-1"	2'-1"			[illegible]	0.85#	10'-3"	48	492'	418#	10'-3"	96	984'	836#	22'
25'	d	3'-0"	2'-11"	2'-2"			[illegible]	0.85#	10'-3"	54	554'	471#	10'-3"	108	1107'	941#	25'
28'	d	3'-0"	2'-11"	2'-2"			[illegible]	0.85#	10'-3"	60	615'	523#	10'-3"	120	1230'	1046#	28'
30'	d	3'-0"	2'-11"	2'-2"			[illegible]	0.85#	10'-3"	64	656'	558#	10'-3"	128	1312'	1115#	30'
32'	d	3'-0"	2'-11"	2'-2"			[illegible]	0.85#	10'-3"	68	697'	592#	10'-3"	136	1394'	1185#	32'
18'	e	3'-8"					[illegible]	0.85#	4'-0"	38	152'	129#	4'-0"	76	304'	258#	18'
20'	e	3'-8"					[illegible]	0.85#	4'-0"	42	168'	143#	4'-0"	84	336'	285#	20'
22'	e	3'-8"					[illegible]	0.85#	4'-0"	48	192'	163#	4'-0"	96	384'	326#	22'
25'	e	3'-8"					[illegible]	0.85#	4'-0"	54	216'	184#	4'-0"	108	432'	367#	25'
28'	e	3'-8"					[illegible]	0.85#	4'-0"	60	240'	204#	4'-0"	120	480'	408#	28'
30'	e	3'-8"					[illegible]	0.85#	4'-0"	64	256'	218#	4'-0"	128	512'	435#	30'
32'	e	3'-8"					[illegible]	0.85#	4'-0"	68	272'	231#	4'-0"	136	544'	462#	32'

Girders

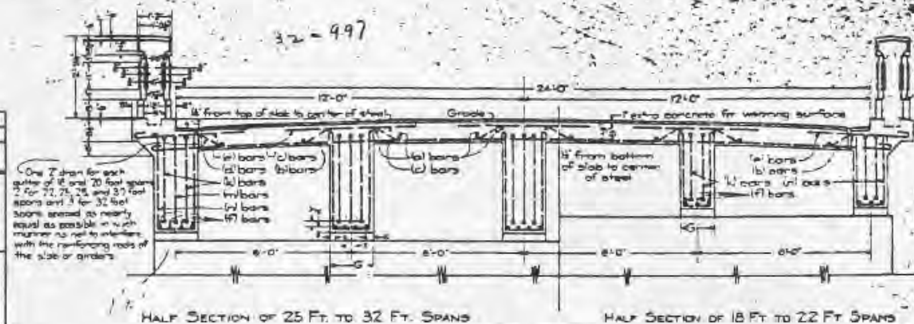
Span	Notation	A	B	C	D	E	Size	Weight per Foot	Single Span Length	Single Span Number	Single Span Total Length	Single Span Total Weight	Double Span Length	Double Span Number	Double Span Total Length	Double Span Total Weight	Span
18'	f				20'-2"	21'-6"	1"	3.40#	21'-2"	15	318'	1081#	22'-0"	30	660'	2244#	18'
20'	f				22'-6"	23'-8"	1"	3.40#	23'-6"	15	353'	1200#	24'-2"	30	725'	2465#	20'
22'	f				24'-10"	25'-10"	[illegible]	2.60#	25'-10"	20	517'	1344#	26'-4"	40	1053'	2738#	22'
25'	f				27'-10"	28'-10"	1"	3.40#	28'-10"	20	577'	1962#	29'-4"	40	1173'	3988#	25'
28'	f				30'-10"	31'-10"	[illegible]	4.30#	31'-10"	20	637'	2739#	32'-4"	40	1293'	5560#	28'
30'	f				33'-2"	34'-0"	[illegible]	5.31#	34'-2"	20	683'	3626#	34'-6"	40	1380'	7328#	30'
32'	f				35'-6"	36'-2"	[illegible]	6.43#	36'-6"	20	730'	4694#	36'-9"	40	1467'	9433#	32'
18'	k	2'-2½"	3'-11"	13'-9"	1'-0"	8'-0"	[illegible]	1.91#	23'-0"	10	230'	439#	29'-6"	20	590'	1127#	18'
20'	k	2'-4½"	3'-4½"	15'-5"	1'-2"	8'-8"	[illegible]	1.91#	25'-6"	10	255'	487#	32'-6"	20	650'	1242#	20'
22'	k	2'-6½"	3'-7"	17'-1"	1'-4"	9'-3"	[illegible]	1.91#	27'-11"	10	279'	520#	35'-2"	20	707'	1350#	22'
25'	k	2'-8½"	3'-10"	19'-9"	1'-4"	10'-3"	[illegible]	1.91#	31'-1"	10	311'	594#	39'-6"	20	790'	1509#	25'
28'	k	2'-10½"	4'-1"	22'-5"	1'-4"	11'-3"	1"	3.40#	34'-3"	10	343'	1166#	43'-8"	20	873'	2968#	28'
30'	k	3'-0½"	4'-3½"	24'-1"	1'-6"	11'-11"	1"	3.40#	36'-5"	10	367'	1248#	46'-7"	20	932'	3169#	30'
32'	k	3'-2½"	4'-5½"	25'-9"	1'-8"	12'-7"	1"	3.40#	39'-2"	10	392'	1333#	49'-7"	20	992'	[illegible]	32'
18'																	18'
20'																	20'
22'	m	2'-6½"	3'-7"	12'-8"	3'-4½"	11'-6½"	[illegible]	1.91#	27'-11"	5	140'	267#	35'-4"	10	353'	674#	22'
25'	m	2'-8½"	3'-10"	14'-10"	3'-3½"	12'-3½"	[illegible]	1.91#	31'-1"	5	155'	296#	39'-6"	10	395'	754#	25'
28'	m	2'-10½"	4'-1"	17'-2"	[illegible]	13'-0½"	1"	3.40#	34'-3"	5	171'	581#	43'-8"	10	437'	1485#	28'
30'	m	3'-0½"	4'-3½"	18'-6"	[illegible]	[illegible]	1"	3.40#	36'-5"	5	183'	622#	46'-7"	10	466'	1584#	30'
32'	m	3'-2½"	4'-5½"	19'-10"	[illegible]	[illegible]	1"	3.40#	39'-2"	5	196'	[illegible]	49'-7"	10	496'	1686#	32'
18'	n	2'-3½"	1'-8"				[illegible]	0.48#	6'-3"	130	813'	390#	6'-3"	260	1625'	780#	18'
20'	n	2'-3½"	1'-1½"				[illegible]	0.48#	6'-9"	130	878'	421#	6'-9"	260	1756'	843#	20'
22'	n	2'-4½"	1'-1½"				[illegible]	0.48#	7'-1"	130	921'	442#	7'-1"	260	1842'	884#	22'
25'	n	2'-5½"	1'-3½"				[illegible]	0.48#	7'-7"	130	986'	473#	7'-7"	260	1972'	947#	25'
28'	n	2'-6½"	1'-3½"				[illegible]	0.48#	7'-11"	130	1029'	494#	7'-11"	260	2058'	988#	28'
30'	n	2'-9½"	1'-5"				[illegible]	0.48#	8'-3"	130	1073'	515#	8'-3"	260	2145'	1030#	30'
32'	n	2'-11½"	1'-5½"				[illegible]	0.48#	8'-7"	130	1116'	536#	8'-7"	260	2232'	1071#	32'



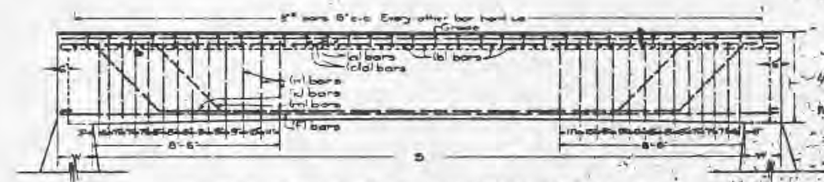
NOTE

This table does not hold good for bridges askew or of more than two spans. Bridges of spans greater than 32 feet in the clear, or of more than two spans, and instances where good footings can not be found within four feet of the bottom of the stream shall be referred to the Bridge Department for special consideration.

In bridges of two spans the first three stirrups on each side of the pier shall be inverted.

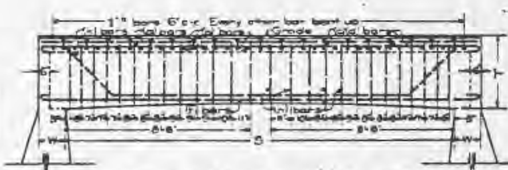


SECTION F-F

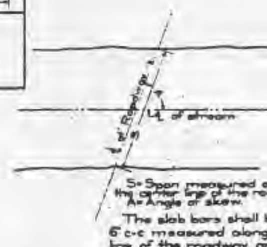


LONGITUDINAL SECTION ON CENTER LINE OF 22 FT. TO 32 FT. SPANS
Showing the steel in the girders and slab

Spacing of Reinforcing Rods in Girders							
S	18'	20'	22'	25'	28'	30'	32'
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



LONGITUDINAL SECTION ON CENTER LINE OF 18 FT. AND 20 FT. SPANS
Showing the steel in the girders and slab



S = Span measured along the center line of the roadway
A = Angle of skew.

The slab bars shall be spaced 6" c-c measured along the center line of the roadway and so placed as to make the angle "A" with the center line of the roadway.

FOR SKEW BRIDGES

APPROVED: [signature] MAY 20, 1919 CHIEF ENGINEER
REVISION APPROVED: [signature] CHIEF ENGINEER

STATE ROADS COMMISSION
STANDARD GIRDER BRIDGES
DETAILS
J. N. MACKALL, CHIEF ENGINEER
BALTIMORE, MD., MAY 20, 1919
DESIGNED BY W.L.R.
TRACED BY M.J.O.
CHECKED BY W.L.R.
SHEET NO. 2 OF 2
REVISION BY [illegible]

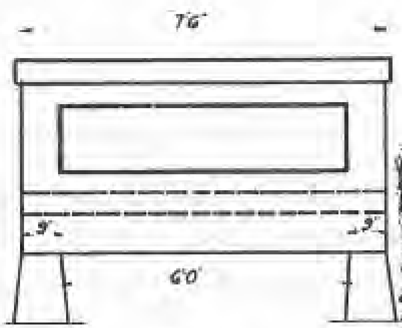
1924 Standard Plans

CONTRACT [redacted] STR. [redacted]

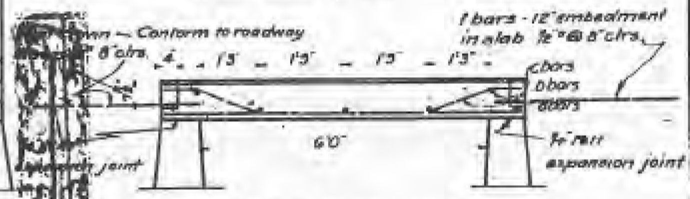
CROSS SECTION OF ROADWAY
Scale, ¼"=1'0"

General Notes:

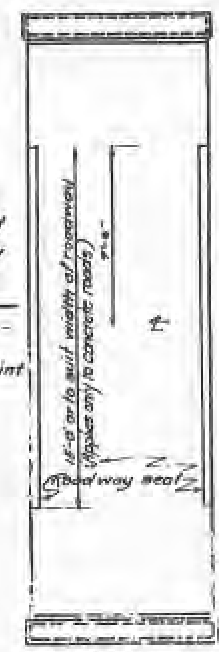
All concrete to be class A, 1:2:4 Main Superstructure.
All steel to be deformed bars.
All intersecting bars shall be rigidly wired together with No. 16 annealed wire.
Interior paneling to be the same as exterior paneling.
Specifications - Bridge - 1920.



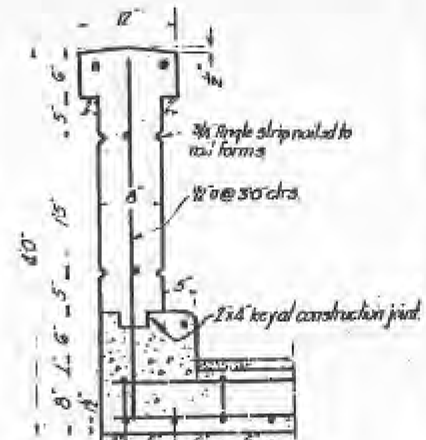
ELEVATION
Scale, ½"=1'0"



LONGITUDINAL SECTION ALONG ℄
Scale, ½"=1'0"

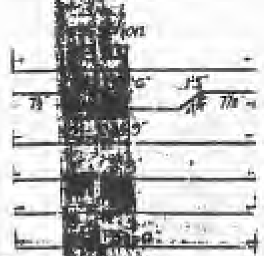


PLAN
Scale, ⅛"=1'0"



DETAIL OF HAND-RAIL
Scale, 1"=1'0"

Mark	No.	Size	Length	Total Lnth.	Wt. # 1'	Total Wt.
a	26	⅝" φ	7'3"	188'6"		
b	26	⅝" φ	7'5"	192'10"		
c.	5	⅝" φ	25'5"	128'5"	104	530
d	6	½" φ	3'8"	22'0"		
e	10	½" φ	7'5"	72'6"	.86	80
f	46	½"	4'-0"	184'-0"	.65	1.56



APPROXIMATE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY.
31 cy. Class A Concrete in superstructure
fee pounds deformed steel bars
* If roadway surfacing is of other material than concrete omit these bars from steel list.

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD 6' SLAB BRIDGE

Scales, Various   Nov. 1, 1920
J. N. MACKALL, CHAIRMAN & CHIEF ENGINEER
MADE BY L.B.J.   APPROVED,
TRACED BY L.B.J.
CORRECT: CHIEF ENGR.
BRIDGE ENGINEER

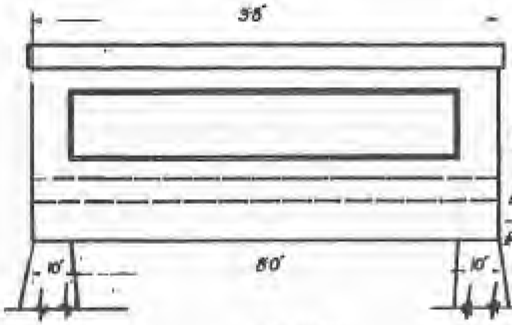
A-8

CONTRACT [redacted] STR. [redacted]

CROSS-SECTION OF ROADWAY
Scale, ¾" = 1'0"

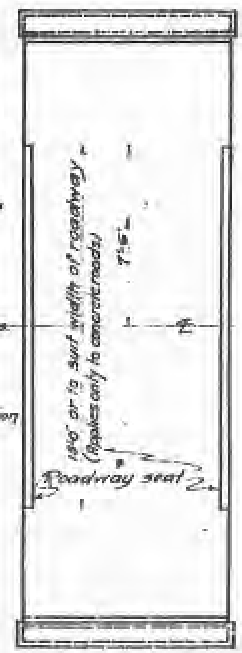
General Notes

All concrete in superstructure to be Class 'A' 1:2:4 Mix
All steel to be deformed bars
All intersecting bars shall be rigidly wired together with No. 16 annealed wire
Interior paneling to be the same as exterior paneling
Specifications - Bridge 1920

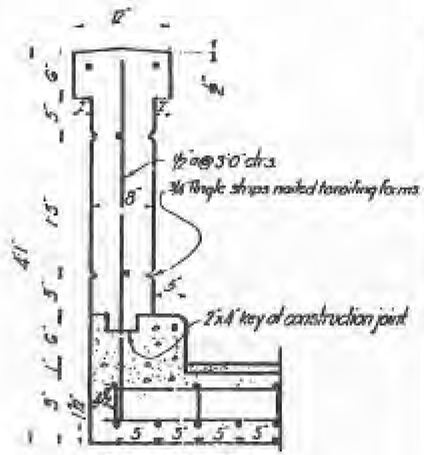


ELEVATION
Scale, ½" = 1'0"

LONGITUDINAL SECTION ALONG ℄
Scale, ½" = 1'0"



PLAN
Scale, ¼" = 1'0"



DETAIL OF HAND-RAIL
Scale, 1" = 1'0"

Mark	No.	Size	Length	Total Lgth.	Wt. per ft.	Total Wt.	Description
a	31	⅝" ϕ	9'5"	291'11"			9'5"
b	31	⅝" ϕ	9'7"	297'1"			[illegible]
c	5	⅝" ϕ	25'5"	128'5"	1.04	747	25'5"
d	8	½" □	3'8"	29'4"			3'8"
e	10	½" □	3'5"	34'7"	.85	106	3'5"
* f	46	½" ϕ	4'0"	184'0"	.85	156	4'0"

APPROXIMATE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY.
10 cy Class 'A' Concrete in superstructure.
1000 pounds deformed steel bars.

* If roadway surfacing is of other material than concrete omit these bars from steel list.

A-9

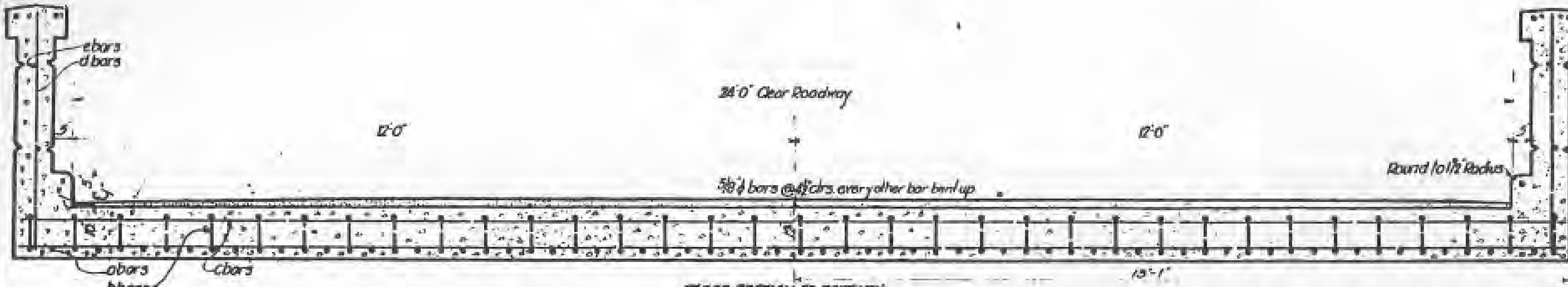
STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD 8' SLAB BRIDGE

Scales, Various — Mar. 1, 1924

J. N. MACKALL, CHAIRMAN & CHIEF ENGINEER
MADE BY A.B.J. APPROVED,
TRACED BY A.B.J.
CORRECT, ______ CHIEF ENGR.
______ BRIDGE ENGR.

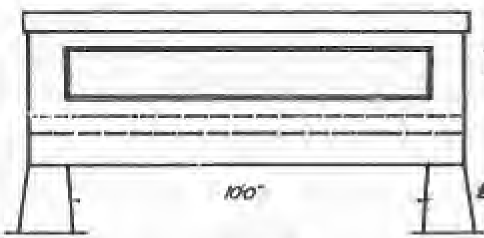
CONTRACT [redacted] STA. [redacted]



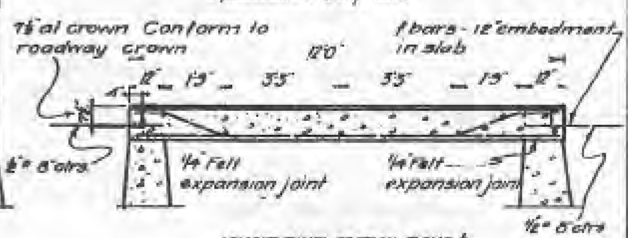
CROSS SECTION OF ROADWAY
Scale, ¾"-1'0"

General Notes,

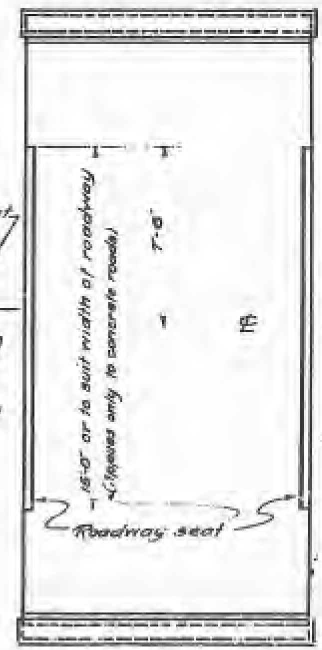
All concrete in superstructure to be Class A, 1:2:4 Mix.
All steel to be deformed bars.
All intersecting bars shall be rigidly wired together with No. 16 annealed wire.
Interior paneling to be the same as exterior paneling.
Specifications - Bridge 1920.



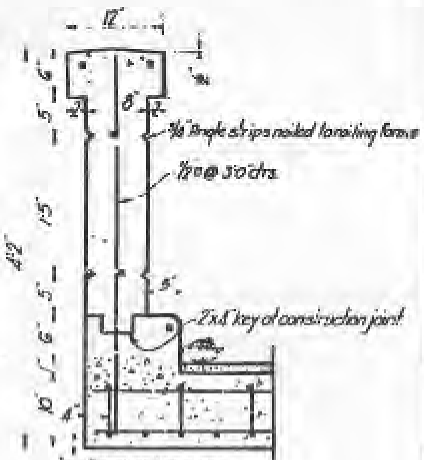
ELEVATION
Scale, ⅜"-1'0"



LONGITUDINAL SECTION ALONG ℄
Scale, ⅜"-1'0"



PLAN
Scale, ⅛"-1'0"



DETAIL OF HAND-RAIL
Scale, 1"-1'0"

Mark	No.	Size	Length	Total Lth	Wt. 1 ft	Total Wt
a	34	⅝"ϕ	11'9"	399'6"		
b	35	⅝"ϕ	11'11"	417'1"		
c	5	⅝"ϕ	25'5"	128'3"	1.04	983
d	10	½"◻	3'9"	37'6"		
e	10	½"◻	11'9"	117'6"	.85	132
* f	46	½"	4'-0"	184'-0"	.85	156

Description

APPROXIMATE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY
13.3 cy. Class "A" Concrete in superstructure.
[?] pounds deformed steel bars.

* [redacted] surfacing is of other material than concrete [redacted] bars from steel list.

A-10

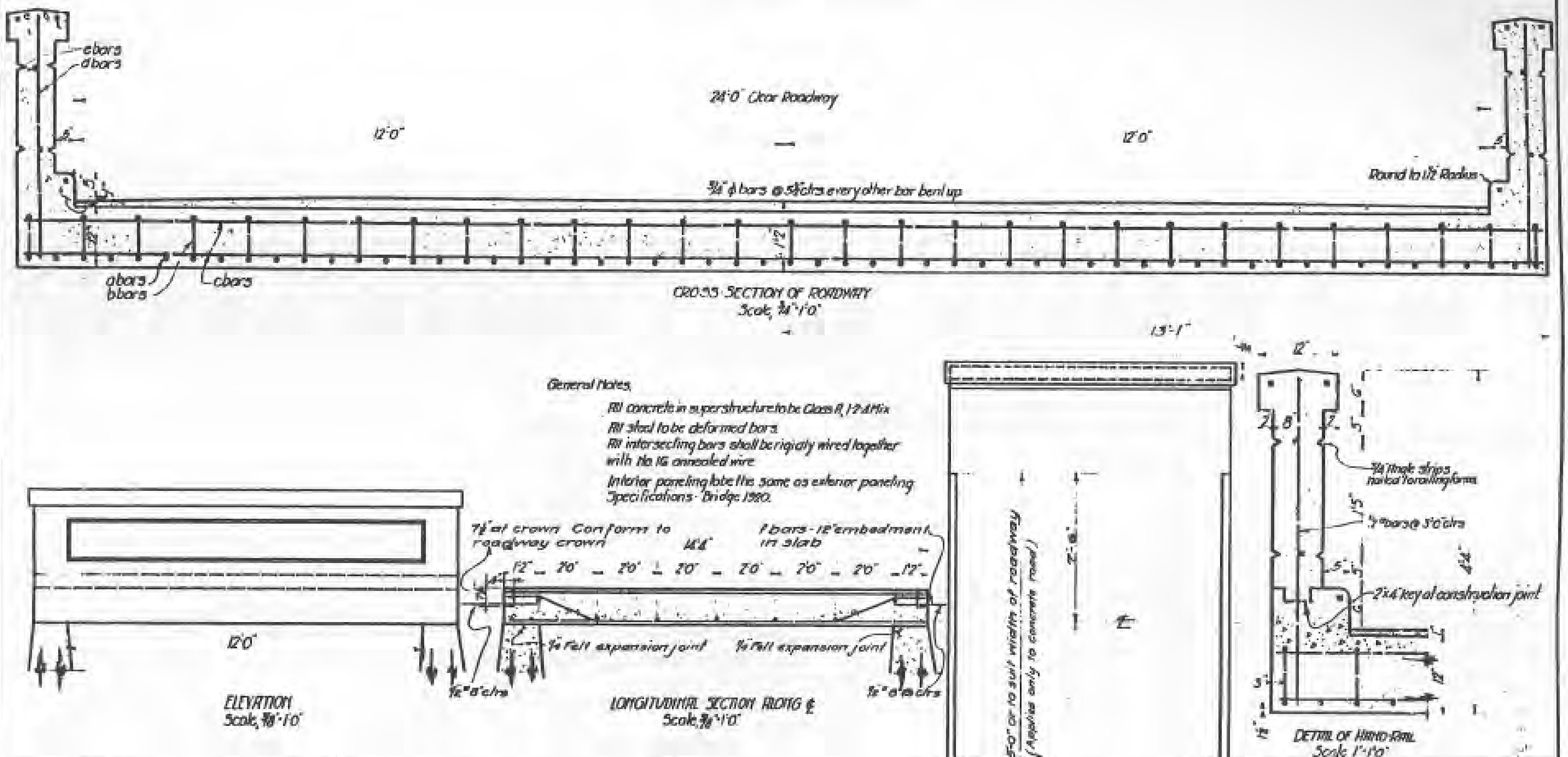
STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD 10' SLAB BRIDGE

Scales, Various | Mar. [?] 1922

J. N. MACKALL, CHAIRMAN & CHIEF ENGINEER
MADE BY L.B.J. ... APPROVED
TRACED BY L.B.J. ....
CORRECT .... CHIEF ENGR.
.... BRIDGE ENGR.

CONTRACT [redacted] STA. [redacted]



General Notes,

All concrete in superstructure to be Class A, 1:2:4 Mix

All steel to be deformed bars.

All intersecting bars shall be rigidly wired together with No. 16 annealed wire.

Interior paneling to be the same as exterior paneling.

Specifications - Bridge 1920.

Mark	No.	Size	Length	Total Lgth	Wt. #/ft	Total Wt.	Description
a	28	¾ ϕ	14'-1"	394'-4"			14'-1"
b	29	¾ ϕ	14'-5"	418'-1"			1'0½ – 2½ – 8'0" – 2½ – 1'0½
c	7	¾ ϕ	25'-9"	180'-3"	1.50	1489	25'9"
d	12	½ ϕ	4'0"	48'0"			4'0"
e	10	½ ϕ	14'-1"	140'-10"	.85	161	14'-1"
* f	46	½"	4'-0	184'-0"	.85	156	4'-0"

APPROXIMATE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY

18.7 c.y. Class A concrete in superstructure

1806 pounds of Deformed Steel bars.

* If roadway surfacing is of other material than concrete omit these bars from steel list

PLAN
Scale, ¼"-1'0"

A-11

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

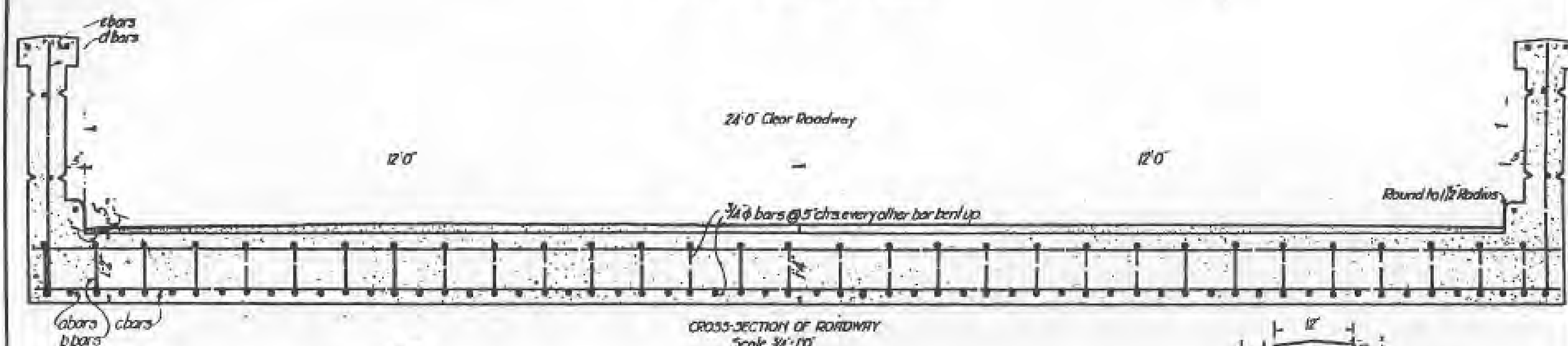
STANDARD 12" SLAB BRIDGE

Scales, Various — Mar. 1, 1924

J. N. MACKALL, CHAIRMAN & CHIEF ENGINEER

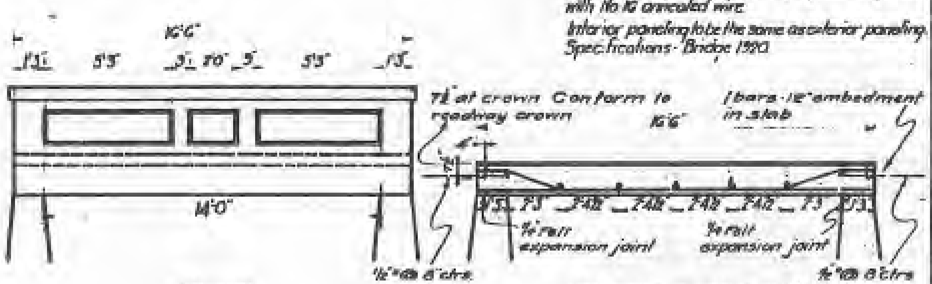
MADE BY L.B.J. APPROVED,
TRACED BY L.B.J.
CORRECT, ___ CHIEF ENGR.
___ BRIDGE ENGR.

CONTRACT [redacted] STA [redacted]



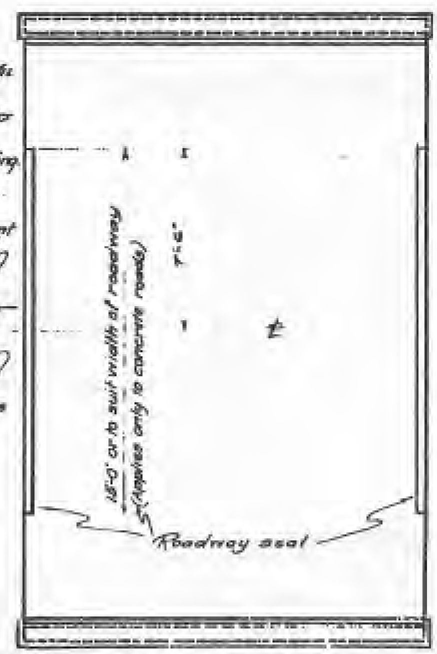
CROSS-SECTION OF ROADWAY
Scale, ¾"-1'0"

General Notes:
All concrete in superstructure to be Class "A", 1:2:4 Mix.
All steel to be deformed bars.
All intersecting bars shall be rigidly wired together with No 16 annealed wire.
Interior paneling to be the same as exterior paneling.
Specifications - Bridge 1920.

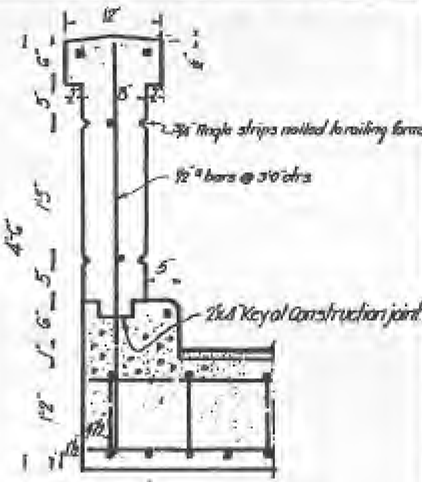


ELEVATION
Scale, ¼"-1'0"

LONGITUDINAL SECTION ALONG ℄
Scale, ¼"-1'0"



PLAN
Scale, ¼"-1'0"



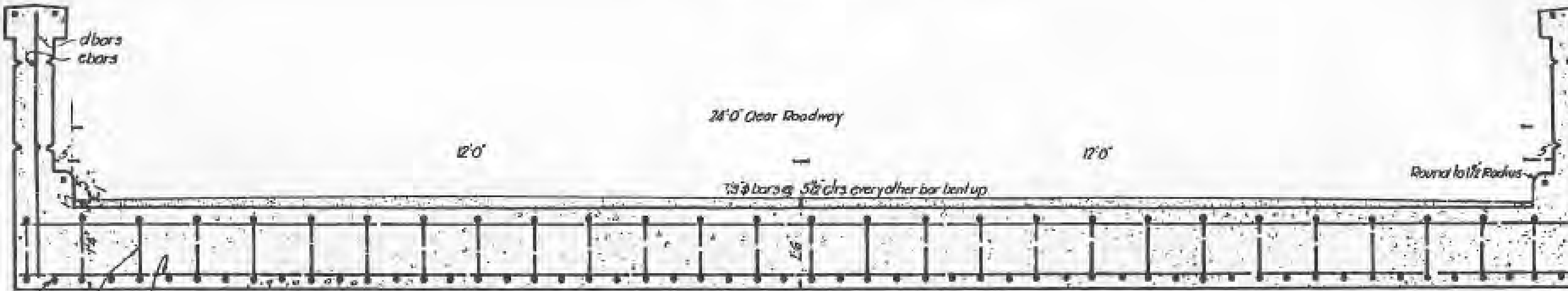
DETAIL OF HAND-RAIL
Scale, 1"-1'0"

Mark	No.	Size	Length	Total Length	Wt. %	Total Wt.	Description
a	31	¾" ϕ	16'3"	503'3"			16'3"
b	31	¾" ϕ	16'7"	514'1"			1'1½" 2'2" 8'6" 1'1½"
c	7	¾" ϕ	25'3"	180'3"	1.50	1751	25'3"
d	12	½" ϕ	4'3"	51'0"			4'3"
e	10	½" ϕ	16'3"	162'6"	.85	182	16'3"
f	46	½"	4'-0"	184'-0"	.85	156	4'-0"

APPROXIMATE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY
73.6 cy. Class "A" concrete in superstructure
2138 pounds of deformed steel bars.
* If roadway surfacing is of other material than concrete omit these bars from steel list.

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.
STANDARD 14' SLAB BRIDGE
Scales, Various | Mar. 1, 1924.
J. N. MACKALL, CHAIRMAN & CHIEF ENGINEER
MADE BY L.B.J. APPROVED,
TRACED BY L.B.J.
CORRECT, CHIEF ENGR.
BRIDGE ENGINEER

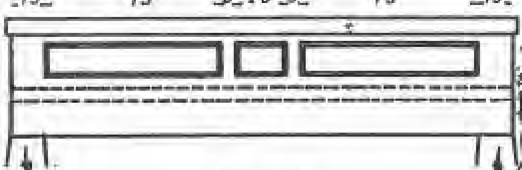
A-12



CROSS-SECTION OF ROADWAY
Scale, ¼"=1'0"

General Notes.

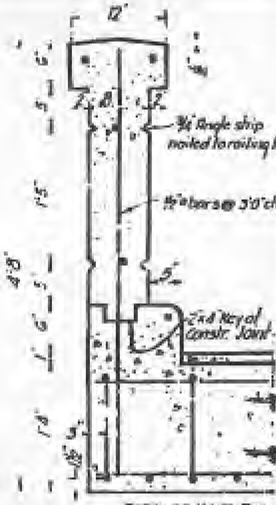
All concrete in Superstructure to be Class A, 1:2:4 Mix.
All steel to be deformed bars.
All intersecting bars shall be rigidly wired together with No. 16 annealed wire.
Interior paneling to be the same as exterior paneling.
Specifications - Bridge 1920



ELEVATION
Scale, ¼"=1'0"

LONGITUDINAL SECTION ALONG ℄
Scale, ¼"=1'0"

PLAN
Scale, 5/16"=1'0"



DETAIL OF HAND-RAIL
Scale, 1"=1'0"

Mark	No.	Size	Length	Total Lgth	Wt. #/ft.	Total Wt.
a	28	7/8"φ	20'1"	576'4"		
b	29	7/8"φ	21'1"	611'5"		
c	8	7/8"φ	25'5"	208'0"	2.04	2843
d	16	½"φ	4'5"	70'8"		
e	10	½"φ	20'1"	205'10"	.85	235
* f	46	½"φ	4'-0"	184'-0"	.85	156

Description

APPROXIMATE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY
33.1 c.y. Class A concrete in superstructure.
3234 pounds deformed steel bars.

* If roadway surfacing is of other material than concrete omit these bars from steel list.

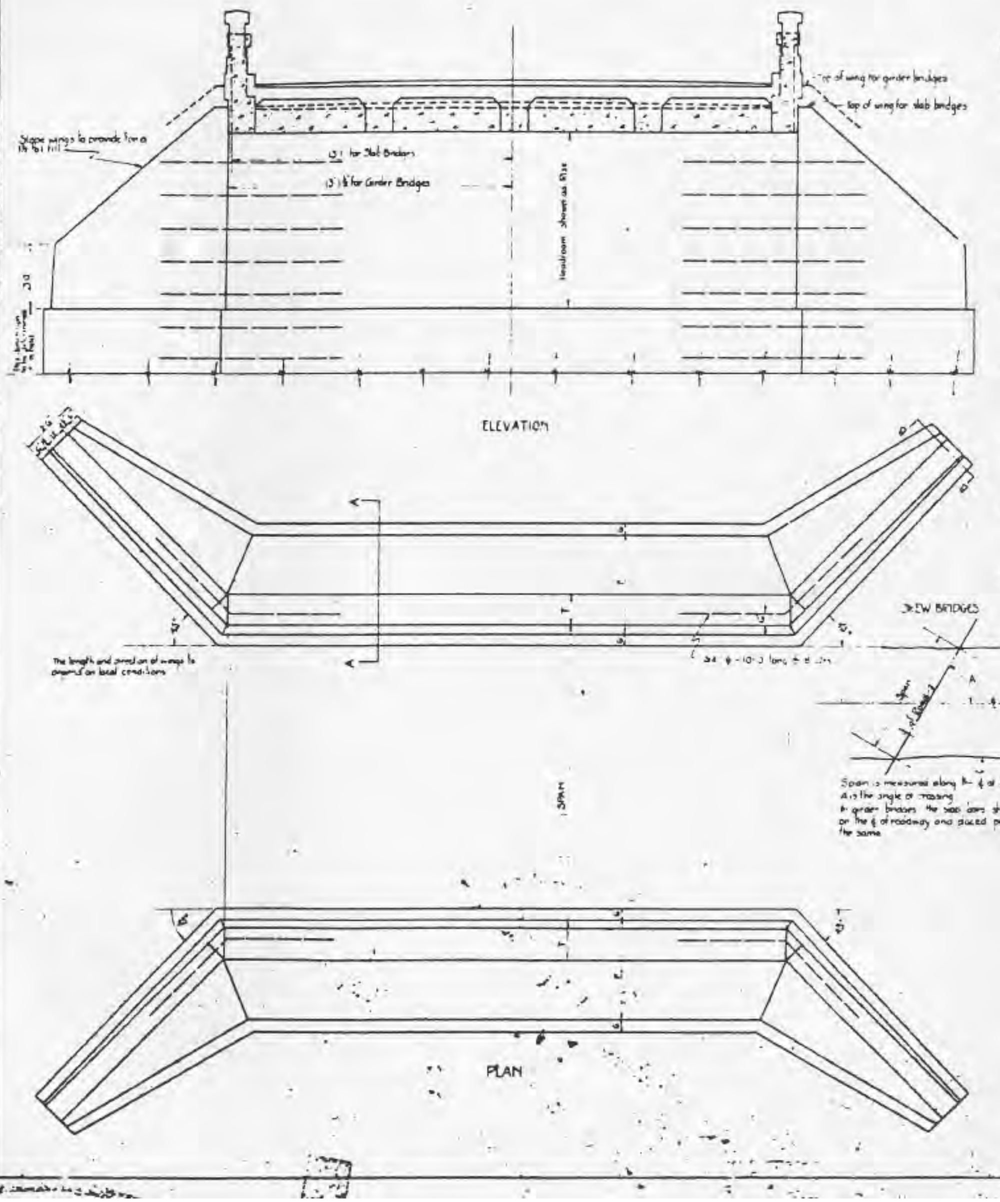
A-13

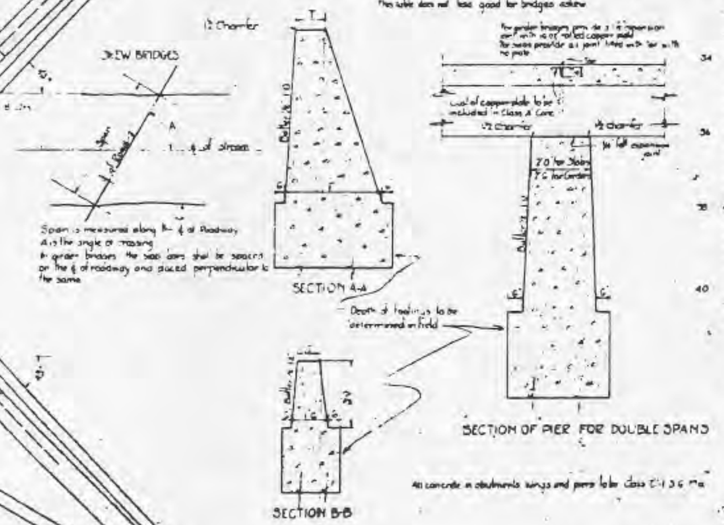
STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.
STANDARD 18' SLAB BRIDGE

Scales, Various | Mar. 1, 1928

J. N. MACKALL, CHAIRMAN & CHIEF ENGINEER
MADE BY L.B.J. ... APPROVED,
TRACED BY L.B.J. ....
CORRECT, ... CHIEF ENGR.
.... BRIDGE ENGR.

Note The quantities given in these tables are not to be used for final estimates





DIMENSIONS & QUANTITIES SLAB BRIDGE ABUTMENTS

Span Feet	Rise Feet	T Inches	F	Abuts Proper	Footings 2 ft	Footings 3 ft	Footings 4 ft	Wings Proper	Wing Footings 2 ft	Wing Footings 3 ft	Wing Footings 4 ft	Total Cu. Yd. 3' footing
6	3	9	1'7"	24	58	146	133	[illegible]	14	20	27	245
	4	9	2'0"	104	93	170	[illegible]	30	32	47	44	351
	5	9	2'4"	146	126	185	231	34	33	79	103	470
	6	9	2'9"	198	142	213	284	94	74	114	52	615
8	3	10	1'7"	48	58	146	[illegible]	12	13	23	30	245
	4	10	2'0"	107	85	170	227	32	34	51	68	360
	5	10	2'5"	153	129	194	259	65	55	83	110	450
	6	10	2'10"	208	143	217	290	99	79	119	158	643
10	3	12	1'8"	76	101	151	202	14	16	24	32	253
	4	12	2'0"	113	115	170	227	33	35	53	70	369
	5	12	2'5"	162	127	194	259	63	56	84	112	507
	6	12	2'10"	217	145	217	290	103	81	122	162	659
12	3	14	1'8"	51	101	151	202	17	19	29	38	278
	4	14	2'1"	125	116	174	233	38	39	59	78	394
	5	14	2'6"	173	132	198	265	68	60	90	120	575
	6	14	2'11"	232	148	222	296	[illegible]	85	128	170	657
14	3	15	1'9"	93	104	[illegible]	206	[illegible]	22	33	44	188
	4	15	2'2"	103	[illegible]	160	213	47	42	63	84	411
	5	15	2'6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	95	[illegible]	545
	6	15	2'11"	256	145	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	126	[illegible]
16, 18, 20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

This table does not hold good for bridges askew

DIMENSIONS & QUANTITIES GIRDER BRIDGE ABUTMENTS

Span Feet	Rise Feet	T Main	F Main	Abutments Proper	Footings 2 ft	Footings 3 ft	Footings 4 ft	Wings Proper	Wing Footings 2 ft	Wing Footings 3 ft	Wing Footings 4 ft	Total Abutments Complete 3' footing
22	3	16"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22–40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

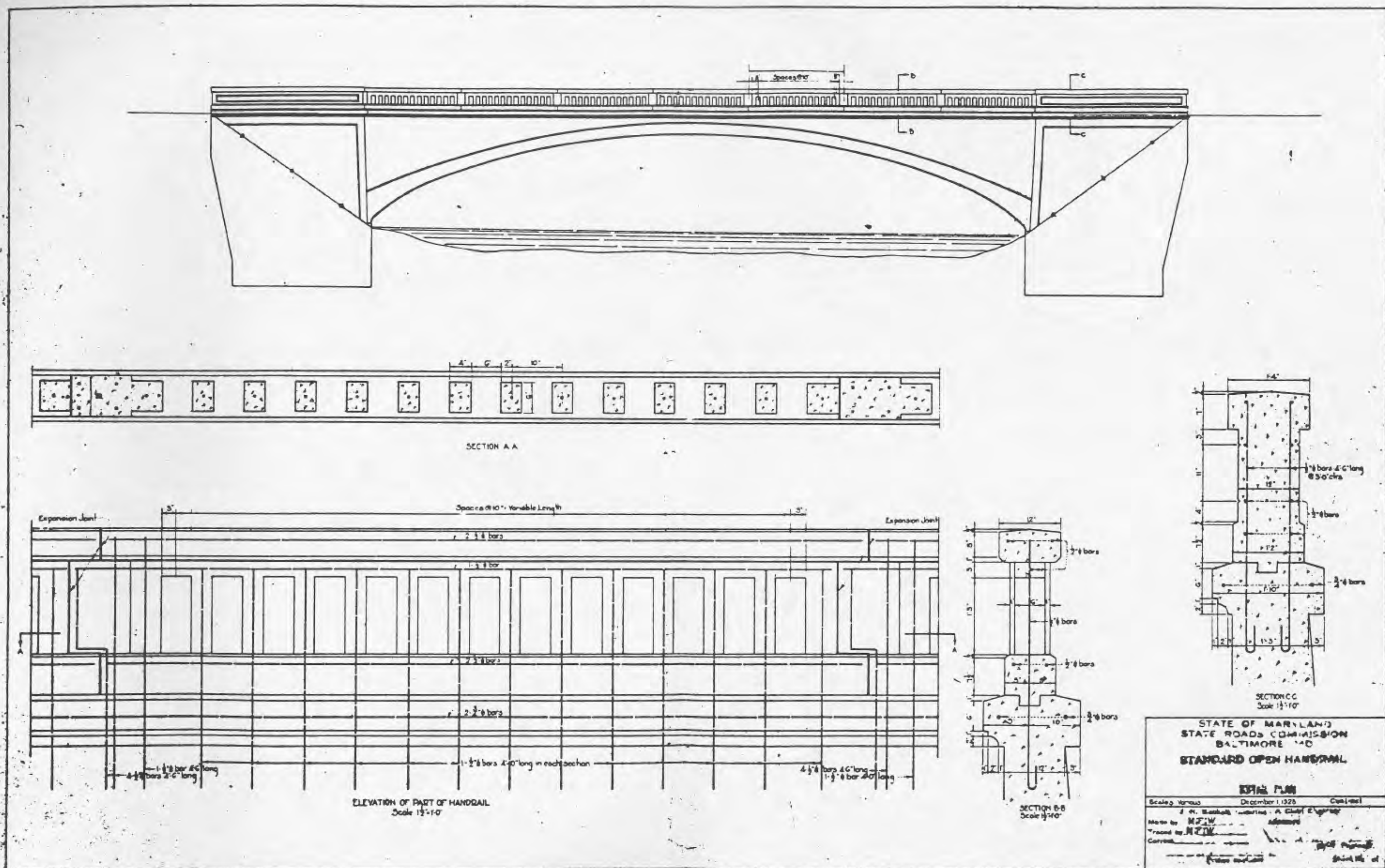
This table does not hold good for bridges askew

For girder bridges provide a ½" expansion joint with ¼" rolled copper plate. For slabs provide a joint filled with tar with no plate.
Cost of copper plate to be included in Class A Conc.
½ Chamfer
2'0 for Slabs
2'6 for Girders
All concrete in abutments, wings and piers to be class C 1:3:6 mix

STANDARD BRIDGE ABUTMENTS

1924

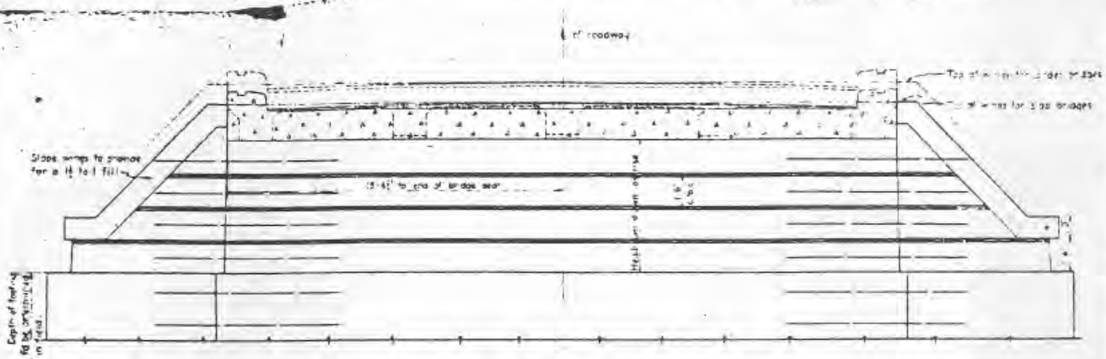
1928 Standard Plans



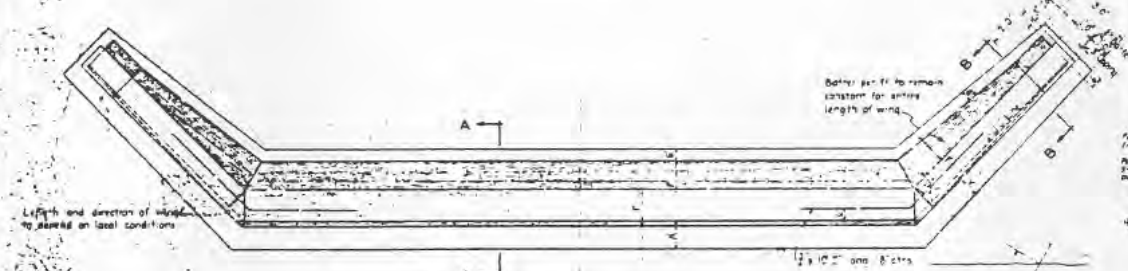
SECTION A-A
Expansion Joint
ELEVATION OF PART OF HANDRAIL
Scale 1½"=1'-0"
SECTION B-B
Scale 1½"=1'-0"
SECTION C-C
Scale 1½"=1'-0"
STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE MD
STANDARD OPEN HANDRAIL
Scale Various
December 1, 1926
Made by M.F.W.
Traced by M.F.W.

A-16

1930 Standard Plans



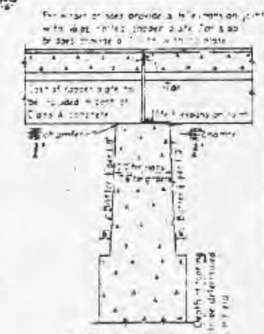
ELEVATION



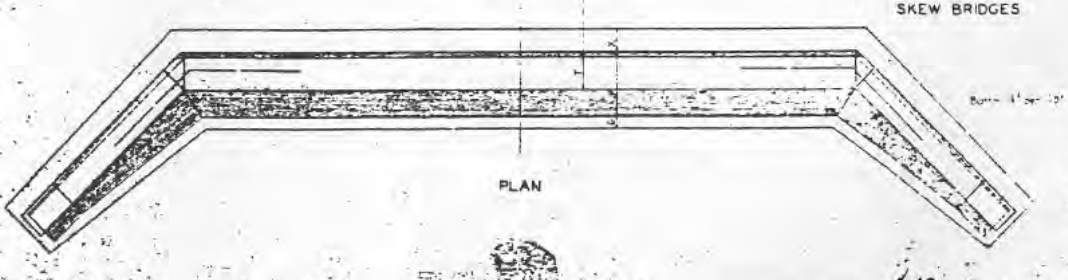
Span is measured along the ℄ of roadway. A is the angle of crossing. In girder bridges the slab bars shall be spaced on the ℄ of roadway and placed perpendicular to the same.

SKEW BRIDGES

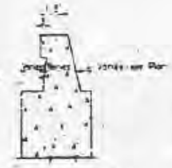
SECTION A-A



SECTION THRU PIER FOR DOUBLE SPANS



PLAN



SECTION B-B

SCORING DETAIL

NOTE: QUANTITIES GIVEN IN THESE TABLES ARE NOT TO BE USED FOR FINAL ESTIMATES

DIMENSIONS & QUANTITIES - SLAB BRIDGE ABUTMENTS

THIS TABLE DOES NOT HOLD GOOD FOR BRIDGES ASKEW

Clear Span	Rise	T	F	X	Abutments Cubic Yards: Above Footing	Depth of Footing 2'-0"	3'-0"	4'-0"	Wings Cubic Yards: Above Footing	Depth of Footing 2'-0"	3'-0"	4'-0"	Total Cu. Yd. 4'-0" Ftg.
6'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

For slab spans on grade use 1" dowels 3'-0" c-c 1'-6" long 3" projection into fixed end of slab.

For girder spans on grade use 4-1" dowels 3'-0" long at fixed end of each girder 1'-6" projection into girders.

DIMENSIONS & QUANTITIES - GIRDER BRIDGE ABUTMENTS

THIS TABLE DOES NOT HOLD GOOD FOR BRIDGES ASKEW

Clear Span	Rise	T	F	X	Abutments Cubic Yards: Above Footing	Depth of Footing 2'-0"	3'-0"	4'-0"	Wings Cubic Yards: Above Footing	Depth of Footing 2'-0"	3'-0"	4'-0"	Total Cu. Yd. 4'-0" Ftg.
22'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
34'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
36'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
38'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40'-0"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Maximum soil pressure [illegible]

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE MD.

STANDARD BRIDGE ABUTMENTS
TO ACCOMPANY STANDARD SUPERSTRUCTURE DETAILS

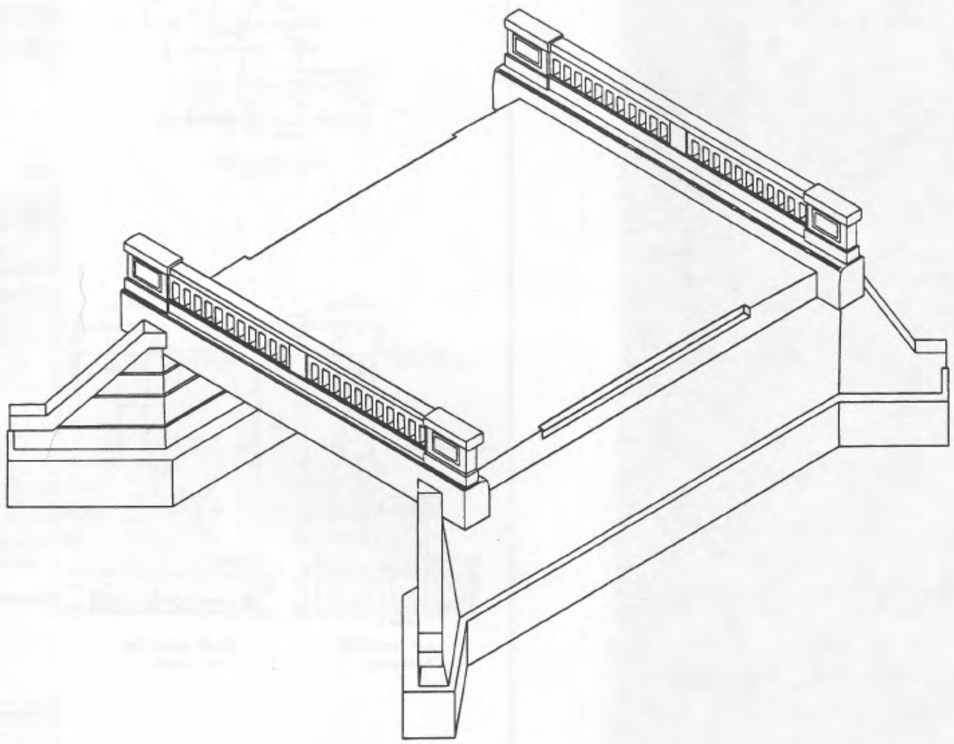
SCALE [illegible] Mar. 1930

MADE BY W. J. M. [illegible]
TRACED BY [illegible]

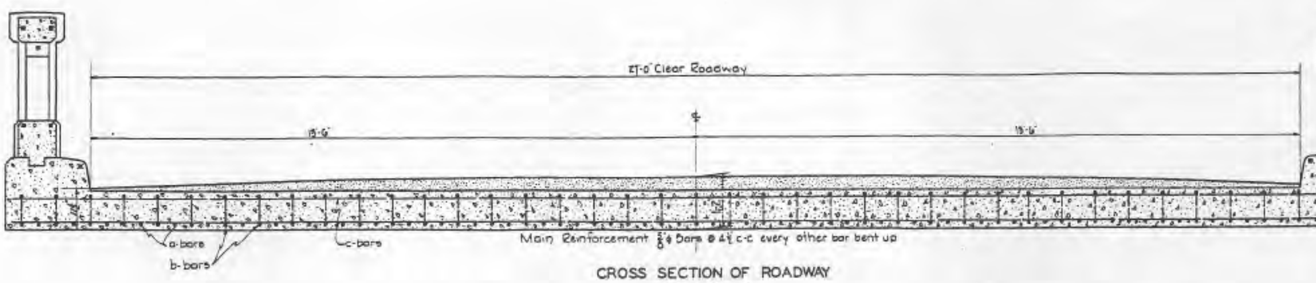
Revisions: Transfer of top of piers changed [illegible] W.J.M. Dowels in fixed end of spans on grade 6-18-1930

5/5/90

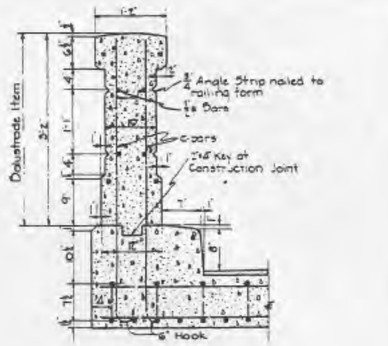
1930



Revisions	STATE OF MARYLAND STATE ROADS COMMISSION BALTIMORE, MD. STANDARD SLAB BRIDGE ISOMETRIC VIEW
	Scale $\frac{1}{4}$" = 1'-0" · Mar. 1, 1930 · Contract
	Made by C.T. · Traced by · Checked by · Approved · Chief Engineer
	Correct · Bridge Engineer · 5/5/30 · Sheet No. of

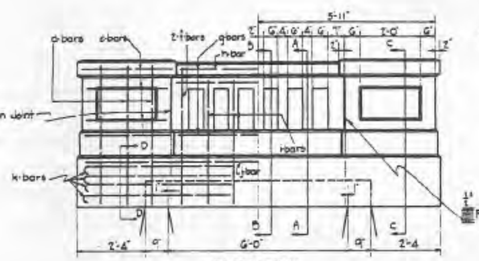


CROSS SECTION OF ROADWAY
Scale 3/8" = 1'-0"

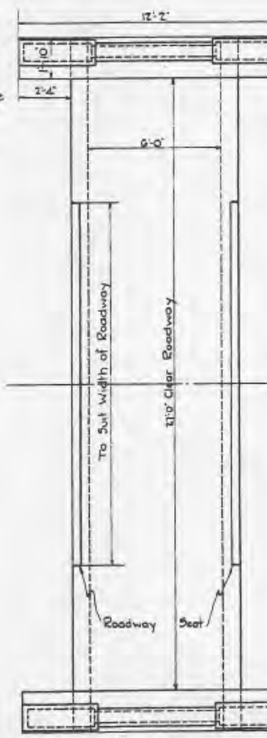


SECTION C-C
Scale 1" = 1'-0"

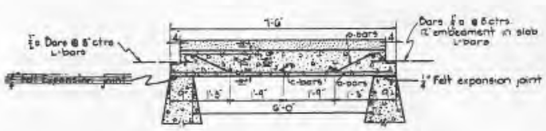
General Notes
All concrete in superstructure to be Class A,1-2-4 Mix
All steel to be deformed bars
All intersecting bars to be rigidly wired together with No 16 annealed wire
Interior and exterior paneling on end posts to be same
Cost of felt expansion joints to be included in cost of Class A concrete
Specifications - Latest S.R.C. Specifications
Loading H-20 as per U.S. Dept. of Agriculture Bulletin # 1259



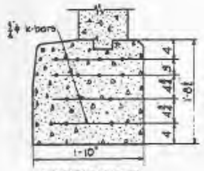
ELEVATION
Scale 1/2" = 1'-0"



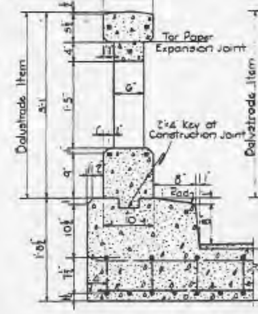
PLAN
Scale 3/8" = 1'-0"



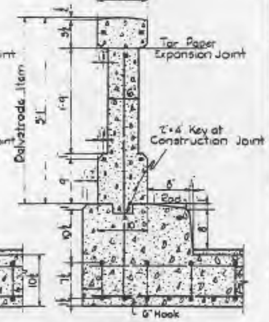
LONGITUDINAL SECTION ALONG ℄
Scale 1/2" = 1'-0"



SECTION D-D
Scale 1" = 1'-0"



SECTION B-B
Scale 1" = 1'-0"



SECTION A-A
Scale 1" = 1'-0"

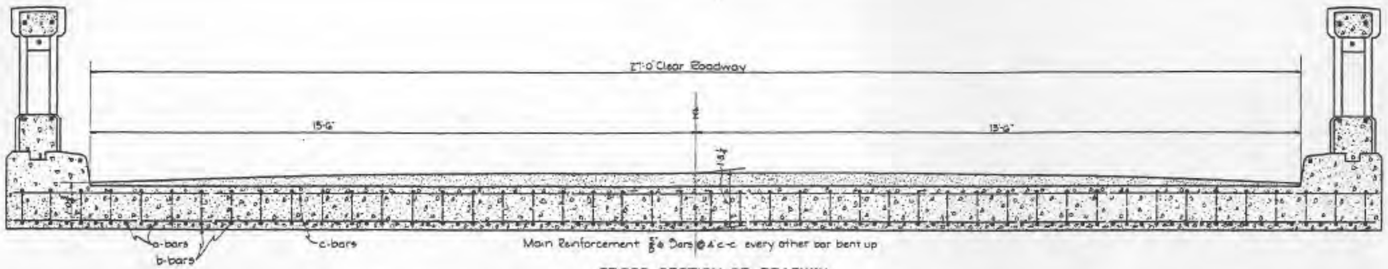
APPROXIMATE SUPERSTRUCTURE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY
10.97 C. Yd's. Concrete Excluding Balustrades
2.26 C. Yd's. Concrete in Balustrades

TOTAL WEIGHT OF REINFORCING STEEL = 1666#

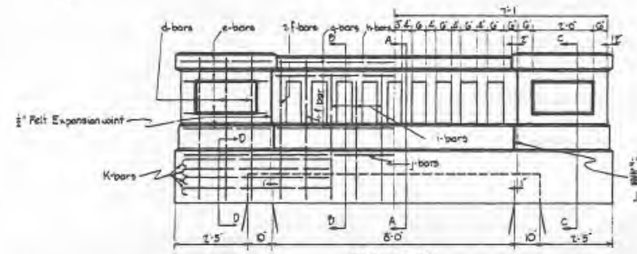
Nota	No.	Size	Length	Total Length	Wt. #/ft	Total Weight	Description
a	40	5/8"ϕ	7'-5"	290'-0"	1.04	301.6	7'-5"
b	41	5/8"ϕ	8'-3"	338'-3"	1.04	351.8	8" hook ... 8" hook
c	5	5/8"ϕ	30'-5"	152'-1"	1.04	158.2	30'-5"
d	24	1/2"□	5'-1"	122'-0"	.85	103.7	4'-7" 6" hook
e	32	1/2"□	2'-10"	90'-10"	.85	77.2	2'-10"
f	4	1/2"□	5'-0"	20'-0"	.85	17.0	4'-6" 6" hook
g	8	1/2"□	5'-4"	42'-8"	.85	36.3	5'-4"
h	2	1/2"□	5'-8"	11'-4"	.85	9.6	5'-8"
i	12	1/2"□	4'-7"	55'-0"	.85	46.8	4'-1" 6" hook
j	2	1/2"□	11'-10"	23'-8"	.85	20.1	11'-10"
k	48	3/4"ϕ	5'-8"	272'-0"	1.50	408.0	5'-0" 6" hook
L	80	1/2"□	2'-0"	160'-0"	.85	136.0	2'-0"

* These bars to be omitted if roadway surfacing is of other material than concrete.

REVISIONS	
1. Expansion joints in handrail ~~and~~ ~~bridge seat~~ changed from 1/4" to 1/2". Exp. joint removed from bridge seat at one end of span. 4-28-31 W.J.M.	STATE OF MARYLAND STATE ROADS COMMISSION BALTIMORE MD. STANDARD 6'-0" SLAB BRIDGE SUPERSTRUCTURE DETAILS
	SCALE Various — March 1, 1930 — CONTRACT
	MADE BY J.L.B. — TRACED BY H.L.L.-C.I. — CHECKED BY — CORRECT [signature] BRIDGE ENGINEER 5/5/30 — APPROVED [signature] CHIEF ENGINEER 5/5/30 — SHEET NO. OF

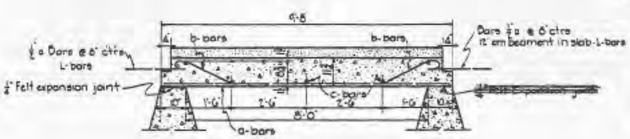


CROSS SECTION OF ROADWAY
Scale 3/4" = 1'-0"

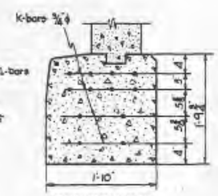


ELEVATION
Scale 1/2" = 1'-0"

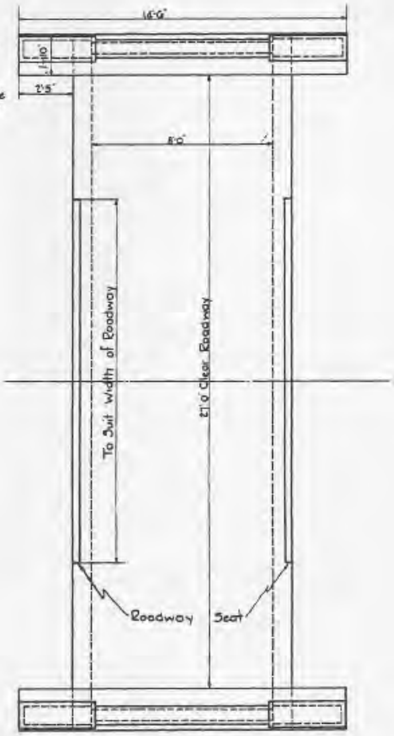
General Notes
All concrete in superstructure to be Class A, 1:2:4 Mix
All steel to be deformed bars
All intersecting bars to be rigidly wired together with No 16 annealed wire
Interior and exterior paneling on end posts to be same
Cost of felt expansion joints to be included in cost of Class A concrete
Specifications - Latest S.R.C. Specifications
Loading H-20 as per U.S. Dept of Agriculture Bulletin #1259



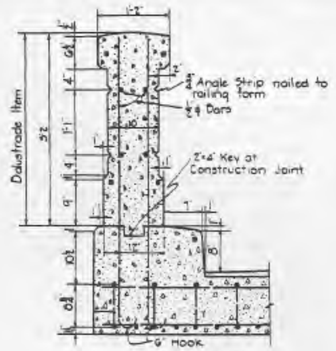
LONGITUDINAL SECTION ALONG ℄
Scale 1/2" = 1'-0"



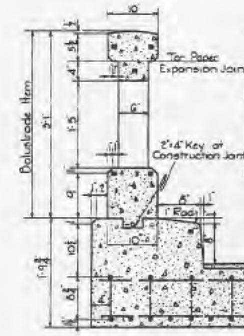
SECTION D-D
Scale 1" = 1'-0"



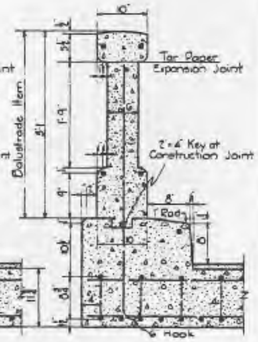
PLAN
Scale 3/8" = 1'-0"



SECTION C-C
Scale 1" = 1'-0"



SECTION B-B
Scale 1" = 1'-0"



SECTION A-A
Scale 1" = 1'-0"

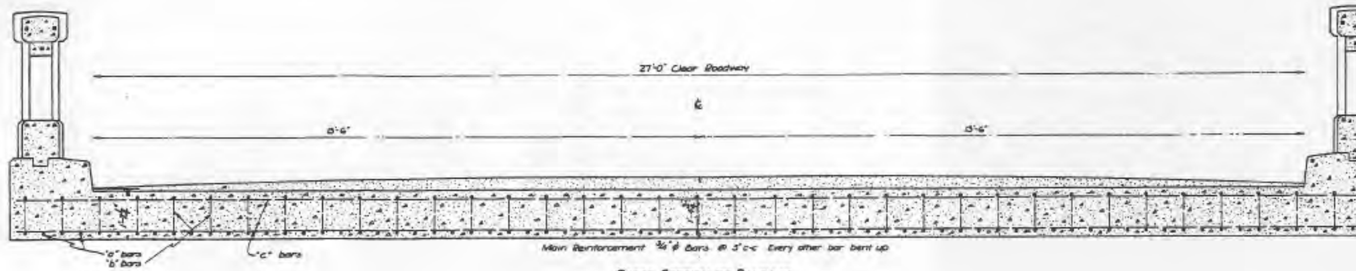
APPROXIMATE SUPERSTRUCTURE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY
15.05 C. Yds. Concrete Excluding Balustrades
2.61 C. Yds. Concrete in Balustrades

TOTAL WEIGHT OF REINFORCING STEEL = 2,015#

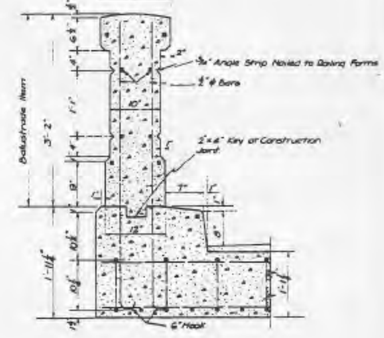
Nota	No.	Size	Length	Total Length	Wt. #/ft	Total Weight	Description
a	46	5/8"φ	9'-5"	433'-2"	1.04	450.5	9'-5"
b	46	5/8"φ	10'-5"	479'-2"	1.04	498.3	8" hook, 5'-0", 8" hook
c	5	5/8"φ	30'-5"	152'-1"	1.04	158.2	30'-5"
d	24	1/2"□	5'-3"	126'-0"	.85	107.1	4'-9", 6" hook
e	32	1/2"□	2'-10"	90'-8"	.85	77.1	2'-10"
f	6	1/2"□	5'-2"	31'-0"	.85	26.4	4'-8", 6" hook
g	8	1/2"□	7'-8"	61'-4"	.85	52.1	7'-8"
h	2	1/2"□	8'-0"	16'-0"	.85	13.6	8'-0"
i	16	1/2"□	4'-8"	74'-8"	.85	63.5	4'-2", 6" hook
j	2	1/2"□	14'-2"	28'-8"	.85	24.4	14'-2"
k	48	3/4"φ	5'-8"	272'-0"	1.50	408.0	5'-0", 8" hook
* L	80	1/2"□	2'-0"	160'-0"	.85	136.0	2'-0"

* These bars to be omitted if roadway surfacing is of other material than concrete.

REVISIONS	STATE OF MARYLAND STATE ROADS COMMISSION BALTIMORE MD. STANDARD 8'-0" SLAB BRIDGE SUPERSTRUCTURE DETAILS
1. Expansion joints in ~~...~~ changed from 1/4" to 1/2". Expansion joint removed from bridge seat at one end of span. 9-26-51 W.J.M.	SCALE Various — Mar. 1, 1930 — CONTRACT
	MADE BY J.L.B. / TRACED BY C.T. / CHECKED BY / CORRECT [signature] BRIDGE ENGINEER 5/5/30 / APPROVED [signature] CHIEF ENGINEER 5/5/30 / SHEET NO. OF

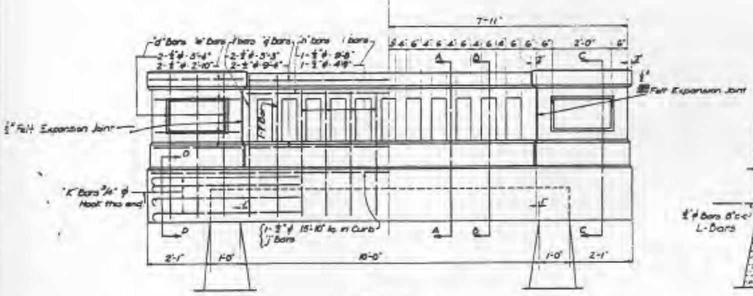


CROSS SECTION OF ROADWAY
Scale 3/4"=1'-0"

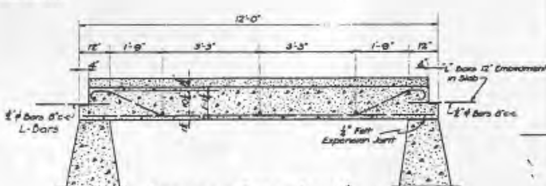


SECTION C-C
Scale 1"=1'-0"

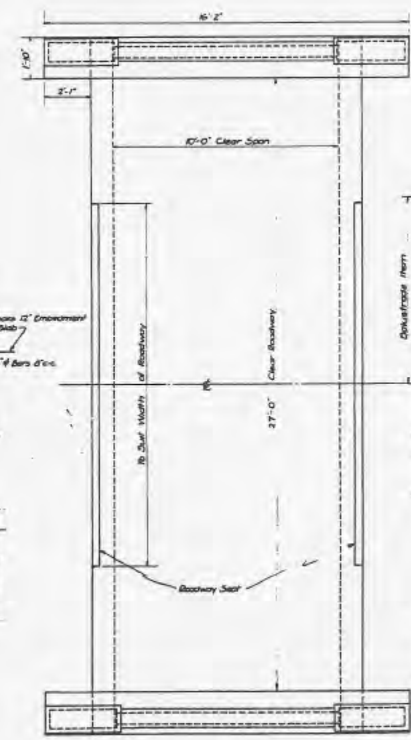
General Notes:
All concrete in superstructure to be Class "A", 1-2-4 Mix.
All steel to be deformed bars.
All intersecting bars shall be rigidly wired together with No 16 annealed wire.
Interior and exterior paneling on end posts to be same.
Cost of felt expansion joints to be included in cost of class "A" concrete.
Specifications: Latest S.R.C. Bridge Specifications.
Loading H-20 as per U.S. Dept. of Agriculture Bulletin #1259



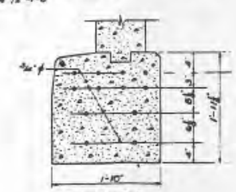
ELEVATION
Scale 1/2"=1'-0"



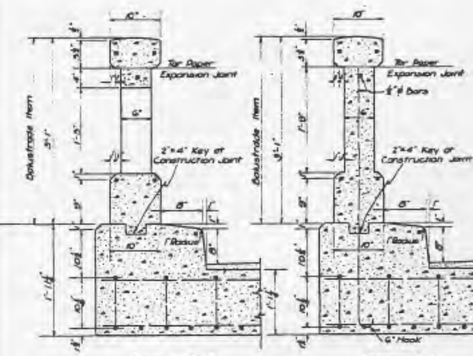
LONGITUDINAL SECTION ALONG ℄
Scale 1/2"=1'-0"



PLAN
Scale 1/8"=1'-0"



SECTION D-D
Scale 1"=1'-0"



SECTION B-B
Scale 1"=1'-0"

SECTION A-A
Scale 1"=1'-0"

APPROXIMATE SUPERSTRUCTURE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY
19.43 C. Yd's. Concrete Excluding Balustrades
2.87 C. Yd's. Concrete in Balustrades

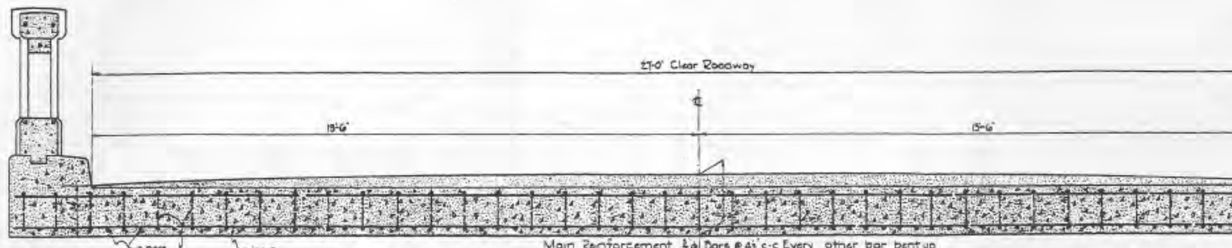
TOTAL WEIGHT OF REINFORCING STEEL = 2,519#

Nota.	No.	Size	Length	Total Length	Wt #/ft	Total Wt.	Description
a	36	3/4" ϕ	11'-9"	423'-0"	1.50	634.5	11'-9"
b	37	3/4" ϕ	12'-10"	474'-10"	1.50	712.2	8" hook, 8" hook
c	5	3/4" ϕ	30'-5"	152'-1"	1.50	228.1	30'-5"
d	24	1/2" ▫	5'-4"	128'-0"	.85	108.8	4'-10", 6" hook
e	32	1/2" ▫	2'-10"	90'-8"	.85	77.1	2'-10"
f	6	1/2" ▫	5'-3"	31'-6"	.85	26.8	4'-9", 6" hook
g	8	1/2" ▫	9'-4"	74'-8"	.85	65.5	9'-4"
h	2	1/2" ▫	9'-8"	19'-4"	.85	16.4	9'-8"
i	20	1/2" ▫	4'-9"	95'-0"	.85	80.8	4'-3", 6" hook
j	2	1/2" ▫	15'-10"	31'-8"	.85	26.9	15'-10"
k	48	3/4" ϕ	5'-8"	272'-0"	1.50	408.0	5'-0", 8" hook
* L	80	1/2" ▫	2'-0"	160'-0"	.85	136.0	2'-0"

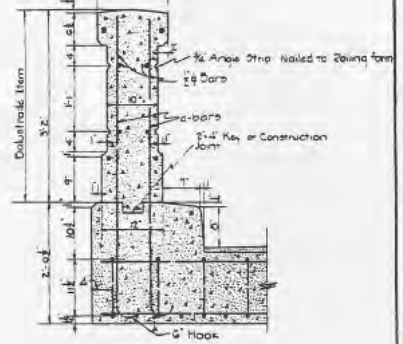
* These bars to be omitted if roadway surfacing is of other material than concrete.

A-22

REVISIONS	STATE OF MARYLAND STATE ROADS COMMISSION BALTIMORE, MD. STANDARD 10'-0" SLAB BRIDGE SUPERSTRUCTURE DETAILS
Expansion joints in handrail ~~and parapet~~ changed from 1/4" to 1/2" 4-28-31 W.J.M.	SCALE Various Mar. 1, 1950 CONTRACT MADE BY J.L.B. TRACED BY CHECKED BY APPROVED [signature] CHIEF ENGINEER 5/5/30 CORRECT [signature] BRIDGE ENGINEER 5/5/30 SHEET NO. OF

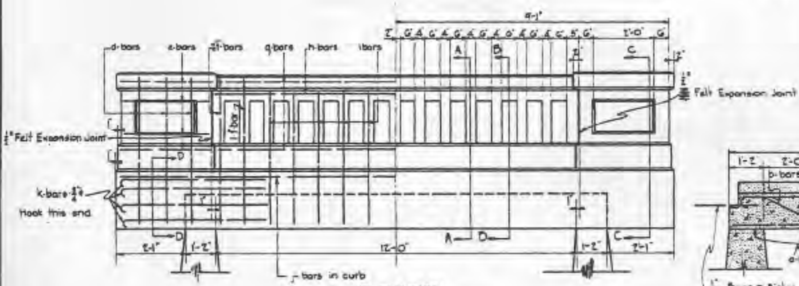


CROSS SECTION OF ROADWAY
Scale 3/4" = 1'-0"

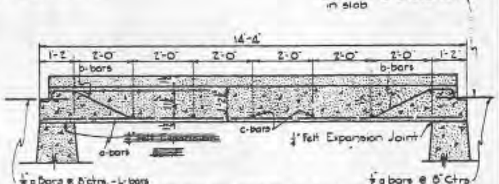


SECTION C-C
Scale 1" = 1'-0"

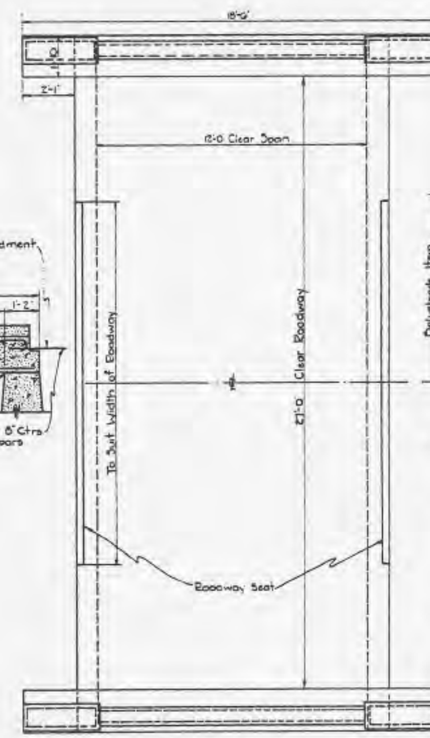
General Notes
All concrete in superstructure to be Class A, 1-2-4 Mix
All steel to be deformed bars
All intersecting bars shall be rigidly wired together with No. 16 annealed wire
Interior and exterior paneling on end posts to be same
Cost of felt expansion joints to be included in cost of class "A" concrete
Specifications: Latest S.R.C. Bridge Specifications
Loading H-20 as per U.S. Dept. of Agriculture Bulletin #1259



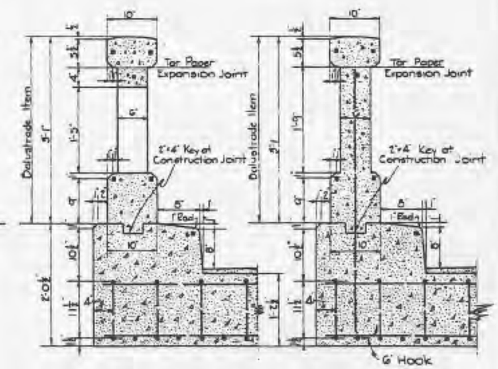
ELEVATION
Scale 1/2" = 1'-0"



LONGITUDINAL SECTION ALONG ℄
Scale 1/2" = 1'-0"



PLAN
Scale 3/16" = 1'-0"



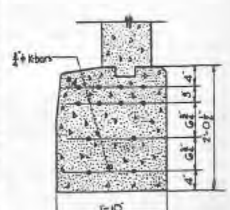
SECTION B-B
Scale 1" = 1'-0"

SECTION A-A
Scale 1" = 1'-0"

APPROXIMATE SUPERSTRUCTURE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY
23.43 C. Yds. Concrete Excluding Balustrades
3.23 C. Yds. Concrete in Balustrades

TOTAL WEIGHT OF REINFORCING STEEL = 3,095#

Nota	No.	Size	Length	Total Length	Wt. #/ft.	Total Weight	Description
a	40	3/4"ϕ	14'-1"	563'-4"	1.50	845.0	14'-1"
b	41	3/4"ϕ	15'-2"	621'-10"	1.50	932.7	8" hook; 0'-8½", 2'-0", 8'-0", 2'-0", 0'-8½"; 8" hook
c	7	3/4"ϕ	30'-5"	212'-11"	1.50	319.4	30'-5"
d	24	1/2"□	5'-5"	130'-0"	.85	110.5	4'-11"; 6" hook
e	32	1/2"□	2'-10"	90'-8"	.85	77.1	2'-10"
f	6	1/2"□	5'-4"	32'-0"	.85	27.2	4'-10"; 6" hook
g	8	1/2"□	11'-8"	93'-4"	.85	79.3	11'-8"
h	2	1/2"□	12'-0"	24'-0"	.85	20.4	12'-0"
i	26	1/2"□	4'-11"	127'-10"	.85	108.7	4'-5"; 6" hook
j	2	1/2"□	18'-2"	36'-4"	.85	30.9	18'-2"
k	48	3/4"ϕ	5'-8"	272'-0"	1.50	408.0	5'-0"; 8" hook
L*	80	1/2"□	2'-0"	160'-0"	.85	136.0	2'-0"



SECTION D-D
Scale 1" = 1'-0"

*These bars to be omitted if roadway surfacing is of other material than concrete.

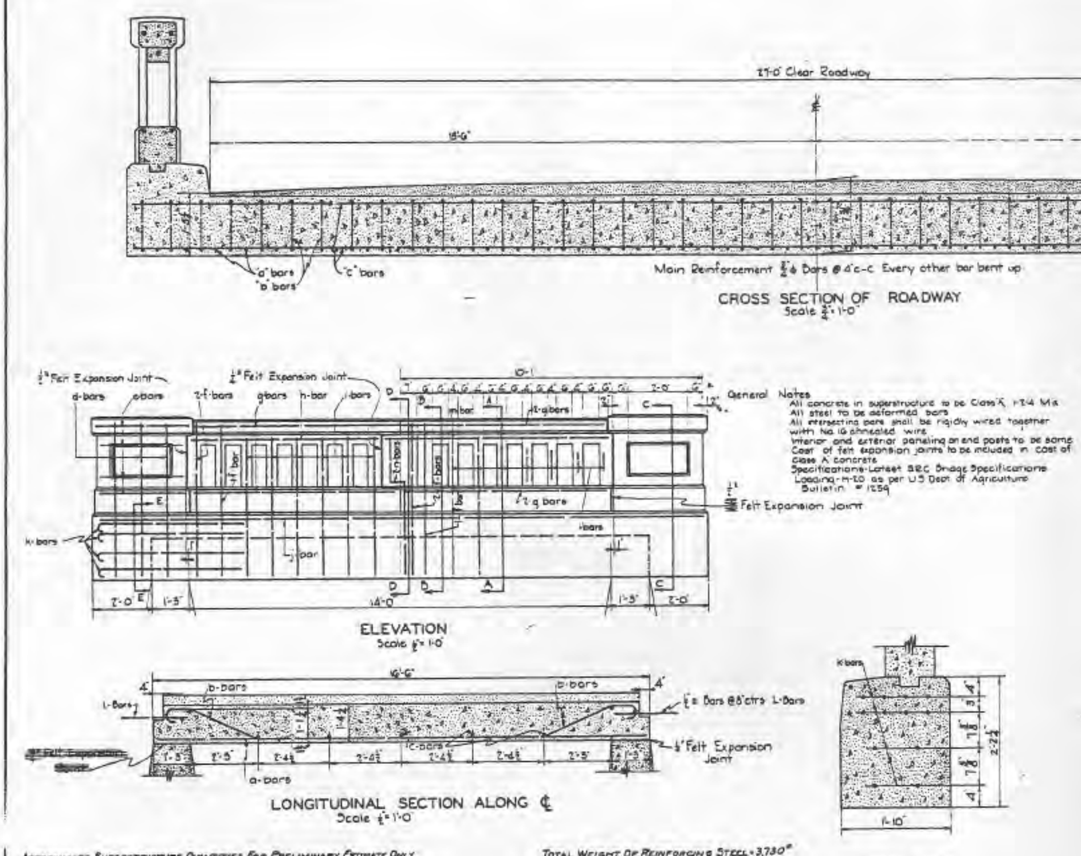
REVISIONS
1. Expansion joints in handrail and bridge seat changed from 1/2" to 1/4". Expansion joint removed from bridge seat at one end of span.
9-28-31 W.A.M.

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD 12'-0" SLAB BRIDGE
SUPERSTRUCTURE DETAILS

SCALE Various | March 1, 1930 | CONTRACT

MADE BY J.L.B.
TRACED BY C.T.
CHECKED BY
CORRECT
5/5/30
BRIDGE ENGINEER
APPROVED
CHIEF ENGINEER
5/5/30
SHEET NO. OF

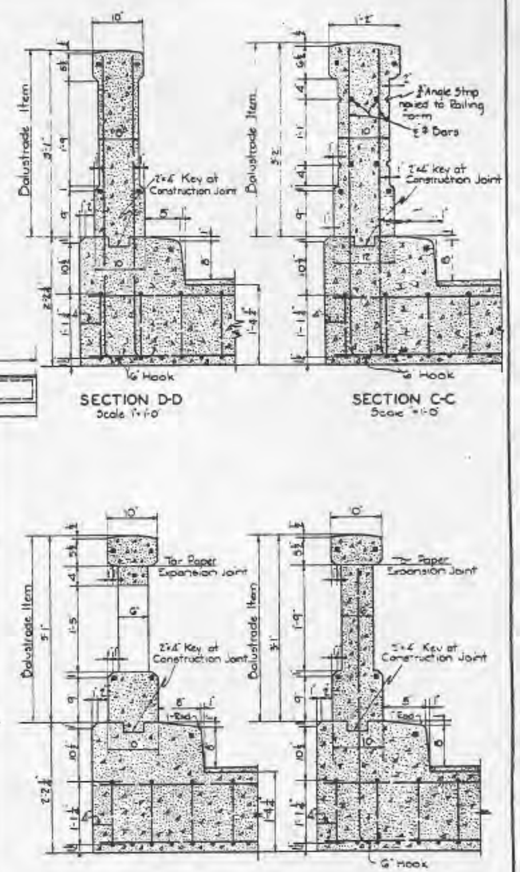


CROSS SECTION OF ROADWAY
Scale 3/4" = 1'-0"

ELEVATION
Scale 1/2" = 1'-0"

LONGITUDINAL SECTION ALONG ℄
Scale 1/4" = 1'-0"

SECTION E-E
Scale 1" = 1'-0"

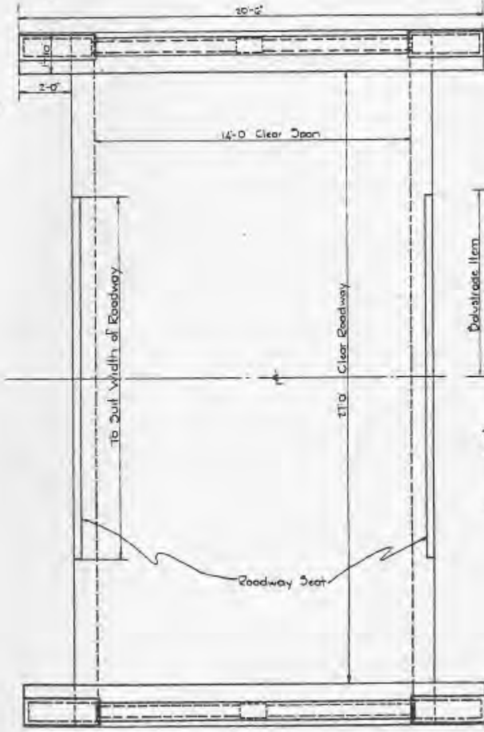


SECTION D-D
Scale 1" = 1'-0"

SECTION C-C
Scale 1" = 1'-0"

SECTION B-B
Scale 1" = 1'-0"

SECTION A-A
Scale 1" = 1'-0"



PLAN
Scale 3/8" = 1'-0"

Approximate Superstructure Quantities For Preliminary Estimate Only
31.84 C.Yds. Concrete Excluding Balustrades
3.63 C.Yds. Concrete in Balustrades

Total Weight Of Reinforcing Steel = 3,730#

Nota	No.	Size	Length	Total Length	Wt #/Ft	Total Weight	Description
a	46	3/4" ϕ	16'-5"	747'-6"	1.50	1121.3	16'-5"
b	46	3/4" ϕ	17'-5"	801'-2"	1.50	1201.8	6" hook
c	7	3/4" ϕ	30'-5"	212'-11"	1.50	319.4	30'-5"
d	24	1/2" ▫	5'-7"	134'-0"	.85	113.9	5'-1" 6" hook
e	32	1/2" ▫	2'-10"	90'-8"	.85	77.1	2'-10"
f	12	1/2" ▫	5'-6"	66'-0"	.85	56.1	5'-0" 6" hook
g	16	1/2" ▫	6'-9"	108'-0"	.85	91.8	6'-9"
h	2	1/2" ▫	6'-4"	12'-8"	.85	10.8	6'-4"
i	26	1/2" ▫	5'-0"	130'-0"	.85	127.5	4'-6" 6" hook
j	2	1/2" ▫	20'-2"	40'-4"	.85	34.3	20'-2"
k	48	3/4" ϕ	5'-8"	272'-0"	1.50	408.0	5'-0" 6" hook
* L	80	1/2" ▫	2'-0"	160'-0"	.85	136.0	2'-0"
m	2	1/2" ▫	7'-6"	15'-0"	.85	12.8	7'-6"
n	4	1/2" ▫	5'-7"	22'-4"	.85	19.0	6" hook

*These bars to be omitted if roadway surfacing is of other material than concrete.

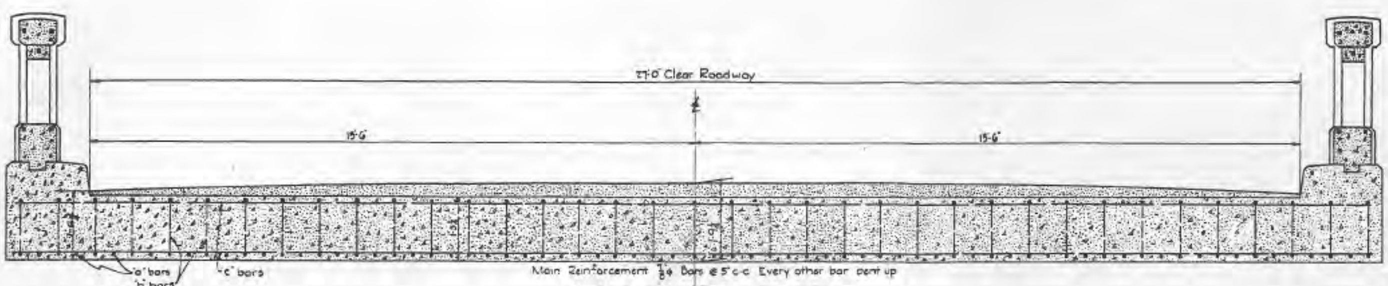
Revisions
1. Expansion joints at end posts in handrail ~~[illegible]~~ changed from 1/2" to 3/4". Expansion joint removed from bridge seat at one end of span 4-18-31 W.J.M.

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

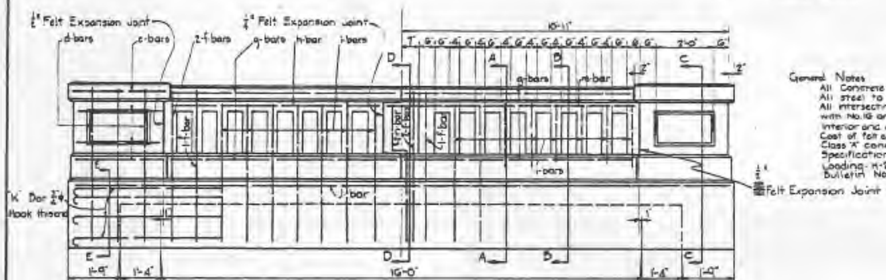
STANDARD 14'-0" SLAB BRIDGE
SUPERSTRUCTURE DETAILS

Scale Various — Mar. 1, 1930 — Contract

Made by J.L.B.
Traced by G.T.
Checked by
Correct
[signature] Bridge Engineer 5/5/30
Approved [signature] Chief Engineer 5/5/30
Sheet No. of

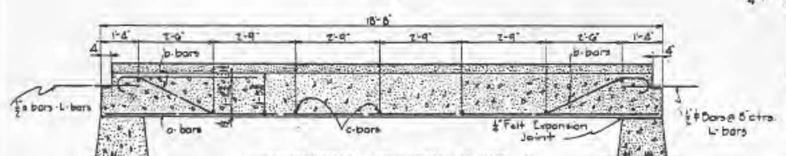


CROSS SECTION OF ROADWAY
Scale 3/4" = 1'-0"

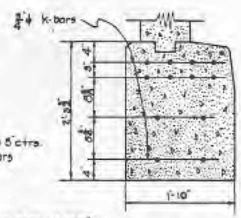


ELEVATION
Scale 1/2" = 1'-0"

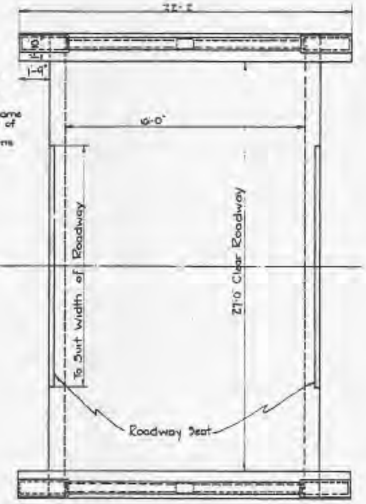
General Notes
All Concrete in Superstructure to be Class A, 1:2:4 Mix
All steel to be deformed bars.
All intersecting bars shall be rigidly wired together with No. 16 annealed wire
Interior and exterior paneling on end posts to be same
Cost of felt expansion joints to be included in cost of Class "A" concrete
Specifications — Latest S.R.C. Bridge Specifications
Loading - H-20 as per U.S. Dept. of Agriculture Bulletin No. 1259



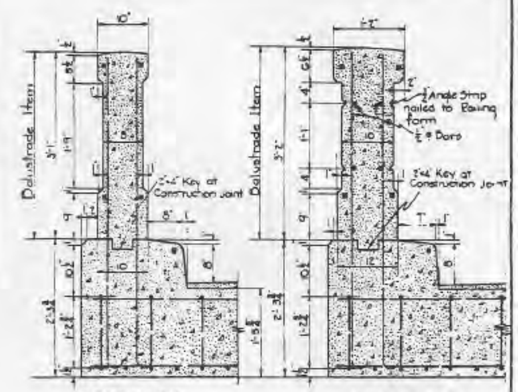
LONGITUDINAL SECTION ALONG ℄
Scale 1/2" = 1'-0"



SECTION E-E
Scale 1" = 1'-0"

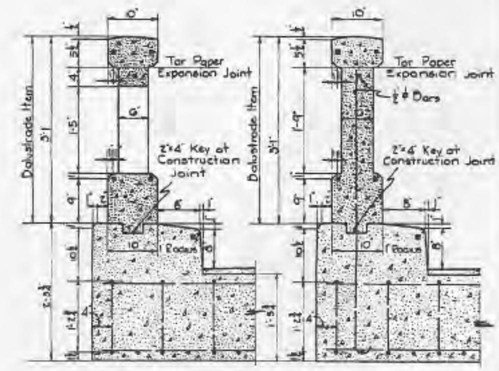


PLAN
Scale 1/4" = 1'-0"



SECTION D-D
Scale 1" = 1'-0"

SECTION C-C
Scale 1" = 1'-0"



SECTION B-B
Scale 1" = 1'-0"

SECTION A-A
Scale 1" = 1'-0"

APPROXIMATE SUPERSTRUCTURE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY
38.51 C. Yds. Concrete Excluding Balustrades
3.80 C. Yds. Concrete in Balustrades

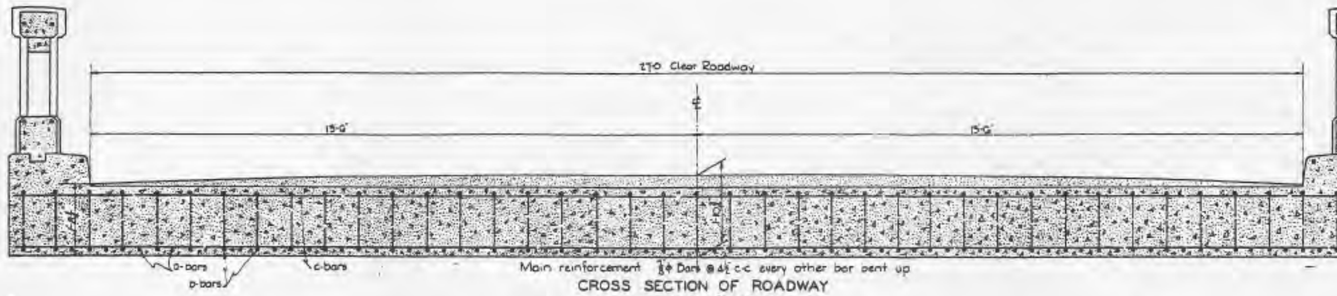
TOTAL WEIGHT OF REINFORCING STEEL - 4,386#

Nota	No.	Size	Length	Total Lnth	Wt. #/'	Total Wt.	Description
a	36	7/8" φ	18'-5"	663'-0"	2.04	1352.5	18'-5"
b	37	7/8" φ	19'-8"	727'-8"	2.04	1484.4	6" hook ... 11'-0" ... 6" hook
c	7	7/8" φ	30'-5"	212'-11"	2.04	434.4	30'-5"
d	24	1/2" □	5'-9"	138'-0"	.85	117.3	6" hook
e	32	1/2" □	2'-10"	90'-8"	.85	77.1	2'-10"
f	12	1/2" □	5'-8"	68'-0"	.85	57.8	6" hook
g	16	1/2" □	7'-7"	121'-4"	.85	103.1	7'-7"
h	2	1/2" □	7'-2"	14'-4"	.85	12.2	7'-2"
i	30	1/2" □	5'-2"	155'-0"	.85	131.8	6" hook
j	2	1/2" □	21'-10"	43'-8"	.85	37.1	21'-10"
k	48	3/4" φ	5'-8"	272'-0"	1.50	408.0	6" hook
L	80	1/2" □	2'-0"	160'-0"	.85	136.0	2'-0"
m	2	1/2" □	8'-4"	16'-8"	.85	14.2	8'-4"
n	4	1/2" □	5'-8"	22'-8"	.85	19.3	6" hook; Make this bend 90° from direction of hook

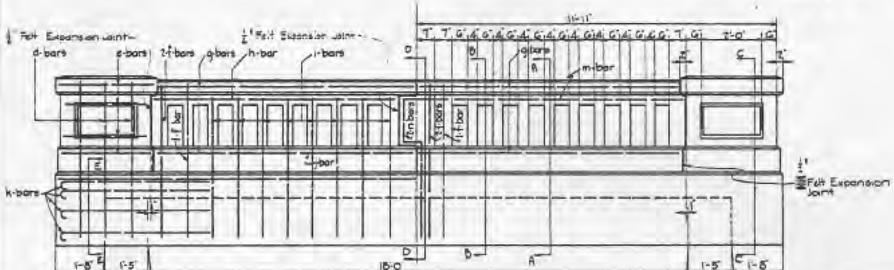
*These bars to be omitted if roadway surfacing is of other material than concrete.

REVISIONS	
Expansion joints at end posts in handrail; changed from 1/4" to 1/2" 9-28-31 W.J.M.	STATE OF MARYLAND STATE ROADS COMMISSION BALTIMORE, MD. STANDARD 16'-0" SLAB BRIDGE SUPERSTRUCTURE DETAILS

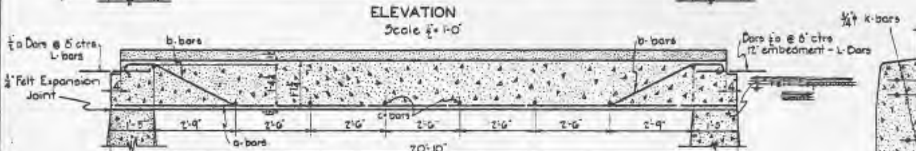
SCALE Various — Mar. 1, 1930 — CONTRACT
MADE BY J.L.B.
TRACED BY C.T.
CHECKED BY
CORRECT — Bridge Engineer 5/5/30
APPROVED — Chief Engineer 5/5/30
SHEET NO. OF



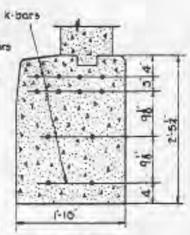
CROSS SECTION OF ROADWAY
Scale 1/2"=1'-0"



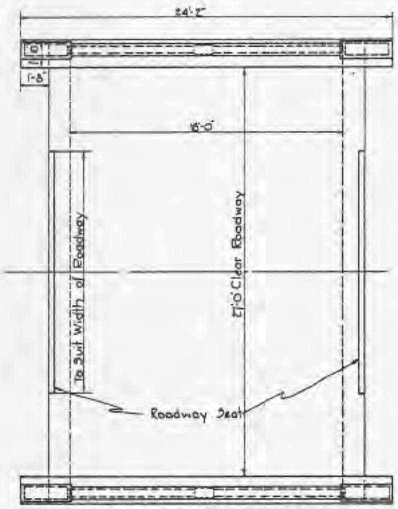
ELEVATION
Scale 1/4"=1'-0"



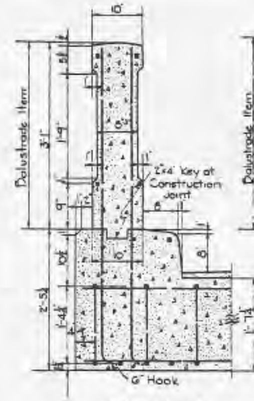
LONGITUDINAL SECTION ALONG ℄
Scale 1/2"=1'-0"



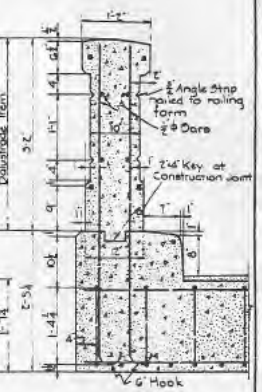
SECTION E-E
Scale 1"=1'-0"



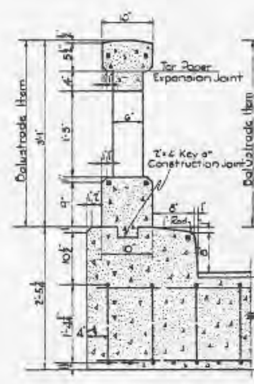
PLAN
Scale 1/4"=1'-0"



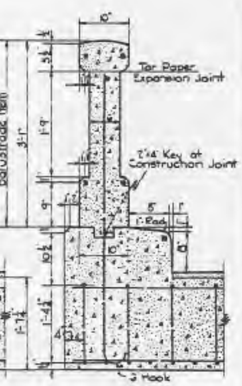
SECTION D-D
Scale 1"=1'-0"



SECTION C-C
Scale 1"=1'-0"



SECTION B-B
Scale 1"=1'-0"



SECTION A-A
Scale 1"=1'-0"

APPROXIMATE SUPERSTRUCTURE QUANTITIES FOR PRELIMINARY ESTIMATE ONLY
45.69 C. Yds Concrete Excluding Balustrades
4.12 C. Yds. Concrete in Balustrades

TOTAL WEIGHT OF REINFORCING STEEL = 5,169#

Nota.	No.	Size	Length	Total Length	Wt. #/ft.	Total Weight	Description
a	40	7/8" φ	20'-7"	823'-4"	2.04	1679.6	20'-7"
b	41	7/8" φ	21'-11"	898'-7"	2.04	1833.1	8" hook, 15'-6", 8" hook
c	8	7/8" φ	30'-5"	243'-4"	2.04	496.4	30'-5"
d	24	1/2" □	5'-10"	140'-0"	.85	119.0	5'-4", 6" hook
e	32	1/2" □	2'-10"	90'-8"	.85	77.1	2'-10"
f	12	1/2" □	5'-9"	69'-0"	.85	58.7	5'-3", 6" hook
g	16	1/2" □	8'-7"	137'-4"	.85	116.7	8'-7"
h	2	1/2" □	8'-2"	16'-4"	.85	13.9	8'-2"
i	34	1/2" □	5'-4"	181'-4"	.85	154.1	4'-10", 6" hook
j	2	1/2" □	23'-10"	47'-8"	.85	40.5	23'-10"
k	48	3/4" φ	5'-8"	272'-0"	1.50	408.0	5'-0", 8" hook
L*	80	1/2" □	2'-0"	160'-0"	.85	136.0	2'-0"
m	2	1/2" □	9'-4"	18'-8"	.85	15.9	9'-4"
n	4	1/2" □	5'-10"	23'-4"	.85	19.8	6" hook, 3'-3", 1'-9", Bend this bend 90° from direction of hooks

* These bars to be omitted if roadway surfacing is of other material than concrete.

General Notes

All concrete in superstructure to be Class A, 1-2-4 Mix
All steel to be deformed bars
All intersecting bars shall be rigidly wired together with No. 16 annealed wire
Interior and exterior paneling on end posts to be same
Cost of felt expansion joints to be included in cost of Class A concrete
Specifications - Latest S.R.C. Specifications
Loading H-20 as per U.S. Dept. of Agriculture Bulletin #1259

REVISIONS
1. Expansion joints at end posts in handrail ~~[illegible]~~ changed from 1/4" to 1/2". Expansion joint removed from bridge seat at one end of span. 9-28-31 W.J.M.

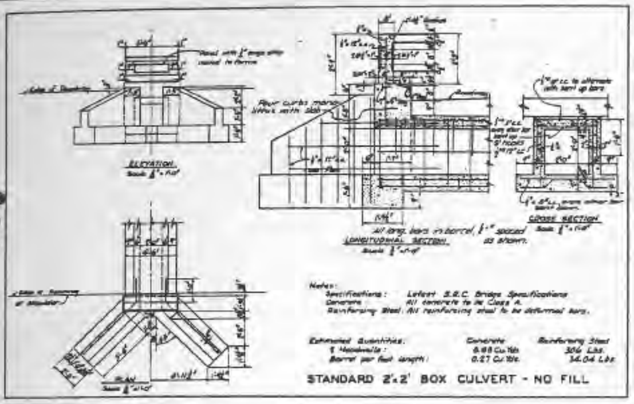
STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE MD.

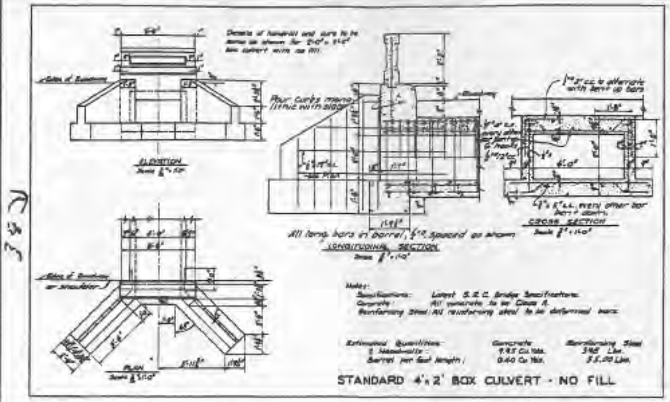
STANDARD 18'-0" SLAB BRIDGE
SUPERSTRUCTURE DETAILS

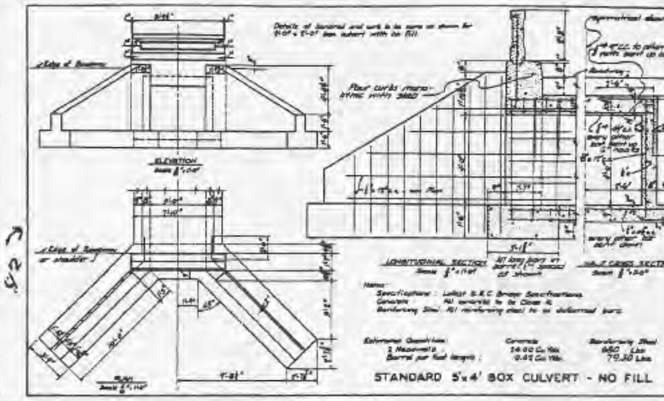
SCALE Various — Mar. 1, 1930 — CONTRACT

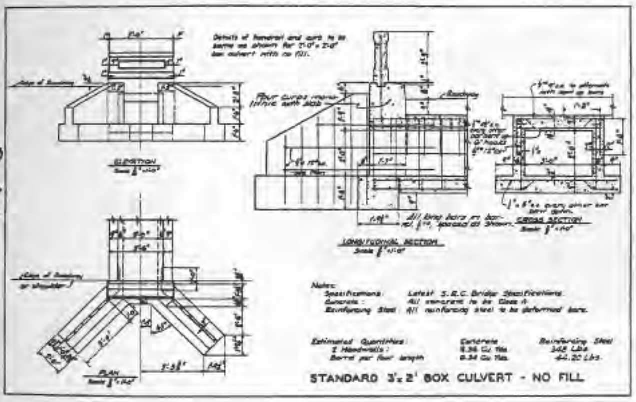
MADE BY J.L.B.
TRACED BY C.T.
CHECKED BY
CORRECT [signature] 5/5/30 BRIDGE ENGINEER
APPROVED [signature] 5/5/30 CHIEF ENGINEER
SHEET NO.

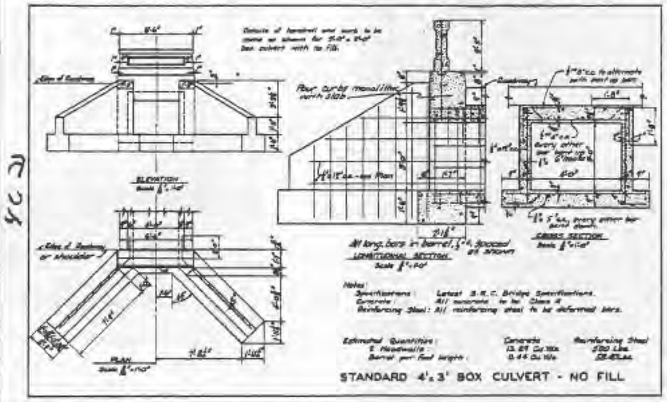
1931 Standard Plans

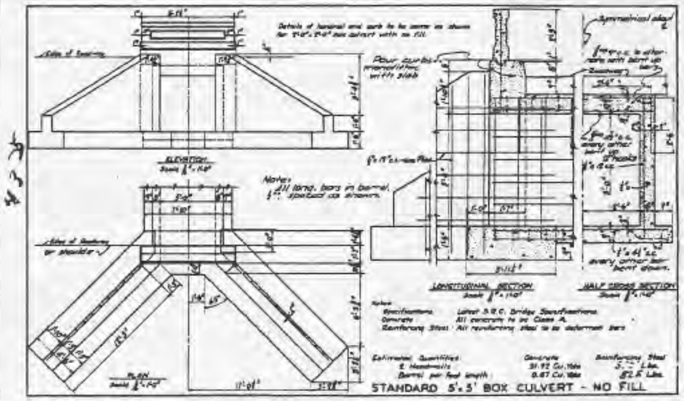


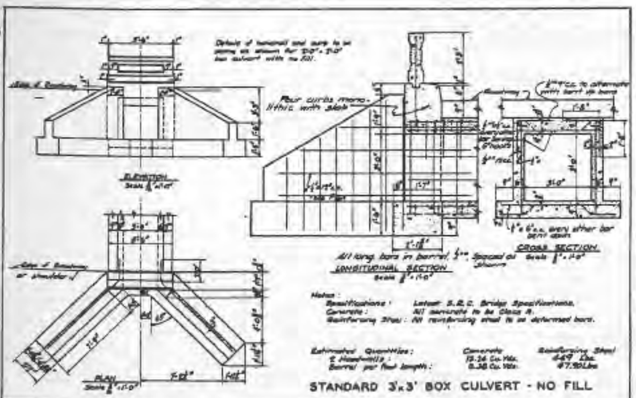


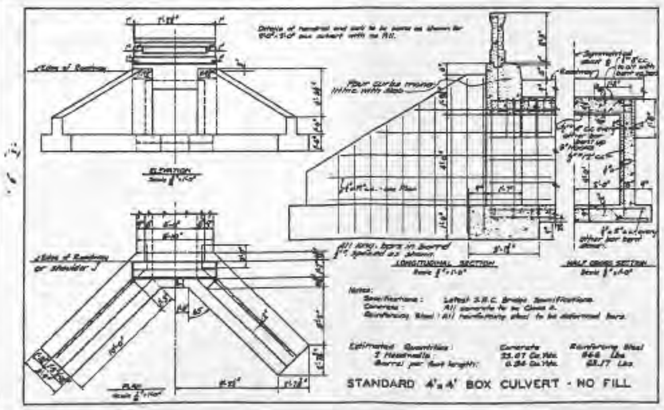










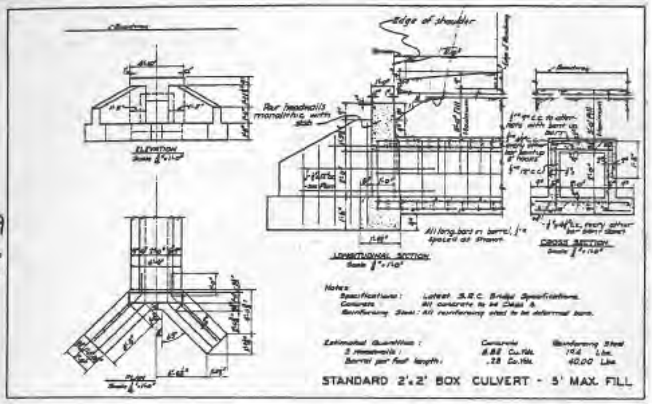


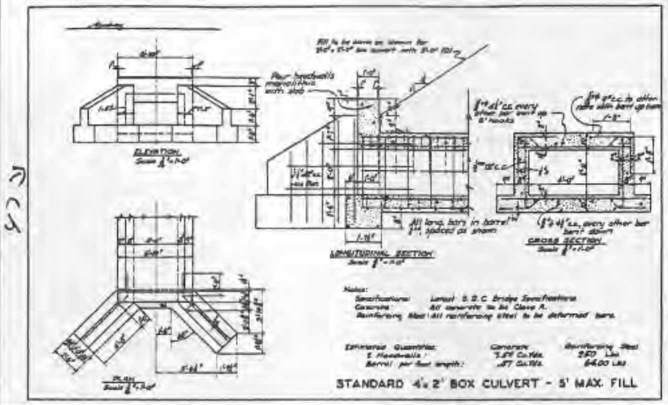
General Notes:
Loading: H-20 as per U.S. Dept. of Agriculture Bulletin No. 1259.
Impact: 30%.
Live Load Distribution: e = 0.7S + W, in which e = distribution factor (feet), S = clear span (feet) and W = 1.67 ft. for H-20.
To allow for effect of 2 overlapping wheels, e is reduced by: e = ½(e+3). This latter factor used to determine fraction of wheel load (16000 lbs.) per foot length of barrel.
L.L. computed as concentrated load. No distribution in direction of span of slab.

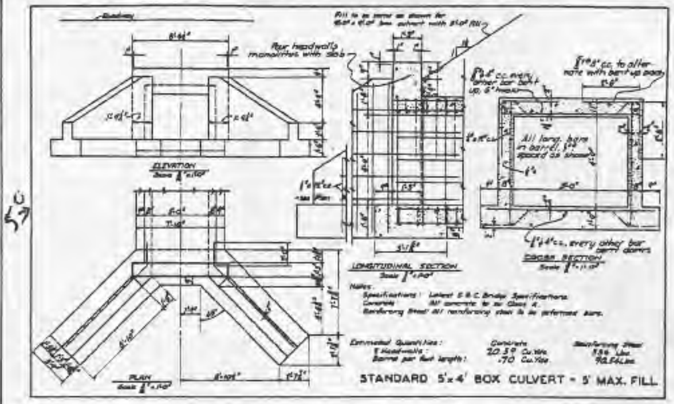
Earth Pressure: Sidewalls and wings designed for a pressure of an earth fluid weighing 30 lbs. per cu. ft. A surcharge of 2'-0" is added to all heights for computing earth pressures.

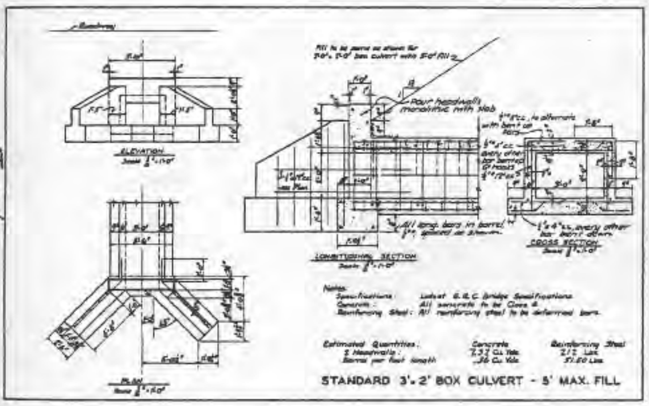
Moments: In computing moments use distance c. to c. supports.

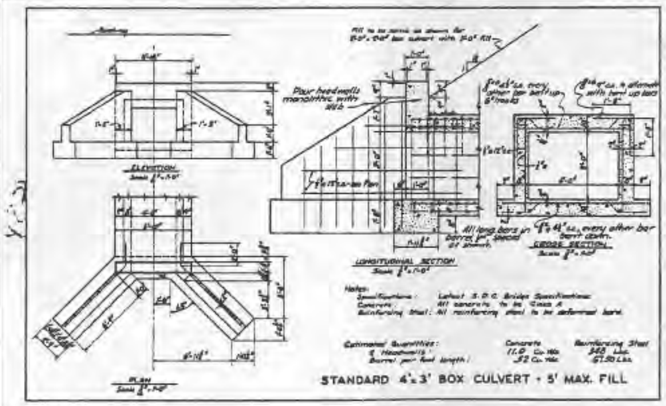
Revisions	STATE OF MARYLAND STATE ROADS COMMISSION BALTIMORE MD. STANDARD REINFORCED CONCRETE BOX CULVERTS NO FILL
	Scale As Noted — Mar 30, 1931 — Contract
	Made By A.L.G. & W.J.M. Traced By W.J.M. & A.L.G. Checked By [signature] Correct [signature] Bridge Engineer 5/4/31 Approved [signature] Chief Engineer 5/4/31 Sheet No. of

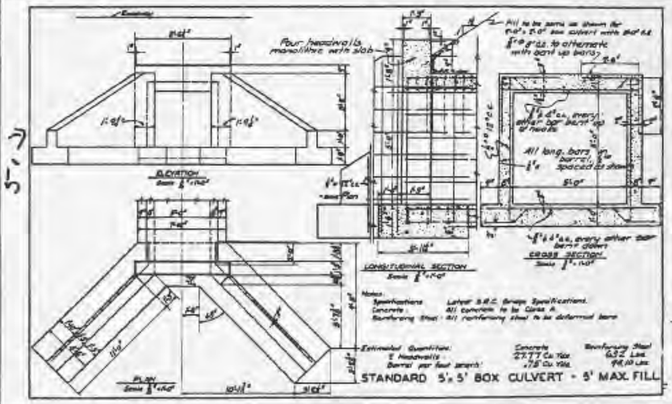


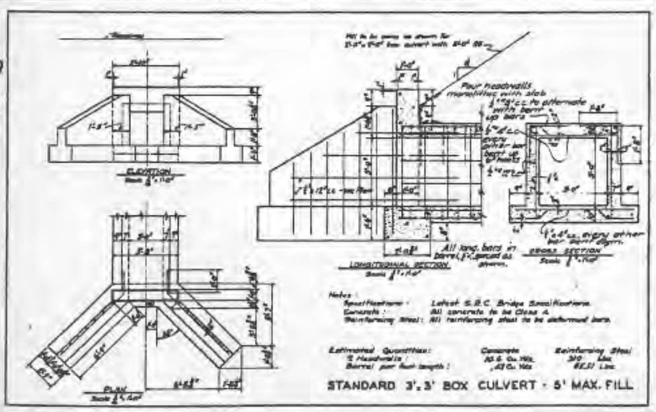


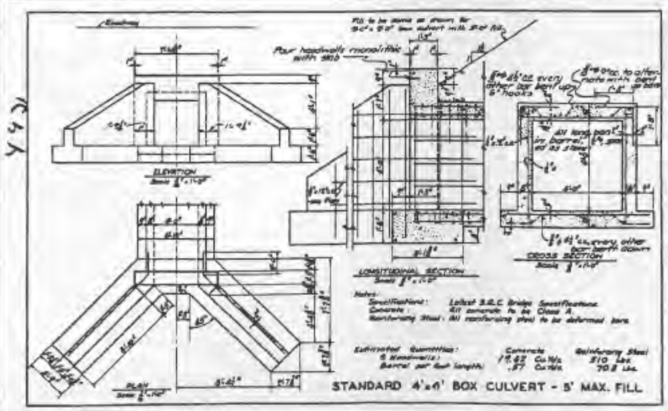












General Notes:

Loading: H 20 as per U.S. Dept. of Agriculture Bulletin No. 1259. Culverts designed for all fills of 5.0" or less.
Impact: 30% of LL for Fills from 0' to 5' inclusive.
Live Load Distribution: To determine fraction of truck wheel load (16000 lbs.) per foot strip of barrel, use transverse distribution factors given in table below.
L.L. figured as concentrated load on all fills from 0.0" to 5.0", no distribution in direction of span of slab.

Earth Pressure: Sidewalls and wings designed for a pressure of an earth fluid weighing 30 lbs. per cu. ft. A surcharge of 2'-0" is added to all heights for computing earth pressures.

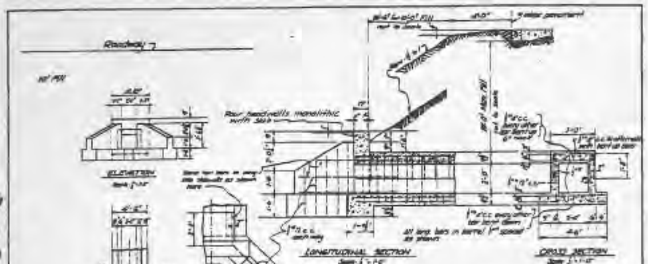
Moments: In computing moments use distance c. to c. supports.

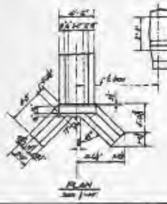
L.L. distributions for Fills up to 5.0"

Span	Transverse distributions
2'-0"	3.2'
3'-0"	3.6'
4'-0"	4.2'
5'-0"	4.5'

Revisions	
	STATE OF MARYLAND STATE ROADS COMMISSION BALTIMORE, MD. STANDARD REINFORCED CONCRETE BOX CULVERTS 5' MAXIMUM FILL
	SCALE As Noted — April 9, 1931 — CONTRACT
	MADE BY A.L.G. & W.J.M. TRACED BY W.J.M. & A.L.G. CHECKED BY [signature] CORRECT [signature] BRIDGE ENGINEER 5/4/31 APPROVED [signature] CHIEF ENGINEER 5/4/31 SHEET NO. OF

7150



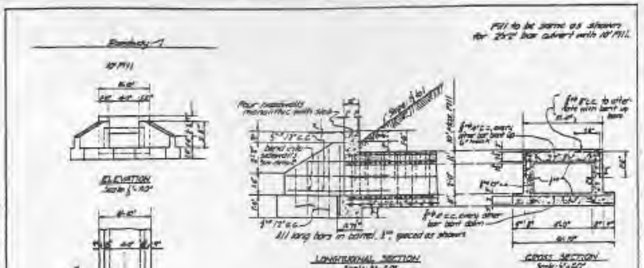


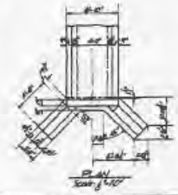
Notes:
Specifications: Latest S.R.C. Bridge Specifications.
Concrete: All concrete to be Class A.
Reinforcing Steel: All reinforcing steel to be deformed bars.

Estimated Quantities:	Concrete	Reinforcing Steel
2-Headwalls & 4-wings:	6.94 Cu. yds.	193 Lbs.
Barrel per foot length:	.29 Cu. yds.	43.6 Lbs.

STANDARD 2'x2' BOX CULVERT - 10' MAX. FILL

Fill to be same as shown for 2'x2' box culvert with 10' Fill.



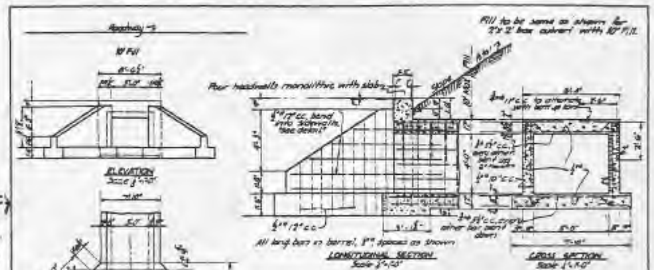


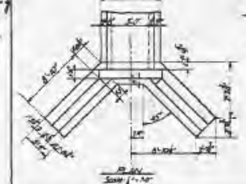
Notes:
Specifications: Latest S.R.C. Bridge Specifications.
Concrete: All concrete to be Class A.
Reinforcing Steel: All reinforcing steel to be deformed bars.

Estimated Quantities:	Concrete	Reinforcing Steel
2-Headwalls & 4-wings:	7.75 Cu. yds.	255 Lbs.
Barrel per foot length:	.51 Cu. yds.	70.2 Lbs.

STANDARD 4'x2' BOX CULVERT - 10' MAX. FILL

Fill to be same as shown for 2'x2' box culvert with 10' Fill.



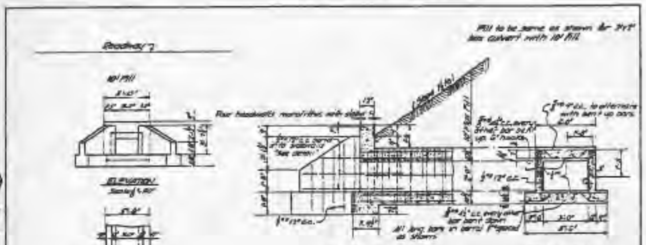


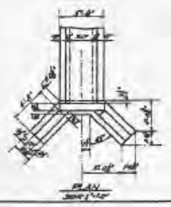
Notes:
Specifications: Latest S.R.C. Bridge Specifications.
Concrete: All concrete to be Class A.
Reinforcing Steel: All reinforcing steel to be deformed bars.

Estimated Quantities:	Concrete	Reinforcing Steel
2-Headwalls & 4-wings:	30.6 Cu. yds.	594 Lbs.
Barrel per foot length:	.72 Cu. yds.	95.5 Lbs.

STANDARD 5'x4' BOX CULVERT - 10' MAX. FILL

Fill to be same as shown for 3'x3' box culvert with 10' Fill.



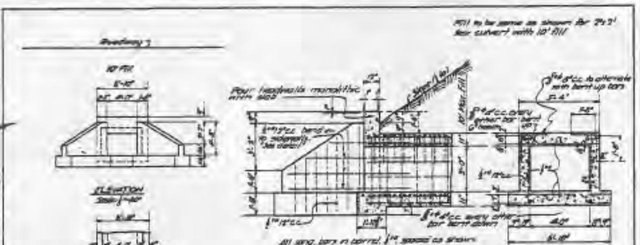


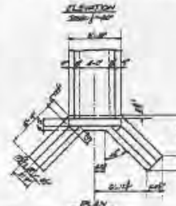
Notes:
Specifications: Latest S.R.C. Bridge Specifications.
Concrete: All concrete to be Class A.
Reinforcing Steel: All reinforcing steel to be deformed bars.

Estimated Quantities:	Concrete	Reinforcing Steel
2-Headwalls & 4-wings:	7.58 Cu. yds.	229 Lbs.
Barrel per foot length:	.38 Cu. yds.	54.6 Lbs.

STANDARD 3'x2' BOX CULVERT - 10' MAX. FILL

Fill to be same as shown for 2'x2' box culvert with 10' Fill.



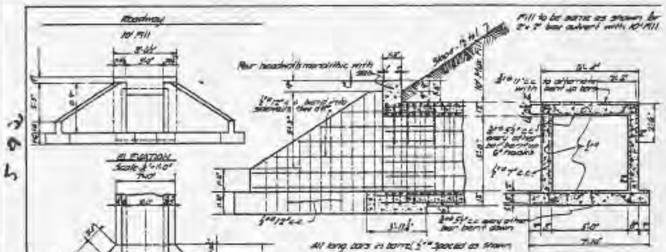


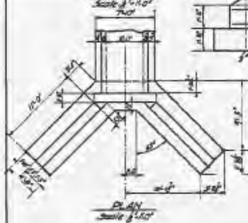
Notes:
Specifications: Latest S.R.C. Bridge Specifications.
Concrete: All concrete to be Class A.
Reinforcing Steel: All reinforcing steel to be deformed bars.

Estimated Quantities:	Concrete	Reinforcing Steel
2-Headwalls & 4-wings:	11.10 Cu. yds.	370 Lbs.
Barrel per foot length:	.57 Cu. yds.	73.5 Lbs.

STANDARD 4'x3' BOX CULVERT - 10' MAX. FILL

Fill to be same as shown for 2'x2' box culvert with 10' Fill.



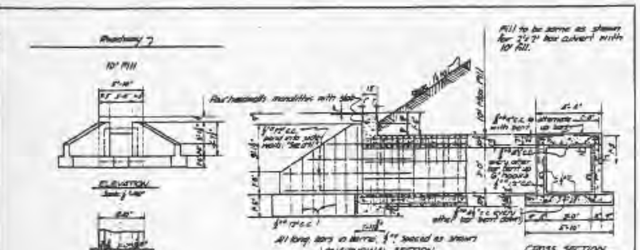


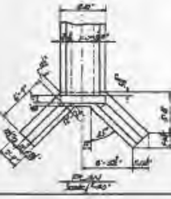
Notes:
Specifications: Latest S.R.C. Bridge Specifications.
Concrete: All concrete to be Class A.
Reinforcing Steel: All reinforcing steel to be deformed bars.

Estimated Quantities:	Concrete	Reinforcing Steel
2-Headwalls & 4-wings:	27.93 Cu. yds.	761 Lbs.
Barrel per foot length:	.77 Cu. yds.	105.1 Lbs.

STANDARD 5'x5' BOX CULVERT - 10' MAX. FILL

Fill to be same as shown for 2'x2' box culvert with 10' Fill.



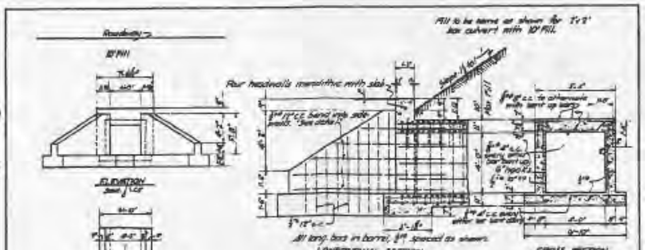


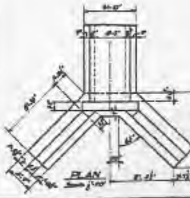
Notes:
Specifications: Latest S.R.C. Bridge Specifications.
Concrete: All concrete to be class A.
Reinforcing Steel: All reinforcing steel to be deformed bars.

Estimated Quantities:	Concrete	Reinforcing Steel
2-Headwalls & 4-wings:	10.85 Cu. yds.	316 Lbs.
Barrel per foot length:	.48 Cu. yds.	60.4 Lbs.

STANDARD 3'x3' BOX CULVERT - 10' MAX. FILL

Fill to be same as shown for 3'x3' box culvert with 10' Fill.





Notes:
Specifications: Latest S.R.C. Bridge Specifications.
Concrete: All concrete to be Class A.
Reinforcing Steel: All reinforcing steel to be deformed bars.

Estimated Quantities:	Concrete	Reinforcing Steel
2-Head walls & 4-wings:	19.83 Cu. yds.	514 Lbs.
Barrel per foot length:	.61 Cu. yds.	78.9 Lbs.

STANDARD 4'x4' BOX CULVERT - 10' MAX. FILL

General Notes:
Loading - H-20 truck loading as per U.S. Bureau Public Roads, Bulletin No 1259.
Impact - 15% of L.L. for all fills from 5.0' to 10.0'
Dead Load - All culverts on this sheet designed for 10.0' Fill (Earth = 100 lbs per cu. ft.) and 225 lbs per foot of span (top slab) for concrete and wearing surface.
Live Load - Total L.L. acting on a foot length of barrel obtained by dividing truck rear wheel (16000 lbs) by transverse distribution given in table below. This load is assumed to act as a uniform load over the clear span. Distribution, uniform L.L. and Impact increment for various spans given in table below (for fills from 5' to 10' only).
Earth Pressure - Sidewalls and wings designed for a pressure of an earth fluid weighing 30 lbs. per cu. ft. A surcharge of 2.0' is added to all heights for computing earth pressures.
Moments - In computing moments use dist. c. to c. supports.

Unif. L.L. for boxes with 5' to 10' Fills.

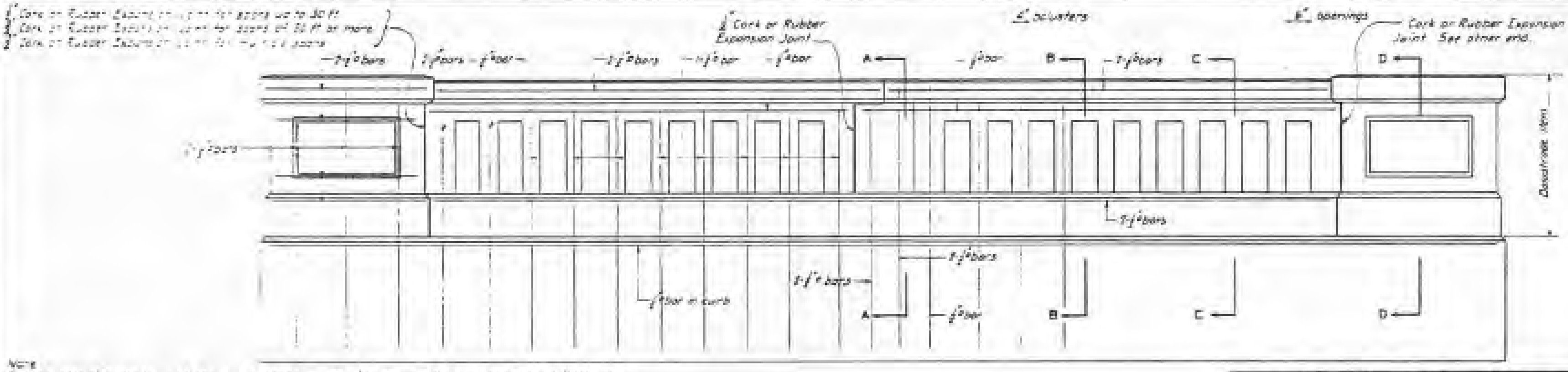
Span	Trans. distr.	Unif. L.L.	15% Imp.	L.L.+Imp.
2'-0"	1.25'	6400#	960#	7360#
3'-0"	1.95'	3450	520	3970
4'-0"	2.00'	2000	300	2300
5'-0"	2.15'	1490	225	1715

REVISIONS

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.
STANDARD
REINFORCED CONCRETE BOX CULVERTS
10' MAXIMUM FILL

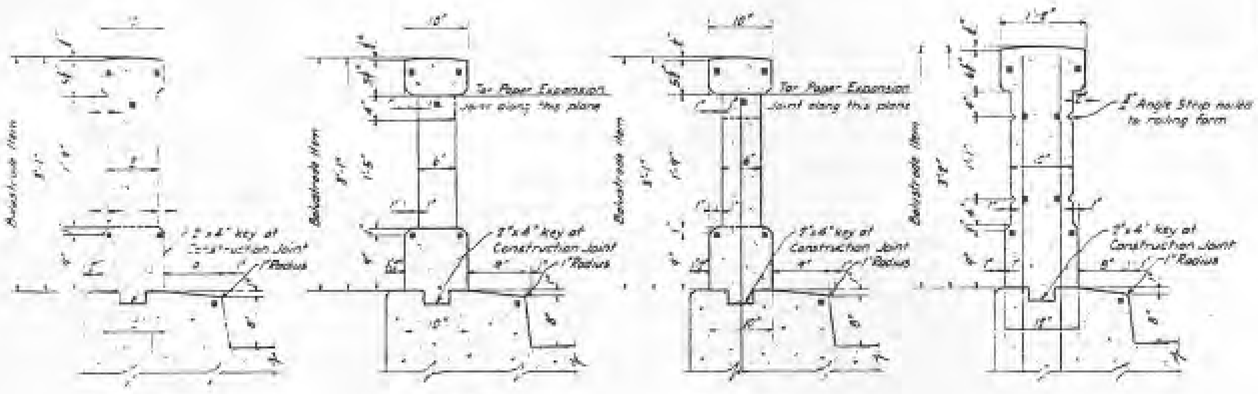
SCALE As Noted | April 16, 1931 | CONTRACT
MADE BY A.L.G.
TRACED BY A.L.G.
CHECKED BY
CORRECT
5/4/31
BRIDGE ENGINEER
APPROVED
5/4/31
CHIEF ENGINEER
SHEET NO. OF

1933 Standard Plans



Note

ELEVATION



SECTION A-A   SECTION B-B   SECTION C-C   SECTION D-D

All reinforcing in balustrade bars

Mean Temperature for day when Balustrade is poured	Size of Joint to be used where Joint Specified	Size of Joint to be used where Joint Specified	Size of Joint to be used where Joint Specified
25°F to 49°F 50°F to 74°F 75°F or over	[illegible]	[illegible]	[illegible]

GENERAL NOTES

SPECIFICATIONS: Latest S.R.C. Specifications and A.A.S.H.O. Standard Specifications.
CONCRETE: All concrete in balustrade to be "Class A."
REINFORCING: All reinforcing to be deformed steel bars.
PANELING: Interior and Exterior panels on end posts to be the same.
CHAMFER: All exposed edges to be chamfered 1" or as directed.
EXPANSION JOINTS: Cost of all material in balustrade expansion joints and placing of same to be included in the contract unit price for "Class A Concrete Balustrade." The cost of providing a thicker expansion joint than shown on plans shall be included in the contract unit price for "Class A Concrete Balustrade" as no additional compensation will be allowed.

A-32

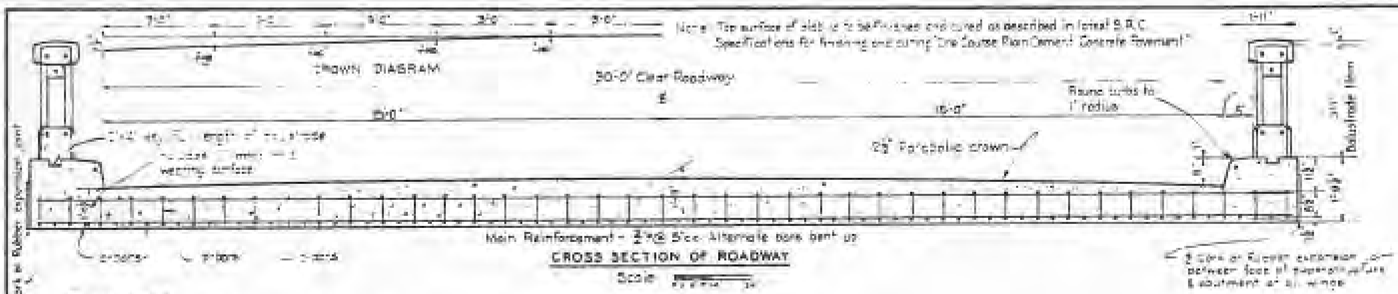
STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD BALUSTRADE DETAILS

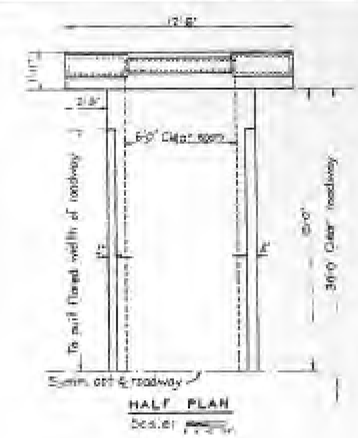
Revisions	Scale: As Noted	March 1933
Revised April 1934	Made By JON Traced By JON Checked By A.L.S. Correct 5/8/33	Approved Chief Engineer 5/9, 1933

CB-33

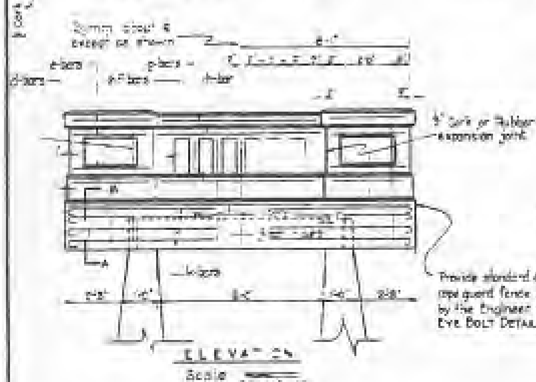
Note: Top surface of slab is to be finished and cured as described in latest S.R.C. Specifications for finishing and curing "One Course Plain Cement Concrete Pavement."



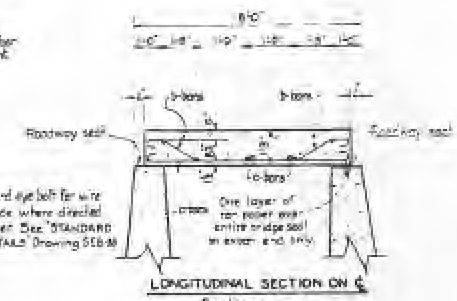
CROSS SECTION OF ROADWAY



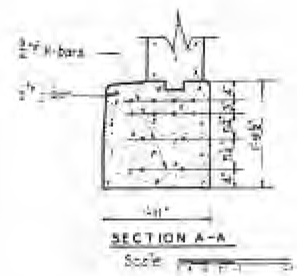
HALF PLAN



ELEVATION



LONGITUDINAL SECTION ON ℄



SECTION A-A

Mark	No.	Size	Length	Total Length	Wt./Ft.	Total Weight	Detail
a	40	¾"	8'-5"	336'-8"	[illegible]	512	6" hook, 6" hook
b	41	¾"	8'-9"	358'-9"	[illegible]	545	6" hook, 6" hook
c	5	¾"	33'-7"	167'-11"	[illegible]	255	33'-7"
d	24	½"	5'-2"	124'-0"	[illegible]	107	4'-8", 6" hook
e	32	½"	2'-10"	90'-8"	[illegible]	78	2'-10"
f	4	½"	5'-1"	20'-4"	[illegible]	17	4'-7", 6" hook
g	8	½"	5'-7"	44'-8"	[illegible]	38	5'-7"
h	2	½"	5'-11"	11'-10"	[illegible]	10	5'-11"
i	12	½"	4'-8"	56'-0"	[illegible]	48	4'-2", 6" hook
j	2	½"	12'-2"	24'-4"	[illegible]	21	12'-2"
k	48	¾"	5'-8"	272'-0"	[illegible]	413	5'-2", 6" hook
						2044#	

GENERAL NOTES

SPECIFICATIONS: Latest S.R.C. Specifications & A.A.S.H.O. Stand. Specifications.
LOADING: H-20, with double (L.L.+ impact).
UNIT STRESSES: fc = 1200#/in² – fs = 24,000#/in²
CONCRETE: All concrete in superstructure to be "Class A".
REINFORCING: All reinforcing to be deformed steel bars.
PANELING: Interior & exterior panels on end posts to be the same.
CHAMFER: All exposed edges to be chamfered 1" or as directed.
EXPANSION JOINTS: Cost of all material in superstructure expansion joints & placing of same to be included in the contract unit price for "Class A Concrete." or "Class A Concrete Balustrade."

APPROXIMATE QUANTITIES IN SUPERSTRUCTURE (For preliminary estimate only)
3.98 Cu. yd. Class "A" Concrete, excluding balustrades.
2.26 Cu. yd. Class "A" Concrete in balustrades.
2044 lb. Deformed Steel Bars.

Note: For sections and additional balustrade details see "STANDARD BALUSTRADE DETAILS" Drawing CB-33

A-33

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

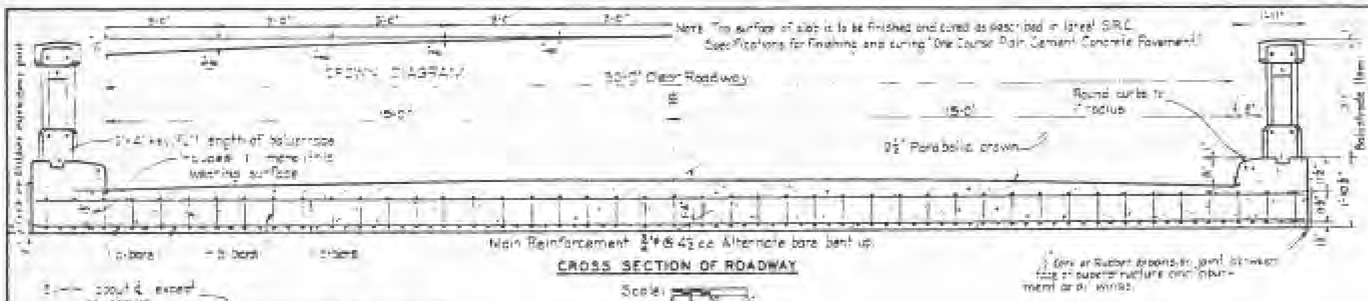
STANDARD 6'-0" SLAB BRIDGE
SUPERSTRUCTURE DETAILS

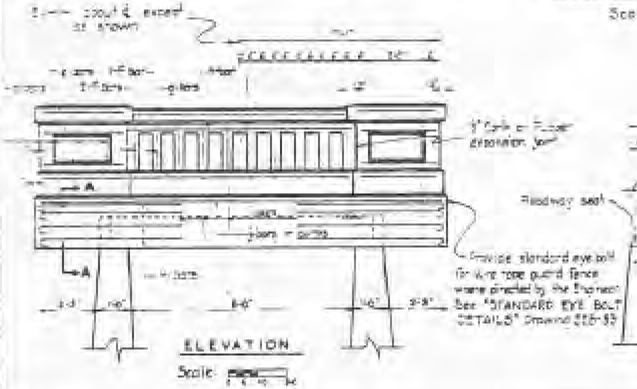
SCALE: As Noted — MARCH, 1933

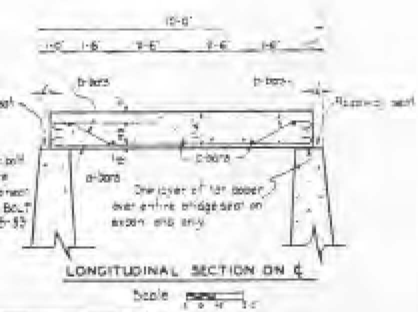
REVISIONS

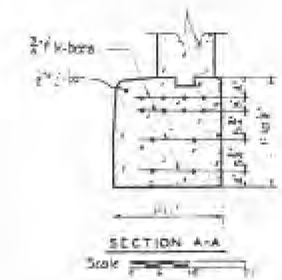
MADE BY: [signature]
TRACED BY: [signature]
CHECKED BY: [signature]
CORRECT: [signature] BRIDGE ENGINEER 5/8/33
APPROVED: [signature] CHIEF ENGINEER 5/9/1933

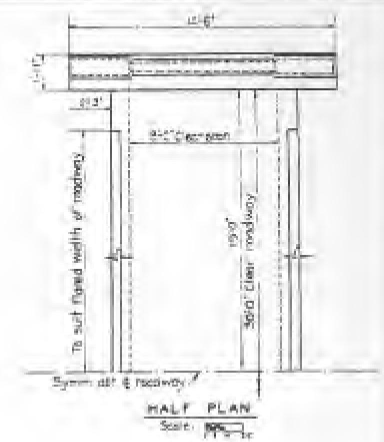
CS-6-33











Mark	No.	Size	Length	Total Length	Wt. #/ft.	Total Weight	Detail
a	44	¾"ϕ	10'-5"	458'-4"	1.52	697	8" hook — 8" hook
b	45	¾"ϕ	10'-9"	483'-9"	1.52	735	8" hook — 8" hook
c	8	¾"ϕ	23'-7"	187'-11"	1.52	285	
d	24	½"ϕ	5'-3"	126'-0"	.66	108	8" hook
e	32	½"ϕ	2'-10"	90'-8"	.66	78	
f	6	½"ϕ	5'-2"	31'-0"	.66	27	8" hook
g	8	½"ϕ	7'-7"	60'-8"	.66	52	
h	2	½"ϕ	7'-11"	15'-10"	.66	14	
i	16	½"ϕ	4'-8"	74'-8"	.66	64	8" hook
j	2	½"ϕ	14'-2"	28'-4"	.66	24	
k	48	¾"ϕ	5'-8"	272'-0"	1.52	413	8" hook
						2467 #	

GENERAL NOTES

Specifications: Latest S.R.C. Specifications & A.A.S.H.O. Stand. Specifications
Loading: H 20 with double (L.L. + impact)
Unit Stresses: Fc = 1200#/□" — Fs = 24,000 #/□"
Concrete: All concrete in superstructure to be "Class A".
Reinforcing: All reinforcing to be deformed steel bars.
Paneling: Interior & exterior panels on end posts to be the same.
Chamfer: All exposed edges to be chamfered 1" or as directed.
Expansion Joints: Cost of all material in superstructure expansion joints & placing of same to be included in the contract unit price for "Class A Concrete" or "Class A Concrete Balustrade."

Approximate Quantities in Superstructure (for preliminary estimate only)
17.86 Cu. yd. Class "A" Concrete, excluding balustrades.
2.54 Cu. yd. Class "A" Concrete in balustrades.
2467 Lb. Deformed Steel Bars.

A-34

Note: For sections and additional balustrade details see "Standard Balustrade Details" Drawing CS-33

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD 8'-0" SLAB BRIDGE
SUPERSTRUCTURE DETAILS

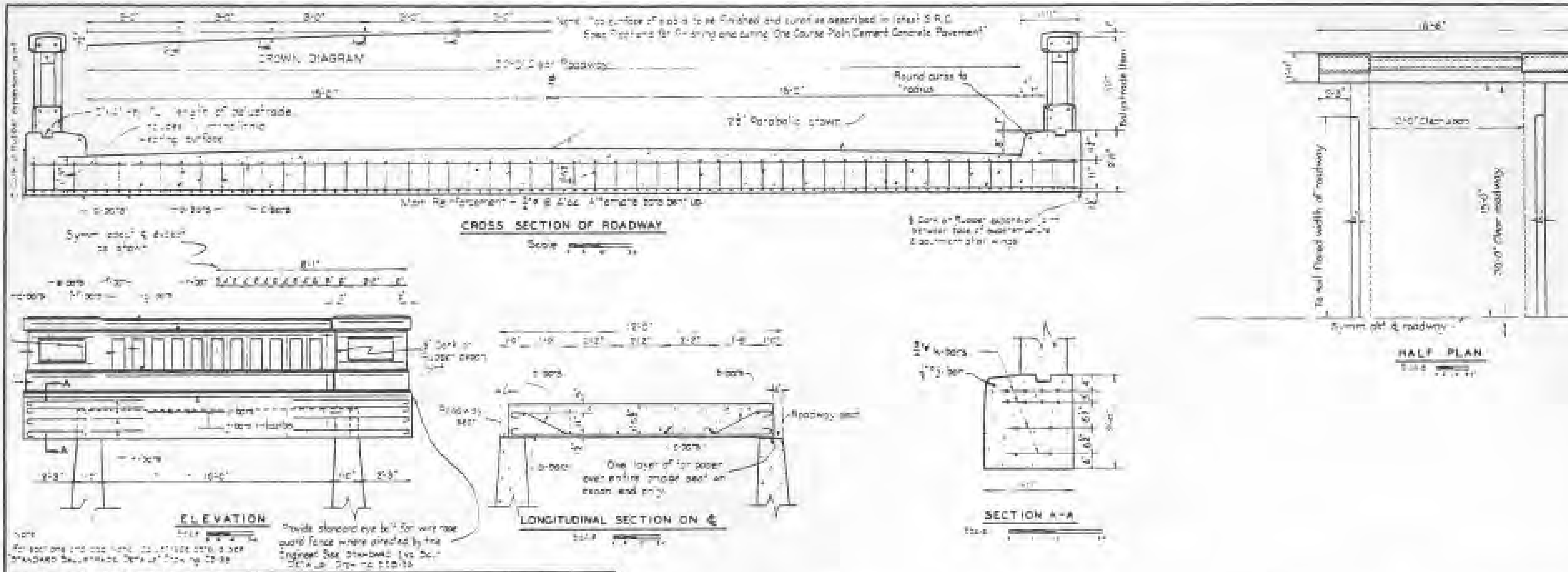
Scale: As Noted — March, 1933

Revisions

Made by — Traced by — Checked by — Correct — Bridge Engineer — 5/8/33

Approved — Chief Engineer — 5/19/1933

CS-8-33



Mark	No.	Size	Length	Total Length	Wt. #/ft	Total Weight	Detail
a	50	¾"φ	[illegible]	620'-10"	1.52	944	6" hook — 6" hook
b	51	¾"φ	[illegible]	658'-9"	1.52	1001	6" hook — 6" hook
c	6	¾"φ	[illegible]	[illegible]	1.52	306	
d	24	[illegible]	5'-4"	[illegible]	.86	110	6" hook
e	32	[illegible]	[illegible]	90'-8"	.86	78	
f	6	[illegible]	5'-3"	[illegible]	.86	27	6" hook
g	9	[illegible]	[illegible]	76'-8"	.86	66	
h	2	[illegible]	[illegible]	19'-10"	.86	17	
i	20	[illegible]	4'-3"	85'-0"	.86	82	6" hook
j	2	[illegible]	16'-2"	32'-4"	.86	28	
k	46	¾"φ	[illegible]	272'-0"	1.52	413	6" hook
						3072 #	

GENERAL NOTES

Specifications: Latest S.R.C. Specifications & A.A.S.H.O. Stand. Specifications.
Loading: H-20, with double (L.L. + impact)
Unit Stresses: Fc = 1200#/□" Fs = 24,000#/□"
Concrete: All concrete in superstructure to be "Class A"
Reinforcing: All reinforcing to be deformed steel bars.
Paneling: Interior & exterior panels on end posts to be the same.
Chamfer: All exposed edges to be chamfered 1" or as directed.
Expansion Joints: Cost of all material in superstructure expansion joints & placing of same to be included in the contract unit price for "Class A Concrete" or "Class A Concrete Balustrade."

Approximate Quantities in Superstructure (for preliminary estimate only)
22.85 Cu. yd. Class "A" Concrete, excluding balustrades.
2.63 Cu. yd. Class "A" Concrete in balustrades.
3072 Lb. Deformed Steel Bars.

A-35

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

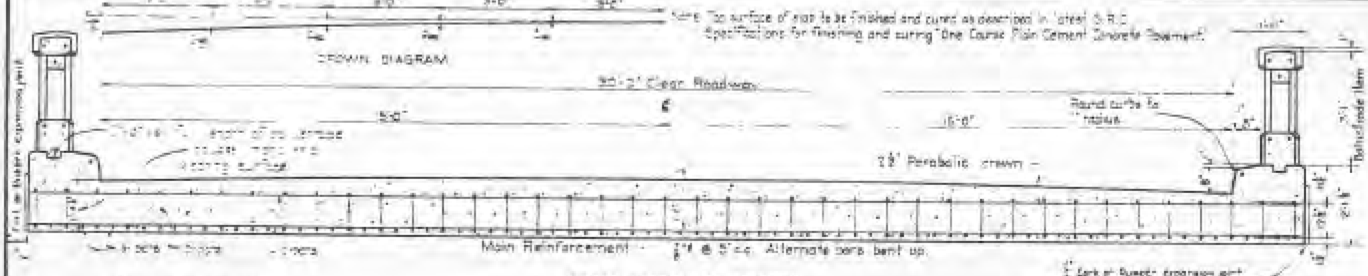
STANDARD 10'-0" SLAB BRIDGE
SUPERSTRUCTURE DETAILS

Scale: As Noted — March, 1933

REVISIONS

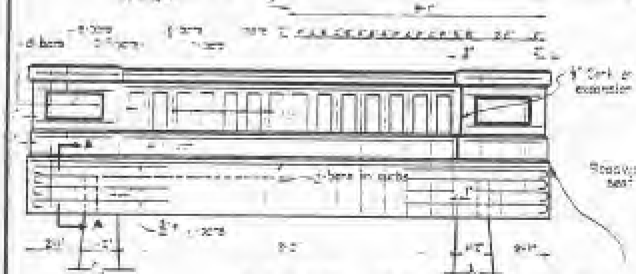
Made by: — Traced by: — Checked by: — Correct: — Bridge Engineer — 6/8/33
Approved: — Chief Engineer — 7/19, 1933

CS-10-33



CROSS SECTION OF ROADWAY

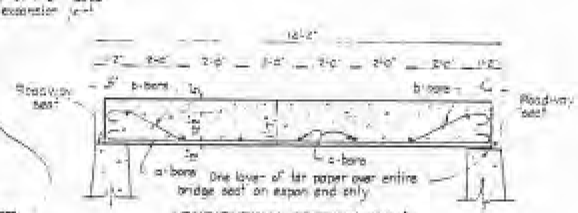
Scale



ELEVATION

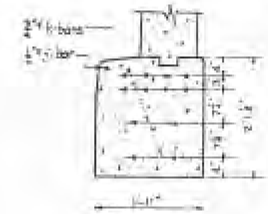
Scale

Provide standard eye bolt for wire type guard fence where directed by the Engineer. See "STANDARD EYE BOLT DETAILS", Drawing SEB-33



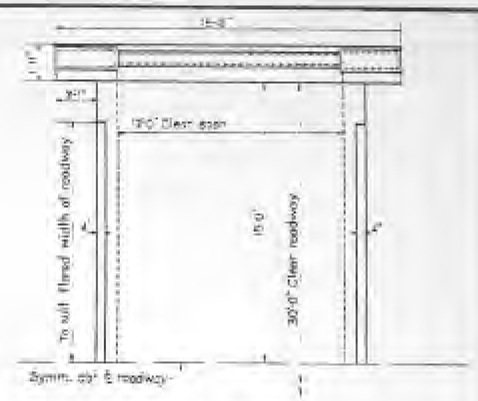
LONGITUDINAL SECTION ON ℄

Scale



SECTION A-A

Scale



HALF PLAN

Scale

Mark	No.	Size	Length	Tot. Length	Wt. # ft.	Total Weight	Detail
a	40	[illegible]	14'-9"	590'-0"	[illegible]	221	8" hook — 8" hook
b	41	[illegible]	16'-3"	1675'-0"	[illegible]	1284	8" hook — 8" hook
c	[illegible]	[illegible]	22'-1"	255'-1"	[illegible]	467	22'-1"
d	24	[illegible]	5'-2"	31'-0"	.38	114	5'-0" 6" hook
e	32	[illegible]	7'-2"	30'-6"	.66	78	3'-0"
f	6	[illegible]	5'-5"	32'-6"	.66	28	4'-11" 6" hook
g	8	[illegible]	[illegible]	93'-8"	.66	80	11'-1"
h	2	[illegible]	[illegible]	23'-0"	.66	21	11'-8"
i	36	[illegible]	5'-6"	50'-0"	.66	112	4'-8" 6" hook
j	3	[illegible]	18'-2"	36'-4"	.88	31	18'-2"
k	48	[illegible]	5'-8"	272'-6"	.66	419	5'-0" 6" hook
						3879#	

GENERAL NOTES

SPECIFICATIONS: Latest S.R.C. Specifications & A.A.S.H.O. Stand. Specifications.
LOADING: H 20, with double (L.L. + Impact)
UNIT STRESSES: fc = 1200#/in², fs = 24000#/in²
CONCRETE: All concrete in superstructure to be class "A".
REINFORCING: All reinforcing to be deformed steel bars.
PANELING: Interior & exterior panels on end posts to be the same.
CHAMFER: All exposed edges to be chamfered 1" or as directed.
EXPANSION JOINTS: Cost of all material in superstructure expansion joints & placing of same to be included in the contract unit price for "Class A Concrete" or "Class A Concrete Balustrade".

APPROXIMATE QUANTITIES IN SUPERSTRUCTURE (For preliminary estimate only)
28.10 Cu.yd. Class "A" Concrete, excluding balustrades
3.12 Cu.yd. Class "A" Concrete in balustrades
3879 Lb. Deformed Steel Bars.

A-36

Note: For sections and adjoining balustrade details see "STANDARD BALUSTRADE DETAILS" Drawing CB-33

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD

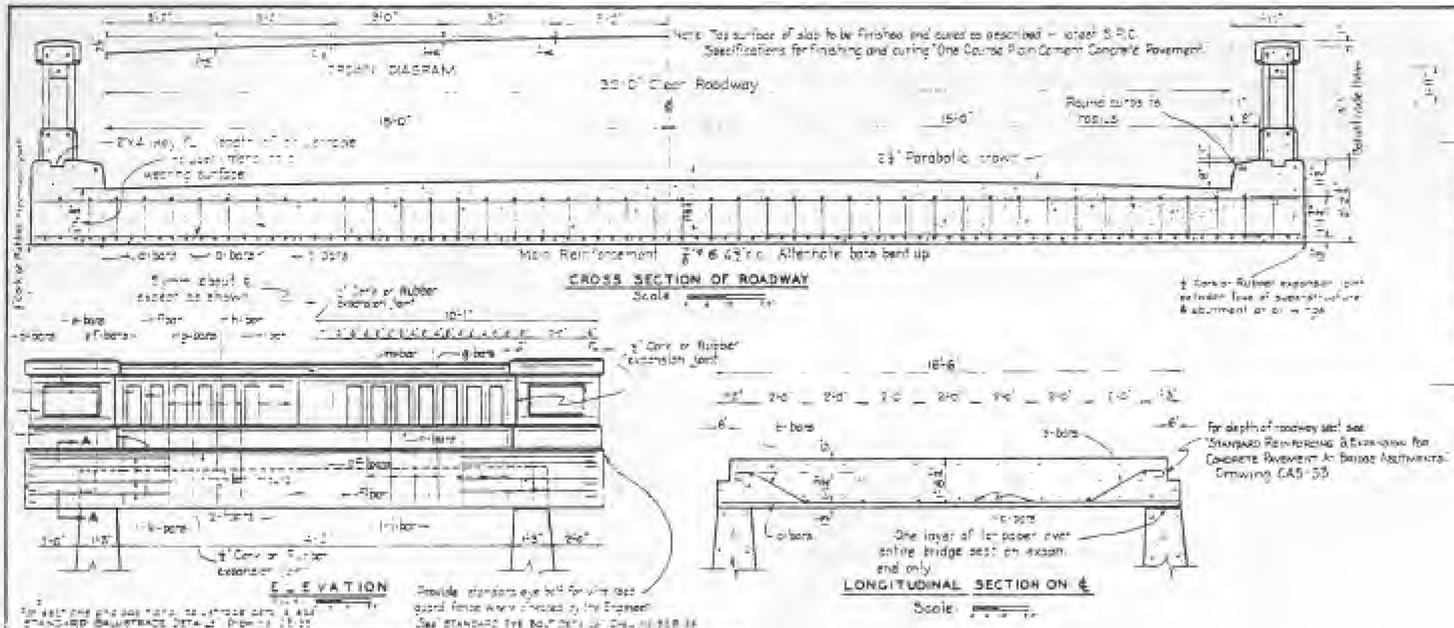
STANDARD 12'-0" SLAB BRIDGE
SUPERSTRUCTURE DETAILS

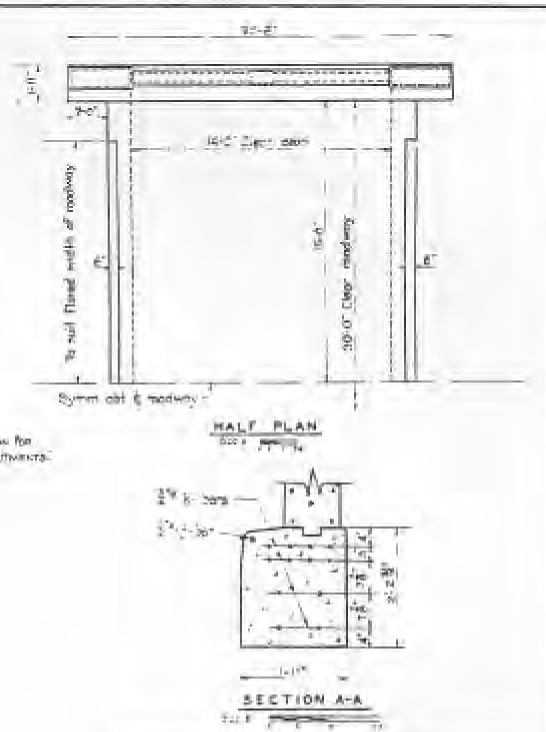
SCALE: AS NOTED | MARCH, 1933

REVISIONS

MADE BY
TRACED BY
CHECKED BY
CORRECT
BRIDGE ENGINEER
APPROVED
CHIEF ENGINEER
5/19 1933

CS-12-33





Mark	No.	Size	Length	Total Length	Unit Wt.	Weight	Detail
a	45	⅞" ⌀	16'-3"	731'-3"	[illegible]	[illegible]	16'-3"
b	44	⅞" ⌀	17'-3"	759'-0"	[illegible]	[illegible]	6" hook … 6" hook
c	8	⅞" ⌀	33'-[illegible]	268'-8"	[illegible]	556	33'-[illegible]
d	24	½" ⌀	5'-6"	132'-0"	.66	[illegible]	6" hook
e	32	½" ⌀	2'-10"	90'-8"	.66	78	2'-10"
f	12	½" ⌀	5'-5"	65'-0"	.66	56	6" hook
g	8	½" ⌀	6'-5"	53'-4"	.66	46	6'-5"
h	2	½" ⌀	6'-3"	12'-6"	.66	11	6'-3"
i	30	½" ⌀	5'-0"	150'-0"	.66	129	6" hook
j	2	½" ⌀	20'-2"	40'-4"	.66	35	20'-2"
k	48	¾" ⌀	5'-8"	272'-0"	[illegible]	413	6" hook
m	2	½" ⌀	7'-5"	14'-10"	.66	13	7'-5"
n	4	½" ⌀	13'-9"	55'-0"	.66	47	13'-9"
						4583#	

GENERAL NOTES

SPECIFICATIONS: Latest S.R.C. Specifications & A.A.S.H.O. Stand. Specifications.
LOADING: H-20, with double (L.L. + impact)
UNIT STRESSES: fc = 1200#/□" fs = 24,000#/□"
CONCRETE: All concrete in superstructure to be "Class A."
REINFORCING: All reinforcing to be deformed steel bars.
PANELING: Interior & exterior panels on end posts to be the same.
CHAMFER: All exposed edges to be chamfered 1" or as directed.
EXPANSION JOINTS: Cost of all material in superstructure expansion joints & placing of same to be included in the contract unit price for "Class A Concrete" or "Class A Concrete Balustrade."

APPROXIMATE QUANTITIES IN SUPERSTRUCTURE (for preliminary estimate only.)
35.70 Cu. yd. Class 'A' Concrete, excluding balustrades.
3.44 Cu. yd. Class 'A' Concrete in balustrades.
4,583 Lb. Deformed Steel Bars.

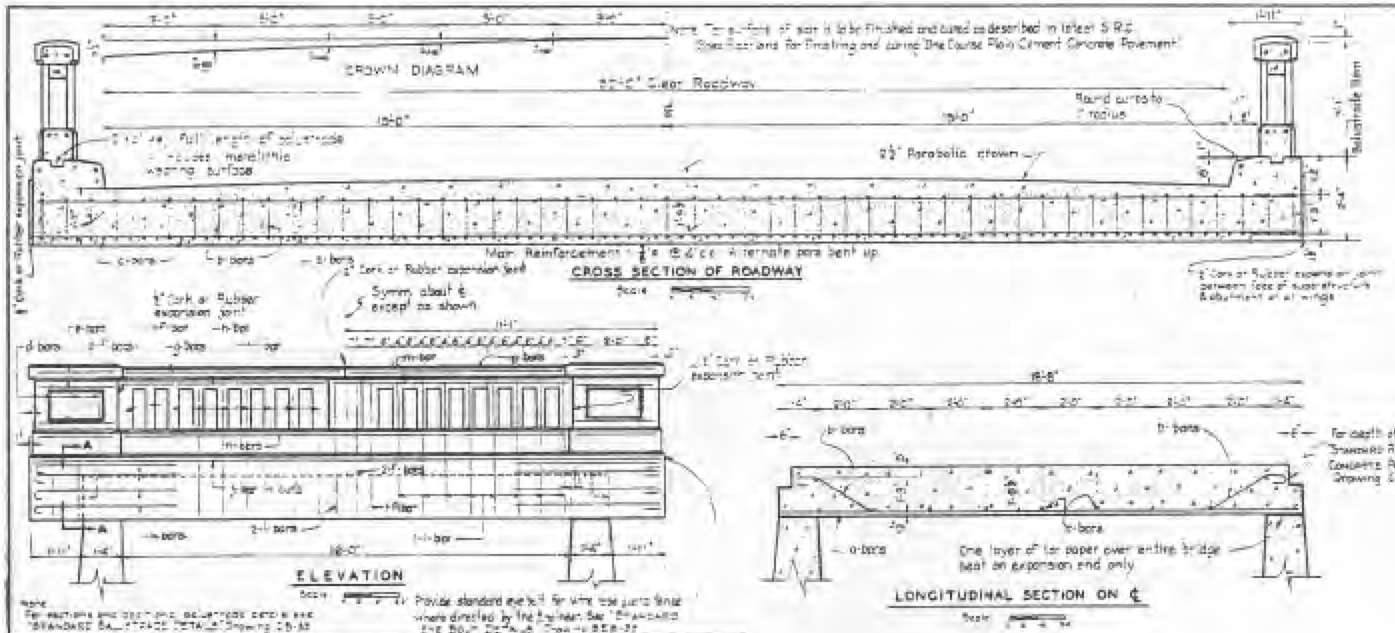
A-37

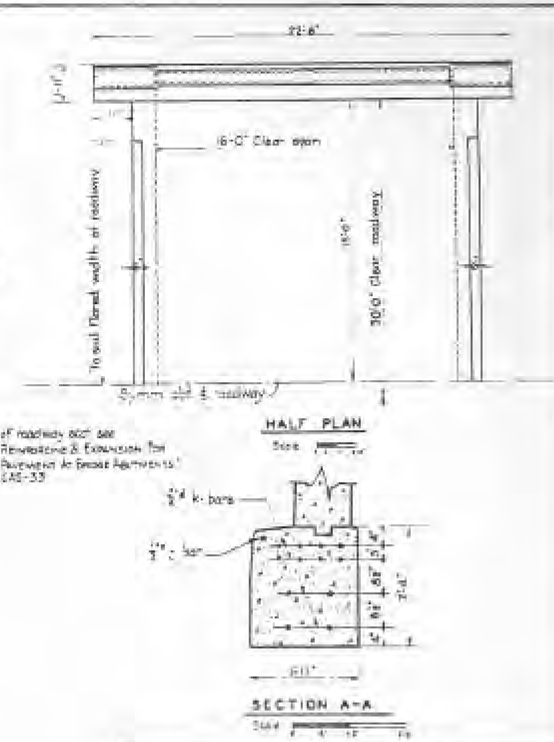
STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD 14'-0" SLAB BRIDGE
SUPERSTRUCTURE DETAILS

SCALE: As Noted — MARCH, 1933
MADE BY: [signature] TRACED BY: [signature] CHECKED BY: [signature]
CORRECT: [signature] BRIDGE ENGINEER 5/9/33
APPROVED: [signature] CHIEF ENGINEER 5/19, 1933.
REVISIONS

CS14-33





Mark	No.	Size	Length	Total Length	Wt. Per Ft.	Total Weight	Detail
a	50	⅞"	18'-5"	920'-10"	2.07	1906	
b	51	⅞"	19'-5"	990'-3"	2.07	2050	6" hook / 6" hook
c	9	⅞"	33'-7"	302-3"	2.07	626	
d	24	½"	5'-9"	138'-0"	.66	119	6" hook
e	32	½"	2'-10"	90'-8"	.66	78	
f	12	½"	5'-8"	68'-0"	.66	58	6" hook
g	8	½"	7'-8"	61'-4"	.66	53	
h	2	½"	7'-3"	14'-6"	.66	12	
i	34	½"	5'-2"	175'-8"	.66	151	6" hook
j	2	½"	22'-2"	44'-4"	.66	38	
k	48	⅝"	5'-8"	272'-0"	1.52	413	6" hook
m	2	½"	8'-5"	16'-10"	.66	14	
n	4	½"	15'-9"	63'-0"	.66	54	
						5572#	

GENERAL NOTES

SPECIFICATIONS: Latest S.R.C. Specifications & A.A.S.H.O. Stand. Specifications.
LOADING: H20, with double (L.L. + impact)
UNIT STRESSES: Fc = 1200#/in² — Fs = 24,000#/in²
CONCRETE: All concrete in superstructure to be "Class A"
REINFORCING: All reinforcing to be deformed steel bars.
PANELING: Interior & exterior panels on end posts to be the same.
CHAMFER: All exposed edges to be chamfered 1" or as directed.
EXPANSION JOINTS: Cost of all material in superstructure expansion joints & placing of same to be included in the contract unit price for "Class A Concrete" in "Class A Concrete Balustrade"

APPROXIMATE QUANTITIES IN SUPERSTRUCTURE (for preliminary estimate only)
42.70 Cu. yd. Class "A" Concrete, excluding balustrades.
3.93 Cu. yd. Class "A" Concrete in balustrades.
5,572 Lb. Deformed Steel Bars.

A-38

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD 16'-0" SLAB BRIDGE
SUPERSTRUCTURE DETAILS

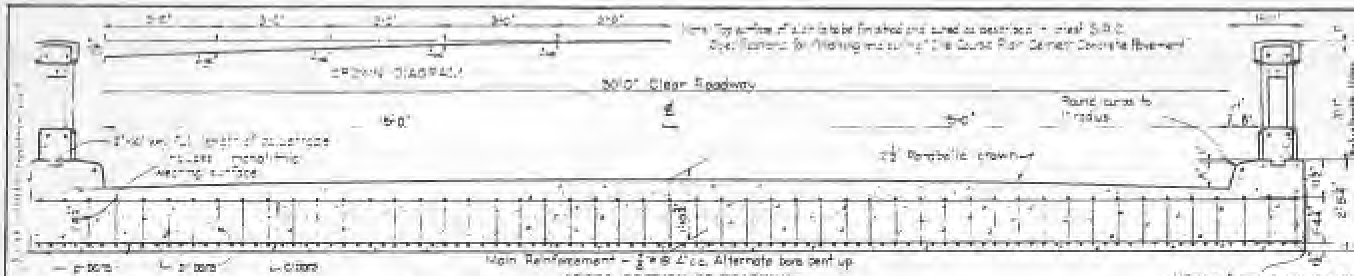
SCALE: AS NOTED — MARCH, 1933

REVISIONS

MADE BY ...
TRACED BY ...
CHECKED BY ...
CORRECT: ...
BRIDGE ENGINEER
5/8/33

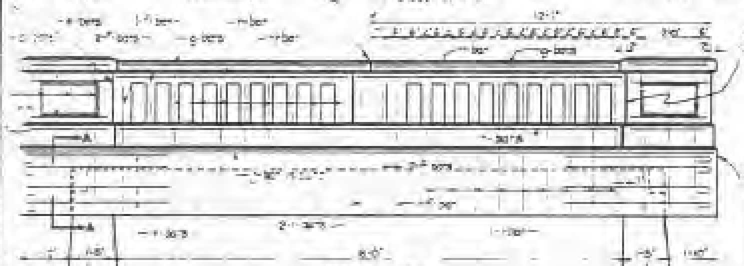
APPROVED: ...
CHIEF ENGINEER
May 19, 1933

CS-16-33



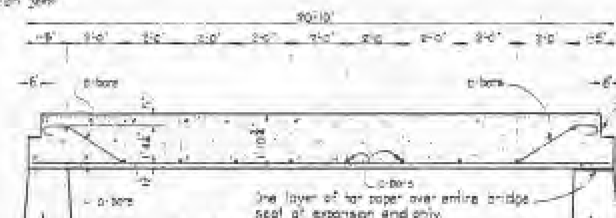
CROSS SECTION OF ROADWAY

Scale



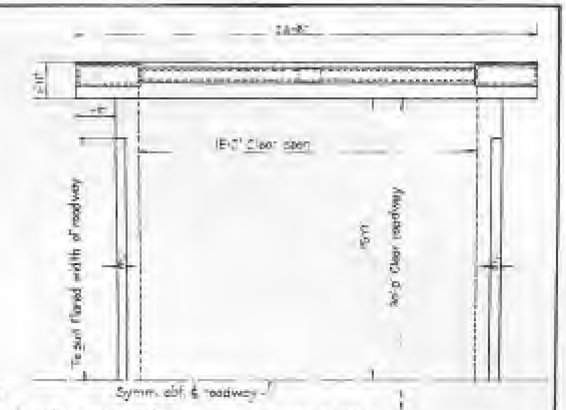
ELEVATION

Scale



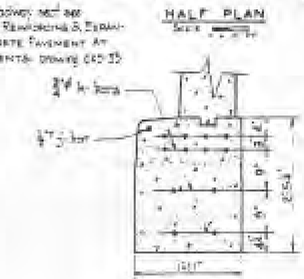
LONGITUDINAL SECTION ON ℄

Scale



HALF PLAN

Scale



SECTION A-A

Scale

Mark	No.	Size	Length	Total Length	Wt. P.F.	Total Weight	Detail
[illegible]	50	7/8"	20'-7"	1029'-2"	2.07	[illegible]	20'-7"
[illegible]	51	7/8"	21'-9"	1109'-3"	2.07	2298	8" hook ... 8" hook
[illegible]	10	7/8"	33'-7"	335'-10"	2.07	698	33'-7"
[illegible]	24	1/2"	5'-10"	140'-0"	.86	120	5'-10" 6" hook
[illegible]	32	1/2"	2'-10"	90'-8"	.86	78	2'-10"
[illegible]	12	1/2"	5'-8"	68'-0"	.86	59	5'-8" 6" hook
[illegible]	8	1/2"	8'-8"	69'-4"	.86	60	8'-8"
[illegible]	2	1/2"	8'-3"	16'-6"	.86	14	8'-3"
	38	1/2"	5'-3"	199'-6"	.86	112	4'-9" 6" hook
[illegible]	2	1/2"	24'-2"	48'-4"	.86	42	24'-2"
[illegible]	48	3/4"	5'-8"	272'-0"	1.52	413	5'-0" 8" hook
[illegible]	2	1/2"	9'-5"	18'-10"	.86	16	9'-5"
[illegible]	4	1/2"	17'-9"	71'-0"	.86	61	17'-9"
						6156#	

GENERAL NOTES

SPECIFICATIONS: Latest S.R.C. Specifications & A.A.S.H.O. Stand. Specifications.
LOADING: H-20, with double (L.L. + impact).
UNIT STRESSES: Fc = 1200#/□" — Fs = 24,000#/□"
CONCRETE: All concrete in superstructure to be "Class A".
REINFORCING: All reinforcing to be deformed steel bars.
PANELING: Interior & exterior panels on end posts to be the same.
CHAMFER: All exposed edges to be chamfered 1" or as directed.
EXPANSION JOINTS: Cost of all material in superstructure expansion joints & placing of same to be included in the contract unit price for "Class A Concrete" or "Class A Concrete Balustrades".

APPROXIMATE QUANTITIES IN SUPERSTRUCTURE. (For preliminary estimate only.)
50.50 Cu. Yd. Class "A" Concrete, excluding balustrades.
4.03 Cu. Yd. Class "A" Concrete in balustrades.
6,156 Lb. Deformed Steel Bars.

A-39

REVISIONS

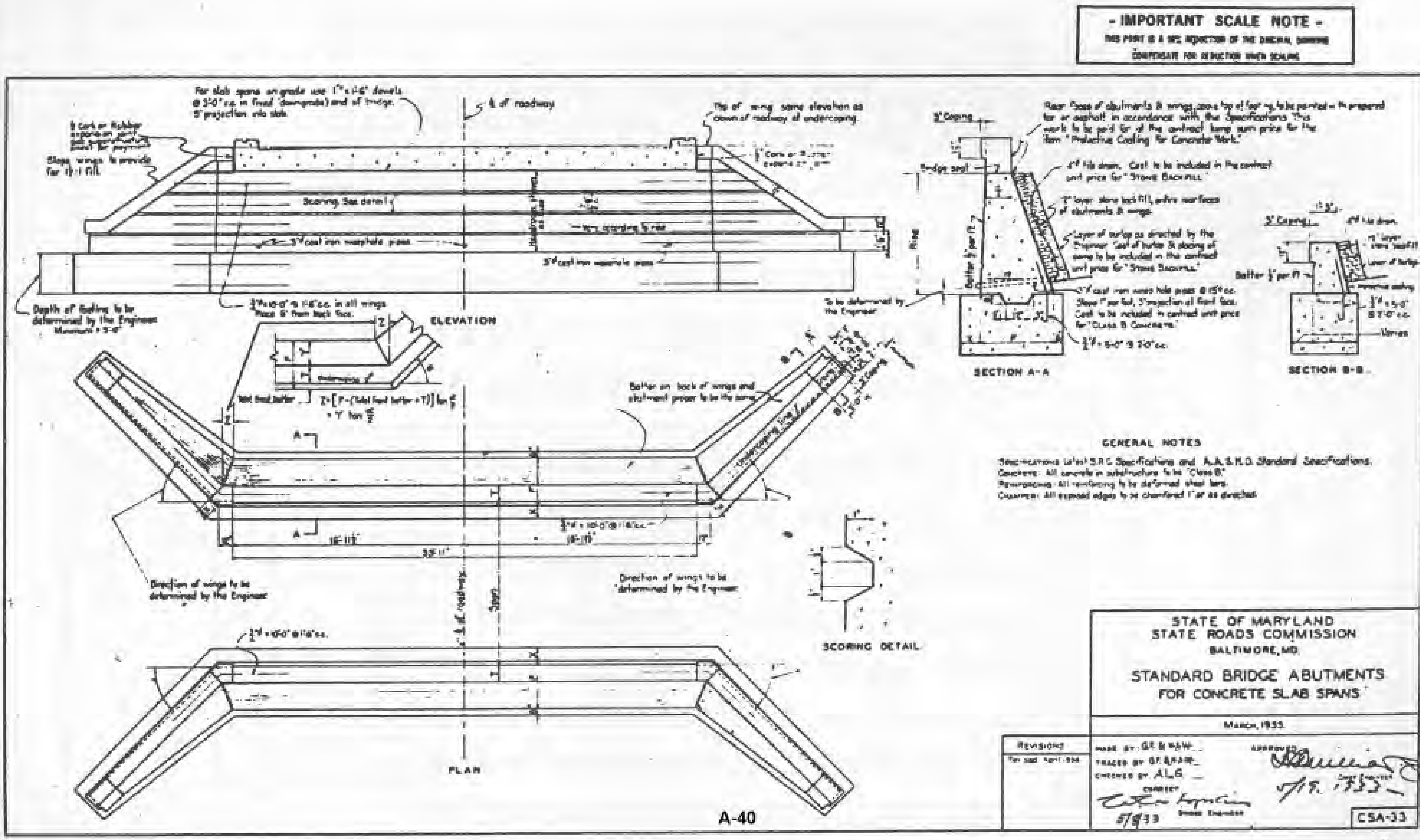
STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD 18' 0" SLAB BRIDGE
SUPERSTRUCTURE DETAILS

SCALE: AS NOTED — MARCH, 1933

MADE BY — TRACED BY — CHECKED BY —
CORRECT: — BRIDGE ENGINEER — 5/8/33
APPROVED: — CHIEF ENGINEER — 5/19, 1933

CS-18-33


- IMPORTANT SCALE NOTE -
ELEVATION
PLAN
SECTION A-A
SECTION B-B
SCORING DETAIL
GENERAL NOTES
Specifications: Latest S.R.C. Specifications and A.A.S.H.O. Standard Specifications.
Concrete: All concrete in substructure to be "Class B."
Reinforcing: All reinforcing to be deformed steel bars.
Chamfer: All exposed edges to be chamfered 1" or as directed.
STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.
STANDARD BRIDGE ABUTMENTS
FOR CONCRETE SLAB SPANS
MARCH, 1933
REVISIONS
MADE BY: G.F. & W.B.W.
TRACED BY G.F. & R.A.M.
CHECKED BY ALG
CORRECT
BRIDGE ENGINEER
APPROVED
CHIEF ENGINEER
CSA-33

- IMPORTANT SCALE NOTE -

THIS PRINT IS A 50% REDUCTION OF THE ORIGINAL DRAWING
COMPENSATE FOR REDUCTION WHEN SCALING

NOTE:- THE QUANTITIES GIVEN IN THESE TABLES ARE NOT TO BE USED FOR FINAL ESTIMATES.
THESE TABLES DO NOT HOLD GOOD FOR BRIDGES ASKEW

DIMENSIONS & QUANTITIES - SLAB BRIDGE ABUTMENTS

Clear Span	Rise	T	F	X	Abutments - Cubic Yards: 2 Abuts Proper	Abutments - Depth of Footing 2'-0"	3'-0"	4'-0"	Wings - Cubic Yards: 4 Wings Proper	Wings - Depth of Footing 2'-0"	3'-0"	4'-0"	Total Cu. Yd. 4'-0" Ftg.
6'-0"	3'-0"	1'-0"	1'-11"	1'-0"	11.7	18.5	27.8	37.0	3.5	5.5	8.3	11.0	63.2
	4'-0"	-	2'-4"	1'-0"	17.6	20.4	30.6	40.8	8.2	8.1	12.2	16.2	81.0
	5'-0"	-	2'-10"	1'-0"	23.4	22.9	34.5	45.8	10.0	10.9	16.4	21.8	103.0
	6'-0"	-	3'-3"	1'-0"	33.0	25.0	37.5	50.0	14.0	13.8	20.7	27.6	124.6
8'-0"	3'-0"	1'-0"	1'-11"	1'-0"	11.9	18.6	27.8	37.0	3.8	5.8	8.7	11.6	64.3
	4'-0"	-	2'-5"	1'-0"	18.3	20.7	31.0	41.4	6.6	8.4	12.6	16.8	83.1
	5'-0"	-	2'-10"	1'-0"	26.5	22.9	34.4	45.8	10.0	11.0	16.5	22.0	103.3
	6'-0"	-	3'-4"	1'-0"	34.0	25.3	37.9	50.6	15.5	14.3	21.5	28.6	128.7
10'-0"	3'-0"	1'-0"	2'-0"	1'-0"	12.1	18.5	27.8	37.0	4.0	6.2	9.3	12.4	65.5
	4'-0"	-	2'-6"	1'-0"	19.6	21.2	31.7	42.4	7.0	8.8	13.2	17.6	85.6
	5'-0"	-	2'-11"	1'-0"	25.8	23.2	34.8	46.4	11.0	11.7	17.6	23.4	106.6
	6'-0"	-	3'-4"	1'-0"	34.2	25.3	38.0	50.6	16.1	14.9	22.4	29.8	130.7
12'-0"	3'-0"	1'-2"	2'-1"	1'-0"	14.5	19.4	29.1	38.8	4.4	6.4	9.6	12.8	70.5
	4'-0"	-	2'-6"	1'-0"	19.8	21.6	32.3	43.2	7.5	9.0	13.5	18.0	88.5
	5'-0"	-	3'-0"	1'-0"	27.8	24.0	36.1	48.0	11.7	11.8	17.8	23.6	110.6
	6'-0"	-	3'-5"	1'-0"	36.3	26.1	39.2	52.2	16.4	15.0	22.5	30.0	135.4
14'-0"	3'-0"	1'-3"	2'-2"	1'-0"	14.6	19.7	29.6	39.4	4.8	6.8	10.3	13.8	72.4
	4'-0"	-	2'-7"	1'-0"	20.8	21.9	33.0	43.8	7.8	9.4	14.1	18.8	91.2
	5'-0"	-	3'-0"	1'-0"	28.8	24.0	36.1	48.0	12.1	12.4	18.5	24.8	113.5
	6'-0"	-	3'-6"	1'-0"	38.1	26.5	39.8	53.0	17.8	15.6	23.4	31.2	140.1
	8'-0"	-	4'-5"	1'-3"	59.6	32.8	49.4	65.6	33.4	23.4	35.3	48.8	205.6
	10'-0"	-	5'-3"	1'-3"	65.8	36.6	55.0	73.2	58.2	32.0	48.0	64.0	280.8
16'-0"	3'-0"	1'-4"	2'-2"	1'-0"	14.9	19.8	29.7	39.6	4.9	7.0	10.5	14.0	73.4
	4'-0"	-	2'-8"	1'-0"	21.8	22.4	33.7	44.8	8.6	9.6	14.4	19.2	94.4
	5'-0"	-	3'-1"	1'-0"	29.5	24.6	36.9	49.2	13.0	12.6	19.0	25.2	116.9
	6'-0"	-	3'-6"	1'-3"	38.7	28.2	42.1	56.4	19.0	16.4	24.6	32.8	146.9
	8'-0"	-	4'-5"	1'-3"	59.8	32.8	49.4	65.6	36.8	24.1	36.2	48.2	210.4
	10'-0"	-	5'-4"	1'-3"	68.3	37.0	55.7	74.0	65.1	32.5	48.8	65.0	288.4
18'-0"	3'-0"	1'-6"	2'-8"	1'-0"	15.5	20.2	30.2	40.4	5.6	7.5	11.3	15.0	76.5
	4'-0"	-	2'-8"	1'-0"	22.4	22.5	33.8	45.0	9.0	10.0	15.0	20.0	96.4
	5'-0"	-	3'-2"	1'-0"	29.7	25.0	37.5	50.0	13.5	13.0	19.5	26.0	119.2
	6'-0"	-	3'-7"	1'-3"	40.5	28.6	42.8	57.2	19.4	16.8	25.3	33.6	150.5
	8'-0"	-	4'-6"	1'-3"	62.9	33.3	50.0	66.6	38.0	24.3	36.5	48.6	215.7
	10'-0"	-	5'-5"	1'-3"	69.0	37.7	56.7	75.4	63.8	33.2	50.0	66.4	294.6
20'-0"	3'-0"	1'-6"	2'-3"	1'-0"	16.7	20.5	30.8	41.0	6.0	7.6	11.4	15.2	77.9
	4'-0"	-	2'-9"	1'-0"	25.2	25.0	34.5	46.2	9.6	10.4	15.6	20.8	99.8
	5'-0"	-	3'-2"	1'-0"	31.8	25.4	38.2	50.8	14.2	15.4	20.2	28.8	125.6
	6'-0"	-	3'-8"	1'-3"	42.0	29.2	43.6	58.4	20.8	17.9	26.5	35.0	156.2
	8'-0"	-	4'-6"	1'-3"	64.4	33.5	50.3	67.0	36.5	24.6	37.0	49.2	219.1
	10'-0"	-	5'-5"	1'-3"	92.4	37.7	56.6	75.4	66.0	33.6	50.8	67.2	300.0

DIMENSIONS & QUANTITIES — GIRDER BRIDGE ABUTMENTS

Clear Span	Rise	T	F	X	Abutments - Cubic Yards: 2 Abuts Proper	Abutments - Depth of Footing 2'-0"	3'-0"	4'-0"	Wings - Cubic Yards: 4 Wings Proper	Wings - Depth of Footing 2'-0"	3'-0"	4'-0"	Total Cu. Yd. 4'-0" Ftg
22'-0"	3'-0"	1'-6"	2'-7"	1'-0"	17.8	22.2	33.3	44.4	8.2	9.3	14.0	18.6	89.0
	4'-0"	-	3'-1"	1'-0"	26.1	24.5	36.8	49.0	12.8	12.8	19.2	25.6	113.5
	5'-0"	-	3'-6"	1'-0"	34.9	26.7	40.1	53.4	18.7	15.6	23.7	31.6	138.6
	6'-0"	-	3'-11"	1'-0"	44.6	28.9	43.4	57.8	25.9	19.2	28.8	38.4	166.7
	8'-0"	-	4'-10"	1'-3"	68.0	34.9	52.4	69.8	46.2	27.4	41.1	54.8	238.8
	10'-0"	-	5'-9"	1'-3"	96.8	39.6	59.4	79.2	75.4	36.8	55.2	73.6	325.0
	12'-0"	-	6'-8"	1'-6"	128.0	45.0	67.5	90.0	115.0	48.5	72.5	96.6	429.6
24'-0"	3'-0"	1'-6"	2'-8"	1'-0"	18.0	22.4	33.6	44.8	8.6	10.1	15.2	20.2	91.6
	4'-0"	-	3'-1"	1'-0"	26.1	24.6	36.9	49.2	13.2	13.0	19.5	26.0	114.5
	5'-0"	-	3'-6"	1'-0"	34.9	26.7	40.0	53.4	19.1	15.9	23.9	31.8	139.2
	6'-0"	-	4'-0"	1'-0"	45.3	29.2	43.8	58.4	27.1	19.8	29.7	39.6	170.4
	8'-0"	-	4'-11"	1'-3"	65.0	35.0	52.5	70.0	47.2	28.0	42.0	56.0	242.7
	10'-0"	-	5'-9"	1'-3"	96.8	39.8	59.4	79.2	76.0	37.2	55.8	74.4	328.4
	12'-0"	-	6'-8"	1'-6"	129.0	45.0	67.5	90.0	115.0	48.8	73.2	97.6	431.6
26'-0"	3'-0"	1'-6"	2'-8"	1'-0"	18.4	22.7	34.0	45.4	8.7	10.3	15.5	20.6	93.1
	4'-0"	-	3'-1"	1'-0"	26.2	24.7	37.0	49.4	13.4	13.3	20.0	26.6	115.6
	5'-0"	-	3'-7"	1'-0"	35.5	27.1	40.7	54.2	19.9	16.6	24.9	33.2	142.8
	6'-0"	-	4'-0"	1'-0"	45.9	29.4	44.1	58.8	27.7	20.1	30.2	40.2	172.0
	8'-0"	-	4'-11"	1'-3"	65.4	35.2	52.8	70.4	49.3	28.7	43.1	57.4	246.5
	10'-0"	-	5'-10"	1'-3"	98.0	39.6	59.4	79.2	79.6	38.1	57.1	76.2	333.0
	12'-0"	-	6'-9"	1'-6"	130.2	45.4	68.1	90.8	122.9	49.5	74.3	99.1	443.0
28'-0"	3'-0"	1'-8"	2'-9"	1'-0"	19.4	22.9	34.5	45.8	9.4	10.6	15.9	21.3	95.9
	4'-0"	-	3'-2"	1'-0"	28.6	25.0	37.5	50.0	14.2	13.6	20.4	27.2	118.0
	5'-0"	-	3'-8"	1'-0"	35.9	27.5	41.3	55.0	20.8	17.1	25.6	34.2	145.9
	6'-0"	-	4'-1"	1'-0"	46.2	29.6	44.4	59.2	28.6	20.5	30.8	41.0	175.0
	8'-0"	-	5'-0"	1'-3"	69.9	35.6	53.4	71.2	51.2	29.4	44.1	58.8	251.1
	10'-0"	-	5'-11"	1'-3"	98.4	40.0	60.0	80.0	83.1	38.7	58.1	77.4	338.9
	12'-0"	-	6'-9"	1'-6"	130.2	45.5	68.3	91.0	125.1	50.1	75.1	100.2	446.5
30'-0"	3'-0"	1'-8"	2'-10"	1'-0"	20.2	23.4	35.1	46.8	10.3	11.5	17.3	23.0	100.3
	4'-0"	-	3'-3"	1'-0"	28.7	25.6	38.4	51.2	15.3	14.5	21.7	29.0	124.4
	5'-0"	-	3'-9"	1'-0"	38.3	28.2	42.3	56.4	22.3	17.8	26.7	35.6	152.8
	6'-0"	-	4'-2"	1'-0"	48.7	30.2	45.3	60.4	30.6	21.5	32.2	43.0	182.7
	8'-0"	-	5'-1"	1'-3"	73.5	36.3	54.5	72.6	55.7	30.4	45.6	60.8	260.8
	10'-0"	-	6'-0"	1'-3"	105.1	40.8	61.2	81.6	85.0	39.9	59.9	79.8	349.5
	12'-0"	-	6'-10"	1'-6"	136.0	46.3	69.4	92.6	129.9	51.4	77.1	102.8	461.5

Clear Span	Rise	T	F	X	Abutments - Cubic Yards: 2 Abuts Proper	Abutments - Depth of Footing 2'-0"	3'-0"	4'-0"	Wings - Cubic Yards: 4 Wings Proper	Wings - Depth of Footing 2'-0"	3'-0"	4'-0"	Total Cu. Yd. 4'-0" Ftg
32'-0"	3'-0"	1'-10"	2'-11"	1'-0"	21.3	24.2	36.3	48.4	11.3	11.9	17.9	23.8	104.8
	4'-0"	-	3'-4"	1'-0"	29.7	26.3	39.5	52.6	16.5	14.9	22.3	29.8	128.8
	5'-0"	-	3'-10"	1'-0"	40.8	29.1	43.6	58.2	23.4	18.4	27.6	36.8	159.2
	6'-0"	-	4'-3"	1'-0"	51.1	31.0	46.5	62.0	32.3	22.3	33.6	44.6	190.0
	8'-0"	-	5'-2"	1'-3"	76.3	37.2	55.8	74.4	57.2	31.3	47.0	62.6	270.5
	10'-0"	-	6'-1"	1'-3"	106.0	41.6	62.4	83.2	88.5	41.2	61.4	82.4	360.1
	12'-0"	-	6'-11"	1'-6"	140.0	47.6	71.4	95.2	152.0	52.5	78.7	106.0	472.2
34'-0"	3'-0"	1'-10"	3'-0"	1'-0"	21.4	24.6	36.9	49.2	12.2	12.5	18.7	25.0	108.3
	4'-0"	-	3'-6"	1'-0"	31.3	27.2	40.8	54.4	18.2	15.8	23.7	31.6	133.5
	5'-0"	-	3'-11"	1'-0"	40.9	29.3	44.0	58.6	28.8	19.3	29.0	38.6	165.7
	6'-0"	-	4'-4"	1'-0"	51.6	31.3	47.0	62.8	35.0	22.9	34.3	45.8	195.0
	8'-0"	-	5'-5"	1'-3"	77.0	37.7	56.6	75.4	60.5	32.3	48.4	64.8	277.5
	10'-0"	-	6'-2"	1'-3"	107.3	42.0	63.0	84.0	96.5	42.1	65.1	84.2	372.0
	12'-0"	-	7'-1"	1'-6"	142.2	47.8	71.7	95.6	144.3	54.3	81.4	108.6	490.7
36'-0"	3'-0"	2'-0"	3'-2"	1'-0"	24.0	25.7	38.5	51.4	13.8	13.4	20.1	26.8	116.0
	4'-0"	-	3'-7"	1'-0"	33.1	27.8	41.7	55.6	20.0	16.7	25.0	33.4	142.1
	5'-0"	-	4'-1"	1'-0"	43.8	30.4	45.6	60.8	28.1	20.4	30.6	40.8	173.5
	6'-0"	-	4'-6"	1'-0"	55.2	32.5	48.7	65.0	37.7	24.2	36.3	48.4	206.3
	8'-0"	-	5'-5"	1'-3"	81.4	38.6	57.9	77.2	65.6	33.8	50.7	67.6	291.8
	10'-0"	-	6'-4"	1'-3"	112.0	43.1	64.6	86.2	100.7	43.7	65.5	87.4	386.3
	12'-0"	-	7'-2"	1'-6"	145.5	48.8	73.2	97.6	150.8	55.7	83.5	111.4	505.3
38'-0"	3'-0"	2'-0"	3'-3"	1'-0"	24.4	26.0	39.0	52.0	15.0	14.1	21.1	28.2	118.6
	4'-0"	-	3'-8"	1'-0"	33.7	28.4	42.6	56.8	21.5	17.4	26.1	34.8	146.8
	5'-0"	-	4'-2"	1'-0"	44.8	30.8	46.2	61.6	30.2	21.2	31.8	42.4	178.8
	6'-0"	-	4'-7"	1'-0"	56.0	33.0	49.5	66.0	40.4	25.0	37.5	50.0	212.4
	8'-0"	-	5'-6"	1'-3"	82.8	39.0	58.5	78.0	66.0	34.6	51.9	69.2	297.8
	10'-0"	-	6'-5"	1'-3"	113.4	43.6	65.4	87.2	106.6	44.8	67.2	89.6	396.8
	12'-0"	-	7'-4"	1'-6"	148.0	49.6	74.4	99.2	158.0	57.4	86.1	114.8	520.0
40'-0"	3'-0"	2'-0"	3'-4"	1'-0"	24.8	26.6	39.9	53.2	16.0	14.6	21.9	29.2	123.2
	4'-0"	-	3'-9"	1'-0"	34.1	28.7	43.0	57.4	22.8	18.0	27.0	36.0	150.3
	5'-0"	-	4'-3"	1'-0"	48.0	31.2	46.8	62.4	31.8	21.8	32.7	43.6	187.8
	6'-0"	-	4'-8"	1'-0"	56.7	33.4	50.1	66.8	42.5	25.8	38.7	51.6	217.4
	8'-0"	-	5'-7"	1'-3"	85.5	39.4	59.1	78.8	71.0	35.6	53.4	71.2	304.5
	10'-0"	-	6'-6"	1'-3"	114.6	44.0	66.0	88.0	111.0	45.8	68.7	91.6	405.2
	12'-0"	-	7'-5"	1'-6"	149.0	50.0	75.0	100.0	163.0	58.4	87.6	116.8	528.8

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

STANDARD BRIDGE ABUTMENTS

DIMENSIONS & QUANTITIES

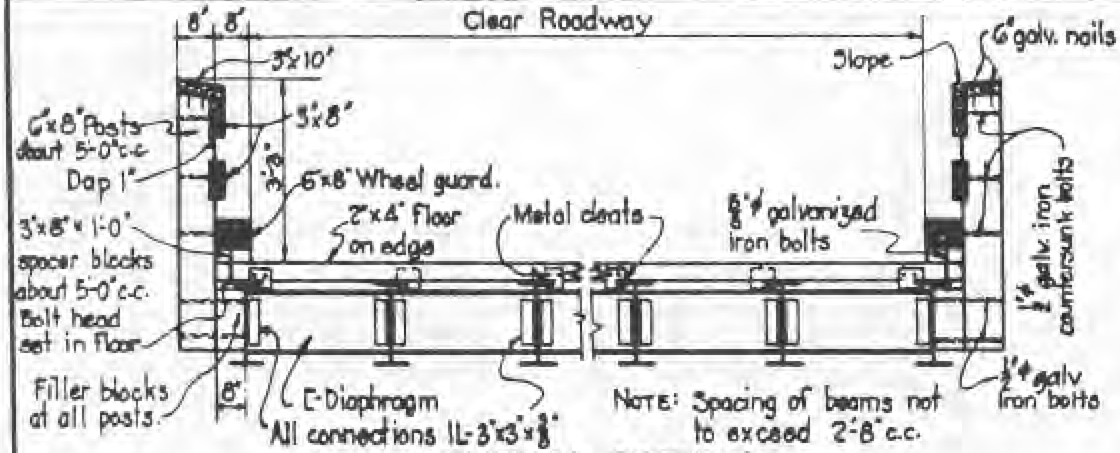
MARCH 1933

REVISIONS

MADE BY: [illegible]
TRACED BY: [illegible]
CHECKED BY: [illegible]
CORRECT: [illegible]
5/8/33

APPROVED: [illegible]
CHIEF ENGINEER
5/19, 1933

CAQ-33



TYPICAL SECTION

GENERAL NOTES

SPECIFICATIONS: Latest S.R.C. Specifications. and A.A.S.H.O. Standard Specifications, except that f_s = 18,000#/□"

LOADING: One lane, H15. (single LL & Impact)

RIVETS: 3/4"φ

OPEN HOLES: 13/16"φ, except those required for bolts.

BOLT HOLES: All bolt holes in timber to be bored with an auger 1/16" smaller than bolt diameter.

BOLTS, NAILS, ETC.: All bolts, nails, spikes, washers, cleats, etc. to be of galvanized iron

STRUCTURAL STEEL: Open hearth, structural grade.

NAILS: Use 20d nails to fasten metal cleats to flooring and also to fasten adjacent strips of flooring together. Where not specified, nails shall be of proper size & quantity for the connection.

PAINT:- Structural steel to be given one shop coat & two field coats in accordance with S.R.C. Specifications. All timber used in handrail to be painted with three coats of Standard S.R.C. paint.

Provide suitable anchor bolts & bearing plates for type of bridge seat contemplated. Provide for expansion at one end of each span.

BEAM & DIAPHRAGM DATA

Clear Span	Size of Beams	No. of Diaphragms	Size of Diaphragms
10' to 14'	12" I @ 25#	1	8" [@ 18.75#
15' to 19'	14" I @ 30#	1	10" [@ 20#
20' to 24'	14" I @ 34#	1	12" [@ 25#
25' to 29'	16" I @ 36#	1	12" [@ 25#
30' to 34'	18" I @ 47#	2	15" [@ 33.9#
35' to 39'	18" I @ 47#	2	15" [@ 33.9#
40' to 44'	21" I @ 59#	2	18" [@ 42.7#
45' to 49'	21" I @ 59#	2	18" [@ 42.7#
50' to 54'	24" I @ 74#	3	18" [@ 42.7#
55' to 59'	27" I @ 91#	3	18" [@ 42.7#

APPROVED:

[signature]

Chief Engineer

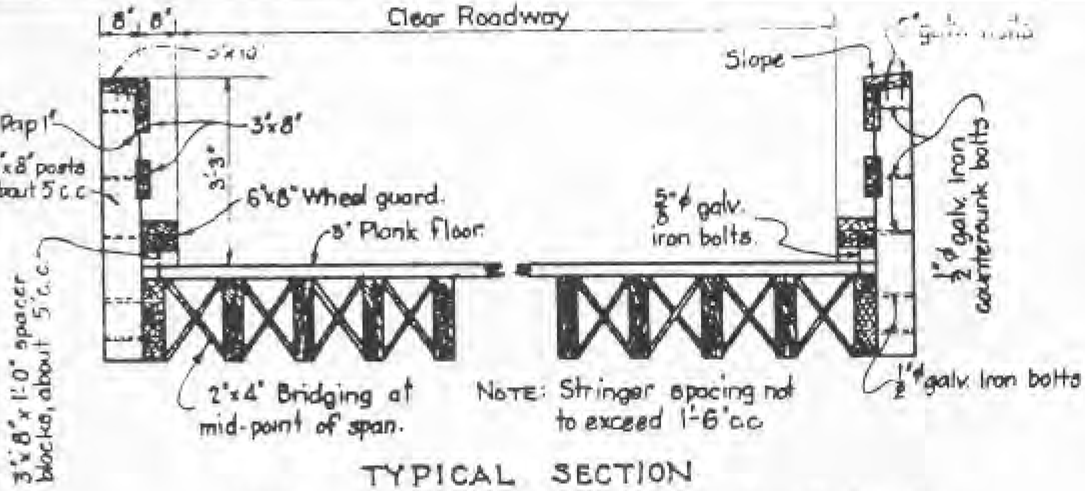
DATE: July 6 - 1933

STATE OF MARYLAND
STATE ROADS COMMISSION

STANDARD STEEL BEAM BRIDGES
FOR SECONDARY ROADS

Office of Bridge Engineer.
June, 1933

SBB-H15-33



TYPICAL SECTION

NOTE: To be used only on infrequently travelled roads and with the approval of the Chief Engineer.

GENERAL NOTES.

SPECIFICATIONS: Latest S.R.C. Specifications & A.A.S.H.O. Standard Specifications.

LOADING: One lane, H10.

BOLT HOLES: All bolt holes to be bored with an auger 1/16" smaller than the bolt diameter.

BOLTS, NAILS, ETC:- All bolts, nuts, washers, nails, spikes, etc. to be galvanized iron. Where not specified, nails shall be of proper size & quantity for the connection.

PAINT: All timber used in handrail shall be painted with three coats of Standard S.R.C. Paint.

TIMBER: Species of timber to be of a quality to provide a safe working stress of 1600 lb. per sq. in.

STRINGER DATA

Clear Span	Size of Stringer
10'-0"	3"x14" or 4"x12"
12'-0"	3"x14" or 4"x12"
14'-0"	3"x16" or 4"x14"
16'-0"	3"x16" or 4"x14"
18'-0"	3"x18" or 4"x16"
20'-0"	3"x18" or 4"x18"

APPROVED:

W. Williams Jr. (signature)

Chief Engineer

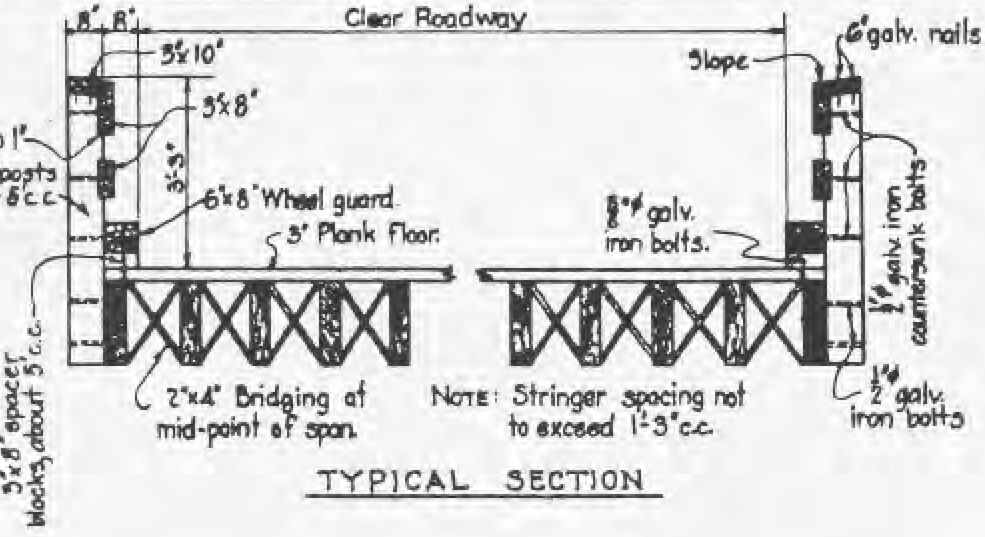
DATE: Dec 1 - 1933

STATE OF MARYLAND
STATE ROADS COMMISSION

STANDARD TIMBER BRIDGES
FOR SECONDARY ROADS

Office of Bridge Engineer
Nov., 1933

TB-H10-33



TYPICAL SECTION

General Notes.

Specifications: Latest S.R.C. Specifications & A.A.S.H.O Standard Specifications.

Loading: One lane, H15

Bolt Holes: All bolt holes are to be bored with an auger 1/16" smaller than the bolt diameter.

Bolts, Nails, Etc.: All bolts, nuts, washers, nails, spikes, etc. to be galvanized iron. Where not specified, nails shall be of proper size & quantity for the connection.

Paint: All timber used in handrail shall be painted with three coats of Standard S.R.C. paint.

Timber: Species of timber to be of a quality to provide a safe working stress of 1600 lb. per sq. in.

Stringer Data

Clear Span	Size of Stringer
10'-0"	3"x16" or 4"x14"
12'-0"	3"x16" or 4"x14"
14'-0"	3"x18" or 4"x16"
16'-0"	3"x18" or 4"x16"
18'-0"	4"x18" or 6"x14"
20'-0"	6"x14"

Approved: [signature]
Chief Engineer

Date: July 6. 1933

STATE OF MARYLAND
STATE ROADS COMMISSION

STANDARD TIMBER BRIDGES FOR SECONDARY ROADS

Office of Bridge Engineer.
June, 1933

TB-H15-33