

Methodology for 2019 Concrete Arch Bridge Reevaluation

Introduction

The PennDOT Historic Bridge Inventory and Evaluation, one of the earliest comprehensive inventories of historic highway bridges in the country when it was completed in 2001, identified bridges that meet the criteria for National Register of Historic Places (National Register) listing. This inventory considered all concrete arch bridges included in the 2001 survey and in PennDOT's Bridge Management System (BMS2)¹ built before 1957 with an arch opening greater than 20 feet. There has been a significant loss of historic bridges in the intervening 18 years. The Historic Bridge Inventory and Evaluation, begun in 1996 and completed in 2001, identified 666 Concrete arch bridges. By 2019, the population dropped to 515 concrete arch bridges, a 23% loss.² In consideration of this loss, PennDOT, in consultation with the Pennsylvania State Historic Preservation Office (SHPO), is now updating that inventory and evaluation with a focus on concrete arch bridges. The purpose of this document is to provide the methodological approach for recommendations of National Register eligibility made under the 2019 concrete arch bridge inventory update.

The methodology is based on continuing the approach outlined in a *Historic Context for Common Bridge Types in Pennsylvania* (1998) and the *Pennsylvania Historic Bridge Inventory and Evaluation* (A.G. Lichtenstein, 1999) with some updates and/or revisions based on recent scholarship. Several historic bridge surveys have been completed since 2001, most notably Indiana (2009) and Maryland (2011). These and other useful publications, including NCHRP's *A Context for Common Historic Bridge Types* (2005), were consulted in the refinement of the methodology. The methodology is also based on the 2017 metal truss bridge inventory update³ which developed a point system for a consistent and replicable approach to determine the eligibility of a bridge regardless of its type, materials, features, or age. The 2019 concrete arch bridge reevaluation adapts the point system outlined in the metal truss bridge reevaluation to assess eligibility of the concrete arch population.

As part of the update effort, bridges were only evaluated for National Register significance under Criterion C for engineering significance or relative to having high artistic merit. Given the focus of the update on engineering significance, the concrete arch bridge population was divided by closed and open spandrel design. Population loss numbers were examined to understand rarity across the state and in regions (PennDOT engineering districts were utilized as representing a region⁴). In addition, evaluation criteria were developed for each type (Appendix A). A point-based system based on the 2017 metal truss bridge reevaluation, provides a consistent and replicable approach to determining the eligibility of a bridge, regardless of its type, materials, features, or age.

Bridges determined not eligible for the National Register during the inventory update lack integrity due to alterations; are part of a remaining population that includes earlier and more complete examples; or

¹ PennDOT's Bridge Management System or "BMS2" is a database used by PennDOT and FHWA that stores, updates, and reports on the physical and operating characteristics of road related structures in Pennsylvania, with bridges being the largest category of structures. BMS2 provides information such as location, features carried/crossed, owner, maintenance responsibility, posting status, structural capacity, load rating, inspection condition information, underwater inspection information and proposed/completed maintenance items. The database is updated daily.

² Many of these bridges are locally owned and their removal may not have been federally funded.

³ <https://www.paprojectpath.org/docs/default-source/penndot-crm---general-documents/hmtb-survey-update-methodology-12-21-17.pdf?sfvrsn=6>

⁴ PennDOT divides the Commonwealth into eleven Engineering Districts (Districts 1-6, 8-12) which are responsible for the state maintained transportation network in that region.

are late examples of designs which do not possess engineering significance in Pennsylvania. Of the 515 remaining concrete arch bridges, 419 bridges are recommended not individually eligible after the bridge inventory update.

Concrete arch bridges recommended to be National Register eligible during this 2019 inventory update include: 70 closed spandrel concrete and 26 open spandrel concrete arch bridges. A total of 40 arch bridges were elevated as National Register eligible and they include: 34 closed spandrel concrete arch bridges and 6 open spandrel concrete arch bridges.

One hundred nine (109) concrete arch bridges were identified as eligible or listed in the National Register during either the 2001 statewide inventory. The 2019 reevaluation found that only 90 of these bridges remained (a 17% loss in the eligible/listed population). The 2019 reevaluation identified 40 bridges to be potentially elevated to the National Register, bringing the number of eligible and listed bridges to a total of 96. This number reflects the removal of 35 previously eligible bridges that are recommended not eligible as they did not receive sufficient points to remain eligible by the 2019 reevaluation.

The eligibility recommendations for the 40 additional bridges identified through this 2019 update as meeting National Register criteria will be sent to the PennDOT engineering districts, and the FHWA, for input prior to being finalized. It is possible that the final list will be different from the recommendations included in this document.

Research

In preparation for this inventory update, background research included an examination of the following sources and consultation with the following people:

- PennDOT's *Historic Context for Common Bridge Types in Pennsylvania* (1998)
- PennDOT's *Pennsylvania Historic Bridge Inventory and Evaluation* (1999)
- NCHRP's *A Context for Common Historic Bridge Types* (2005)
- *Indiana Historic Bridge Inventory: Volume I: National Register Eligibility Results* (2009)
- *Historic Highway Bridges in Maryland: 1631-1960, Historic Context Report* (1995)
- *A Survey of Masonry and Concrete Arch Bridges in Virginia* (2000)
- *Ohio 2006 Arch Bridge Assessment Report of Concrete Open Spandrel Arch Bridges, Concrete Filled Spandrel Arch Bridges with Three or More Spans, and Stone Spandrel Arch Bridges with Three or more spans* (2006)
- PennDOT standard bridge plans
- Gerry Kunzio and Mary McCahan, historians who worked on the 2001 Pennsylvania historic bridge inventory
- Mike Cuddy, Historic Bridge Engineer, Transystems
- Brandon Newpher, Bridge Engineer, McCormick Taylor
- PennDOT Historic Bridge Survey database (2001)
- PennDOT Bridge Management System (BMS2)
- PA SHPO files related to bridges, including survey records, Historic American Engineering Record forms, nominations for National Register listing, and determinations of eligibility
- Historic Bridges website www.historicbridges.org
- Bridge Hunters website www.bridgehunter.com
- Bridges & Tunnels of Allegheny County and Pittsburgh, PA website www.pghbridges.com
- Bridge Mapper www.bridgemapper.com

- Google Maps/Google Earth

A list of all concrete arch bridges from the 2001 Statewide Historic Bridge Inventory was compiled and an effort was undertaken by PennDOT interns and SHPO staff to reconcile the data. The data reconciliation effort consisted of:

- Identifying extant and demolished bridges
- Verifying Bridge Key numbers⁵ and Bridge Management System (BMS) identification numbers⁶
- Linking bridges with current photo documentation from online resources such as: HistoricBridges.org, bridgehunter.com, pghbridges.com, bridgemapper.com, BMS2 inspection photos, and/or Google Maps or Earth

The *Historic Context for Common Bridge Types in Pennsylvania* (1998) provides the framework to understand the significant broad patterns of roadway transportation development and bridge design and construction in Pennsylvania. The understanding of relevant themes that emerged from the context study shaped the methodology for evaluating the National Register significance of bridges as part of this update for metal truss bridges. The *Pennsylvania Historic Bridge Inventory and Evaluation* (1999) and National Register eligibility evaluation justifications from the accompanying database were consulted in the development of the methodology for the 2019 concrete arch bridge inventory and evaluation update.

Information sources on bridge alterations consulted in assessing the integrity of these bridges included: the 2001 Statewide Historic Bridge Inventory and Evaluation, recent photographs available on relevant bridge websites (e.g. historicbridges.org, bridgehunter.com, pghbridges.com, Google maps), and PennDOT’s bridge inspection files and photographs.⁷

Approach

The 2019 reevaluation of concrete arch bridges is based on the 2017 reevaluation of National Register eligibility for metal truss bridges and was carried out by a committee that included staff from both PennDOT and the Pennsylvania SHPO⁸. In meetings, bridges were individually examined within their relevant context (by design, as well as within the regional and statewide populations) using established National Register registration requirements. Questions requiring further research were tabled for review and revisited in subsequent committee meetings.

An examination of the (2001) Statewide Historic Bridge Inventory revealed inconsistencies in National Register eligibility evaluations and an inconsistent level of detail regarding character defining features. For example, the inventory provided more detailed information for early bridges, calling out design features or characteristics (e.g. unique parapet or the work of a prominent builder). Other bridges with the same characteristics would be described as “common technology” or “not among the earliest” with little descriptive information beyond “no innovative and distinctive features.” The inconsistencies and

⁵ Bridge Key or BK numbers refer to the bridge structure itself and are a second structure reference number established by PennDOT for the Bridge Management System 2 (BMS2) database to provide each bridge structure with a unique identification number that will not change for the life of the bridge.

⁶ Bridge Management System (BMS) identification numbers or BMS numbers are a 14-digit structure identification number assigned to each bridge location and may be subject to change.

⁷ In a few cases, site visits were made by PennDOT staff to collect updated information on integrity

⁸ PennDOT staff included Kara Russell and Kris Thompson. SHPO staff included Barbara Frederick, Tyra Guyton, and Elizabeth Rairigh.

lack of consistent information on character defining features of previously evaluated bridges made it difficult to formulate a consistent approach for the reevaluation effort.

For some bridge designs the previous approach to evaluation was determined to be no longer viable. For example, in the 2001 inventory those bridges with minor alterations were determined not eligible because "earlier and longer examples of the same design are common throughout the state"; only the most complete examples were considered significant. For some designs, only a few early or complete examples remain in 2019. In addition, the previous inventory did not reevaluate National Register eligibility of preexisting determinations of eligibility (DOEs). This included state owned bridges listed in the National Register in 1988 following the 1983-1986 inventory. These earlier determinations often neglected to include any information on engineering significance or notable features.

After developing an understanding of the shortcomings of the 2001 inventory and reviewing more recent inventories from other states, the team reevaluating the metal truss bridge population decided on a points-based system to produce a more consistent application of the National Register Criteria for Evaluation. The point system awards points to all bridges with distinctive characteristics, special features, or innovations, as well as early and rare bridges and subtracts points for loss of distinctive characteristics and features. The system is similar to that used in the evaluation of the state of Indiana's historic bridge population (2009). The point system provides a consistent and replicable approach to determining the eligibility of a bridge, regardless of its type design, materials, features, or age and was meant to be applied to other bridge designs.

Like the metal truss bridge reevaluation, the reevaluation of National Register eligibility for concrete arch bridges recorded in PennDOT's BMS2 was carried out by a committee that included staff of the agencies of PennDOT (Kara Russell and Kris Thompson) and the Pennsylvania SHPO (Barbara Frederick, Tyra Guyton, and Elizabeth Rairigh). The point system was applied to all concrete arch bridges in BMS built before 1957. Previously determined eligible and listed bridges helped guide which distinctive characteristics, special features and important innovations were awarded points. Concrete arch bridges that were previously not evaluated for individual significance due to their status as contributing to a historic district were evaluated for individual significance under Criterion C.

The concrete arch bridge reevaluation is based on the application of National Register Criterion C. Although these bridges may be eligible for the National Register under any of the National Register criteria, only Criterion C was considered for this reevaluation. Assessment of significance under National Register Criterion A was not undertaken but notes were made when a need for evaluation of potential historic significance under Criterion A was identified. It was not practical or feasible to evaluate bridges for associative value under Criterion A or B as part of this effort. Criterion A assessments, including contributing status to historic districts, will be ongoing, and generally undertaken on a case-by-case basis during future Section 106 project reviews. In most cases, bridges will not be individually eligible under Criterion A but may be contributing components of historic districts or historic sites.

Like any resource evaluation, the significance of a historic bridge is best judged and explained when the bridge is evaluated within its historic context, in this case the context emphasizes engineering significance as manifested in particular types and designs. Consideration was also given to the work of important bridge builders. An understanding of the historic context for bridges in Pennsylvania informed the development of the point system used to evaluate each bridge type. The point-based system includes three steps:

- 1) Establish significance
- 2) Assess integrity

3) Determine eligibility

More detail on the points-based system is provided below and in Appendix A

Recent Loss of the Concrete Arch Bridge Population

The reassessment of National Register eligibility considers the loss of concrete arch bridges both regionally and statewide since the conclusion of the statewide inventory in 2001. In the previous inventory, 680 concrete arch bridges were identified. This included 13 bridges with a waterway opening less than 20 feet that are not included in the 2019 reevaluation, one bridge built in 1996, and one bridge that was duplicated in the 2001 inventory and found to have two bridge key numbers. These 15 bridges were removed from the 2001 population numbers to account for their absences in the 2019 population. The reevaluation also identified one additional bridge that was not included in the 2001 survey. This bridge was added to the 2001 population numbers to account for its inclusion in the 2019 population, bringing the total population of concrete arch bridges to 666. The 2019 reevaluation found that only 515 concrete arch bridges remained as of April 2019, a population loss of 23%. Table 1 summarizes the loss of historic concrete arch bridges by bridge type. A greater number of closed spandrel arch bridges were constructed than open spandrel. The closed spandrel arch bridge population decreased from 603 bridges in 2001 to 471 in 2019, for a 22% loss in the population over the last 18 years. Open spandrel concrete arch population fell from 63 bridges in 2001 to 44 bridges in 2019, a population loss of 30%.

Table 1. Summary of Concrete Arch Bridge Population Loss between 2001 and 2019 by Type

Type	Date Range	Extant		% Loss
		2001 Population	2019 Population	
Closed Spandrel	1900-1954	603*	471	22
Open Spandrel	1905-1955	63	44	30
Total of All Bridges		666*	515	23
<small>*These numbers includes two bridge missed in the 2001 survey (BK#26631, 20883), and excludes 13 bridges included in the 2001 survey with an arch opening less than 20ft.(BK#20652, 7360, 14836, 21256, 29789, 13811, 13575, 35, 11034, 19319, 3578, 1604, and 1603), a bridge built in 1996 (BK#33797), and a bridge that was duplicated in the 2001 survey (BK#30072 is a duplicate of BK#29877).</small>				

Recent Loss of the National Register Eligible Concrete Arch Bridge Population

The statewide historic bridge inventory update identified 666 concrete arch bridges. Prior to the 2019 reevaluation, 109 of those 666 bridges were considered eligible for, or listed in, the National Register of Historic Places. This included bridges that were determined eligible after 2001 as part of the Section 106 review process.⁹

National Register eligible or listed concrete arch bridges remain extant in higher percentages than the overall population of concrete arch bridges with 17% loss. Table 4 summarizes the loss of National Register eligible concrete arch bridges by type. Eleven of the concrete closed spandrel eligible or listed bridges have been lost since 2001 for a 14% decrease in the population (from 80 to 69). A greater

⁹ Bridges determined to be contributing components of a National Register eligible historic district but not individually eligible are not included in this number.

percentage of the open spandrels were lost with 28% of the total eligible or listed population gone (from 29 to 21).

Some general assumptions can be made from the pattern of concrete arch bridge loss. Bridges that are at the greatest risk for demolition are older and narrower bridges. Bridges that are retained and rehabilitated as part of the transportation system are generally younger and wider bridges. It was also noted that more loss has occurred with longer closed spandrels bridges and shorter open spandrels bridges.

Table 4: Summary of National Register Eligible Concrete Arch Bridge Loss by 2019

Type	Date Range	NR Eligible Bridges		
		Prior to Reevaluation*	2019 Population	% Loss
Closed Spandrel	1869-1940	80	70	14
Open Spandrel	1871-1949	29	20	28
Total of All Bridges		109	90	17
*This number includes bridges determined individually eligible by the previous bridge inventory and through the Section 106 review process.				

Regional Population of Concrete Arch Bridges

The population of concrete arch bridges was analyzed at the regional level to determine which regions had experienced the greatest loss since the previous bridge inventory, the earliest remaining bridges in a region, and regional distribution of bridge types. Each of the 11 PennDOT engineering districts was considered a region for the purposes of this evaluation. The largest concentration of concrete arch bridges is found in district regions 5, 6, 8 and 11. The district region 6 has lost the least number of concrete arch bridges with a 6% loss (from 125 to 117 bridges).

While closed spandrels were found in every district region in Pennsylvania, fewer bridges are found in the northern part of the state in district regions 1, 2, 3, 4, and 10. The district regions 3 and 10 have experienced the greatest loss in the closed spandrel arch bridge population at 46% (from 24 to 13 bridges and 39 to 21 bridges) with district regions 4, 5, and 6 experiencing the least loss with a 0%, 6%, and 8% loss, respectively (from 16 to 16, from 78 to 72, from 113 to 108).

Open spandrel concrete arch bridges are localized in district 4, 5, 6, and 11 with only 4 open spandrel bridges remaining between districts 3, 8, and 9. Open spandrels have been completely lost in districts 1, 2, and 12 while none were identified in District 10 in the 2001 statewide inventory. District region 11 experienced the least number of open spandrel concrete arch bridge loss with a population decrease of 14% (from 14 to 12).

Table 5. Closed Spandrel Concrete Arch District Population of Bridges, 2001 and 2019

Closed Spandrel	PennDOT District											Total
	1	2	3	4	5	6	8	9	10	11	12	
2001 Population	17	32	24	16	78	113	79	61	39	80	64	603
2019 Population	12	23	13	16	72	108	58	43	21	60	45	471
% Loss	29	28	46	0	8	4	27	30	46	25	30	22

Table 6. Open Spandrel Concrete Arch District Population of Bridges, 2001 and 2019

Open Spandrel	PennDOT District											Total
	1	2	3	4	5	6	8	9	10	11	12	
2001 Population	2	1	1	8	18	12	3	3	0	14	1	63
2019 Population	0	0	1	5	14	9	1	2	0	12	0	44
% Loss	100	100	0	38	22	25	67	33	-	14	100	30

Table 7. All Concrete Arch District Population of Bridges, 2001 and 2019

All Concrete Arches	PennDOT District											Total
	1	2	3	4	5	6	8	9	10	11	12	
2001 Population	19	33	25	24	96	125	85	64	39	94	65	666
2019 Population	12	23	14	21	86	117	59	45	21	72	45	515
% Loss	37	30	44	13	10	6	31	30	46	12	31	23

National Register Significance—Criterion C

Concrete arch bridges may be eligible for the National Register under Criterion C in the areas of engineering and/or architecture for their age, technological significance, as the work of a master, or for aesthetics. As per PennDOT’s *Pennsylvania Historic Bridge Inventory and Evaluation* (1999)

Criterion C . . . addresses bridges that meet at least one of the following characteristics: they embody distinctive characteristics of a type, period, or method of construction; they are the work of a master; they possess high artistic value. . . The criterion affords recognition of the evolution of bridge types and bridge building technology over time, as well as the importance of the engineer/engineering firm who designed a bridge and the fabricator/contractor who erected it. Architectonic and aesthetic bridges, bridges with unusual construction details or rare surviving examples of a type that was significant in the development of a bridge technology . . . can be eligible under Criterion C.

Common types will be evaluated to identify which examples are technologically significant. Priority will be placed on identifying examples that mark the introduction of a particular technology, illustrate engineering advances within a technology, and/or have distinguishing details. This often means that significant examples are the earlier, longer, or more complicated bridges. Evaluation of common bridge types and designs will be done at a regional and statewide basis to ensure the most significant examples are identified.

As explained above, the team evaluating the concrete arch bridge population decided on a points-based system to foster a consistent application of the National Register Criteria for Evaluation. The point system awards points to bridges with distinctive characteristics, special features, or innovations as well as early and rare bridges.

Bridges were awarded points for items under the following categories which correspond with the requirements of National Register Criterion C:

- Distinctive characteristics of type, period, or method of construction

- A variation, evolution, and/or transition of a type that reflects an important phase in bridge construction
- High artistic value
- Work of a master/builder

Distinctive characteristics of a type, period, and method of construction

Early examples of a bridge usually represent the pioneering period for a bridge type and are becoming increasingly rare, therefore all bridges built before 1910 were awarded points. The previous bridge inventory methodology and context provided a date range that was considered early for each bridge type, however, in consideration of the loss in population especially of the earliest bridges, the earliest examples in the state population for each type were award additional points. The earliest bridge in each PennDOT district was also award points for earliest example in the region. This allowed for the earliest bridges that represent the pioneering period to accumulate enough points to be eligible.

Increasingly **rare** bridge types important in the development of concrete arch bridge technology were awarded points. As outlined in the 1999 methodology, “Unique, rare, or infrequent surviving types . . . are also evaluated as having engineering significance under Criterion C . . . the unique, rare or infrequent criterion will be evaluated on a county and statewide basis.” The 2019 update examined rarity based on the remaining statewide and engineering district populations. The statewide population identified open spandrels as an **uncommon and distinctive type** of arch bridge and awarded points to these bridges. Regional rarity was defined as 3 or fewer remaining examples of a bridge type and design in an engineering district. Rarity is also seen in **method of construction**. For example, bridges constructed without reinforced concrete were assigned points for rarity.

Examples of **early standard plans** from the State Highway Department were also recognized because of the important role the Pennsylvania Department of Highways played in the development of the state’s bridges. As outlined in the previous statewide bridge inventory methodology, this includes bridges that demonstrate early use, or evolution of, State Highway Department design types. Information on standard designs for concrete arch bridges was compiled from PennDOT’s website *Plans, Standards and Specifications*¹⁰ which links to an excel spreadsheet, *Old Bridge Standards Lookup List*.¹¹ This list was filtered to show all standard designs related to concrete arch bridge plans dating from 1960 or older. Thirty-two concrete arch bridge plans dating from 1918 to 1941 were identified. Note that many of these designs are for short spans with less than a 20 feet arch opening. A summary of the bridges and a link to their plans can be found in Appendix F. Based on an examination of PennDOT bridge plans available, points were awarded to bridges built to the state standard design starting in 1919.

Variation, evolution, or transition that reflects an important phase in bridge construction.

Points were awarded to features or innovations that illustrate an **important change, transition, or experimentation in technology within the remaining bridge population**. This refers to notable design details related to engineering innovations or variations or refinements within a type including achievement of exceptional bridge span and overall length. Points were awarded to bridges with exceptional span length and bridges with exceptional overall length in the statewide population. Bridge length was not considered on a regional/district level. Exceptional lengths were sometimes noted in the

¹⁰ <https://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans,-Standards-and-Specifications.aspx>

¹¹ http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old_Standards/Old_Bridge_Standards_Lookup_List.xlsx

2001 Statewide Historic Bridge Inventory and these numbers were used to guide the assessment of exceptional technological achievement. Bridges of a particular type were compared and where a noticeable difference in size was recognized between bridges, a baseline was set, and points given to bridges that exceeded the baseline. For example, a 431-foot long closed spandrel arch (bridge key #28906) was noted as “individually significant as a long, early, and very well detailed example of its bridge type” in the 2001 inventory. A comparison of the overall length of all the closed spandrel bridges sees a gradual increase of 1 to 5 feet between bridges with an occasional outlier, until bridge length reaches 431 feet (bridge key #28906). The next longest bridge (bridge key #14941) is 482 feet, a difference of 51 feet from bridge key #28906. At this point, the differentiation in length of the remaining 14 bridges increases considerably with a median difference of 34 feet and a range of 482 to 1607 feet between bridges. In consideration of the noted length in the previous inventory, and comparison of the length of all the bridges, a baseline of 480 feet was established for exceptional overall length of closed spandrel bridges and points were awarded to any bridge that exceeded this length.

Bridges with **important special features or innovations** reflect innovations by engineers, designers, fabricators, or builders, compared to common designs and features for a type. The previous bridge inventory often indicated when a change, transition, or technology was considered early and important and generally only the earliest examples were evaluated as significant. However, considering the amount of demolition that has occurred over the past 15 years, these dates ranges were analyzed to determine if they are valid for the remaining population or need adjustment. These innovations include early innovations such as rib arches in closed spandrel bridges and idiosyncratic features, such as the application of tufa stone. In addition, **bridges with highly important or unusual** special features include bridges with the patented Melan or Luten arch reinforcing system and represent an important early reinforced concrete bridge technology and method of construction. These innovations and features were generally identified in the previous bridge inventory and points were applied to all bridges that exhibited these innovations. In a few cases, idiosyncratic features were noted by bridge historians that were not noted in the statewide inventory and, upon validation, points were awarded. Luten designed bridges are harder to identify in the absence of original construction plans or destructive investigation, therefore, bridges built by companies known to be agents of the Luten Bridge Company were awarded points for possibly being a Luten design.

Points were also awarded for bridges that show **outstanding technological achievement** and include bridges that exhibit multiple example of innovations and special features. For example, bridge key # 13957 receives points for outstanding technological achievement because it is both a Luten design closed spandrel bridge (based on builder information) and exhibits multiple spans. Bridge key #38904 receives points for outstanding technological achievement because it a multiple span concrete arch with a 40-degree skew and incorporates a masonry arch in the length of the bridge.

Possesses High Artistic Values

Several bridges evaluated in the 2019 evaluation have outstanding ornamentation, style, or architectural treatments that could be considered “high artistic value” as outlined under National Register Criterion C. This ornamentation ranges from simple non-standard decorative railing such as parapets that curve to the contour of the arch ring, to bridges that reflect neoclassical architecture attributed to the City Beautiful movement. Bridges with multiple examples of ornamental or architectural treatment in the overall design were awarded points. Notable but isolated ornamentation, such as decorative railings or end posts, also received recognition but were assigned less points than those bridges that incorporated ornamentation into their overall design.

Work of a Master

Bridges were evaluated as the work of a master if they were documented as attributable to specific engineers, designers, fabricators, or builders of national recognition, or Pennsylvania-based individuals or firms that designed and built bridges within the state and whose work is distinguishable. Often, these were the engineers, designers, fabricators, or builders that were prolific bridge builders in the state. Bridges built by out-of-state builders without national recognition were not considered to be the work of a master unless unusual evidence suggests otherwise. All bridges attributable to a master through distinguishing design features were awarded points. Work of a master was considered important in conjunction with other features, such as a high artistic value or unusual features or innovations. Therefore, to meet the point threshold for significance, “work of a master” bridges had to receive points for other characteristics as well.

Following is a list of builders that were identified in the previous bridge inventory as significant as either a major bridge builder in Pennsylvania or a region or as a significant innovator in bridge construction in the nation. They represent the most prolific bridge builders in the state as identified in the previous bridge inventory.

Table 8. Notable Concrete Arch Bridge Fabricators and Builders

Bridge Company	Significance (Information from previous bridge study)
Chaney & Armstrong	Prolific Engineer, later known as Chaney Engineering Co.
Charles A. Williams	Engineer in York County who designed distinctive bridges during the mid-1910s
City of Pittsburgh	Public Works Dept. initiated a bridge building program in 1908 and embraced the City Beautiful movement building reinforced concrete bridge arches with classical style architecture details
City of Philadelphia	Noted for building concrete arch bridges with an innovative philosophy and emphasis on aesthetics that became the hallmark of the City Beautiful movement <ul style="list-style-type: none"> • George S. Webster, Chief Engineer & Surveyor of the Bureau of Surveys, Dept. of Public Works from 1893-1920 • Harold H. Quimbly, Assistant Engineer of Bridge Design Unit
David A. Keefe	Prolific Engineer in Bradford and Tioga Counties
Farris Bridge Co.	Prolific Engineers in Western Pennsylvania known for standard design reinforced concrete and steel bridges
Ferro Concrete Co	Regional concrete bridge contractor based in Harrisburg and a known agent for the Luten Bridge Co.
Nelson Construction Co.	Noteworthy Chambersburg contractors that adopted early reinforced concrete arch bridge technology and promoted its widespread use to county and municipal offices. Also known as Nelson-Merydith Co. (1901 Successor to Nelson & Buchanan)
Whittaker & Diehl	Prominent statewide bridge building firm based in Harrisburg and a known agent for the Luten Bridge Co.

National Register Significance Assessment (Appendix A)

A matrix to assess significance was developed for each bridge type (Appendix A). Accordingly, those bridges with more points represent the earliest bridges with distinctive characteristics, special features, and important innovations. Any bridge that received 13 or more points was determined to have significance and was advanced for an assessment of integrity.

National Register Integrity Assessment (Appendix B)

National Register eligibility is a combination of significance and integrity. Integrity is the ability of a resource to convey its significance. In accordance with National Register Criterion C, integrity is directly related to whether a bridge retains sufficient integrity of materials, design and workmanship- those aspects of integrity that allow a structure to convey its physical features as well as characterize the type, period, or method of construction. In the points-based system of eligibility assessment, points were deducted for those bridges that have lost integrity of materials, design, and workmanship.

In assessing retention of integrity, consideration was given to the following factors:

- extent of change to historic character (appearance from the period of significance)
- importance of character defining features
- continued ability of bridge to convey historic significance (engineering function)
- visibility of the alteration to the public
- craftsmanship

Integrity loss was divided into 7 categories, as outlined in more detail in Appendix B:

Level 0 integrity loss involves replacement in kind of character defining features and ornamentation in accordance with the Secretary of the Interior's (SOI) Standards as well as application of coating or patching that does not cover ornamentation or replaces ornamentation in kind. Replacement in kind refers to replacement of deteriorated features with new features that match the old in design, color, texture, and other visual qualities and, where possible, material. Bridges receive no deduction of points with these minor replacements and alterations.

Level 1 integrity loss involves replacement of character defining features and ornamentation not in kind but in character and the limited application of coating or patching that covers decorative features or ornamentation. Replacement in character refers to the replacement of a deteriorated feature with a new feature that is similar, but not identical, in size, material, detailing, and is visually compatible and does not detract from the overall historic appearance. If a bridge had one issue of integrity loss under this category, then a total of 1 point was deducted from its overall score. Multiple issues of integrity loss under this category moved it to a Level 2.

Level 2 integrity loss involves removal of secondary character defining features and ornamentation without replacement such as lighting details and decorative medallions and brackets. If a bridge had one issue of integrity loss under this category, then a total of 2 points were deducted from its overall score. Multiple issues of integrity loss under this category moved it to a Level 3.

Level 3 integrity loss involves additions and alterations to character defining features not in accordance with the SOI Standards such as removal of parapets without a replacement or non-historic scoring patterns applied to the spandrel wall. If a bridge has one issue of integrity loss under this category, then a total of 3 points was deducted from its overall score. Multiple issues of integrity loss under this category moved it to a Level 4.

Level 4 integrity loss involves replacement, additions, and alterations to character defining features not in accordance with the SOI Standards such as inappropriate replacement of parapet, strengthening the spandrel walls with tie rods that are visually prominent, attachment of guide rails to the spandrel walls, and major widening that doubles the size of the deck or more and does not obscure the original construction method. If a bridge has one issue of integrity loss under this category, then a total of 5 points was deducted from its overall score. Multiple issues of integrity loss under this category moved it to a Level 5.

Level 5 integrity loss involves additions and alterations not in accordance with the SOI Standards such as any widening that obscures the original construction method and application of coatings that obscure outstanding ornamentation. If a bridge has one issue of integrity loss under this category, then a total of 7 points was deducted from its overall score. Multiple issues of integrity loss under this category moved it to a Level 6.

Level 6 integrity loss involves excessive replacement, removal, alteration, or additions to essential character defining features not in accordance with the SOI Standards in a manner that significantly affects historic character and the ability to convey engineering significance.

If a bridge had multiple levels of integrity loss, points were deducted from the highest level only. For example, if a bridge had one issue of integrity loss at Level 2 and one issue of integrity loss at Level 4, then 5 points was deducted from the bridges overall score.

The 1999 methodology from the Statewide Historic Bridge Inventory states, “When a resource type or detail becomes so infrequent or rare that losing one or two examples will mean that it is no longer represented in the bridge population, then the integrity question is secondary to recognizing the worthiness of preserving a disappearing bridge type or design.” The point system recognizes a lower threshold for integrity is sometimes acceptable for bridges that are extraordinarily rare. More points are awarded to rare bridges which allows for more points to be deducted for integrity loss while still staying within the point range for eligibility. Therefore, bridge types with few other extant examples are justified in accepting a greater degree of alteration or fewer remaining physical features to convey the engineering significance of the type. However, three bridges, not considered extraordinarily rare, were excessively altered and not able to convey their significance. The review committee recommended these bridges not eligible, although they retained points to be recommended eligible.¹²

Recommendations of National Register Eligibility

Following the significance and integrity assessments, a bridge received a total point value. Bridges that met the established point threshold (13 points) were recommended eligible for the National Register or recommended to remain National Register eligible if previously determined eligible. Those bridges that did not meet the threshold were recommended not eligible except for bridges that were previously listed in the National Register. These bridges remain listed regardless of points. See Appendix C for a significance statement for each elevated bridge and the associated rationale for the eligibility recommendation. See Appendix D for a significance statement and the associated rationale for each bridge that remains eligible. See Appendix E for a list of previously determined eligible bridges that will

¹² Bridge Key #39154 and 39165 located in Philadelphia, PennDOT District 6, were recommended not eligible. One side of each bridge was backfilled with dirt and developed making the spandrel wall and arch completely obscured. Bridge Key #5275 located in the Berks County, PennDOT District 5, was recommended not eligible. Most of the character defining features of this bridge were removed or altered during rehabilitation of the bridge.

be recommended not eligible as a result of this reevaluation. Table 9 summarizes all the bridges that are recommended eligible or recommended to remain National Register eligible. Geospatial data and images of each bridge recommended elevated or demoted can be found at the following website: <https://www.dot7.state.pa.us/OneMap?map-id=19502>

Table 9: Summary of National Register Eligible Bridges as a result of the 2019 Reevaluation

Type	Date Range	Population of Eligible Bridges by District											Total
		1	2	3	4	5	6	8	9	10	11	12	
Closed Spandrel	1900-1932	0	2	3	3	17	26	8	6	1	3	1	70
Open Spandrel	1907-1954	0	0	1	3	10	6	1	2	0	3	0	26
	Total	0	2	4	6	27	32	9	8	1	6	1	96

Recommendations

This document outlines the methodology for the development of eligibility recommendations for the 2019 historic concrete arch bridge update. It is possible that new or additional information on significance or integrity may become known about a bridge, such as at the time of a project. This information may warrant reconsideration of eligibility. For example, an alteration that was not apparent through available records or photographs may be identified as affecting the ability of a bridge to convey its significance. The bridge should then undergo reevaluation through application of the points-based system used in the current assessment, outlined in Appendix A of this document.

The methodology that was developed for the 2017 metal truss bridge inventory update and adapted for the 2019 concrete arch bridge inventory update provides a consistent and replicable approach to determining the eligibility of a bridge, regardless of its type, design, materials, features, or age. This methodology can be replicated for other bridge types and designs. The 2017 amendment to the Federal Aide Programmatic Agreement between FHWA, PennDOT and the SHPO establishes a process by which the signatories to the agreement will consult at least every 10 years to determine if conditions have changed that would require updating the list of National Register eligible bridges. Future bridge updates should be completed using the methodology outlined in these documents.

APPENDIX A CRITERION C POINT APPLICATION FOR SIGNIFICANCE BY CONCRETE ARCH BRIDGE TYPE

Category	Item	Bridge type and design	Points to assign
Distinctive characteristics of type, period, or method of construction	Built before a specified year	Bridges built 1910	7
	Building material OR Method of construction	Defined for each bridge type and design	7
	Distinctive type and/or uncommon type OR Only known example in the state	Defined for each bridge type and design	7
	Early example in the state	Defined for each bridge type and design	7
	Early standard plan in the state		3
	Earliest example in a PennDOT district	Defined for each bridge type and design	4
	Rare in a PennDOT district	Three or fewer examples within the PennDOT district	3
Variation, evolution, and/or transition of a type	Exceptional length of main span	Defined for each bridge type and design	3

	Exceptional length overall	Defined for each bridge type and design	3
	Special features/innovations – important or unusual	Defined for each bridge type and design	3
	Special features/innovations – highly important or unusual	Defined for each bridge type and design	4
	Outstanding technological achievement	Defined for each bridge type and design	7
High artistic value	Selected ornamentation, notable but isolated	Single decorative feature	3
	Outstanding ornamentation or architectural treatment in overall design	Highly artistic or decorative	6
Work of a master	Prolific or important designer/builder/engineer		3

APPENDIX B CRITERION C POINT APPLICATION FOR INTEGRITY BY CONCRETE ARCH BRIDGE TYPE

Level 0 Integrity Loss	Replacement in kind	Replacement in kind ¹³ of primary and/or secondary character defining features and ornamentation such as: <ul style="list-style-type: none"> • Parapet, balustrade • Decorative features: lighting, brackets, medallions • Decorative features: brackets, medallions 	-0
	Alterations/Additions	Application of coating/patching that does not cover ornamentation or with in kind replacement of ornamentation: <ul style="list-style-type: none"> • Scoring of spandrel wall or arch • Rustication 	-0
Level 1 Integrity Loss	Replacement not in kind	Replacement of character defining features and ornamentation not in kind but in character ¹ such as: <ul style="list-style-type: none"> • Replacement of paneled parapets with solid parapet • Replacement of historic lighting with modern lighting that replicates historic feel 	-1
	Alterations/Additions	Limited application of patch coating that covers decorative features or ornamentation <ul style="list-style-type: none"> • Large areas of spalling or loss of material 	-1
Level 2 Integrity Loss	Alterations/Additions	Removal of secondary character defining features and ornamentation such as: <ul style="list-style-type: none"> • Lighting • brackets 	-2
		Two or more examples from the Level 1 Integrity loss category	-2
Level 3 Integrity Loss	Alterations/Additions	Removal of Character defining features such as: <ul style="list-style-type: none"> • parapet (without addition of new parapet or guide rails) 	-3
		Application/addition of ornamentation not in character such as: <ul style="list-style-type: none"> • Non-historic scoring pattern 	-3
		Functional and Safety Improvements not in accordance with the SOI Standards	-3

¹³ In kind replacement refers to Secretary of the Interior’s Standards for Rehabilitation, Standard 6: Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and other visual qualities and, where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence. In character replacement is differentiated by being similar in size, material, detailing, and is visually compatible and does not detract from the overall historic appearance.

		<ul style="list-style-type: none"> • Minor widening that does not obscure construction method (arch and spandrel wall are still visible) • Application of coating that obscures ornamentation 	
	Two or more examples from the Level 2 Integrity loss category		-3
Level 4 Integrity Loss	Replacement not in kind	Inappropriate replacement of parapet that is not in character such as: <ul style="list-style-type: none"> • Replacement of balustrade with solid parapet • Alteration of parapets by infilling balustrade with concrete 	-5
	Additions/Alterations	Strengthening not in accordance with the SOI Standards: <ul style="list-style-type: none"> • Strengthening of spandrel walls through application of tie rods that are visually prominent 	-5
		Functional and Safety Improvement not in accordance with the SOI Standards <ul style="list-style-type: none"> • Major widening that doubles the size of the deck or more without obscuring the original construction method (arch and spandrel walls are visible) • Attachment of guide rails to the spandrel wall 	-5
	Two or more examples from the Level 3 Integrity loss category		-5
Level 5 Integrity Loss	Additions/Alterations	Functional and Safety Improvement not in accordance with the SOI Standards <ul style="list-style-type: none"> • Any widening that either doubles the size of the deck or obscures the original construction method (arch and spandrel walls are not visible)Application of coating that obscures outstanding ornamentation 	-7
	Two or more examples from the Level 4 Integrity loss category		-7
Level 6 Integrity Loss	Additions/Alterations	Strengthening not in accordance with the SOI <ul style="list-style-type: none"> • Removal of concrete support structures and replacement with metal • Enclosing open spandrel with concrete 	-10
	Two or more examples from the Level 5 Integrity loss category		-10

APPENDIX C BRIDGES ELEVATED TO ELIGIBLE UNDER CRITERION C¹⁴

County	District	Bridge Key #	BMS #	Design	Significance
Allegheny	11	2441	02730100003087	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • One of two bridges known to utilize unhewn tufa stone in world • Artistic value – outstanding ornamentation
Allegheny	11	2444	02730100003090	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • One of two bridges known to utilize unhewn tufa stone in world • Artistic value – outstanding ornamentation
Allegheny	11	2496	02730100009604	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Earliest example of type in the district • Artistic value – notable but isolated ornamentation
Bedford	9	4305	05300900400000	Closed Spandrel	<ul style="list-style-type: none"> • Exceptional overall length • Multiple spans • Artistic value – outstanding ornamentation
Berks	5	4944	06100300900000	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Multiple spans • Artistic Value – outstanding ornamentation
Berks	5	5035	06200500100112	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Exceptional overall length • Multiple spans • Artistic value – outstanding ornamentation
Berks	5	5300	06710106710005	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – notable but isolated ornamentation
Berks	5	5395	06722304949541	Closed Spandrel	<ul style="list-style-type: none"> • Multiple spans • Possible Luten design • Important designer, builder, or engineer
Berks	5	5396	06722304989542	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Multiple spans
Berks	5	4605	06006103700000	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Multiple spans • Artistic value – notable but isolated ornamentation
Blair	9	5963	07721503784001	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Possibly a Luten design • Artistic value – notable but isolated ornamentation • Important designer, builder, or engineer
Blair	9	5965	07721503973022	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Earliest example of type in the district

¹⁴ Geospatial data and images of elevated bridges can be found here:

To search for bridges on the website: Open the link, click on the filter option in the upper right corner, enter the bridge key number under elevated bridges, and turn the search function on by sliding the dot across from “Elevated Bridges” to the right. An elevated bridge will appear as a green diamond on the map and an image of the bridge can be viewed by clicking on the diamond. It may be necessary to zoom out of the map to access the crossing information for the bridge.

County	District	Bridge Key #	BMS #	Design	Significance
Blair	9	5971	07721504543065	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Earliest example of type in the district
Bradford	3	6684	08723608810040	Closed Spandrel	<ul style="list-style-type: none"> • Early example of type in the state • Earliest example of type in the district • Exceptional Span length • Multiple spans • Important designer, builder, or engineer
Chester	6	10404	15202100140000	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Substantial skew
Cumberland	8	13557	21001100101508	Closed Spandrel	<ul style="list-style-type: none"> • Possibly a Luten Design • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Cumberland	8	13957	21400700101302	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Multiple span • Possibly a Luten Design • Important designer, builder, or engineer
Dauphin	8	14418	22084900100000	Closed Spandrel	<ul style="list-style-type: none"> • Exceptional span length • Exceptional overall length • Multiple spans • Artistic value – outstanding ornamentation
Dauphin	8	14732	22730140004007	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Possibly a Luten design • Important designer, builder, or engineer
Delaware	6	15217	23200500100000	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Delaware	6	15241	23201000602704	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Artistic value – outstanding ornamentation
Juniata	2	20037	34007506601759	Closed Spandrel	<ul style="list-style-type: none"> • Early example of type in the state • Artistic value – outstanding ornamentation
Lehigh	5	23182	39037800740000	Closed Spandrel	<ul style="list-style-type: none"> • Exceptional span length • Exceptional overall length • Multiple spans (includes 2 metal truss spans) • Artistic value – outstanding ornamentation
Lehigh	5	23518	39730200000102	Closed Spandrel	<ul style="list-style-type: none"> • Exceptional span length • Exceptional overall length • Multiple spans • Artistic value – outstanding ornamentation
Luzerne	4	23614	40001107200229	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Exceptional overall length • Multiple spans • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Mifflin	2	26631	44720504200002	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Earliest example of type in the district • Multiple Spans • Possible Luten design • Important designer, builder, or engineer
Montgomery	6	27916	46704602200200	Closed Spandrel	<ul style="list-style-type: none"> • Exceptional overall length • Multiple spans • Artistic value – outstanding ornamentation
Northampton	5	28626	48061101800046	Closed Spandrel	<ul style="list-style-type: none"> • Multiple spans • Possible Luten design • Artistic value – outstanding ornamentation

County	District	Bridge Key #	BMS #	Design	Significance
Northumberland	3	29408	49740506200044	Closed Spandrel	<ul style="list-style-type: none"> • Early example of type in the state • Earliest example of type in the district • Artistic value – outstanding ornamentation
Philadelphia	6	38904	67300300402203	Closed Spandrel	<ul style="list-style-type: none"> • Multiple spans (includes masonry arch span) • Substantial skew • Artistic value – outstanding ornamentation
Philadelphia	6	38975	67301500301234	Closed Spandrel	<ul style="list-style-type: none"> • Multiple spans • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Philadelphia	6	38976	67301500302408	Closed Spandrel	<ul style="list-style-type: none"> • Multiple spans • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Philadelphia	6	39123	67730100200163	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – outstanding ornamentation
Philadelphia	6	39141	67730100400007	Closed Spandrel	<ul style="list-style-type: none"> • Exceptional overall length • Multiple spans • Artistic value – outstanding ornamentation
Philadelphia	6	39145	67730100400223	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Philadelphia	6	39153	67730100500261	Closed Spandrel	<ul style="list-style-type: none"> • Early example of type in the state • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Philadelphia	6	39215	67730101200102	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Rare construction method • Early example of type in the state • Artistic value – notable but isolated ornamentation • Important designer, builder, or engineer
Philadelphia	6	39239	67730101800156	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – notable but isolated ornamentation
Schuylkill	5	31014	53742600009128	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Multiple spans • Artistic value – outstanding ornamentation
Snyder	9	31760	55402100400033	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Earliest example of type in the district • Important designer, builder, or engineer

APPENDIX D BRIDGES THAT WILL REMAIN ELIGIBLE OR LISTED UNDER CRITERION C

County	District	Bridge Key #	BMS #	Design	Significance
Allegheny	11	674	02003002600000	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Exceptional overall length • Multiple spans • Artistic value – outstanding ornamentation
Allegheny	11	1387	02100600100342	Closed Spandrel	<ul style="list-style-type: none"> • Artistic value – outstanding ornamentation
Allegheny	11	2387	02730100002271	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Artistic value – outstanding ornamentation

County	District	Bridge Key #	BMS #	Design	Significance
Allegheny	11	2419	02730100003047	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Early example of type in the state • Earliest example of type in the district • Possibly Melan design • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Armstrong	10	3110	03100700260000	Closed Spandrel	<ul style="list-style-type: none"> • Multiple spans • Artistic value – outstanding ornamentation
Bedford	9	3973	05003003940000	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Regionally rare • Multiple spans • Substantial skew • Artistic value – outstanding ornamentation
Berks	5	4742	06018300300309	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Multiple spans • Artistic value - outstanding ornamentation
Berks	5	5021	06102901600324	Closed Spandrel	<ul style="list-style-type: none"> • Multiple spans • Artistic value – outstanding ornamentation
Berks	5	5059	06202100700056	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Multiple spans • Artistic value – outstanding ornamentation
Berks	5	5102	06204000101226	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – notable but isolated
Berks	5	5130	06206901101649	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – notable but isolated
Berks	5	4696	06208201523322	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – notable but isolated
Berks	5	5221	06342200501493	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Early example of type in the state • Earliest example of type in the district • Exceptional overall length • Multiple spans • Artistic value – outstanding ornamentation
Berks	5	5471	06724004230002	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Luten design • Important designer, builder, or engineer
Berks	5	5487	06730100009171	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Multiple spans • Artistic value – outstanding ornamentation
Bucks ¹⁵	6	7476	09700900100013	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Early ribbed closed arch • multiple spans • Artistic value – outstanding ornamentation
Bucks	6	7566	09700904390030	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Early ribbed closed arch
Chester	6	10081	15011303401747	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Multiple spans
Columbia	3	12667	19200500201127	Closed Spandrel	<ul style="list-style-type: none"> • Multiple spans • Possibly a Luten design • Artistic value – outstanding ornamentation • Important designer, builder, or engineer

¹⁵ Bridge Key No 7476 was demolished shortly after the start of the reevaluation.

Dauphin	8	14531	22301200300000	Closed Spandrel	<ul style="list-style-type: none"> •Exceptional overall length •Multiple spans •Artistic value – outstanding ornamentation
County	District	Bridge Key #	BMS #	Design	Significance
Dauphin	8	14532	22301200800161	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Earliest example of type in the district •Exceptional overall length •Early ribbed closed arch, multiple spans •Artistic value – outstanding ornamentation
Dauphin	8	14539	22301400300000	Closed Spandrel	<ul style="list-style-type: none"> •Exceptional overall length •Multiple spans •Artistic value – notable but isolated ornamentation •Important designer, builder, or engineer
Dauphin	8	14743	22730140004021	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Earliest example of type in the district •Exceptional overall length •Early ribbed closed arch •Multiple spans •Artistic value – outstanding ornamentation
Delaware	6	15410	23702303900072	Open Spandrel	<ul style="list-style-type: none"> •Uncommon type •Exceptional span length •Artistic value – outstanding ornamentation
Franklin	8	17579	28400600100783	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Earliest example of type in the district •Early ribbed closed arch •Multiple spans •Artistic value – notable but isolated ornamentation •Important designer, builder, or engineer
Huntington	9	18946	31722503773014	Closed Spandrel	<ul style="list-style-type: none"> •Early ribbed closed arch •Multiple spans •Artistic value – outstanding ornamentation
Lackawanna	4	20793	35400500300000	OPEN SPANDREL ARCH	<ul style="list-style-type: none"> •Uncommon type •Early example of type in the state •Earliest example of type in the district •Artistic value – notable but isolated ornamentation
Lackawanna	4	20872	35721104370101	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Earliest example of type in the district •Melan design
Lackawanna	4	20883	35730119080005	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Earliest example of type in the district •Melan design
Lancaster	8	21270	36046200100000	Open Spandrel	<ul style="list-style-type: none"> •Uncommon type •Earliest example of type in the district •Regionally rare •Exceptional overall length •Multiple spans •Artistic value – outstanding ornamentation
Lehigh	5	23217	39100202500000	Open Spandrel	<ul style="list-style-type: none"> •Uncommon type •Exceptional overall length •Artistic value – outstanding ornamentation
Lehigh	5	23331	39205500200000	Open Spandrel	<ul style="list-style-type: none"> •Uncommon type •Early example of type in the state •Exceptional overall length •Multiple spans

County	District	Bridge Key #	BMS #	Design	Significance
					•Artistic value – outstanding ornamentation
Luzerne	4	23967	40100900200082	Open Spandrel	<ul style="list-style-type: none"> •Uncommon type •Exceptional overall length •Multiple spans •Artistic value – outstanding ornamentation •Important designer, builder, or engineer
Northampton	5	28590	48032900300216	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Multiple spans •Possibly a Luten design •Artistic value – notable but isolated ornamentation •Important designer, builder, or engineer
Northampton	5	28638	48061106100668	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Luten design •Artistic value – notable but isolated ornamentation •Important designer, builder, or engineer
Northampton	5	28696	48103300100034	Closed Spandrel	•Artistic value – outstanding ornamentation
Northampton	5	28804	48720104709130	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state
Northampton	5	28906	48730100009088	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Multiple spans •Artistic value – outstanding ornamentation
Northampton	5	28943	48793564505310	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Earliest example of type in the district •Possibly Melan design
Northumberland	3	29159	49101400100000	Open Spandrel	<ul style="list-style-type: none"> •Uncommon type •Earliest example of type in the district •Regionally rare •Exceptional overall length •Multiple spans •Artistic value – outstanding ornamentation
Philadelphia	6	38302	67000100200625	Closed Spandrel	•Artistic value – outstanding ornamentation
Philadelphia	6	38408	67001303040302	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Earliest example of type in the district •Melan •Artistic value – outstanding ornamentation •Important designer, builder, or engineer
Philadelphia	6	38791	67101600200000	Closed Spandrel	<ul style="list-style-type: none"> •Multiple spans •Artistic value – outstanding ornamentation •Important designer, builder, or engineer
Philadelphia	6	38793	67101600301317	Closed Spandrel	•Artistic value – outstanding ornamentation
Philadelphia	6	38977	67301500520399	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Artistic value – outstanding ornamentation
Philadelphia	6	39000	67302300100000	Closed Spandrel	<ul style="list-style-type: none"> •Built before 1910 •Early example of type in the state •Artistic value – outstanding ornamentation •Important designer, builder, or engineer
Philadelphia	6	39033	67400100501334	Open Spandrel	<ul style="list-style-type: none"> •Uncommon type •Exceptional span length •Artistic value – outstanding ornamentation •Important designer, builder, or engineer

County	District	Bridge Key #	BMS #	Design	Significance
Philadelphia	6	39074	67401300201859	Open Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Uncommon type • Earliest example of type in the state • Earliest example of type in the district • Exceptional span length • Multiple span • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Philadelphia	6	39166	6773010000608	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – notable but isolated ornamentation • Important designer, builder, or engineer
Philadelphia	6	39104	67730100100293	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – notable but isolated ornamentation • Important designer, builder, or engineer
Philadelphia	6	39135	67730100300129	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Philadelphia	6	39136	67730100300173	Closed Spandrel	<ul style="list-style-type: none"> • Rare construction method • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Philadelphia	6	39235	67730101700093	Closed Spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Philadelphia	6	39251	67730102300283	Closed Spandrel	<ul style="list-style-type: none"> • Multiple spans • Artistic value – outstanding ornamentation • Important designer, builder, or engineer
Somerset	9	31849	55720603253024	Open Spandrel	<ul style="list-style-type: none"> • Uncommon type • Early example of type in the state • Earliest example of type in the district • Regionally rare
Westmoreland	12	36696	64401900700068	Closed spandrel	<ul style="list-style-type: none"> • Built before 1910 • Early example of type in the state • Earliest example of type in the district
York	8	38084	66720305253123	Closed Spandrel	<ul style="list-style-type: none"> • Early example of type in the state • Artistic value – notable but isolated ornamentation • Important designer, builder, or engineer

APPENDIX E BRIDGES THAT ARE RECOMMENDED NOT ELIGIBLE (DEMOTED) UNDER CRITERION C¹⁶

County	District	Bridge Key #	BMS #	Design
Allegheny	11	837	02006500900745	Closed Spandrel
Allegheny	11	1167	02037607540000	Open Spandrel
Allegheny	11	2162	02710812452266	Closed Spandrel
Allegheny	11	2230	02711820582616	Closed Spandrel
Berks	5	4610	06007300300000	Closed Spandrel
Berks	5	4661	06007802941480	Open Spandrel
Berks	5	5159	06301900101111	Closed Spandrel
Berks	5	5386	06722103920006	Closed Spandrel
Blair	9	5998	07740380123083	Closed Spandrel
Bucks	6	7257	09203700510277	Closed Spandrel
Bucks	6	7514	09700903620042	Closed Spandrel
Bucks	6	7526	09700903760050	Closed Spandrel
Dauphin	8	14386	22042200902197	Closed Spandrel
Dauphin	8	14741	22730140004019	Closed Spandrel
Erie	1	16397	25403200100249	Closed Spandrel
Erie	1	16510	25730288074052	Closed Spandrel
Indiana	4	35871	63721803550134	Closed Spandrel
Lawrence	11	22409	37200600320000	Closed Spandrel
Lebanon	5	23215	39100201401273	Closed Spandrel
Lehigh	6	39206	67730101000348	Closed Spandrel
Lehigh	6	39213	67730101100349	Closed Spandrel
McKean	2	25572	42720715180005	Closed Spandrel
Mifflin	2	26618	44720403230107	Closed Spandrel
Montour	3	28453	47720803620018	Closed Spandrel
Somerset	9	31645	55202200903000	Closed Spandrel
Somerset	9	31869	55721403383041	Closed Spandrel
Susquehanna	4	32530	57203200201403	Closed Spandrel
Susquehanna	4	32543	57204100900000	Closed Spandrel
Washington	12	34797	62100901201165	Closed Spandrel
Wyoming	4	37217	65102500200000	Closed Spandrel
York	8	37737	66203801100000	Closed Spandrel
York	8	38292	66742440004311	Closed Spandrel

APPENDIX F: CONCRETE ARCH STATE STANDARD DESIGN FROM 1918 TO 1941

Standard No.	Title	Approval Date	Webfile	Description/Remarks
S 227	Plain Concrete Arch. 6'-0" Span	1/8/1918	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old_Standards/S_Series/S_227.pdf	6' span
S 249	Reinforced Concrete Arch	3/27/1919	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old_Standards/S_Series/S_249.pdf	50' span, 16' 9" clear incised or paneled parapets end posts and center post scoring of spandrel wall

¹⁶ Geospatial data and images of demoted bridges can be found here:

To search for bridges on the website: Open the link, click on the filter option in the upper right corner, enter the bridge key number under demoted bridges, and turn the search function on by sliding the dot across from "Demoted Bridges" to the right. A demoted bridge will appear as a red diamond on the map and an image of the bridge can be viewed by clicking on the diamond. It may be necessary to zoom out of the map to access the crossing information for the bridge.

Standard No.	Title	Approval Date	Webfile	Description/Remarks
S 260	Reinforced Concrete Arch Span 50ft Clear 25ft	5/26/1919	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S 260.pdf	50' span, 25' clear incised or paneled parapets end posts and posts every two panels scoring of spandrel wall
S 256	Concrete Arch Bridge	5/29/1919	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S 256.pdf	24' span, 14' clear incised or paneled parapets end posts and center post Keystone scored into center post scoring of spandrel wall
S 246	Reinforced Concrete Arch Bridge	6/20/1919	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S 246.pdf	28' span, 10' 6" clear incised or paneled parapets end posts and center post scoring of spandrel wall
S 265	Reinforced Concrete Arch 60ft. Span 23ft. 6in. Clear	6/26/1919	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S 265.pdf	60' span, 23' 6" clear incised or paneled parapets end posts and posts every two panels scoring of spandrel wall First set of plans labeled "Standard"
S 269	Concrete Arch Bridge, 3-60ft. Spans.	7/15/1919	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S 269.pdf	3 spans 60' span 4% grade incised or paneled parapets end posts and posts every two panels Scoring above arch ring First plans with multi span
S 268	Concrete Arch. Bridge, Span 23ft. Clear Height 11'-9"	7/18/1919	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S 268.pdf	23' span, 11' 9" clear incised or paneled parapets end posts and center post 60° Skew First plans with a skew
S 284	Reinforced Concrete Arch Bridge, Span 50ft.	6/21/1920	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S 284.pdf	50' span incised or paneled parapets end posts over pilasters paneled parapet on abutment with end posts keystone scored in center
S 319	Reinforced Concrete Arch, 60ft Span 13ft Clear	6/6/1921	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S 319.pdf	60' span, 13' clear Incised or paneled parapet Panels have "bushhammered" finish Post between panels varies Labeled "Standard"
S-349	Plain Concrete Arch	12/9/1922	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S-349.pdf	20' 9" span, 11' clear Incised or paneled parapets End posts and center posts Panels have "bushhammered" finish Scoring above arch ring
S-359	Concrete Arch Bridge	6/8/1923	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S-359.pdf	14' span, 11' clear Incised or paneled parapets End posts Panels have "bushhammered" finish
S-367	Reinforced Concrete Arch	3/3/1924	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1918-1930 Vol. 1.pdf	Included in book of standards for old bridges (from 1918 to 1930) 20' spans
S-228	Concrete Arches	6/29/1925	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1918-1930 Vol. 1.pdf	Included in book of <i>Standards For Old Bridges (from 1918 to 1930)</i> 4' to 12' spans Incised or paneled parapets End posts
S-494	Reinforced Concrete Arch	7/11/1928	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S Series/S-494.pdf	28' span Parapet with rounded arch openings End posts

Standard No.	Title	Approval Date	Webfile	Description/Remarks
S-525	Reinforced Concrete Arch	7/3/1929	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S_Series/S-525.pdf	60' span, 18' rise Parapet has 5 panels w/ rd. arch openings separated by solid panel End posts
S-532	Reinforced Concrete Arch	7/17/1929	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S_Series/S-532.pdf	24' span, 12' rise No parapet
S-544	Reinforced Concrete Arch	8/9/1929	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/S_Series/S-544.pdf	70' span 60° Skew Parapet has 5 panels w/ rd. arch openings separated by solid panel End posts
S-228	Concrete Arches	12/1/1937	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1931-1940 Vol. 2.pdf	Included in book of <i>Standards For Old Bridges (from 1931 to 1940)</i> 6' – 16' span Labeled “standard” 6 – 8' span has paneled parapet w/ “bushhammered” 10' span or more has parapet panels w/ rd. arch openings
S-228-A	Reinforced Concrete Arches	12/1/1937	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1931-1940 Vol. 2.pdf	Same as S-228 above
S-705	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1941-1960 Vol. 3.pdf	Included in book of <i>Standards For Old Bridges (from 1941 to 1960)</i> 6' – 12' span 90° Skew 6 – 8' span has paneled parapet 10' -12 'span has parapet panels w/ rd. arch openings
S-705-45	Std Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1941-1960 Vol. 3.pdf	Same as above but with 45° skew
S-705-60	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1941-1960 Vol. 3.pdf	Same as above but with 60° skew
S-705-75	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1941-1960 Vol. 3.pdf	Same as above but with 75° skew
S-706	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1941-1960 Vol. 3.pdf	Included in book of <i>Standards For Old Bridges (from 1941 to 1960)</i> 14' – 16' span 90° Skew Parapet panels w/ rd. arch openings
S-706-45	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1941-1960 Vol. 3.pdf	Same as above with 45° skew
S-706-60	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1941-1960 Vol. 3.pdf	Same as above with 60° skew
S-706-75	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old Standards/Standards for Old Bridges 1941-1960 Vol. 3.pdf	Same as above with 75° skew

Standard No.	Title	Approval Date	Webfile	Description/Remarks
S-707	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old_Standards/Standards_for_Old_Bridges_1941-1960_Vol.3.pdf	Included in book of <i>Standards For Old Bridges (from 1941 to 1960)</i> 18' – 20' span 90° Skew Parapet panels w/ rd. arch openings
S-707-45	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old_Standards/Standards_for_Old_Bridges_1941-1960_Vol.3.pdf	Same as above with 45° skew
S-707-60	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old_Standards/Standards_for_Old_Bridges_1941-1960_Vol.3.pdf	Same as above with 60° skew
S-707-75	Concrete Arches	2/1/1941	http://www.dot.state.pa.us/public/Bureaus/BOPD/Bridge/Old_Standards/Standards_for_Old_Bridges_1941-1960_Vol.3.pdf	Same as above with 75° skew

Summary of Concrete Arch Standard Design

The first concrete arch bridge plan attributed to the Commonwealth of Pennsylvania State Highway Department, Bridge Division, is a 6' span plain concrete arch (S 227) dated 1918. The first concrete arch standard plan with a waterway opening greater than 20 ft. (S 249) was approved May 26, 1919 and is a 50 ft. span bridge with incised or paneled parapets, end posts, a center post and scored spandrel walls that accents the arch ring. Seven plans are approved in 1919 and include minor design changes such as parapets with a post between every two panels (S 260), scoring of the center post in the parapet with a keystone symbol (S 256), a multi span bridge (S 269), a skewed bridge (S 268) and the first set of concrete arch bridge plans labeled "standard" (S 265). Bridge plans remained the same until a "bushhammered" finish is noted on the parapet of a 60' span dated 1921 (S 319). This finishing technique was noted on plans through 1923.

In 1983, the Commonwealth of Pennsylvania Department of Transportation, Bureau of Highway Design, Bridge Division, compiled the standard designs into a three-volume book, *Standards For Old Bridges*. The first volume looks at bridges from 1918 to 1930 and includes only two plans for concrete arch bridges, one for a 20' span dated 1924 and one for 4' to 12' spans dated 1925. It is unknown why the earlier concrete bridge plans were not included in this compilation. Also not included are four plans from 1928 and 1929. Three of these plans are the first to exhibit a parapet composed of rounded arch openings instead of a solid panel (S-494, S-525, S-544).

Volume 2 of the *Standards For Old Bridges* compiles plans from 1931 through 1940 and includes plans for small span bridge of 12' or less with skews of 45°, 60°, and 75°. The smaller bridges (less than 8') have paneled parapets, whereas bridges over 8' have parapets composed with rounded arch openings. More standardization is seen in the Volume 3 which includes plans from 1941 to 1930. These bridges range in size from 6' to 20' with skews from 45° to 75°. Like those plans in Volume 2, parapet design is determined by the size of the bridge.

APPENDIX G: CONCRETE ARCH POINT SYSTEM

Category	Item	Subtype		Points to Assign
		Closed Concrete Arch	Open Concrete Arch	
1. Distinctive characteristics of type, period, or method of construction	A. Built before specified year	Built before 1910		7
	B. Method of Construction	Unreinforced concrete arch	None	7
	C. Distinctive type and/or uncommon type or Only known example in the state		Yes – uncommon type	7
	D. Early example in the State	Before 1911	Before 1915	7
	E. Early standard plan in the State	Three earliest bridges with state standard design after 1919		3
	F. Earliest example in PennDOT district	Earliest example in each district		4
	G. Rare – PennDOT Dist. (<= 3 bridges)	Not rare in any region	Rare in District 3, 8, 9 (None found in District 1, 2, 10, and 12)	3
2. Variation, evolution, and/or transition of a type	A. Exceptional length – main span	Greater than 120 feet	Greater than 200 feet	3
	B. Exceptional length – overall	Greater than 480 feet	Greater than 1000 feet	3
	C. Special feature/ innovations - important or unusual	Early ribbed closed arch up to 1920 (Ribbed bridges were not common in the state BK# 38360) Variable depth of the arch barrel (Sidewalk arch barrel is shallower than bridge barrel, see BK# 38287) Multiple Spans Substantial skew (45 degrees or greater) represents a construction method to address engineering challenges Application of tufa stone Main span incorporates multiple bridge type (metal truss or masonry arch)		3
	D. Special feature/ innovations – highly important or unusual	The patented Melan and Luten arch system reinforcing represents an important method of construction ¹		4
	E. Outstanding technological achievement	Multiple example from 2C and 2D above		7
3. High artistic value	A. Selected ornamentation, notable but isolated	Non- standard decorative railing with other aesthetic treatment, balustrade, parapets that curve to the contour of the arch ring, rusticated façade, brick or stone veneer, molded details or decorative brackets, obelisk, medallions, ornamental piers, caps or pilasters, ornamental lighting		3
	B. Outstanding ornamentation or architectural treatment in overall design	Multiple examples from 3A above		6
4. Work of a Master	A. Prolific or Important Designer/Builder/Engineer	See list of Designers/Builders/Engineers		3

¹ The Luten Company, Ferro Concrete Co. and Whitaker & Diehl Co. were agents licensed to build the Luten design. In the absence of original construction plans, methods to verify if a bridge is a Luten design would compromise the integrity of the bridge, therefore, bridges built by these companies were awarded points as possible Luten designs.