4. Recommendations for National Register Eligibility of Bridges Constructed Between 1947 and 1965 Applying *Criterion C*

Thirty bridges are recommended eligible under *Criterion C* related to engineering. Eligibility recommendations were determined by representatives of FHWA, NDOR, and SHPO. The section is organized according to bridge type. Each bridge type subsection includes a summary of prior inventory findings, recommendations for eligibility, and reasons for recommendations of not eligible. Lists of eligible and not eligible bridges, organized by county, are in Appendix B and D, respectively. Historic Bridge Inventory forms for eligible bridges are in Appendix C.

A. Metal truss bridges

The number of metal truss bridges identified in BISON for this study includes 113 structures, or 8 percent, of all bridges being evaluated. Truss bridges were well established prior to the subject period, with standard designs commonly employed for both state and county bridges. Of the 113 truss bridges in the subject period, 93 percent are currently county-owned structures; however, many of these are believed to have been built as state bridges and subsequently relocated and/or transferred to county ownership. The 87 truss bridges field-surveyed for their potential to be eligible for the National Register represent four truss types: Camelback, Parker, Warren, and Pratt. Truss bridges were chosen for field survey based on their configuration (truss type), arrangement (overhead, pony, or deck), and unusual main-span length or overall structure length. During field survey additional or special engineering and design features were identified. Five truss bridges were found to be replaced or under replacement, and two were found to be located on the Interstate system and subject to the Interstate Exemption. As a result, 80 truss bridges are discussed in this report.

Bridges were included in the study if BISON had a year-built or year-reconstructed date from 1947 through 1965. Bridges with a pre-1947 year-built date, but a 1947-1965 year-reconstructed date, were included in the study because the year-reconstructed date *may* indicate a new superstructure within the study period.[5] Field-survey and post-field-survey analysis, however, suggest that the year-built date is the accurate construction date for many metal truss bridges and the year-reconstructed date indicates a relocation or alteration.[6]

[5] The assignment of year-reconstructed dates in BISON is discussed further in Section 1.B above.

[6] The metal truss bridges selected for field survey involved several issues of complicated and inconsistent assignments of dates in BISON. Of the extant metal truss bridges selected for field survey, 36 have a year-built date that pre-dates the subject period and a year-reconstructed date between 1947 and 1965. Bridges that were built prior to 1947 are outside of the scope of this project and are understood to have been reviewed and evaluated as part of the 1991 *Nebraska Historic Bridge Survey* and the 1996 *Nebraska Historic Bridge Inventory Update*. Therefore, it is recommended that these bridges, with construction dates visually confirmed during field survey to be pre-1947, be excluded from additional evaluation. Truss bridges with a year-built date within the subject period include a number that are similar in appearance, including member size, to pre-subject-period trusses, suggesting that their year-built dates are not accurately recorded in BISON.

Camelback truss

One Camelback truss bridge, recorded in BISON with a year-built date of 1950, was evaluated in this study to determine its eligibility for the National Register. The Camelback, a subtype of the Pratt truss, was developed in the mid-nineteenth century and few were ever built in Nebraska. Character-defining features of the Camelback truss include the polygonal top chord with exactly five slopes in the upper chord and end posts, verticals in compression and diagonals in tension, and steel construction. The 1991 *Nebraska Historic Bridge Inventory* and the 1996 *Nebraska Historic Bridge Inventory Update* evaluated 17 early Camelback truss bridges, resulting in listing one in the National Register, which is extant. Because this bridge was reported to be built in 1950, it was not evaluated in previous studies.

One pin-connected through Camelback truss (C007802365) is recommended eligible for the National Register under *Criterion C*. Although this bridge has a 1950 construction date in BISON, field survey and analysis indicate a much earlier construction date, probably before 1920, judging from the light weight of the individual members and the use of pin connections. It is possible that the 1950 date represents the year that this bridge was relocated to its present site, although relocation was not determined by field survey. The bridge is a significant representative of this unusual and early truss type in Nebraska. It embodies the characteristics of the type and it retains integrity of materials, design, and workmanship.

Table 3
Eligible Camelback Truss

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
C007802365	SD00-337	1	Saunders	1950 (pre-1920 construction date assigned based on visual evidence)	Significant representative example of an early truss type that was uncommon in Nebraska.

Parker truss

Seven Parker truss bridges were identified for field survey. Of these, two have an assigned year-built date before 1947 and five have an assigned year-built date within the subject period. The Parker truss, a long-span subtype of the Pratt truss, was developed in the mid-nineteenth century; however, the bridge type was never commonly used in Nebraska. The 1991 *Nebraska Historic Bridge Inventory* and the 1996 *Nebraska Historic Bridge Inventory Update* evaluated 14 early Parker truss bridges; four were determined eligible for the National Register, of which three are extant.

The Parker trusses were surveyed because they represent a truss configuration not commonly used in Nebraska. Character-defining features of the Parker truss during the subject period include the polygonal top chord, verticals in compression and diagonals in tension, inclined end posts, steel construction, heavier bridge members, gusset plates at the connections, and rigid (usually riveted) connections.

None of the Parker truss bridges constructed during the subject period are recommended eligible for the National Register under *Criterion C* because they are undistinguished examples of an established bridge type with no distinctive engineering features; three were built using NDOR's standard detail plans.

Pratt truss

The Pratt truss was developed in the mid-nineteenth century and used in Nebraska throughout the subject period. The 1991 *Nebraska Historic Bridge Inventory* and 1996 *Nebraska Historic Bridge Inventory Update* identified 442 early Pratt truss bridges; 30 were determined eligible for the National Register. Of these, 22 are extant. For this study, 59 Pratt trusses, including 50 pony trusses and nine overhead trusses, were identified for field survey and further consideration for National Register eligibility based on overhead arrangement, connection type, and unusual length of main span or structure. Character-defining features of the Pratt truss during the subject period include the Pratt truss arrangement, verticals in compression and diagonals in tension, parallel top and bottom chords, heavier members, gusset plates at connections, and pinned or riveted (rigid) connections. Of the 59 Pratt truss bridges surveyed, 25 with reconstruction dates within the subject period were confirmed to have been constructed prior to the subject period and thus had been evaluated in previous studies. The remaining 34 have year-built dates during the subject period; however, field survey and analysis indicated that many were constructed prior to 1947. Because these bridges were reported to be built post-1946, they were not evaluated in previous studies. Of the Pratt trusses constructed during the subject period, five are recommended eligible for the National Register for the engineering features they incorporate in this established bridge type.

Two Pratt trusses (S094 00025, Thurston County; S067 05206, Otoe County) are recommended eligible for the National Register under *Criterion C* as long examples of the rigid-connected (riveted) Pratt through-truss type with a skewed portal, which is a special engineering design feature. Constructed in 1951 and 1955, both have main spans longer than that of the previously listed trusses, indicating engineering that pushes the design to its maximum limit. The skewed portal is a significant engineering variation on the traditional skewed truss. In the conventional approach, the two truss units in the structure are offset, thus creating a skew (with skewed floor beams) for the entire length of the bridge. In these two examples, the trusses are aligned for all panels (with perpendicular floor beams) except the end panels, which are skewed. Both bridges retain integrity of materials, design, and workmanship.

Bridge C007614620 is recommended eligible for its exceptional engineering for the type, involving number of spans and length of main span. Most rigid-connected Pratt pony truss bridges are single spans or single main spans with girder (non-truss) approach spans. This bridge includes three rigid-connected (riveted) Pratt pony-truss spans. In addition, this example has a main span of 101 feet, which is exceptionally long for a pony truss and especially a pony truss with parallel top chords instead of polygonal top chords. It retains its integrity of materials, design, and workmanship.

Bridges C001123405 and C001111435, Burt County, are recommended eligible because they demonstrate a significant technological innovation within the bridge type. Both bridges, constructed in 1960 and 1961, respectively, have welded connections instead of pinned or riveted connections. Each truss of each bridge was fabricated offsite in two all-welded halves using rolled beams. The halves were transported to the site and bolted together during the erection process. While all-welded bridge fabrication was employed nationally beginning in the 1930s and 1940s, it was rarely used in Nebraska and then usually for built-up girder bridges. Welded connections required a testing technology to ensure safe and secure welds, and bridge welding was beyond the capability of general welding shops. These two examples are the only all-welded truss bridges identified in Nebraska. In addition to representing an innovative technology, they also point to the existence of a local or regional fabricator with the sophisticated arc-welding capability necessary for safe bridge work. Both bridges retain integrity of materials, design, and workmanship.

The remaining Pratt truss bridges are recommended as not eligible for the National Register under *Criterion C*. These were determined not eligible because they are undistinguished examples of an established bridge type without any indication of distinctive engineering features.

Table 4
Eligible Pratt Truss

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
S094 00025	TS00-101	3	Thurston	1955	Unusual span or structure length indicating exceptional engineering for the site; skewed portal is a special engineering feature.
S067 05206	OT05-011	1	Otoe	1951	Unusual span or structure length indicating exceptional engineering for the site; skewed portal is a special engineering feature.
C007614620	SA00-207	1	Saline	1961 (pre-1940 construction date assigned based on visual evidence)	Exceptional engineering reflected in three-span structure with unusually long main span for type.
C001123405	BT00-099	3	Burt	1960	All-welded truss fabrication represents a rare Nebraska example of an innovative technology.
C001111435	BT00-098	3	Burt	1959	All-welded truss fabrication represents a rare Nebraska example of an innovative technology.

Warren truss

The Warren truss was developed in the late nineteenth century and continued to be used into the subject period. The 1991 *Nebraska Historic Bridge Inventory* and 1996 *Nebraska Historic Bridge Inventory Update* evaluated 46 early Warren truss bridges; 12 were determined eligible for the National Register, of which seven are extant. Warren trusses from the subject period were selected for field survey under *Criterion C* if they represented an unusual arrangement (overhead), length greater than 100 feet for pony trusses, or 160 feet for overhead trusses. Twelve Warren trusses were identified for field survey and further consideration for National Register eligibility. Six of the field survey bridges were constructed prior to the subject period and have a reconstructed date within the subject period. These are not being reevaluated because their design and construction are consistent with those pre-dating the subject period and they were included in the earlier study. Six have a year-built date within the subject period and these have been evaluated for National Register eligibility. Most of these are similar in design and construction (including member size) to pre-1947 Warren trusses. Character-defining features of the Warren truss during the subject period include parallel top and bottom chords, inclined end posts, diagonals in tension, heavier members, steel construction, gusset plates at the connections, and riveted connections. Significant variations of the Warren truss type include polygonal top chords, double-intersection trusses, and deck-truss arrangements.

One Warren truss bridge (C007423310, Richardson County) is recommended eligible for the National Register under *Criterion C* because it represents a significant variation of features within the bridge type. Bridge C007423310 features a polygonal top chord, a significant variation within the type, and a long main span (100 feet) that represents the maximum span length for the type in the subject period. The bridge retains its integrity of materials, design, and workmanship.

The other Warren truss bridges are recommended as not eligible for the National Register under *Criterion C*. These bridges were determined not eligible because they are undistinguished examples of an established bridge type and do not have distinctive engineering features.

Table 5
Eligible Warren Truss

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
C007423310	RH00-540	1	Richardson	1953	Polygonal top chord represents significant variation within type; span length represents maximum possible for this type.

Prefabricated modular truss

One prefabricated modular truss was identified for field survey and further consideration for National Register eligibility. Prefabricated modular designs were developed largely in the 1930s for temporary crossings, usually for military use. The most well-known example is the Bailey Bridge, patented in 1934 by Sir Donald Bailey, a British military engineer. Variations of the Bailey Bridge

continue to be used today, as are other types of prefabricated trusses, some of which were developed for civilian use. The 1991 *Nebraska Historic Bridge Inventory* and the 1996 *Nebraska Historic Bridge Inventory Update* did not evaluate prefabricated modular bridges.

The modular truss bridge (C005401905P, Knox County) was selected for field survey under *Criterion C* because it is an uncommon type and is recommended eligible for the National Register under *Criterion C*. Bridge C005401905P is the only prefabricated modular truss identified in Nebraska. It is not a Bailey Bridge, although it is similar in concept and function. It retains integrity of materials, design, and workmanship. This bridge appears to be a World War II or post-war, prefabricated modular bridge, designed for easy assembly, disassembly, and relocation. It can be utilized in different span lengths, depending on the number of modules employed. The modules, which are manufactured as truss-end units (with one sloped chord) or as center-span units (parallel chords), are joined together with large cotter-pin connectors. The size and connection of module members allow the truss to be erected in either a deck or pony truss arrangement, thus adding to the flexibility of the design. The Nebraska example is installed in a deck-truss arrangement, making it particularly unusual because deck trusses of any type are rare both in Nebraska and nationally. Following an informal national search among bridge historians and preservationists, similar prefab modular examples of this bridge were identified in Arkansas and Texas. The two Arkansas examples are listed in the National Register, but none of the examples have documented the original fabricator, manufacturer, designer, or date of current installation.

Table 6
Eligible Prefabricated Modular Truss

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
C005401905P	KX00-358	3	Knox	1946/1965	Nebraska's only example of a prefabricated modular truss design that is uncommon nationally.*

***** Also recommended eligible under *Criterion A,* see Section 5.

B. Slab and beam/girder bridges

Concrete slab

Of the 235 concrete slabs in BISON from the subject period, 27 examples were identified for field survey because of their unusual length and/or number of spans, and were evaluated under *Criterion C.* The concrete slab bridge type was introduced prior to the subject period and was a prevalent bridge type in Nebraska both before and during the subject period. The character-defining feature of this type is the cast-in-place, reinforced concrete, flat slab. The 1991 *Nebraska Historic Bridge Inventory* and 1996 *Nebraska Historic Bridge Inventory Update* reviewed 16 concrete-slab bridges, resulting in National Register listing of one example, which is extant.

The concrete-slab bridges reviewed for this study are recommended as not eligible for the National Register under *Criterion C* because they are common examples of an established bridge type without any indication of distinctive engineering features.

Concrete multi-beam

Of the 20 concrete multi-beam bridges in BISON from the subject period, three were selected for field survey because of their unusual length and/or number of spans, and were evaluated for the National Register under *Criterion C.* The multi-beam type was introduced prior to the subject period and was a prevalent bridge type in Nebraska. The character-defining feature of this type is multiple (three or more) reinforced concrete beams, each equally supporting, but not integrated with, the deck, which only distributes live loads to the girders. The 1991 *Nebraska Historic Bridge Inventory* and 1996 *Nebraska Historic Bridge Inventory Update* did not consider concrete multi-beam bridges, even though there are examples with pre-1947 year-built dates. This bridge type was commonly used after 1965.

Of the three bridges field-surveyed, one was identified as a channel beam and one as a tee beam, thus moving each from the multi-beam discussion to its correct type, where it is now included in the discussion. The third bridge, plus one additional bridge (recorded in BISON as a concrete girder and floor beam system bridge, but identified during field survey as a concrete multi-beam), are recommended not eligible for the National Register under *Criterion C* because they do not represent technological or engineering advances for the type or have distinguishing technological features.

Concrete girder and floor beam system

Two concrete girder and floor beam system structures were recorded in BISON and selected for field survey. Field survey identified one as a concrete multi-beam and the other as a prestressed concrete girder; each is now included in the discussion of its type. As a result, no concrete girder and floor beam system bridges were identified within the subject period.

Concrete tee beam

Of the 13 concrete tee beams recorded in BISON for the subject period, eight were selected for field survey because of their unusual length and/or number of spans, and were evaluated under *Criterion C*. The concrete tee-beam bridge type was introduced prior to the subject period and was a common bridge type in Nebraska. The character-defining feature of the concrete tee beam is a slab integrated with longitudinal beams to create a tee section. The 1991 *Nebraska Historic Bridge Inventory* and 1996 *Nebraska Historic Bridge Inventory Update* did not consider concrete tee-beam bridges. Although constructed in limited numbers during the subject period, BISON records 76 concrete tee beams constructed after 1965.

One concrete tee beam (S006 30732, Lancaster County) is recommended eligible for the National Register under *Criterion C* as a significant representative example of the concrete tee-beam type with an exceptional structure length. The bridge is an intact variable-depth concrete continuous structure with three spans and a 160-foot overall length. The structure length indicates an engineering design at an exceptional length for this type in order to accommodate site-specific

issues at the crossing. The variable-depth beams are designed with an aesthetically pleasing curve along the beam soffit, or bottom edge, a design element requiring additional design and construction effort and expense. The bridge retains integrity of materials, design, and workmanship.

Table 7
Eligible Concrete Tee Beam

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
S006 30732	LC00-144	1	Lancaster	1954	Bridge includes special feature of variable-depth beams with curved bottom edges, indicating additional engineering effort and expense for special aesthetic effect for this bridge type; structure length also indicates additional engineering and construction effort to accommodate this site.

Concrete rigid frame

The four concrete rigid-frame bridges recorded in BISON for the subject period were selected for field survey because they represent an uncommon type with limited use during the subject period, and were evaluated under *Criterion C.* The concrete rigid-frame bridge type was established prior to the subject period. The character-defining feature of the concrete rigid frame is the integrated design and construction of the vertical and horizontal elements, creating one homogenous unit. The previous 1991 *Nebraska Historic Bridge Inventory* and 1996 *Nebraska Historic Bridge Inventory Update* identified nine rigid-frame structures, resulting in six National Register listings; all are extant.

The four concrete rigid frames were determined not eligible for the National Register under *Criterion C* because they are common examples of an established bridge type with no distinctive engineering features. Although these examples are longer and have more spans than previously listed rigid frames, they post-date the period of significance for this bridge type (1920s-1950). The four rigid frame examples also lack the aesthetic treatment found in earlier examples.

Concrete channel beam

The three concrete channel beams recorded in BISON for the subject period were selected for field survey because of their uncommon type and limited use during the subject period, and were evaluated under *Criterion C.* The concrete channel beam bridge type was established prior to the subject period. The character-defining feature of this type is the use of adjacent, inverted-U-section, reinforced concrete beams. The channel-beam bridge can be distinguished from a tee-beam bridge by the longitudinal seam or joint visible along the soffit or bottom edge of each beam-like element (stem) in the superstructure, reflecting the separation between adjacent channel beams. The previous 1991 *Nebraska Historic Bridge Inventory* and 1996 *Nebraska Historic Bridge Inventory*

Update did not consider concrete channel beam bridges. Constructed in extremely limited numbers during the subject period, the concrete channel beam remained an uncommon type after the subject period. BISON records only 37 concrete channel beams constructed after 1965. Engineers considered the channel beam formwork to be more complicated and expensive, and therefore less desirable than other, simpler, types of concrete beams.

Of the three concrete channel beam bridges, one was determined to post-date the subject period.[7] The two remaining concrete channel-beam bridges (C005303505, Kimball County; and C005506445, Lancaster County) are recommended eligible for the National Register under *Criterion C* as early, significant examples of an uncommon bridge type during the subject period. Both bridges retain integrity of materials, design, and workmanship.

Table 8
Eligible Concrete Channel Beam

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
C005303505	KM00-102	5	Kimball	1960	Significant, early example of this uncommon type.
C005506445	LC00-138	1	Lancaster	1963	Significant, early example of this uncommon type.*

***Also recommended eligible under *Criterion A*, see Section 5.

Concrete continuous box beam

The two concrete continuous box beam bridges in BISON were identified for field survey because they are an uncommon type, and were evaluated under *Criterion C.* The concrete continuous box beam bridge type was introduced prior to the subject period, but was not commonly used in Nebraska or nationally before 1950. According to *Concrete Box Girder Bridges*, published in 1977 by the American Concrete Institute and Iowa State University Press, only four states constructed box-beam bridges before 1950, although their popularity had increased nationally by the 1960s, particularly in the west. The reinforced concrete box beam type is not included in the national historic bridge study, *A Context for Common Historic Bridge Types*, prepared in 2005 for the Transportation Research Council. The previous 1991 *Nebraska Historic Bridge Inventory* and 1996 *Nebraska Historic Bridge Inventory Update* did not consider concrete box beam bridges. No bridges of this type are recorded in BISON prior to the subject period, and a limited number (18) are recorded with year-built dates after 1965.

[7] Subsequent to field survey, information from the Scotts Bluff county engineer determined that bridge C007934910 was built in 1975, not 1965 as recorded in BISON. This bridge, therefore, is outside the subject period and has been excluded from further consideration.

The character-defining feature of the concrete box beam is the hollow, box-shaped, longitudinal beam, which was designed and arranged in many variations, including round or rectangular interior void, variable depth or not, with or without deck, and adjacent or spread.

Both concrete continuous box beams (S012 08127, Keya Paha County and S012 20744, Cedar County) are recommended eligible for the National Register under *Criterion C* because they are the earliest known extant examples of the concrete continuous box beam type in the state. Both have variable depth box beams with curved soffits, giving each design an aesthetically pleasing appearance. Both bridges retain integrity of materials, design, and workmanship.

Table 9
Eligible Concrete Continuous Box Beam

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
S012 08127	KP00-103	8	Keya Paha	1957	Significant example of this uncommon type; earliest example in Nebraska, with aesthetic treatment.
S012 20744	CD00-334	3	Cedar	1959	Significant example of this uncommon type; earliest example in Nebraska, with aesthetic treatment.

Steel beam and girder bridges

Simple, cost-effective, and easily widened, steel beam and girder bridges were widely used by both state and county highway engineers in Nebraska. BISON includes 618 bridges from this subject period, by far the largest proportion (44 percent), by type, of the bridges erected in Nebraska from 1947 to 1965. Because many have been altered over the years by rebuilding substructure elements, widening decks, and replacing railings, 125 were selected for field survey. During field survey, four bridges were identified to be replaced or were in the process of replacement and therefore did not require evaluation.

As identified in BISON, steel beam and girder bridges are subdivided into four primary types: non-continuous (simple) spans with multiple beams or girders (type 302), continuous spans with multiple beams or girders (type 402), non-continuous (simple) spans with floor beam systems (type 303), and continuous spans with floor beam systems (type 403). Characteristic features of these four types were introduced long before the subject period and all were established bridge types by 1947. In the 1991 *Nebraska Historic Bridge Inventory* and the 1996 *Nebraska Historic Bridge Inventory Update,* the floor beam system is identified as a transverse-joist system.

The bridges with floor beam systems (303 and 403) have two large longitudinal beams or girders at the outside edges of the deck and employ an arrangement of floor beams and stringers between the girders to support the deck. This two-girder with floor beam system was used less frequently as the

multi-beam design (302 and 402) grew in popularity during the subject period. In the multi-beam design (302 and 402), which has three or more longitudinal beams of equal depth and no floor beams or stringers, the multiple beams support the deck directly, without floor beams and stringers. The advantages of this design over the floor beam design are two-fold: it requires less material and labor and the additional beams provide built-in redundancy.

Most of Nebraska's steel beam and girder bridges have a deck-girder configuration. A through-girder configuration can exist only in the two-girder, floor system design (303 and 403) and is rare in highway bridge design. In steel beam-and-girder bridges with multiple spans, cantilevering may be used, as well as continuous design, to achieve longer spans with greater economy. Both continuous and cantilever features were introduced in the 1930s. Because these innovations pre-date the subject period, their use in subject-period bridges is less significant than a newly introduced material or technique.

Steel beams and girders are produced by two methods, rolled and built-up, both developed in the mid-nineteenth century. Rolled I-beams were first used for American highway bridges after World War I, and Nebraska began using I-beams for spans up to 75 feet in 1927. When a bridge design requires a beam that is larger than a steel rolling mill can produce, the member is fabricated or "built up" by assembling steel plates into an I-beam section with flange plates at the top and bottom and a web plan between the flanges. When it is built-up in this way, the member is generally known as a girder instead of a beam. Built-up girders are more expensive than comparable rolled beams because they require more material and labor, and, therefore, are less commonly used. They are found in longer-span bridges, for the most part.

Until arc welding was used in the 1930s, riveting was the only method for assembling built-up bridge girders. Welded girders were more cost-effective than riveted girders because web and flange plates could be welded together directly, without the use of angle sections required by the riveting method to make the connections. Thus, the amount of materials and labor was reduced. New testing technology was required to verify safe and permanent welds, but once the testing techniques were established, and national welding specifications distributed, welding became the accepted technology for fabrication of built-up girders. Welding for highway bridges in the US lagged behind Europe, where all-welded bridge construction was developed in the 1930s. Bridge welding was a latecomer to the US and Nebraska, where built-up girders continued to be riveted through the 1940s and, occasionally, into the 1950s. Nebraska constructed its first all-welded, plate-girder bridge in 1953, followed by additional examples through the 1950s and after. Welding is the only innovative material or technology for steel beam and girders introduced during the subject period.

Steel beam-and-girder bridges were evaluated for National Register eligibility based on their beam-girder type (rolled or built-up), technology (welded or riveted), age, span length, and design features. For the purpose of this study, an all-welded bridge is defined as one with girders fabricated by welding.

Steel rolled-beam bridges

Of 125 steel beam-and-girder bridges selected for field survey, 102 were fabricated with rolled I-beams. The four bridges described below are recommended as eligible for the National Register.

Two simple-span, steel beam bridges with unusual prefabricated jack-arch deck systems (C001424535, Cedar County, and C008900605, Washington County) are recommended eligible for the National Register under *Criterion C*. Widely used in other states since the 1920s, typical jack-arch bridges consist of a series of longitudinal steel beams that support longitudinal corrugated steel vaulting. The vaulting rests on the lower flanges of the beams and serves as permanent formwork for reinforced concrete deck slabs. A set of standard plans in NDOR files suggest that Nebraska's jack-arch bridges may have utilized prefabricated jack-arch panels patented by Carl Erickson, an engineer for the Lincoln Steel Works. These are the only jack-arch bridges identified in the survey.

One five-span, steel beam bridge (S053 00412, Thayer County) is recommended eligible for the National Register under *Criterion C* as an early example of a design that utilizes cantilever and continuous spans, a combination of special engineering features. With unaltered sheet pile and concrete piers and intact original railings, this bridge retains excellent integrity.

A cantilevered steel stringer bridge with a floor beam system (C007600505, Saline County) is recommended eligible for the National Register under *Criterion C*. The structure's retention of the typically older two-girder/floor beam system, and unusually short cantilever arms, represents one county's adaptation of the cantilever designs developed by state highway engineers during subject period.

The remaining steel rolled-beam bridges are recommended as not eligible for the National Register under *Criterion C* because they are simple, undistinguished, single-span examples of an established bridge type and there is no evidence of engineering innovation or special features.

Table 10
Eligible Steel Rolled-Beam Bridges

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
C001424535	CD00-332	3	Cedar	1955	One of two bridges in Nebraska to utilize a patented jack-arch prefabricated deck system, representing an innovation within this type.
C008900605	WN00-261	2	Washington	1955	One of two bridges in Nebraska to utilize a patented jack-arch prefabricated deck system, representing an innovation within this type.
S053 00412	TY00-270	4	Thayer	1947	Significant early and highly intact example of a combined cantilever/continuous-span design.
C007600505	SA00-203	1	Saline	1950	Significant county adaptation of cantilever design, with extremely short cantilever arms and simple pinned hinges.

Steel built-up girder bridges

Nineteen beam-and-girder bridges were determined to have superstructures with built-up girders and were field-surveyed. Of that number, 15 were determined to have all-welded girders and four were determined to have riveted girders. No built-up girder bridges in this group followed standard plans for superstructures, although the state-designed bridges used some details from standard plans.

The 15 all-welded examples include bridges with year-built dates from 1953 through 1965. The earliest example (C007403435P, Richardson County) was built in 1953 and is recommended eligible for the National Register under *Criterion C*. It is the earliest known all-welded steel girder bridge in the state and is contemporaneous with Nebraska's first all-welded state bridge, which was discussed in the NDOR annual report at the time.[8] This 305-foot, three-span, skewed, continuous structure has three lines of welded, built-up girders with diaphragms. The girders are slightly deeper over the piers. Although the original railing has been replaced, the bridge retains complete design and construction integrity for the welded, built-up girders and sufficient historic integrity to be eligible for the National Register.

[8] This state bridge was identified in NDOR annual reports without locational information and was not identified in an analysis of BISON. Therefore, it is believed to be nonextant.

Bridge S050 00179 (Pawnee County) is a significant representative example of the state-designed, all-welded, steel girder type and is recommended eligible for the National Register under *Criterion C.* It also is the earliest extant state example of the all-welded steel girder type. This multi-girder (type 302) bridge has four all-welded, built-up girders with steel diaphragms, composite decks, and concrete abutments. It retains its original No. 10 gage, Flex-Beam guard railings. It retains complete design integrity and is believed to be one of a group of early, all-welded girder bridges completed or under contract by the state by 1956, according to an NDOR annual report.

Bridge S044 05113, an urban viaduct in Kearney, Buffalo County, is recommended as eligible for the National Register under *Criterion C*. It represents an innovative use of welding to create a built-up girder that has adequate load-carrying capacity, but is shallow enough to conform to under-deck clearance requirements and bridge height and length constraints. With a 26-inch web, the all-welded, built-up girders are within the general size range for rolled beams, but are fabricated to specifications apparently not available in rolled beams. With the exception of a replaced railing, the bridge retains full design integrity.

Among the four field-surveyed bridges with steel, riveted, built-up girders, one is a continuous multi-girder type (402), one is a continuous girder with floor system (403), and two are single-span, through-girder types with floor beam systems (303). The continuous deck-girder bridges are examples of a type that pre-dates the subject period and for which earlier examples are extant. These bridges are recommended not eligible.

The two through-girders (C007601330, Saline County, and C007801415, Saunders County) are rare surviving examples of an “important indigenous Nebraska structural type,” according to the 1996 *Nebraska Historic Bridge Inventory Update* and are recommended eligible for the National Register under *Criterion C*. Similar steel through-girders (not viaducts) identified in the 1996 study were dated from 1923 to 1931 and the sole surviving example from that study is dated 1923. According to BISON, Bridge C007601330 has a year-built of 1927 and a year-reconstructed of 1960, and Bridge C007801415 has a year-built of 1965 with no year-reconstructed date. The construction dates of these bridges are uncertain and it is possible that they predate the subject period and were relocated to their current sites in the 1960s. The two bridges have very similar built-up through girders, as each is constructed of steel plates with both vertical and horizontal riveted seams. The deck is located just below the horizontal seam, which is at the mid-point of each of the girders.

The other steel built-up girder bridges are recommended as not eligible for the National Register under *Criterion C*. These were determined not eligible because they are undistinguished examples of an established bridge type. They continue the built-up girder technology exemplified best in the eligible earlier examples and show no evidence of engineering innovation or special features.

Table 11
Eligible Steel Built-Up Girder Bridges

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
C007403435P	RH00-538	1	Richardson	1953	Earliest all-welded steel girder bridge in Nebraska, erected same year as earliest welded state bridge. Significant representative county example of type.
S050 00179	PW00-357	1	Pawnee	1954	Earliest extant all-welded state bridge with substantial integrity.
S044 05113	BF05-658	4	Buffalo	1960	A viaduct featuring innovative use of welding to fabricate a series of built-up girders of varying plate sizes to accommodate site constraints.*
C007601330	SA00-204	1	Saline	1927/1960 (1927 is believed to be the construction date; 1960 is believed to be a relocation date)	Rare survivor of indigenous Nebraska bridge type (riveted steel through-girder).
C007801415	SD00-335	1	Saunders	[c1927]/1965 (c1927 construction date assigned based on visual evidence; 1965 is believed to be a relocation date)	Rare survivor of indigenous Nebraska bridge type (riveted steel through-girder).

***** Also recommended eligible under *Criterion A*, see Section 5.

Timber stringer

Of the 293 timber stringers in BISON from the subject period, 14 timber stringer bridges were identified for field survey because of their unusual length and number of spans, and were evaluated under *Criterion C.* The timber stringer bridge type was introduced prior to the subject period and was a prevalent bridge type in use in Nebraska. The character-defining feature of this type is the use of

longitudinal timber beams. The 1991 *Nebraska Historic Bridge Inventory* and the 1996 *Nebraska Historic Bridge Inventory Update* found two timber stringer bridges eligible for the National Register. Both bridges have been replaced.

One timber stringer (C003744110, Gosper County) is recommended eligible for the National Register under *Criterion C*. This bridge is recommended eligible because it is a significant representative example of the timber stringer type with a long structure length (154 feet). It illustrates the county's effort to solve an engineering problem by simple and economical means. The structure length indicates an effort by the county to achieve maximum use of this simple, inexpensive bridge type. Bridge C003744110 retains integrity of materials, design, and workmanship. This would be the state's only National Register-eligible example of the timber-stringer type, which was widely used by Nebraska counties.

The other timber stringers are recommended not eligible for the National Register under *Criterion C* because of altered substructures, added main members, or other alterations affecting historical integrity. Moreover, all are undistinguished examples of an established bridge type without any indication of distinctive engineering features.

Table 12
Eligible Timber Stringer

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
C003744110	GO00-061	7	Gosper	1963	Significant representative example of an economical bridge type widely used by counties, with long overall structure length.

C. Prestressed concrete bridges

Prestressed concrete bridge design was introduced nationally in the 1950s, following the 1949 construction of the first prestressed concrete bridge in the US, the Walnut Lane Bridge in Philadelphia, Pennsylvania. The introduction of prestressed concrete to bridge design is a significant technological advancement within the subject period. Prestressed concrete components were manufactured and used in Nebraska in the mid-1950s. Standard plans for prestressed concrete bridges were not fully developed by NDOR until 1958.

At least two companies supplied NDOR and county highway departments with prestressed concrete structural members for bridge projects in the 1950s. Wilson Concrete Company began operations in 1905 in Red Oak, Iowa, and was the first producer of reinforced concrete pipe in the US. The company expanded to include 17 operations in prestressed concrete products, concrete pipe, and pre-mix concrete in the Midwest. Three of Wilson Concrete Company's four prestressed concrete plants were located in Nebraska, two in Omaha, and one in Grand Island. Wilson Concrete was one of the first companies in the US to use prestressing metal strands in its concrete products.

Nebraska Prestressed Concrete Company (NPCC) in Lincoln was founded in 1955 to supply prestressed concrete bridge components for the new Interstate System. From the beginning, NPCC supplied prestressed bridge beams for state and county projects in Nebraska. The company also produced prestressed structural materials for many types of buildings in Nebraska and other states. The company continued to grow throughout the 1960s and 1970s, and became Concrete Industries, Inc. in 1974.

Prestressed concrete multi-beam

Of the 98 prestressed concrete multi-beam bridges in BISON within the subject period, 22 were identified for field survey because of their early (pre-1960) construction date, representing the introduction of this material and technology in Nebraska, and exceptional span length, and were evaluated under *Criterion C.* The prestressed concrete multi-beam type was introduced during the subject period as a technological innovation in concrete and first used in Nebraska in 1955. However, prestressed concrete bridges generally represent a relatively small number of bridges constructed in Nebraska during the subject period. Prestressed concrete became a more prevalent construction material after the subject period. The character-defining feature of this type is the use of prestressed concrete beams, the essential component of the superstructure, supporting a concrete deck slab.

Two prestressed concrete multi-beam bridges are recommended eligible for the National Register under *Criterion C*. Bridge S022 06567, Nance County, is recommended eligible because it has been identified as a significant early representative example of the type in the state. The bridge was built in 1957, prior to NDOR's issuance of its first standard plan for prestressed concrete beams (1958). The bridge retains integrity of its essential superstructure component, the prestressed concrete beams; the original railing has been replaced with a concrete barrier railing, which does not alter the historic engineering integrity.

Bridge S080 23113 in Dawson County, built in 1964, is recommended eligible because it represents a complex engineering solution applied to a specific location. This location required a curved roadway at the crossing. A prestressed concrete beam cannot be curved, but a curved deck can be built on a prestressed concrete beam superstructure, an engineering feature that is more difficult and expensive to design and build than a straight deck. This bridge has the only curved deck on a prestressed concrete superstructure identified in the state within the subject period. Standard plan 1660-C was modified to accommodate the super-elevated deck curve.

The other prestressed concrete beam bridges are recommended not eligible for the National Register under *Criterion C* because year-built dates post-date NDOR's first standard plan for prestressed concrete girders (1958), resulting in examples of an established bridge type without distinctive engineering features.

Table 13
Eligible Prestressed Concrete Beam

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
S022 06567	NC00-189	4	Nance	1957	Significant, early representative example of the use of prestressed concrete in Nebraska, a new bridge material and technology.
S080 23113	DS00-047	6	Dawson	1964	Significant example of a special site-specific engineering feature: a curved deck on a prestressed concrete beam superstructure.

Prestressed concrete tee beam

The two prestressed concrete tee beams in BISON were identified for field survey as uncommon types during the subject period and were evaluated under *Criterion C*. The prestressed concrete tee beam bridge type was introduced during the subject period as a technological innovation in concrete. Prestressed concrete bridges represent a relatively small number of bridges constructed in Nebraska during the subject period. After the subject period, usage of the prestressed concrete tee beam increased and the type became more prevalent. The character-defining feature of the prestressed concrete tee beam is a slab integrated with longitudinal beams.

One prestressed concrete tee beam (C008910905, Washington County) is recommended eligible for the National Register under *Criterion C*. This bridge is recommended eligible because it is one of the earliest extant examples of the use of prestressed concrete in bridge design and construction in Nebraska. It also is an early example of the prestressed concrete tee-beam type from the subject period. Although constructed in extremely limited numbers during the subject period, 441 prestressed concrete tee beams were constructed after 1965 according to BISON.
Bridge C008910905 retains its integrity of materials, design, and workmanship.

Table 14
Eligible Prestressed Concrete Tee Beam

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
C008910905	WN00-271	2	Washington	1955	Significant early representative example of the use of prestressed concrete in Nebraska and for this type.

Prestressed concrete channel beam

The two prestressed concrete channel beams in BISON from the subject period were identified for field survey as an uncommon type and were evaluated under *Criterion C.* The prestressed concrete channel beam bridge was introduced during the subject period as a technological innovation in

concrete, expanding the span-length capability of the earlier reinforced concrete channel beam that was not prestressed. Prestressed concrete bridges represent a relatively small number of bridges constructed in Nebraska during the subject period and the prestressed channel beam in particular was rarely used. Historically, it appears that the channel beam was a transitional type as engineers and fabricators moved toward prestressed box beams and double-tee beams. The character-defining feature of this type is the incorporation of adjacent, inverted U-section, prestressed beams.

Both prestressed concrete channel beams (C007203810, Polk County and M018503610, Morrill County) are recommended eligible for the National Register under *Criterion C* as significant early examples of an uncommon bridge type from the subject period. The prestressed concrete channel beam never has become a prevalent bridge type in Nebraska and there are no post-1965 prestressed concrete channel beams recorded in BISON. Both bridges retain their integrity of materials, design, and workmanship.

Table 15
Eligible Prestressed Concrete Channel Beams

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
C007203810	PK00-218	4	Polk	1956	Significant early example of uncommon type in Nebraska utilizing new material and technology.
M018503610	M003-063	5	Morrill	1955	Significant early example of uncommon type in Nebraska utilizing new material and technology.

Prestressed concrete box beams

BISON records four prestressed concrete box beams within the subject period. The four are multiple (adjacent) beam types and were selected for field survey because they are an uncommon type, and were evaluated under *Criterion C.*

The prestressed concrete box beam bridge was introduced during the subject period as a technological innovation in concrete design and production. It evolved from the tee beam and channel beam types to produce a design that was capable of achieving longer span lengths. One advantage over the other types was the addition of the bottom (soffit) slab, which allowed the use of additional prestressing strands, thus increasing the potential maximum span length. The multiple box-beam bridge, where the beams are arranged adjacent to each other, had the advantage of using the concrete top of the beams as the driving surface. In later configurations the box beams were separated, in a configuration known as a “spread box-beam bridge,” and a concrete deck slab was added.

Prestressed concrete bridges in general, and prestressed box beams in particular, represent a very small number of bridges constructed in Nebraska during the subject period. Only nine post-1965 prestressed concrete box beams of any type are recorded in BISON. Character-defining features of

the prestressed concrete box beam include box-shaped longitudinal beams in either adjacent (multiple) or spread configuration, and in either continuous or non-continuous arrangement.

Three prestressed concrete box beams (C005500505, C005501110, and C005513170, Lancaster County) were designed and produced simultaneously in 1959 for Lancaster County by the NPCC in Lincoln. They were the firm's first prestressed bridge beams produced for a county highway department and among NPCC's first prestressed bridge beams for any client. NPCC had been founded in 1955 to supply prestressed concrete products for the new Interstate System. They didn't produce any bridge beams until 1958 and 1959, focusing instead on buildings and other structures, including the design and construction of their own production facility in Lincoln.

Bridge C005501110 (Lancaster County) is recommended eligible for the National Register under *Criterion C*. Built in 1959, this multiple prestressed concrete box-beam bridge was determined eligible as an example of a very uncommon type, as one of Nebraska's earliest extant prestressed concrete box-beam bridges designed by a county highway engineer, and as a representative of the first prestressed bridge products of a pioneer Nebraska prestressed concrete manufacturer. Bridge C00550110 is the longest of the NPCC's three 1959 bridges for Lancaster County and represents the design potential of the prestressed box beam for producing longer spans than earlier types. The bridge retains integrity of materials, design, and workmanship.

Bridge C005560320 (Lancaster County) is recommended eligible for the National Register under *Criterion C*. Built in 1964 by NPCC, this multiple prestressed concrete box-beam bridge is a significant representative example of a multiple-span type of prestressed box-beam construction, a very uncommon type in Nebraska. It was produced by NPCC and is the only multiple-span example of a prestressed concrete box beam from the subject period.

The remaining prestressed concrete box-beam bridges are recommended not eligible for the National Register because of their shorter span lengths and single-span configurations, which do not demonstrate the longer-span engineering capacity of the box-beam type. They do not represent any additional engineering features or innovations.

Table 16
Eligible Prestressed Concrete Box Beams

Bridge No.	NeHBS No.	District	County	Year Built/Year Reconstructed	*Criterion C: Significance*
C005501110	LC00-133	1	Lancaster	1959	Significant representative example of a prestressed concrete box beam that demonstrates the longer-span capability of the type; earliest example of type in state; very early example by major Nebraska producer of prestressed concrete bridge products.
C005560320	LC00-143	1	Lancaster	1964	Significant multi-span example of a very uncommon prestressed concrete bridge type.*

* Also recommended eligible under *Criterion A*, see Section 5.