MICHIGAN BRIDGE INVENTORY: THE SURVEY SAMPLE

Submitted to

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MICHIGAN STRUCTURE INVENTORY CODING INSTRUCTIONS	Coded on Card: 3
INVENTORY ITEM 43 - Main Structure Type	3 digits Col. 49-51

The codes are for the main spans. The first digit of the three-digit code indicates type of design and kind of material of the main supporting members and the second and third digits indicate type of design and/or construction.

Special Michigan sub-types shown indented with "(" convert to Federal code immediately above it and are for <u>optional</u> use by local governments.

1	Concrete	00	Other
2	Concrete continuous	01	Slab
3	Steel, simple or Cant.		(71 Slab Timber - Composite
4	Steel continuous	02	Multi-Stringer, W or I-Beam, Non-composite
5	Prestress concrete		(32 Multi-Stringer, W or I-Beam, Composite
6	Prestress concrete continuous		(42 Multi-Stringer, W or I-Beam, Encased
7	Timber		(52 Multi-Stringer, Plate Girder, Non-composite
8	Masonry		(62 Multi-Stringer, I-Beam, Jack Arch Floor
9	Aluminum, W.I. or C.I.		(72 Multi-Stringer, W or I-Beam, Timber Floor
0	Other		(82 Multi-Stringer, Plate Girder, Composite
			(92 Multi-Stringer, Plate Girder, Encased
		03	Girder & Floorbeam - Deck, Non-composite
			(33 Girder & Floorbeam - Composite Girder
			(21 Girder - Thru (Include conc. Camelbacks)
		04	Tee Beam or inverted channel
		05	Box Beam or Girders - Multiple
		06	Box Beam or Girders - Single or spread (segmental)
		07	Frame - Rigid or other (culvert)
		08	Orthotopic
		09	Truss - Deck
		10	Truss - Thru & Pony (343-Thru; 344-Pony)
		11	Arch - Deck, Filled Spandrel
			(22 Arch - Deck, Open Spandrel
		12	Arch - Thru
		13	Suspension
		14	Stayed Girder
		15	Movable - Lift
		16	Movable - Bascule
		17	Movable - Swing
		18	Tunnel
		19	Culvert (Box, Pipe or Pipe Arch)
		20	Mixed types (Note: applicable only to approach span - Item 44)
		21	Segmental Box Girder

<u>Example:</u>	<u>Code</u>
Timber Through Truss	710
Masonry Culvert	819
Steel Suspension	313
Continuous Concrete Multiple Box Girders	205
Simple Span Concrete Slab	101
Tunnel in rock	018

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MICHIGAN BRIDGE INVENTORY: CRITERION C EVALUATION

Comprehensive inventory of historic bridges is, by definition, weighted heavily toward National Register Criterion C. In this process, groups of similarly configured structures are evaluated and compared for relative significance from engineering and construction standpoints. With sometimes hundreds of similarly built bridges in a structural category, a premium is placed on "superlative" features of the bridges (e.g., the oldest, longest, first, best preserved) to differentiate between those that are historic and those that are merely old.

Based on an amalgam of research in the literature and analysis of computer-generated data, the consultants have arrived at the following guidelines, both general and categorical, that will be employed to produce a list of structures that will be included in the field survey sample:

GENERAL GUIDELINES

- Include all bridges through 1955 in the general inventory. The year 1955 was determined by MDOT and SHPO prior to the inception of this project. Historically, the date is appropriate because it marks the beginning of the U.S. interstate highway system. Administratively, it is appropriate because it will give both MDOT and SHPO adequate coverage of bridges that will continue to come within the National Register's 50-year scope of eligibility.

- Include all structures with greater than 20 feet of total length in the general inventory. A minimum overall structure length of 20 feet constitutes the federal definition of "bridge". Except in circumstances of extremely early construction or unusual structural type, the federal bridge definition will capture eligible bridges.

- Include all structurally intact structures through 1915, 1920 or 1925 (depending upon type) in the field survey sample. State standard bridge plans were available for some bridge types as early as 1906, with the passage of the State Reward Road Law. The Michigan State Highway Department issued standards for additional structural types in subsequent years (e.g., Warren pony trusses and plate girders in 1907-1908, straight concrete through girders in 1913-1914, arched concrete through girders in 1921-1922). In the 1913-1914 the state legislature passed the Trunk Line Highway Act, requiring MSHD to design and build all bridges with greater than 30-foot spans on trunk line routes. Since state plans required higher quality components and were engineered for heavier loads than many earlier township bridges, their construction cost was greater. For this reason, the counties and townships embraced the state standards inconsistently. By selecting all structures built before set dates, the field survey sample includes both the earliest examples of MSHD design and noteworthy pre-MSHD bridges built from independently derived designs.

CATEGORICAL GUIDELINES

- In some cases, selection of the survey sample after the early set periods requires additional winnowing to include the significant later bridges. Span length can indicate potentially significant structures. Given the number of bridges similar in design but with various maximum spans, the longest spans are closer to the outer extremes of engineering or economic feasibility and, as such, are more likely to be technologically significant. Changes in maximum span over time also reflect technological evolution, such as the impact of deeper and longer I-beams. Numbers of spans can likewise relate to design development and financial considerations. Multiple spans often mark major crossings as well, frequently giving these bridges historical as well as engineering significance. Furthermore, it is important to recognize the influence of the American Association of State Highway Officials, established in 1914, and the oversight of the U.S. Bureau of Roads, which reviewed any federally funded projects after such funding became available in 1916. Technological benchmarks and changes in state standard plans have been merged with an analysis of span length and number of extant bridges to create the categorical guidelines outlined in the discussions of structural types.

- Some bridges are sufficiently rare or significant that all structurally intact examples of their number, regardless of date or size, should be included in the field survey sample. Concrete rigid frame bridges, for example, evolved relatively late in the milieu of bridge design and have never been common in Michigan. Despite their recent development, they are technologically important and historically significant for their role in the early freeway/parkway movement, and all should therefore be included in the field survey sample. Concrete arches and steel trusses rank among the most significant -- both historically and technologically -- among Michigan's bridge types. All that have retained their structural integrity should be included from these groups as well.

Although Michigan's bridges display a remarkable diversity of type and scale, they can be grouped into a series of broad categories, as defined by the Structure Inventory and Appraisal lists maintained by the DOT. Following is a discussion of these structural types, with brief profiles of Michigan examples of each, and discussions regarding their disposition in the field survey sample.

CONCRETE GIRDER (103, 203, 104, 204, 104, 205, 121, 221)

The first reinforced concrete girder bridge was built in France in 1893. Spans of up to 85 feet appeared by 1904 in Europe, the leader in this design. The earliest documented concrete girder bridge in Michigan was the Ottawa Street Bridge over the Muskegon River in Muskegon

County, a single-span structure built in 1900. Concrete bridges -- and particularly concrete girder spans -- were just beginning to find favor among Michigan county engineers in the early 1910s when the Michigan State Highway Department developed its first standard designs for concrete girders. MSHD designed standards for concrete through girders in the 1913-1914 biennium, delineating simple, straight-sided structures in five-foot increments between 30 and 50 feet.[115] The first MSHD concrete girder was a 50-foot span over the Paint River in Iron County. The oldest remaining girders -- both built in 1916 -- are located on county roads in Delta and Mecosta counties.[116]

Citing the advantages of their maximum under-bridge clearance, MSHD favored through girders for bridges up to 50 feet in span through the late 1910s and early 1920s. The Department had in 1913-1914 engineered a short-span concrete deck girder, which it distinguished from its through girder configuration by calling a T-beam, but it was used sparingly in the late 1910s. "The opportunities for using this economical type of structure are few," MSHD stated in its 1917-1918 Biennial Report, "due to the lack of headroom prevalent on Michigan stream crossings."[117] The first MSHD deck girder bridge was built during the 1921-1922 biennium, the same year that MSHD developed its standard for the curved-chord through girder. "These designs have curved top chords and bottom chord brackets," MSHD stated, making them suitable for relatively long-span applications."[118] The first curved chord girder was a 90-foot span built in 1922 over the Raisin River at Tecumseh.[119] This was followed in the 1920s by a series of curved girders used in single-span or multiple-span configurations.

The drawback of through girders was their inflexibility. With the structural beams above the roadway, they could not be practically widened to accommodate increased traffic. As a result, through girders were superseded by deck girders and stringers when MSHD issued its new standards in 1929-1930. They fell rapidly from favor among the counties after that. Concrete deck girders were built routinely through the 1930s, but these too were overshadowed by steel superstructures in the 1940s. It was not until the development of the interstate highway system in the 1950s and 1960s that concrete girders -- this time in curved, prestressed deck configurations -- found renewed favor with MSHD.

Concrete through girder (121, 221) MSHD developed its first standard through girder designs in the 1913-1914 biennium. All pre-1920 through girders that have

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[115] 5 SHDBR (1913-1914), 100-101.

[116] C.A. Melick, "Summary of the Work of the Bridge Department," *Michigan Roads and Pavements* 22 (1 January 1925): 30-31.

[117] 17 SHDBR (1917-1918), 30-31.

[118] 9 SHDBR (1921-1922), 13-14.

[119] Ibid., 14; Melick, "Summary of the Work," 30.

girder designs in the 1913-1914 biennium. All pre-1920 through girders that have retained integrity should therefore be included for their representation either of pre-MSHD construction or of formative MSHD design. After this, through girders with spans in excess of 50 feet almost all featured arched beams; long-span straight girders were a relative rarity. Moreover, arched through girders -- an uncommon structural type indigenous to Michigan -- are considered sufficiently rare on a national scale that all should be included in the field survey sample. Multiple-span examples of through girders of either type are also rare.

All pre-1955 through girders:	88
Date range: 1900 - 1936	
Span range: 25 feet - 90 feet	
All arched through girders:	40
All pre-1920 straight through girders:	9
Straight girders - 3+ spans or 50-foot span 1920 - 1930:	4
Straight girders - 3+ spans or 50-foot span 1931 - 1940:	0
Straight girders - 3+ spans or 50-foot span 1941 - 1955:	0
Anomalous through girders:	1
TOTAL RECOMMENDED FOR SURVEY	**54**

Concrete deck girder / T-beam (103, 203, 104, 204, 105, 205): MSHD developed its first standard through girder designs in the 1913-1914 biennium, and in the 1910s built a small number of prototypical girder spans. All pre-1920 bridges that have retained integrity should therefore be included for their representation either of pre-MSHD construction or of formative MSHD design. After this, deck girders with spans in excess of 50 feet were a relative rarity, as were multiple-span examples.

All pre-1955 deck girders and T-beams:	430
Date range: 1900 - 1955	
Span range: 16 feet - 81 feet	
All pre-1920 deck girders and T-beams:	25
Deck girders - 3+ spans or 50-foot span 1920 - 1930:	8
Deck girders - 3+ spans or 50-foot span 1931 - 1940:	3
Deck girders - 3+ spans or 50-foot span 1941 - 1955:	19
Anomalous deck girders:	1
TOTAL RECOMMENDED FOR SURVEY	**56**

Concrete Through Girders

Struct No	County	Type	Superstructure	Year	Main spans	Span length
ALLE012	ALLEGAN	121	concrete through girder, arched	1924	1	48.00
ALLE019	ALLEGAN	121	concrete through girder, arched	1926	1	48.00
ALLE020	ALLEGAN	121	concrete through girder, arched	1926	1	48.00
AREN035	ARENAC	121	concrete through girder, arched	1925	1	90.00
BERR030	BERRIEN	121	concrete through girder, arched	1928	1	57.00
CALH011	CALHOUN	121	concrete through girder, arched	1923	1	50.00
CALH020	CALHOUN	121	concrete through girder, arched	1925	1	60.00
CHEB010	CHEBOYGAN	121	concrete through girder, arched	1924	1	85.00
DELT020	DELTA	121	concrete through girder, straight	1919	1	28.00
DICK009	DICKINSON	121	concrete through girder, arched	1927	1	58.00
EATO015	EATON	121	concrete through girder, straight	1916	1	50.00
EMME004	EMMET	121	concrete through girder, arched	1923	1	50.00
GLAD006	GLADWIN	121	concrete through girder, arched	1924	1	60.00
GOGE012	GOGEBIC	121	concrete through girder, arched	1928	1	60.00
GOGE017	GOGEBIC	121	concrete through girder, straight	1922	3	50.00
GOGE043	GOGEBIC	121	concrete through girder, straight	1919	1	33.00
GOGE046	GOGEBIC	121	concrete through girder, arched	1930	1	38.00
GRAT011	GRATIOT	121	concrete through girder, arched	1927	1	55.00
GRAT014	GRATIOT	121	concrete through girder, arched	1925	1	85.00
GRAT015	GRATIOT	121	concrete through girder, arched	1925	1	88.00
GRAT034	GRATIOT	121	concrete through girder, straight (non	1930	1	40.00
HURO037	HURON	121	concrete through girder, straight	1915	1	39.00
INGH031	INGHAM	121	concrete through girder, arched	1935	1	33.00
IONI018	IONIA	121	concrete through girder, arched	1928	1	36.00
IONI020	IONIA	121	concrete through girder, arched	1927	1	36.00
IRON012	IRON	121	concrete through girder, straight	1918	1	50.00
IRON018	IRON	121	concrete through girder, arched	1924	1	60.00
JACK023	JACKSON	121	concrete through girder, arched	1923	1	48.00
LAKE007	LAKE	121	concrete through girder, straight	1900	1	39.00
LAPE014	LAPEER	121	concrete through girder, arched	1928	1	70.00
MASO005	MASON	121	concrete through girder, arched	1924	1	75.00
MASO006	MASON	121	concrete through girder, arched	1925	1	75.00
MENO045	MENOMINEE	121	concrete through girder, arched	1928	1	58.00
MENO049	MENOMINEE	121	concrete through girder, arched	1935	1	88.00
MIDL016	MIDLAND	121	concrete through girder, arched	1927	1	90.00
MIDL037	MIDLAND	121	concrete through girder, arched	1927	1	90.00
MONR068	MONROE	121	concrete through girder	1900	1	30.00
NEWA028	NEWAYGO	121	concrete through girder, arched	1928	1	48.00
OCEA016	OCEANA	121	concrete through girder, straight	1919	1	46.00
OTTA027	OTTAWA	121	concrete through girder, arched	1923	1	58.00
OTTA035	OTTAWA	121	concrete through girder, arched	1923	1	88.00
PRES017	PRESQUE ISL	121	concrete through girder, arched	1935	1	46.00
SAGI028	SAGINAW	121	concrete through girder, straight	1920	3	45.00

Concrete Through Girders

Struct No	County	Type	Superstructure	Year	Main spans	Span length
SAGI029	SAGINAW	121	concrete through girder, straight	1920	3	45.00
SAGI105	SAGINAW	121	concrete through girder, straight	1920	3	45.00
SANI008	SANILAC	121	concrete through girder, arched	1924	1	75.00
SCHO016	SCHOOLCRA	121	concrete through girder, arched	1928	1	90.00
SCHO017	SCHOOLCRA	121	concrete through girder, arched	1929	1	58.00
SHIA007	SHIAWASSEE	121	concrete through girder, arched	1925	1	37.00
STCL039	ST. CLAIR	121	concrete through girder, arched	1925	1	84.00
STCL049	ST. CLAIR	121	concrete through girder	1916	1	32.00
STCL055	ST. CLAIR	121	concrete through girder, arched	1928	2	70.00
STJO004	ST. JOSEPH	121	concrete through girder, arched	1922	3	90.00
WASH024	WASHTENA	121	concrete through girder, arched	1936	1	35.00

Concrete Deck Girder / T-beams

Struct No	County	Type	Superstructure	Year	Main spans	Span length
AREN030	ARENAC	104	concrete T-beam	1917	1	26.00
BARR007	BARRY	104	concrete T-beam	1918	1	23.00
BAY003	BAY	204	concrete cantilevered T-beam	1927	3	90.00
BENZ003	BENZIE	104	concrete T-beam	1929	1	70.00
BERR029	BERRIEN	104	concrete T-beam	1928	3	45.00
BRAN031	BRANCH	104	concrete T-beam	1900	1	26.00
CASS015	CASS	104	concrete T-beam	1919	5	35.00
DELT018	DELTA	104	concrete T-beam, with arched girders	1941	3	34.00
EATO014	EATON	104	concrete T-beam	1910	1	30.00
EATO016	EATON	104	concrete T-beam	1915	1	19.00
EATO048	EATON	204	concrete continuous T-beam	1948	3	68.00
GENE111	GENESEE	204	concrete continuous T-beam	1928	3	27.00
HILL026	HILLSDALE	104	concrete T-beam	1910	1	30.00
HOUG008	HOUGHTON	103	concrete deck girder	1900	1	49.00
INGH001	INGHAM	104	concrete T-beam	1918	1	29.00
INGH013	INGHAM	104	concrete arched cantilever	1952	3	54.00
INGH062	INGHAM	105	concrete girder	1918	1	20.00
IRON015	IRON	205	concrete continuous girder	1955	3	23.00
IRON016	IRON	205	concrete continuous box beam	1955	3	23.00
JACK014	JACKSON	204	concrete cantilevered T-beam	1954	3	58.00
JACK065	JACKSON	204	concrete continuous T-beam	1915	2	31.00
KENT027	KENT	104	concrete T-beam	1910	1	30.00
KENT047	KENT	105	concrete girder	1915	4	25.00
LENA008	LENAWEE	204	concrete continuous T-beam	1953	3	60.00
LENA023	LENAWEE	204	concrete continuous T-beam	1955	3	49.00
LENA042	LENAWEE	104	concrete T-beam	1910	1	28.00
LENA043	LENAWEE	104	concrete T-beam	1910	1	26.00
LIVI024	LIVINGSTON	104	concrete T-beam	1919	1	23.00
MENO002	MENOMINEE	104	concrete T-beam	1929	4	38.00
MENO015	MENOMINEE	104	concrete T-beam	1900	6	54.00
MONR029	MONROE	204	concrete continuous T-beam	1920	3	79.00
MONR053	MONROE	204	concrete continuous T-beam	1955	4	70.00
MONR062	MONROE	204	concrete continuous T-beam	1954	4	78.00
MONR063	MONROE	204	concrete continuous T-beam	1955	4	81.00
MONR064	MONROE	204	concrete continuous T-beam	1954	4	78.00
MONR065	MONROE	204	concrete continuous T-beam	1954	4	56.00
MUSK011	MUSKEGON	103	concrete deck girder	1900	1	31.00
MUSK036	MUSKEGON	103	concrete deck girder	1900	1	31.00
OAKL012	OAKLAND	204	concrete continuous T-beam	1931	7	33.00
OAKL032	OAKLAND	104	concrete T-beam	1930	5	32.00
OSCE019	OSCEOLA	104	concrete T-beam	1929	3	55.00
OSCE021	OSCEOLA	104	concrete T-beam	1900	1	16.00
OSCE022	OSCEOLA	104	concrete T-beam	1900	1	23.00

Concrete Deck Girder / T-beams

Struct No	County	Type	Superstructure	Year	Main spans	Span length
OSCE042	OSCEOLA	105	concrete girder	1900	1	40.00
SAGI036	SAGINAW	104	concrete T-beam	1916	1	22.00
STCL035	ST. CLAIR	104	concrete T-beam	1916	1	38.00
WASH006	WASHTENA	104	concrete T-beam	1954	3	43.00
WASH007	WASHTENA	204	concrete continuous T-beam	1954	4	49.00
WASH008	WASHTENA	204	concrete continuous T-beam	1955	4	65.00
WASH009	WASHTENA	204	concrete continuous T-beam, arched	1944	3	56.00
WASH010	WASHTENA	204	concrete continuous T-beam	1944	3	63.00
WAYN007	WAYNE	204	concrete continuous T-beam	1943	3	58.00
WAYN039	WAYNE	104	concrete T-beam	1932	3	52.00
WAYN112	WAYNE	104	concrete T-beam	1931	3	41.00
WAYN117	WAYNE	104	concrete arched cantilever	1930	3	51.00
WAYN228	WAYNE	104	concrete T-beam	1920	1	28.00

CONCRETE SLAB (101, 201)

With its deck and superstructure poured integrally in a single flat sheet over steel reinforcing, the simple slab was the most rudimentary of the concrete bridge types. A few concrete slabs were built in Michigan by the counties or by railroads and larger cities after the turn of the century, but their use was not widespread. The Michigan State Highway Department similarly eschewed slab construction when it developed its early bridge standards, preferring concrete box and arch culverts for the shortest spans and concrete through girders for spans in excess of 30 feet. Beginning in the early 1920s, the Highway Department had begun to build slab bridges on a limited basis. Outside of urban areas, however, they were used sparingly in Michigan until the development of new standards in the 1930s.

Concrete slab (101, 201): MSHD developed its first standard slab design around 1920. All pre-1925 bridges that have retained integrity should therefore be included for their representation either of pre-MSHD construction or of formative MSHD design. After this, slabs with spans in excess of 50 feet were relatively rare, as were those with four or more spans.

All pre-1955 slabs: Date range: 1900 - 1955 Span range: 13 feet - 54 feet	138
All pre-1925 slabs:	19
Slabs - 4+ spans or 45-foot span 1926 - 1940:	3
Slabs - 4+ spans or 45-foot span 1941 - 1955:	3
Slabs - noteworthy architectural treatment	1
TOTAL RECOMMENDED FOR SURVEY	**26**

Concrete Slabs

Struct No	County	Type	Superstructure	Year	Main spans	Span length
CLAR031	CLARE	101	concrete slab	1922	1	20.00
GENE007	GENESEE	101	concrete slab	1941	4	38.00
GRAT050	GRATIOT	101	concrete slab	1930	1	50.00
IRON019	IRON	101	concrete slab	1900	1	25.00
IRON020	IRON	101	concrete slab	1900	1	25.00
KENT032	KENT	201	concrete continuous slab	1900	2	20.00
LENA028	LENAWEE	101	concrete slab	1924	1	30.00
LIVI018	LIVINGSTON	101	concrete slab	1922	1	20.00
MONR087	MONROE	101	concrete slab	1900	1	24.00
MONT020	MONTCALM	101	concrete slab	1910	1	32.00
MUSK031	MUSKEGON	101	concrete slab	1900	1	16.00
MUSK033	MUSKEGON	101	concrete slab	1900	1	24.00
MUSK038	MUSKEGON	101	concrete slab	1920	1	24.00
MUSK046	MUSKEGON	101	concrete slab	1900	1	30.00
OAKL034	OAKLAND	101	concrete slab, with architectural treat	1940	1	24.00
OSCE041	OSCEOLA	101	concrete slab	1900	1	17.00
STCL044	ST. CLAIR	101	concrete slab	1919	1	16.00
STCL058	ST. CLAIR	101	concrete slab	1920	1	20.00
STCL096	ST. CLAIR	101	concrete slab	1920	1	37.00
STCL097	ST. CLAIR	101	concrete slab	1920	1	27.00
STCL101	ST. CLAIR	101	concrete slab	1955	1	54.00
VANB027	VAN BUREN	101	concrete slab	1910	1	26.00
WAYN084	WAYNE	201	concrete continuous slab	1921	2	32.00
WAYN131	WAYNE	201	concrete continuous slab	1947	4	26.00
WAYN178	WAYNE	101	concrete slab	1935	1	52.00
WAYN186	WAYNE	201	concrete continuous slab	1947	3	28.00

CONCRETE RIGID FRAME (107, 207)

Developed by Westchester County, New York, in the early 1920s, the concrete rigid frame bridge became especially popular for federal relief projects during the 1930s. Both picturesque and practical, the flat or elliptically arched designs appealed to proponents of urban beautification. The Michigan State Highway Department referred to the rigid frame it had developed as a "new type of concrete structure" in its 1935-1936 Biennial Report. "While one of the most modern developments in bridge design, this type has passed the experimental stage and in some locations offers marked advantages over the simple span type."[120] Built in 1935, the first MSHD-designed rigid frame bridge was a two-span structure over Otter Creek south of Monroe. The Highway Department used concrete rigid frame bridges on an occasional basis through the 1930s and early 1940s, particularly at urban grade separations. (All but four of the concrete rigid frame bridges from the general inventory are located within Wayne County.) After World War II, the concrete rigid frame was superseded by prestressed concrete beams for use on most bridges and overpasses.

Concrete rigid frame (107, 207): Because of their relative rarity and because some were the product of federal relief programs in the 1930s, all concrete rigid frame bridges that have retained integrity should be surveyed.

All pre-1955 concrete rigid frames:	21
Date range: 1913 - 1953	
Span range: 28 feet - 77 feet	
TOTAL RECOMMENDED FOR SURVEY	**20**

[120] 15 SHDBR (1935-1936), 57.

Concrete Rigid Frames

Struct No	County	Type	Superstructure	Year	Main spans	Span length
ALGE008	ALGER	107	concrete rigid frame	1939	1	66.00
DICK001	DICKINSON	107	concrete rigid frame	1935	1	36.00
OAKL038	OAKLAND	107	concrete rigid frame	1936	1	33.00
OAKL042	OAKLAND	107	concrete rigid frame	1938	1	30.00
WAYN027	WAYNE	207	concrete rigid frame	1943	2	47.00
WAYN067	WAYNE	207	concrete rigid frame	1942	2	38.00
WAYN068	WAYNE	107	concrete rigid frame	1942	1	77.00
WAYN069	WAYNE	107	concrete rigid frame	1942	1	77.00
WAYN070	WAYNE	107	concrete rigid frame	1942	1	77.00
WAYN071	WAYNE	107	concrete rigid frame	1942	1	77.00
WAYN073	WAYNE	107	concrete rigid frame	1933	1	54.00
WAYN074	WAYNE	107	concrete rigid frame	1933	1	60.00
WAYN079	WAYNE	107	concrete rigid frame	1946	1	29.00
WAYN091	WAYNE	207	concrete rigid frame	1947	2	66.00
WAYN095	WAYNE	107	concrete rigid frame	1951	1	66.00
WAYN096	WAYNE	207	concrete rigid frame	1953	2	67.00
WAYN098	WAYNE	107	concrete rigid frame	1953	1	67.00
WAYN164	WAYNE	107	concrete rigid frame	1947	1	40.00
WAYN173	WAYNE	107	concrete rigid frame	1913	1	28.00
WAYN232	WAYNE	107	concrete rigid frame	1948	1	73.00

CONCRETE ARCH (111, 211)

America's earliest reinforced concrete bridge, the Alvord Lake Bridge in San Francisco (1889), employed a filled spandrel arch configuration. Designed by early engineers as a durable and aesthetic alternative to steel truss construction, concrete arches were used primarily in major urban street crossings in Michigan before 1905. Two of the most earliest and notable examples of this were the West Michigan Avenue Bridge (1903) and the McCamly Street Bridge (1904), both in Battle Creek. Designed by city engineers and bridge contractors such as the Illinois Bridge Company, these medium-span structures typically featured elliptical, relatively low, arch profiles with solid sidewalls, earthen fill and architectural embellishment of the guardrails and spandrels.

Engineers for the Michigan State Highway Department began designing concrete arches as early as 1908, but, unlike its practice on other structural types, the agency did not develop a standard concrete arch design. The bearing and superstructural conditions were too site-specific, MSHD rationalized, making standardization of concrete arches impractical. Instead, the Highway Department used special-design concrete arches up to 80 feet in length "wherever it is possible to secure sufficiently hard foundations, and also where these is clearance enough for the water to flow freely without the arch choking the stream too much," according to its 1917-1918 Biennial Report.[121] MSHD first designed medium-length filled spandrel arches for county and township road crossings around 1910; it built its first state arch -- a 50-foot span over Paint Creek in Kent County -- in 1914.[122] With steel scarce and expensive during World War I, the Highway Department used filled spandrel arches extensively in the late 1910s, sometimes combining them to form multiple-span bridges.

In the 1921-1922 biennium, MSHD began using open spandrel arches for relatively short-span (100-foot) crossings. These aesthetically appealing structures were soon being employed for such monumental urban spans as the Belle Isle Bridge (1923) in Detroit and the Fulton Street Bridge (1928) in Grand Rapids. Whether reinforced or unreinforced, concrete arches consume a prodigious amount of materials and labor in their construction. Eventually, they were displaced as a structural type in Michigan by more efficient concrete and steel beam bridge configurations, and their use dwindled rapidly in the late 1920s.

> **Concrete arch** (111, 211): Because of their relative rarity, because some were the product of federal relief programs in the 1930s, because they represent the longest-span concrete bridges and because many are monumental urban structures with architectural treatment, all concrete arch bridges that have retained integrity should be included in the survey.

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[121] 7 SHDBR (1917-1918), 32.

[122] Melick, "Summary of the Work," 30-31.

All pre-1955 concrete arches: Date range: 1900 - 1955 Span range: 6 feet - 32 feet	89
TOTAL RECOMMENDED FOR SURVEY	**72**

Concrete Arch

Struct No	County	Type	Superstructure	Year	Main spans	Span length
BERR003	BERRIEN	111	concrete filled spandrel arch	1899	1	28.00
BERR033	BERRIEN	111	concrete filled spandrel arch	1916	1	40.00
CALH012	CALHOUN	111	concrete filled spandrel arch	1925	2	58.00
CALH042	CALHOUN	111	concrete filled spandrel arch	1916	1	82.00
CHEB022	CHEBOYGAN	111	concrete filled spandrel arch	1915	1	24.00
EATO004	EATON	111	concrete filled spandrel arch	1921	1	45.00
EATO013	EATON	111	concrete filled spandrel arch	1894	1	36.00
GDTR009	GD. TRAVER	111	concrete filled spandrel arch	1930	1	68.00
GENE009	GENESEE	111	concrete filled spandrel arch	1926	3	72.00
GENE100	GENESEE	111	concrete filled spandrel arch	1919	1	70.00
GENE103	GENESEE	111	concrete filled spandrel arch	1917	2	74.00
GENE104	GENESEE	111	concrete filled spandrel arch	1924	1	60.00
GENE106	GENESEE	111	concrete filled spandrel arch	1921	2	86.00
GENE108	GENESEE	111	concrete filled spandrel arch	1920	1	30.00
GENE109	GENESEE	111	concrete filled spandrel arch	1920	1	26.00
GENE112	GENESEE	111	concrete filled spandrel arch	1924	1	60.00
GENE113	GENESEE	111	concrete filled spandrel arch	1922	3	66.00
GLAD003	GLADWIN	111	concrete filled spandrel arch	1919	2	50.00
HILL033	HILLSDALE	111	concrete filled spandrel arch	1918	1	31.00
HOUG007	HOUGHTON	111	concrete filled spandrel arch	1916	1	54.00
INGH059	INGHAM	111	concrete filled spandrel arch	1924	3	73.00
IONI048	IONIA	111	concrete filled spandrel arch	1952	2	91.00
IRON003	IRON	111	concrete filled spandrel arch	1918	1	90.00
IRON010	IRON	111	concrete filled spandrel arch	1914	1	98.00
ISAB031	ISABELLA	111	concrete filled spandrel arch	1920	1	50.00
ISAB053	ISABELLA	111	concrete filled spandrel arch	1910	1	88.00
ISAB054	ISABELLA	111	concrete filled spandrel arch	1910	1	70.00
JACK060	JACKSON	111	concrete arch with stone veneer	1925	3	8.00
JACK066	JACKSON	111	concrete filled spandrel arch	1903	1	39.00
KALK002	KALKASKA	111	concrete filled spandrel arch	1913	4	29.00
KENT005	KENT	111	concrete filled spandrel arch	1916	1	60.00
KENT055	KENT	111	concrete filled spandrel arch	1920	1	30.00
KEWE003	KEWEENAW	111	concrete filled spandrel arch	1928	1	31.00
LENA006	LENAWEE	111	concrete filled spandrel arch	1919	1	74.00
MACK014	MACKINAC	111	concrete filled spandrel arch	1919	1	60.00
MACO015	MACOMB	111	concrete filled spandrel arch	1935	1	72.00
MACO016	MACOMB	111	concrete filled spandrel arch	1935	2	60.00
MACO050	MACOMB	111	concrete filled spandrel arch	1910	1	21.00
MACO052	MACOMB	111	concrete filled spandrel arch	1909	2	57.00
MACO054	MACOMB	111	concrete filled spandrel arch	1910	1	40.00
MACO055	MACOMB	111	concrete filled spandrel arch	1910	1	25.00
MENO022	MENOMINEE	111	concrete filled spandrel arch	1930	1	24.00
MENO027	MENOMINEE	111	concrete filled spandrel arch	1920	1	50.00

Concrete Arch

Struct No	County	Type	Superstructure	Year	Main spans	Span length
MIDL044	MIDLAND	111	concrete filled spandrel arch	1900	1	28.00
MIDL047	MIDLAND	111	concrete filled spandrel arch	1951	1	45.00
MONR011	MONROE	111	concrete filled spandrel arch	1910	1	16.00
MONR012	MONROE	111	concrete filled spandrel arch	1910	1	16.00
MONR013	MONROE	111	concrete filled spandrel arch	1920	1	67.00
MONR014	MONROE	111	concrete filled spandrel arch	1910	1	16.00
MONR098	MONROE	111	concrete filled spandrel arch	1930	1	20.00
OAKL024	OAKLAND	111	concrete filled spandrel arch	1930	1	28.00
OAKL052	OAKLAND	111	concrete filled spandrel arch	1900	1	28.00
OSCE016	OSCEOLA	111	concrete filled spandrel arch	1939	1	39.00
PRES009	PRESQUE ISL	111	concrete filled spandrel arch	1920	1	50.00
STCL043	ST. CLAIR	211	concrete filled spandrel arch	1919	2	71.00
STCL088	ST. CLAIR	111	concrete filled spandrel arch	1920	1	20.00
STCL091	ST. CLAIR	111	concrete filled spandrel arch	1920	1	20.00
STJO006	ST. JOSEPH	211	concrete filled spandrel arch	1925	2	28.00
STJO010	ST. JOSEPH	211	concrete filled spandrel arch	1920	5	41.00
STJO042	ST.JOSEPH	111	concrete filled spandrel arch			
WASH004	WASHTENA	111	concrete filled spandrel arch	1912	1	105.00
WASH050	WASHTENA	111	concrete filled spandrel arch	1916	2	106.00
WAYN029	WAYNE	111	concrete filled spandrel arch	1931	1	31.00
WAYN085	WAYNE	111	concrete filled spandrel arch	1919	1	60.00
WAYN101	WAYNE	111	concrete filled spandrel arch	1930	1	63.00
WAYN122	WAYNE	111	concrete filled spandrel arch	1930	1	40.00
WAYN156	WAYNE	111	concrete filled spandrel arch	1922	1	35.00
WAYN163	WAYNE	111	concrete filled spandrel arch	1917	1	35.00
WAYN166	WAYNE	111	concrete filled spandrel arch	1913	1	23.00
WAYN168	WAYNE	111	concrete filled spandrel arch	1909	1	40.00
WAYN231	WAYNE	111	concrete filled spandrel arch	1925	1	77.00
WEXF019	WEXFORD	111	concrete filled spandrel arch	1900	1	24.00

CONCRETE BOX CULVERT (119, 219)

Concrete culverts were built by the tens of thousands throughout Michigan in the first two decades of the twentieth century. Featuring box, arch and pipe configurations, they were used at the myriad drainage ditch crossings on the state's county and township road systems. Concrete arch culverts were among the first standards developed by the Michigan State Highway Department in 1905-1906. "The concrete arch culvert is, to a very great extent, replacing the old form of timber structure," MSHD stated in 1908. "While somewhat more costly in the first instance, yet it is, if rightly constructed, a permanent work, and as such, will in a few years, effect a considerable saving in road expenditure."[123]

Updated periodically, the box culvert design was a MSHD staple for decades. Culverts received extensive use throughout the state during the 1920s and 1930s. The overwhelming majority of these small-scale structures employed single-barrel configurations, with spans less than ten feet. Few of these culverts have the requisite 20-foot overall length to be considered bridges by today's definition, though. As a result, only a few culverts are classified as bridges in the state's Structure Inventory and Appraisal. In reality, they constitute only a minute sampling of Michigan's most common drainage structure.

> **Concrete box culvert** (119, 219): None of Michigan's extant box culverts display features (e.g., early construction, span length, span number, architectural detailing) that elevate them from their peers either historically of technologically. Therefore none of these intrinsically undistinguished structures should be included in the survey.

All pre-1955 concrete box culverts: 78
Date range: 1900 - 1955
Span range: 6 feet - 32 feet

TOTAL RECOMMENDED FOR SURVEY 0

[123] 2 SHDBR (1907-1908), 210.

PRESTRESSED CONCRETE BEAM

The first prestressed concrete bridge in the United States was 160-foot span erected in Philadelphia in 1948. MDOT Structure Inventory and Appraisal files report several examples of prestressed stringers and box beams as early as 1900 (the default value in the construction date field), but the early construction date for these structures is the result of data entry error rather than accurate reporting. The erroneous figures are typically the result of one of two errors: (1) mis-classification of structure type; or (2) replacement of original, early superstructure with a more recent span. Correction of these errors has resulted in the elimination of virtually all of the prestressed beam bridges from the field survey sample. If, during the course of field research, some extant pre-1955 examples of prestressed concrete beams are revealed, they will be included in the field survey sample.

STEEL STRINGER (302, 402, 332, 432, 342, 442, 363, 462, 372, 472)

Steel stringer bridges are the most rudimentary type of all-metal spans. Comprised of parallel rows of relatively shallow I-beams, steel stringer bridges began to replace short-span trusses for county roadway use in the late 1890s. Although built in abundance, few of these earliest I-beam spans remain in place in Michigan. After the turn of the century, small-scale steel stringer bridges were built in profusion throughout the state. A steel stringer span with an integrally poured concrete floor (called a "jack arch" deck) was among the earliest standard bridge types delineated by the Michigan State Highway Department in 1905-1906.[124] During the next biennium, the department developed a standard steel stringer design for bridges under 30 feet in length.[125] Since that time, the Highway Department has maintained the steel stringer as a standard design, updating the drawings and extending the spans lengths periodically to reflect changes in the industry.

Steel beam bridges have enjoyed inconstant popularity with Highway Department engineers, depending largely on the price of steel at the time. "The use of steel beams should be discontinued altogether during war time," the department complained after World War I.[126] As prices fell, MSHD resumed its reliance on rolled steel beams for bridge construction in the 1920s. Perhaps more than other bridge types, steel stringer technology has depended closely on the capacity of rolling mills that provided the steel. Limited by the mills' output, early MSHD standards for I-beam bridges ranged from 8 feet to 45 feet. "When this type of structure was first put in use," MSHD stated in 1930, "rolled sections of sufficient strength were not available for spans greater than about forty-five feet. It was necessary, therefore, to use relatively shallow fabricated deck girders for spans greater than forty-five feet. Rather recently, however, steel mills have improved their methods and are able to furnish rolled sections which, on proper spacing, are suitable for spans up to sixty feet."[127] MSHD was able to increase these span lengths to 75 feet when the mills began to roll 33- to 36-inch deep beams in 1928. This longer span made steel bridges more economical than concrete, hence greatly increasing the number of long-span steel beam bridges built in Michigan in the 1930s. The trend has continued to the present. Today steel stringers represent by far the most populous structural type among Michigan's highway bridges.

> **Steel stringer** (302, 402, 332, 432, 342, 442, 372, 472): Since MSHD developed its first standard stringer designs in the 1905-1906 biennium, this structural type has enjoyed widespread use. All pre-1915 stringers that have retained integrity should be

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[124] 1 SHDBR (1905-1906), 105.

[125] 2 SHDBR (1907-1908), 208.

[126] 7 SHDBR (1917-1918), Appendix C.

[127] 13 SHDBR (1929-1930), 53.

included for their representation either of pre-MSHD construction or of formative MSHD design. Between 1915 and 1928, steel stringer bridges were limited in their span lengths by the comparably shallow rolled beams produced by American steel mills. After 1928, the mills began rolling deeper I- and WF-section beams, permitting progressively longer spans for steel beam bridges. The longest examples of these should be included in the field survey sample. Multiple-span examples of steel stringer bridges are relatively rare and should also be included.

All pre-1955 steel stringers: Date range: 1882 - 1954 Span range: 11 feet - 142 feet	1,658
All pre-1915 steel stringers:	69
Steel stringers - 5+ spans or 45-foot span 1916 - 1928:	26
Steel stringers - 5+ spans or 75-foot span 1929 - 1940:	14
Steel stringers - 5+ spans or 75-foot span 1941 - 1955:	34
TOTAL RECOMMENDED FOR SURVEY	143

Steel stringer with jack-arch deck (362, 462): MSHD developed its first standard stringer designs with jack-arch concrete decks in the 1905-1906 biennium. As a subtype of the venerable steel stringer bridge, its utility was relatively short-lived. All pre-1915 examples of this intrinsically short-span structural type that have retained integrity should be included for their representation either of pre-MSHD construction or of formative MSHD design.

All pre-1955 steel stringers with jack-arch decks: Date range: 1900 - 1954 Span range: 16 feet - 44 feet	200
All pre-1915 steel stringers with jack-arch decks:	45
TOTAL RECOMMENDED FOR SURVEY	45

Steel Stringers

Struct No	County	Type	Superstructure	Year	Main spans	Span length
ALLE002	ALLEGAN	302	steel I-beam stringer	1950	6	60.00
ALLE003	ALLEGAN	302	steel I-beam stringer	1943	6	45.00
ALLE041	ALLEGAN	302	steel I-beam stringer	1938	5	42.00
AREN028	ARENAC	372	steel I-beam stringer	1907	1	25.00
BARA012	BARAGA	332	steel composite stringer	1928	1	67.00
BARR015	BARRY	372	steel I-beam stringer	1900	1	23.00
BENZ005	BENZIE	302	steel I-beam stringer	1900	2	30.00
BENZ006	BENZIE	302	steel I-beam stringer	1906	2	30.00
BERR005	BERRIEN	302	steel I-beam stringer	1949	8	50.00
BERR016	BERRIEN	332	steel composite stringer	1955	3	79.00
BERR017	BERRIEN	332	steel composite stringer	1955	3	79.00
BERR046	BERRIEN	302	steel I-beam stringer	1954	6	66.00
BERR052	BERRIEN	302	steel I-beam stringer	1947	5	60.00
BRAN022	BRANCH	302	steel I-beam stringer	1900	1	34.00
BRAN037	BRANCH	302	steel I-beam stringer	1920	1	50.00
CHEB024	CHEBOYGAN	372	steel I-beam stringer	1900	3	14.00
CHIP018	CHIPPEWA	402	steel continuous I-beam stringer	1931	7	60.00
CLAR007	CLARE	332	steel composite stringer	1951	3	86.00
CLAR008	CLARE	302	steel I-beam stringer	1920	1	47.00
DELT017	DELTA	302	steel I-beam stringer	1900	1	23.00
DELT026	DELTA	372	steel I-beam stringer	1900	2	15.00
EATO033	EATON	302	steel I-beam stringer	1908	1	26.00
EATO044	EATON	302	steel I-beam stringer	1913	1	29.00
GENE004	GENESEE	332	steel composite stringer	1954	6	64.00
GENE098	GENESEE	302	steel I-beam stringer	1900	1	46.00
GLAD001	GLADWIN	302	steel I-beam stringer	1939	6	50.00
GLAD009	GLADWIN	332	steel composite stringer	1928	1	60.00
GOGE011	GOGEBIC	302	steel I-beam stringer	1939	5	45.00
GOGE022	GOGEBIC	302	steel I-beam stringer	1928	2	49.00
GRAT048	GRATIOT	372	steel I-beam stringer	1900	1	19.00
HILL017	HILLSDALE	302	steel I-beam stringer	1900	1	35.00
HILL027	HILLSDALE	302	steel I-beam stringer	1898	1	24.00
HILL028	HILLSDALE	302	steel I-beam stringer	1896	1	24.00
HILL032	HILLSDALE	302	steel I-beam stringer	1910	1	20.00
HOUG012	HOUGHTON	302	steel I-beam stringer	1914	1	37.00
HOUG016	HOUGHTON	302	steel I-beam stringer	1900	1	34.00
HOUG018	HOUGHTON	302	steel I-beam stringer	1900	1	34.00
HURO045	HURON	302	steel I-beam stringer	1910	1	44.00
HURO052	HURON	302	steel I-beam stringer	1910	1	38.00
HURO056	HURON	302	steel I-beam stringer	1910	1	19.00
HURO057	HURON	302	steel I-beam stringer	1910	1	19.00
HURO077	HURON	302	steel I-beam stringer	1925	1	52.00
HURO084	HURON	302	steel I-beam stringer	1925	1	57.00

Steel Stringers

Struct No	County	Type	Superstructure	Year	Main spans	Span length
INGH002	INGHAM	332	steel composite stringer	1952	15	85.00
INGH003	INGHAM	332	steel composite stringer	1950	9	92.00
INGH020	INGHAM	302	steel I-beam stringer	1941	5	56.00
INGH060	INGHAM	302	steel I-beam stringer	1946	6	81.00
IONI036	IONIA	302	steel I-beam stringer	1900	1	52.00
JACK008	JACKSON	302	steel I-beam stringer	1926	1	50.00
JACK018	JACKSON	402	steel continuous I-beam stringer	1949	3	81.00
JACK024	JACKSON	342	steel I-beam stringer, concrete encase	1927	4	54.00
JACK048	JACKSON	372	steel I-beam stringer	1910	1	34.00
JACK049	JACKSON	342	steel I-beam stringer, concrete encase	1908	1	22.00
JACK050	JACKSON	302	steel I-beam stringer	1900	1	38.00
KALA004	KALAMAZOO	302	steel I-beam stringer	1951	3	83.00
KALK004	KALKASKA	372	steel I-beam stringer	1910	1	25.00
KENT013	KENT	342	steel I-beam stringer, concrete encase	1925	1	50.00
KENT040	KENT	302	steel I-beam stringer	1932	2	75.00
LAKE010	LAKE	302	steel I-beam stringer	1904	1	25.00
LAKE015	LAKE	302	steel I-beam stringer	1909	1	28.00
LAKE017	LAKE	302	steel I-beam stringer	1909	1	36.00
LAPE039	LAPEER	302	steel I-beam stringer	1900	1	25.00
LENA032	LENAWEE	342	steel I-beam stringer, concrete encase	1940	5	23.00
LENA034	LENAWEE	302	steel I-beam stringer	1910	1	35.00
LIVI017	LIVINGSTON	302	steel I-beam stringer	1910	1	29.00
LIVI025	LIVINGSTON	302	steel I-beam stringer	1900	1	21.00
LUCE002	LUCE	402	steel continuous I-beam stringer	1900	3	12.00
LUCE007	LUCE	302	steel I-beam stringer	1900	1	27.00
MACK001	MACKINAC	302	steel I-beam stringer	1938	5	56.00
MACO004	MACOMB	302	steel I-beam stringer	1939	5	50.00
MACO013	MACOMB	332	steel composite stringer	1950	5	69.00
MACO031	MACOMB	332	steel composite stringer	1951	5	73.00
MACO042	MACOMB	302	steel I-beam stringer	1928	1	48.00
MACO070	MACOMB	332	steel composite stringer	1953	3	87.00
MARQ001	MARQUETTE	302	steel I-beam stringer	1938	3	75.00
MARQ013	MARQUETTE	302	steel I-beam stringer	1928	1	72.00
MARQ030	MARQUETTE	302	steel I-beam stringer	1926	1	57.00
MARQ031	MARQUETTE	302	steel I-beam stringer	1927	1	67.00
MASO001	MASON	302	steel I-beam stringer	1934	5	31.00
MASO019	MASON	302	steel I-beam stringer	1900	1	30.00
MECO006	MECOSTA	302	steel I-beam stringer with concrete sp	1927	1	50.00
MECO012	MECOSTA	302	steel I-beam stringer	1900	1	30.00
MECO014	MECOSTA	302	steel I-beam stringer	1896	1	29.00
MENO010	MENOMINEE	332	steel composite stringer	1952	5	70.00
MIDL004	MIDLAND	302	steel I-beam stringer	1947	6	60.00
MIDL006	MIDLAND	302	steel I-beam stringer	1910	1	28.00

Steel Stringers

Struct No	County	Type	Superstructure	Year	Main spans	Span length
MONR021	MONROE	402	steel continuous I-beam stringer	1925	3	46.00
MONR026	MONROE	302	steel I-beam stringer	1900	1	16.00
MONR028	MONROE	332	steel composite stringer	1927	1	48.00
MONR038	MONROE	332	steel composite stringer	1938	7	54.00
MONR067	MONROE	302	steel I-beam stringer	1900	1	29.00
MONR076	MONROE	302	steel I-beam stringer	1927	1	49.00
MONT017	MONTCALM	302	steel I-beam stringer	1910	1	24.00
MONT024	MONTCALM	342	steel I-beam stringer, concrete encase	1914	2	32.00
MUSK007	MUSKEGON	302	steel I-beam stringer	1927	6	40.00
OAKL026	OAKLAND	302	steel I-beam stringer	1900	1	30.00
OAKL027	OAKLAND	302	steel I-beam stringer	1900	1	30.00
OAKL033	OAKLAND	342	steel I-beam stringer, concrete encase	1929	5	57.00
OGEM007	OGEMAW	302	steel I-beam stringer	1953	3	82.00
OSCE036	OSCEOLA	372	steel I beam stringer	1902	3	24.00
OSCE037	OSCEOLA	372	steel I-beam stringer	1902	3	24.00
OTTA003	OTTAWA	302	steel I-beam stringer	1949	5	52.00
OTTA021	OTTAWA	302	steel I-beam stringer	1932	2	88.00
OTTA031	OTTAWA	302	steel I-beam stringer	1912	4	16.00
OTTA032	OTTAWA	302	steel I-beam stringer	1912	3	16.00
OTTA033	OTTAWA	302	steel I-beam stringer	1948	9	54.00
OTTA042	OTTAWA	302	steel I-beam stringer	1930	12	11.00
SAGI015	SAGINAW	332	steel composite stringer	1927	3	142.00
SAGI027	SAGINAW	302	steel I-beam stringer	1913	1	30.00
SAGI045	SAGINAW	302	steel I-beam stringer	1927	5	65.00
SAGI049	SAGINAW	302	steel I-beam stringer	1912	1	28.00
SAGI054	SAGINAW	302	steel I-beam stringer	1926	2	47.00
SAGI063	SAGINAW	302	steel I-beam stringer	1910	2	13.00
SAGI070	SAGINAW	302	steel I-beam stringer	1895	1	48.00
SAGI084	SAGINAW	302	steel I-beam stringer	1890	1	24.00
SHIA008	SHIAWASSEE	332	steel composite stringer	1900	1	27.00
SHIA029	SHIAWASSEE	302	steel I-beam stringer	1901	1	28.00
STCL071	ST. CLAIR	302	steel I-beam stringer	1920	1	47.00
STCL072	ST. CLAIR	302	steel I-beam stringer	1928	2	57.00
STCL074	ST. CLAIR	372	steel I-beam stringer, timber floor	1912	1	23.00
STCL084	ST. CLAIR	302	steel I-beam stringer	1914		
STJO020	ST. JOSEPH	302	steel I-beam stringer	1911	1	42.00
STJO034	ST. JOSEPH	302	steel I-beam stringer	1901	1	21.00
STJO036	ST. JOSEPH	302	steel I-beam stringer	1909	1	30.00
STJO038	ST. JOSEPH	302	steel I-beam stringer	1910	1	27.00
TUSC009	TUSCOLA	302	steel I-beam stringer	1941	7	60.00
VANB014	VAN BUREN	302	steel I-beam stringer	1928	1	55.00
VANB030	VAN BUREN	302	steel I-beam stringer	1882	1	50.00
WASH051	WASHTENA	342	steel I-beam stringer, concrete encase	1928	10	44.00

Steel Stringers

Struct No	County	Type	Superstructure	Year	Main spans	Span length
WAYN003	WAYNE	332	steel composite stringer	1943	7	79.0
WAYN004	WAYNE	332	steel composite stringer	1943	7	80.0
WAYN009	WAYNE	302	steel I-beam stringer	1948	5	64.00
WAYN024	WAYNE	432	steel continuous composite stringer	1955	5	62.0
WAYN125	WAYNE	302	steel I-beam stringer	1900	1	22.0
WAYN152	WAYNE	402	steel continuous I-beam stringer	1917	2	19.00
WAYN153	WAYNE	302	steel I-beam stringer	1928	7	52.0
WAYN167	WAYNE	342	steel I-beam stringer, concrete encase	1901	1	34.00
WAYN190	WAYNE	332	steel composite stringer	1953	5	92.00
WAYN191	WAYNE	332	steel composite stringer	1953	6	70.0
WAYN195	WAYNE	302	steel I-beam stringer	1954	4	83.00
WAYN202	WAYNE	332	steel composite stringer	1953	6	57.0
WAYN205	WAYNE	332	steel composite stringer	1953	6	57.0
WAYN238	WAYNE	432	steel continuous composite stringer	1953	2	81.00

Steel Stringers with jack-arch decks

Struct No	County	Type	Superstructure	Year	Main spans	Span length
AREN032	ARENAC	362	steel I-beam stringer	1913	2	30.00
BERR035	BERRIEN	362	steel I-beam stringer	1906	1	23.00
CALH028	CALHOUN	362	steel I-beam stringer	1900	1	26.00
CALH034	CALHOUN	362	steel I-beam stringer	1905	1	23.00
DELT021	DELTA	362	steel I-beam stringer	1900	1	35.00
EATO023	EATON	362	steel I-beam stringer	1910	1	18.00
EATO024	EATON	362	steel I-beam stringer	1913	1	23.00
EATO030	EATON	362	steel I-beam stringer	1914	1	44.00
EATO039	EATON	362	steel I-beam stringer	1903	1	25.00
EATO041	EATON	362	steel I-beam stringer	1903	1	19.00
EATO042	EATON	362	steel I-beam stringer	1913	1	28.00
EATO043	EATON	362	steel I-beam stringer	1900	1	23.00
GRAT010	GRATIOT	362	steel I-beam stringer	1900	1	21.00
HURO034	HURON	362	steel I-beam stringer	1910	1	36.00
HURO089	HURON	362	steel I-beam stringer	1910	1	26.00
IONI028	IONIA	362	steel I-beam stringer	1900	1	20.00
IONI035	IONIA	362	steel I-beam stringer	1900	1	28.00
IONI040	IONIA	362	steel I-beam stringer	1907	1	19.00
JACK058	JACKSON	362	steel I-beam stringer	1910	1	31.00
LENA041	LENAWEE	362	steel I-beam stringer	1905	1	24.00
LIVI029	LIVINGSTON	362	steel I-beam stringer	1914	1	25.00
LIVI031	LIVINGSTON	362	steel I-beam stringer	1914	1	26.00
MACO040	MACOMB	362	steel I-beam stringer	1910	1	16.00
MANI008	MANISTEE	362	steel I-beam stringer	1910	1	22.00
MASO023	MASON	362	steel I-beam stringer	1900	1	25.00
MECO019	MECOSTA	362	steel I-beam stringer	1900	1	24.00
MECO107	MECOSTA	362	steel I-beam stringer	1896	1	29.00
MIDL040	MIDLAND	362	steel I-beam stringer	1903	1	18.00
MONR112	MONROE	362	steel I-beam stringer	1900	1	17.00
OCEA014	OCEANA	362	steel I-beam stringer	1900	1	20.00
OCEA017	OCEANA	362	steel I-beam stringer	1910	2	14.00
OCEA019	OCEANA	362	steel I-beam stringer	1910	1	35.00
OSCE023	OSCEOLA	362	steel I-beam stringer	1900	1	17.00
OSCE025	OSCEOLA	362	steel I-beam stringer	1900	1	18.00
OSCE027	OSCEOLA	362	steel I-beam stringer	1900	1	28.00
OSCE028	OSCEOLA	362	steel I-beam stringer	1900	1	19.00
OSCE029	OSCEOLA	362	steel I-beam stringer	1900	1	18.00
OSCE032	OSCEOLA	362	steel I-beam striger	1900	1	30.00
OSCE035	OSCEOLA	362	steel I-beam stringer	1900	2	16.00
OSCE039	OSCEOLA	362	steel I-beam stringer	1900	1	28.00
STCL075	ST. CLAIR	362	steel I-beam stringer	1913	1	23.00
STCL092	ST. CLAIR	362	steel I-beam stringer	1917	1	23.00
STJO014	ST. JOSEPH	362	steel I-beam stringer	1912	1	21.00

Steel Stringers with jack-arch decks

Struct No	County	Type	Superstructure	Year	Main spans	Span length
STJO032	ST. JOSEPH	362	steel I-beam stringer	1910	1	27.00
STJO033	ST. JOSEPH	362	steel I-beam stringer	1912	1	20.00

STEEL GIRDER (303, 403, 321, 421, 333, 433, 352, 452, 382, 482, 392, 492)

Steel girders employ a technology similar to that of stringers, substituting two or more deep-profile beams for the row of relatively shallow stringers. With their more complicated bearing condition, beam arrangement and floor system connections, steel girder bridges mark a step up the technological scale from stringers. It was this increased complexity -- along with relatively heavy superstructural weight and the physical limitation of transporting heavy, factory-fabricated girders -- that limited the application of steel girders for highway use in America in the early twentieth century. The Michigan State Highway Department first delineated plans for a steel plate through girder bridge among its first standards in 1907-1908.[128] Intended for spans between 30 and 60 feet, girders were used with moderate frequency in the state between 1908 and about 1915.

The high cost of steel during and after World War I dampened the use of steel through and deck girders, however. By 1922 MSHD had dropped its through girder altogether and reduced the span range of its deck girder standard to only ten feet between 55 and 65 feet. After the Highway Department redesigned its girder standard and began encasing the steel beams in concrete in 1927-1928, this structural type experienced a resurgence in the state for long-span crossings. Girders -- both encased and open, deck and through -- were used frequently for long-span bridges and grade separations in the 1930s. They continued to be used in the 1940s and 1950s but have gradually been overshadowed by prestressed concrete beam bridges.

Steel deck girder (303, 403, 333, 433, 352, 452, 382, 482): MSHD developed its first standard deck girder designs around 1910, and this structural type enjoyed modest success through the 1910s. All pre-1920 girders that have retained integrity should therefore be included for their representation either of pre-MSHD construction or of formative MSHD design. In subsequent years, girder spans increased incrementally; by the 1940s, they represented as a group the longest beam bridges in the state. The longest examples of these should be included in the field survey sample. Multiple-span examples of steel stringer bridges are relatively rare and should also be included.

All pre-1955 steel deck girders:	110
Date range: 1900 - 1955	
Span range: 20 feet - 158 feet	

All pre-1920 steel deck girders:	4
Deck girders - 5+ spans or 85-foot span 1920 - 1930:	7
Deck girders - 5+ spans or 85-foot span 1931 - 1940:	5
Deck girders - 5+ spans or 100-foot span 1941 - 1955:	20

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[128] 2 SHDBR (1907-1908), 204.

TOTAL RECOMMENDED FOR SURVEY 36

Steel through girder (321, 421): Steel through girder bridges are today sufficiently rare that all pre-1955 examples should be included in the field survey sample.

All pre-1955 steel through girders: 7

Date range: 1900 - 1934

Span range: 47 feet - 95 feet

TOTAL RECOMMENDED FOR SURVEY 7

Concrete-encased steel deck girder (392, 492): Concrete-encased, steel deck girder bridges are today sufficiently rare that both pre-1955 examples should be included in the field survey sample.

All pre-1955 concrete-encased steel deck girders: 2

Date range: 1926 - 1927

Span range: 55 feet - 65 feet

TOTAL RECOMMENDED FOR SURVEY 2

Steel Deck Girders

Struct No	County	Type	Superstructure	Year	Main spans	Span length
BAY005	BAY	482	steel plate deck girder, arched	1938	6	98.00
BERR008	BERRIEN	303	steel deck girder	1950	3	121.00
BERR015	BERRIEN	303	steel plate deck girder, variable depth	1954	5	101.00
DICK004	DICKINSON	303	steel deck girder	1929	6	79.00
HURO053	HURON	303	steel deck girder	1915	1	59.00
HURO054	HURON	303	steel deck girder	1915	1	59.00
INGH010	INGHAM	352	steel plate girder	1930	1	88.00
IONI004	IONIA	352	steel plate deck girder	1948	5	75.00
IONI012	IONIA	403	steel plate deck girder, variable depth	1950	4	130.00
KENT001	KENT	382	steel plate deck girder, variable depth	1929	6	80.00
KENT009	KENT	352	steel deck girder	1936	4	87.00
KENT016	KENT	382	steel deck girder	1930	8	75.00
MASO024	MASON	303	steel girder	1900	1	52.00
MENO001	MENOMINEE	352	steel plate deck girder, arched	1929	13	79.00
MIDL003	MIDLAND	303	steel deck girder	1955	3	110.00
MIDL008	MIDLAND	352	steel plate girder	1933	1	85.00
MONR051	MONROE	303	steel plate deck girder, variable depth	1955	3	158.00
MONT007	MONTCALM	382	steel deck girder	1932	3	87.00
MUSK043	MUSKEGON	303	steel plate girder	1900	5	29.00
OCEA001	OCEANA	303	steel plate deck girder	1954	3	102.00
ONTO015	ONTONAGON	303	steel plate cantilevered deck girder	1952	3	102.00
ONTO016	ONTONAGON	303	steel plate cantilevered deck girder	1952	3	90.00
STCL013	ST. CLAIR	352	steel deck girder	1928	2	75.00
STCL018	ST. CLAIR	303	steel plate deck girder, variable depth	1950	3	146.00
WASH011	WASHTENA	382	steel plate deck girder	1942	5	88.00
WASH013	WASHTENA	382	steel plate deck girder	1942	5	88.00
WASH048	WASHTENA	382	steel plate girder, composite	1928	1	84.00
WAYN013	WAYNE	382	steel plate girder	1954	4	108.00
WAYN021	WAYNE	352	steel plate deck girder	1948	2	119.00
WAYN031	WAYNE	382	steel plate girder	1953	2	118.00
WAYN192	WAYNE	352	steel plate girder	1953	5	77.00
WAYN194	WAYNE	352	steel plate girder	1953	5	67.00
WAYN203	WAYNE	352	steel plate girder	1953	11	134.00
WAYN204	WAYNE	352	steel plate girder	1953	11	130.00
WAYN208	WAYNE	352	steel plate girder	1955	4	121.00
WEXF001	WEXFORD	303	steel deck girder	1948	3	122.00

Steel Through Girders

Struct No	County	Type	Superstructure	Year	Main spans	Span length
ALGE024	ALGER	321	steel plate through girder	1910	1	61.00
BERR039	BERRIEN	321	steel through girder	1900	1	47.00
GOGE038	GOGEBIC	321	steel through girder	1923	1	49.00
MONR114	MONROE	321	steel through girder	1900	1	60.00
OTTA015	OTTAWA	321	steel plate through girder, variable de	1928	7	95.00
STCL008	ST. CLAIR	321	steel plate through girder	1906	1	70.00
WASH005	WASHTENA	321	steel plate through girder	1934	3	81.00

Concrete-encased Steel Deck Girders

Struct No	County	Type	Superstructure	Year	Main spans	Span length
CHIP009	CHIPPEWA	392	steel plate deck girder, concrete encas	1926	1	55.00
JACK010	JACKSON	392	steel plate girder, concrete encased	1927	1	65.00

STEEL PONY AND THROUGH TRUSS 310, 410, 343, 443, 344, 444)

Beginning in the late 1870s, the pin-connected wrought iron truss was the roadway bridge of choice for medium- and long-span crossings in America. The bridge companies that proliferated through the Midwest and Ohio River Valley competed enthusiastically for county and township bridge business, marketing an ever-changing array of truss types through networks of regional sales representatives. Both patented in the 1840s, the Pratt and Warren web configurations -- with their variations and subtypes -- formed the basis for the overwhelming majority of all-metal trusses built in Michigan in the late nineteenth and early twentieth centuries. They were fabricated by such regional firms as the King Iron Bridge Company, the Wrought Iron Bridge Company, the Massillon Bridge Company and the Smith Bridge Company, all of Ohio, and in-state firms such as the Michigan Bridge Company and the Detroit Bridge and Iron Company.

The earliest bridges featured pinned and bolted connections in some combinations; these were largely superseded by all-pinned Pratt-type trusses in the 1880s. Because of their relatively quick erection and easy fabrication, pin-connected trusses dominated the market until portable riveting machines became widely available after the turn of the century. Riveted trusses began to overshadow pinned around 1910. Their use was encouraged by the Michigan State Highway Department, which published its first truss standard -- a rigid-connected Warren pony that ranged in span from 60 to 100 feet -- in the 1907-1908 biennium.[129]

MSHD updated its pony truss standards periodically to accommodate heavier traffic loads and wider roadways, but the agency maintained its reliance on the Warren configuration for short- and medium-span ponies through the 1930s and 1940s. For long-span pony trusses, MSHD developed the design for a rigid-connected Parker truss in the 1921-1922 biennium.[130] This atypically configured truss was used in the 1920s and 1930s as the standard for spans between 100 and 130 feet. For longer spans or trusses that required overhead bracing, MSHD engineers typically employed rigid-connected Pratt through trusses. The agency never developed a through truss standard, however, stating the same individualized-circumstances rationale that it used for concrete arches.

> **Steel through and pony truss** (310, 410, 343, 443, 344, 444): Numerous iron and steel trusses were included in Michigan's initial historic bridge inventory; as a result, trusses are the most thoroughly studied of the state's historic bridge types. To gain a better understanding of truss development, particularly among the later and more common pony truss standards, all through and pony trusses not previously surveyed that have retained integrity should be included.

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[129] 2 SHDBR (1907-1908), 204.

[130] 9 SHDBR (1921-1922), 13.

All pre-1955 pony trusses:	**118**
Date range: 1900 - 1955	
Span range: 6 feet - 32 feet	
All pre-1955 through trusses:	**14**
Date range: 1900 - 1955	
Span range: 6 feet - 32 feet	
All pre-1955 trusses, configuration unknown:	**14**
Date range: 1900 - 1955	
Span range: 6 feet - 32 feet	
TOTAL RECOMMENDED FOR SURVEY	**146**

Steel through and pony trusses

Struct No	County	Type	Superstructure	Year	Main spans	Span length
ALGE017	ALGER	344	rigid-connected Pratt half-hip pony tr	1906	1	26.00
ALGE025	ALGER	344	rigid-connected Pratt half-hip pony tr	1910	1	40.00
ALGE028	ALGER	344	rigid-connected Warren pony truss	1921	1	47.00
ALLE025	ALLEGAN	344	pin-connected Pratt half-hip pony trus	1910	1	50.00
ALLE026	ALLEGAN	344	pin-connected Pratt half-hip pony trus	1915	1	47.00
ALLE027	ALLEGAN	344	pin-connected Pratt half-hip pony trus	1916	1	64.00
ALLE028	ALLEGAN	344	pin-connected Pratt half-hip pony trus	1918	1	41.00
ALLE030	ALLEGAN	344	rigid-connected Pratt half-hip pony tr	1916	1	27.00
ALLE036	ALLEGAN	344	rigid-connected Warren pony truss	1920	1	42.00
ALPE013	ALPENA	344	pin-connected Pratt half-hip pony trus	1921	1	39.00
BENZ007	BENZIE	344	rigid-connected Pratt pony truss	1900	1	55.00
BERR036	BERRIEN	344	rigid-connected Warren pony truss	1928	1	49.00
BRAN027	BRANCH	344	rigid-connected Warren pony truss	1920	2	26.00
BRAN028	BRANCH	344	rigid-connected Pratt half-hip pony tr	1905	1	39.00
BRAN029	BRANCH	344	pin-connected Pratt pony truss	1905	1	60.00
BRAN032	BRANCH	344	pin-connected Pratt half-hip pony trus	1917	1	39.00
BRAN033	BRANCH	344	rigid-connected Warren pony truss	1903	1	60.00
BRAN038	BRANCH	343	pin-connected Pratt through truss	1905	1	88.00
BRAN039	BRANCH	344	pin-connected Pratt pony truss	1900	1	78.00
BRAN042	BRANCH	344	rigid-connected Pratt pony truss	1920	1	64.00
CALH033	CALHOUN	343	pin-connected Pratt through truss	1914	1	80.00
CALH037	CALHOUN	344	rigid-connected polygonal Warren po	1906	1	100.00
CHAR004	CHARLEVOI	344	pin-connected Pratt half-hip pony trus	1900	1	40.00
CHEB013	CHEBOYGAN	344	steel truss	1935	1	32.00
CHIP022	CHIPPEWA	344	rigid-connected Warren pony truss	1920	1	33.00
CHIP023	CHIPPEWA	344	rigid-connected Warren pony truss	1935	1	33.00
CHIP024	CHIPPEWA	344	rigid-connected Warren pony truss	1914	1	51.00
CLAR020	CLARE	344	rigid-connected Pratt pony truss	1915	1	37.00
CLAR023	CLARE	344	rigid-connected Pratt pony truss	1934	1	41.00
CLAR027	CLARE	343	pin-connected Pratt through truss	1929	1	100.00
CLAR028	CLARE	310	steel truss	1929	1	43.00
CLIN001	CLINTON	344	pin-connected Pratt pony truss	1900		
CLIN027	CLINTON	343	pin-connected Pratt through truss	1907	1	99.00
CLIN029	CLINTON	344	rigid-connected Warren ony truss	1906	1	56.00
CLIN033	CLINTON	344	steel I-beam stringer	1920	1	56.00
EATO027	EATON	344	rigid-connected lattice pony truss	1910	1	25.00
EATO049	EATON	344	steel truss			
GLAD011	GLADWIN	344	rigid-connected Warren pony truss	1917	1	65.00
GLAD022	GLADWIN	344	rigid-connected Warren pony truss	1920	1	48.00
GOGE023	GOGEBIC	344	rigid-connected Warren pony truss	1916	1	68.00
GOGE029	GOGEBIC	344	rigid-connected Pratt pony truss	1906	1	68.00
GOGE040	GOGEBIC	344	rigid-connected Warren pony truss	1920	1	64.00
GRAT042	GRATIOT	344	pin-conected Pratt half-hip pony truss	1908	1	34.00

Steel through and pony trusses

Struct No	County	Type	Superstructure	Year	Main spans	Span length
GRAT043	GRATIOT	310	steel truss	1910	1	69.00
GRAT047	GRATIOT	344	rigid-connected Warren pony truss	1920	1	65.00
HOUG017	HOUGHTON	344	rigid-connected Pratt half-hip pony tr	1900	1	40.00
HURO036	HURON	344	rigid-connected two-angle Warren po	1915	1	37.00
HURO041	HURON	344	rigid-connected two-angle Warren po	1915	1	40.00
HURO043	HURON	344	steel truss	1912	1	40.00
HURO050	HURON	344	rigid-connected two-angle Warren po	1915	1	83.00
HURO075	HURON	344	pin-connected Pratt half-hip pony trus	1925	1	47.00
IONI032	IONIA	344	pin-connected Pratt half-hip pony trus	1900	1	28.00
IONI038	IONIA	343	pin-connected Pratt through truss	1906	1	79.00
IONI039	IONIA	344	pin-connected Pratt half-hip pony trus	1900	1	49.00
IRON017	IRON	344	rigid-connected Warren pony truss	1924	2	60.00
IRON023	IRON	410	steel continuous truss	1906	1	101.00
KALA026	KALAMAZOO	344	rigid-connected Warren pony truss	1907	1	28.00
KALK003	KALKASKA	344	pin-connected Pratt half-hip pony trus	1910	2	15.00
KENT038	KENT	344	pin-connected Pratt pony truss	1892	1	60.00
LAPE023	LAPEER	344	rigid-connected Warren pony truss	1889	1	42.00
LENA035	LENAWEE	344	steel truss	1908	1	35.00
LENA036	LENAWEE	344	steel truss	1907	1	39.00
LENA038	LENAWEE	344	steel truss	1910	1	63.00
LENA040	LENAWEE	344	steel truss	1920	1	41.00
LENA045	LENAWEE	344	steel truss	1910	1	39.00
LENA047	LENAWEE	344	steel truss	1897	1	39.00
LENA048	LENAWEE	344	steel truss	1900	1	33.00
LENA060	LENAWEE	344	steel truss	1870		
LIVI033	LIVINGSTON	310	steel truss	1905	1	33.00
LUCE003	LUCE	344	rigid-connected Warren pony truss	1913	1	40.00
MACO049	MACOMB	344	rigid-connected Warren pony truss	1910	1	77.00
MACO056	MACOMB	344	pin-connected Pratt half-hip pony trus	1910	1	58.00
MACO061	MACOMB	344	rigid-connected Pratt pony truss	1928	1	63.00
MACO065	MACOMB	344	pin-connected Pratt pony truss	1920	1	49.00
MARQ075	MARQUETTE	310	steel truss	1909	1	22.00
MASO012	MASON	344	steel truss	1900	1	62.00
MASO016	MASON	344	steel truss	1900	1	45.00
MASO021	MASON	344	steel truss	1900	1	26.00
MASO022	MASON	344	steel truss	1900	1	36.00
MECO016	MECOSTA	344	rigid-connected Warren pony truss	1897	1	61.00
MENO031	MENOMINEE	344	rigid-connected Warren pony truss	1924	1	51.00
MENO046	MENOMINEE	344	steel truss	1926	1	39.00
MIDL007	MIDLAND	344	rigid-connected Parker pony truss	1932	1	109.00
MIDL011	MIDLAND	343	rigid-connected Pratt through truss	1928	1	128.00
MIDL020	MIDLAND	344	rigid-connected Warren pony truss	1930	1	89.00
MIDL021	MIDLAND	344	rigid-connected Pratt pony truss	1906	1	60.00

Steel through and pony trusses

Struct No	County	Type	Superstructure	Year	Main spans	Span length
MIDL022	MIDLAND	310	steel truss	1930	1	30.00
MIDL033	MIDLAND	344	rigid-connected Warren pony truss	1910	1	48.00
MIDL034	MIDLAND	344	pin-connected Pratt half-hip pony trus	1905	1	39.00
MIDL035	MIDLAND	344	rigid-connected Pratt pony truss	1911	1	48.00
MIDL046	MIDLAND	343	steel truss	1900	1	141.00
MISS011	MISSAUKEE	344	pin-connected Pratt pony truss	1920	1	80.00
MISS013	MISSAUKEE	344	pin-connected Pratt pony truss	1908	1	73.00
MONR019	MONROE	344	pin-connected Pratt half-hip pony trus	1910	1	37.00
MONR020	MONROE	344	pin-connected Pratt half-hip pony trus	1899	1	48.00
MONR025	MONROE	344	pin-connected Pratt half-hip pony trus	1910	1	26.00
MONR106	MONROE	344	pin-connected Pratt half-hip pony trus	1900	1	39.00
MONR107	MONROE	344	pin-connected Pratt half-hip pony trus	1900	1	35.00
MONR111	MONROE	344	pin-connected Pratt half-hip pony trus	1900	1	33.00
MORE005	MONTMORE	344	rigid-connected Pratt half-hip pony tr	1930	1	40.00
MUSK037	MUSKEGON	310	steel truss	1910	3	40.00
NEWA017	NEWAYGO	310	steel truss	1920	1	60.00
OSCE031	OSCEOLA	344	pin-connected Pratt half-hip pony trus	1900	1	48.00
OSCE040	OSCEOLA	344	pin-connected Pratt half-hip pony trus	1900	1	42.00
SAGI020	SAGINAW	343	pin-connected Pratt through truss	1913	1	98.00
SAGI055	SAGINAW	344	rigid-connected Warren pony truss	1923	1	60.00
SAGI069	SAGINAW	344	pin-connected Pratt half-hip pony trus	1898	1	43.00
SAGI073	SAGINAW	344	rigid-connected Pratt half-hip pony tr	1907	1	40.00
SAGI076	SAGINAW	344	pin-connected Pratt pony truss	1906	1	69.00
SAGI077	SAGINAW	310	steel truss	1906	1	96.00
SAGI081	SAGINAW	344	rigid-connected Warren pony truss	1885	1	49.00
SAGI082	SAGINAW	344	rigid-connected Pratt pony truss	1887	1	39.00
SAGI083	SAGINAW	344	rigid-connected Warren pony truss	1904	1	67.00
SAGI111	SAGINAW	343	pin-connected Pratt through truss	1885	1	139.00
SANI040	SANILAC	344	steel truss	1905	1	66.00
SANI049	SANILAC	343	steel through truss	1907	1	148.00
SANI064	SANILAC	343	steel through truss	1900	1	96.00
SANI067	SANILAC	344	steel truss	1910	1	70.00
SHIA037	SHIAWASSEE	310	steel truss	1927	1	30.00
SHIA039	SHIAWASSEE	343	pin-connected Pratt through truss	1892	1	89.00
STCL062	ST. CLAIR	310	steel truss	1927	1	61.00
STCL067	ST. CLAIR	310	steel truss	1900	1	98.00
STCL079	ST. CLAIR	344	steel truss	1937		
STCL080	ST. CLAIR	344	steel truss	1910		
STCL081	ST. CLAIR	344	steel truss	1908		
STCL082	ST. CLAIR	343	steel through truss	1914		
STJO012	ST. JOSEPH	310	steel truss	1923	1	90.00
STJO022	ST. JOSEPH	344	pin-connected Pratt half-hip pony trus	1910	1	43.00
STJO024	ST. JOSEPH	344	pin-connected Pratt half-hip pony trus	1915	1	42.00

Steel through and pony trusses

Struct No	County	Type	Superstructure	Year	Main spans	Span length
STJO025	ST. JOSEPH	344	rigid-connected Warren pony truss	1915	1	45.00
STJO026	ST. JOSEPH	344	pin-connected Pratt half-hip pony trus	1912	1	54.00
STJO029	ST. JOSEPH	344	pin-connected Pratt half-hip pony trus	1934	1	50.00
STJO030	ST. JOSEPH	344	pin-connected Pratt pony truss	1914	1	79.00
STJO031	ST. JOSEPH	344	rigid-connected Warren pony truss	1923	1	54.00
STJO035	ST. JOSEPH	344	pin-connected Pratt half-hip pony trus	1909	1	29.00
TUSC027	TUSCOLA	344	rigid-connected Warren pony truss	1910	1	60.00
TUSC042	TUSCOLA	344	rigid-connected Warren pony truss	1930	1	78.00
TUSC053	TUSCOLA	344	pin-connected pony truss	1910	1	37.00
WASH040	WASHTENA	343	pin-connected Pratt through truss	1900	1	109.00
WASH042	WASHTENA	344	rigid-connected Bailey truss	1953	1	100.00
WASH047	WASHTENA	344	pin-connected Pratt half-hip pony trus	1911	1	66.00
WASH054	WASHTENA	344	pin-connected Pratt half-hip pony trus	1900	1	65.00
WAYN090	WAYNE	344	steel truss	1924	2	100.00
WAYN121	WAYNE	310	steel truss	1900	1	158.00
WAYN128	WAYNE	344	steel truss	1933	1	84.00
WEXF011	WEXFORD	344	pin-connected Pratt pony truss	1906	1	80.00

STEEL DECK TRUSS AND DECK ARCH (309, 409, 322)

Like their through and pony truss counterparts, deck trusses employed a variety of web configurations and connection types. Steel or iron deck trusses were rarely used in Michigan by either the local administrations or the State Highway Department. Typically erected over deep ravines or railroad underpasses, deck trusses are uncommon in the United States; this trend holds especially true in Michigan, a state in which the numerous low crossings place a premium on under-bridge clearance.

Steel deck truss and deck arch (309, 409, 322): The one remaining deck truss and three steel deck arches should be included in the field survey sample.

All pre-1955 deck trusses and arches:	4
Date range: 1900 - 1947	
Span range: 38 feet - 300 feet	
TOTAL RECOMMENDED FOR SURVEY	**4**

Steel Deck Truss and Deck Arch

Struct No	County	Type	Superstructure	Year	Main spans	Span length
BARA002	BARAGA	322	steel plate deck arch	1947	1	128.00
MACK006	MACKINAC	322	steel rigid-connected deck arch	1947	3	300.00
MANI002	MANISTEE	322	steel rigid-connected deck arch	1934	3	300.00
OSCE033	OSCEOLA	309	steel deck truss	1900	1	38.00

STEEL RIGID FRAME (307, 407)

Steel rigid-frame bridges were developed in the late nineteenth century and marketed extensively by the bridge fabricators as the bedstead truss. Due primarily to their structural shortcomings, bedsteads largely fell from favor soon after the turn of the century. Rigid-frame girder bridges were erected in the early twentieth century, but their use was limited essentially to urban viaducts and grade separations. The structural type experienced a brief resurgence of use in the 1930s -- along with the concrete rigid frame -- for use in federal relief highway projects, and more recently on the interstate highway system. Through its various permutations, the steel rigid frame bridge was never commonly built; the Michigan State Highway Department employed it only occasionally and did not adopt it as a standard design.

Steel rigid frame (307, 407): The six rigid-frame bedsteads in the general inventory should be included in the field survey sample.

All pre-1955 steel rigid frames: Date range: 1901 - 1910 Span range: 29 feet - 59 feet	6
TOTAL RECOMMENDED FOR SURVEY	**6**

Steel Rigid Frames

Struct No	County	Type	Superstructure	Year	Main spans	Span length
MIDL031	MIDLAND	307	rigid-connected bedstead	1904	1	29.00
MIDL032	MIDLAND	307	pin-connected bedstead	1901	1	41.00
OCEA022	OCEANA	307	pin-connected Pratt bedstead	1912	1	48.00
OCEA023	OCEANA	307	pin-connected Pratt bedstead	1910	1	29.00
OCEA024	OCEANA	307	pin-connected Pratt bedstead	1910	1	51.00
OCEA025	OCEANA	307	pin-connected Pratt bedstead	1910	1	59.00

STEEL MOVABLE SPAN (316, 417)

With a large number of low-level roads intersecting with heavily trafficked rivers, Michigan has housed several movable span steel bridges. Small-scale swing-span structures were built on a township level early in the twentieth century. In 1917-1918 the State Highway Department designed and erected its first bascule bridge over the Spring Lake Outlet in Ottawa County.[131] Other swing and bascule bridges were built in the 1920s, 1930s and 1940s. Most of these were included in the initial historic bridge inventory; six bascules and two swing-span bridges are included in the general inventory for this study.

Steel movable span (316, 417): All eight movable span bridges in the general inventory should be included in the field survey sample.

All pre-1955 steel movable span bridges: 8

Date range: 1886 - 1949

Span range: 70 feet - 194 feet

TOTAL RECOMMENDED FOR SURVEY **8**

[131] Melick, "Summary of the Work," 30.

Steel Movable Spans

Struct No	County	Type	Superstructure	Year	Main spans	Span length
BAY004	BAY	316	steel plate deck girder bascule bridge	1938	1	185.00
BERR007	BERRIEN	316	steel plate deck girder bascule bridge	1949	1	164.00
CHAR001	CHARLEVOI	316	steel bascule bridge	1949	1	111.00
CHEB008	CHEBOYGAN	316	steel plate deck girder bascule	1940	1	70.00
ONTO009	ONTONAGON	417	steel plate deck girder swing span	1939	2	99.00
SAGI114	SAGINAW	417	pin-connected Pratt through truss swi	1886	2	194.00
STCL100	ST. CLAIR	316	steel bascule bridge	1933	1	114.00
WAYN118	WAYNE	316	steel bascule bridge	1922	2	91.00

STEEL PIPE CULVERT (319)

Small-diameter cast iron pipe culverts were used commonly for minor drainages in the nineteenth and early twentieth centuries in Michigan. The pipes were later made of corrugated steel, and large-diameter pipes were fabricated by riveting corrugated plate steel into round or ovaloid shapes. Although the steel culvert was used extensively in Michigan, the overwhelming majority of these small-scale structures employed single-barrel configurations, with spans less than ten feet. Few of these culverts have the requisite 20-foot overall length to be considered bridges by today's definition. And most of those few that have been cataloged in the Structure Inventory and Appraisal lists are erroneously dated replacements of earlier bridges. Those that actually pre-date 1955 are nondescript structures.

Steel pipe culvert (319): None of Michigan's extant pipe culverts display features (e.g., early construction, span length, span number, architectural detailing) that elevate them from their peers either historically of technologically. Therefore none of these intrinsically undistinguished structures should be included in the survey.

All pre-1955 steel pipe culverts: 55
Date range: 1900 - 1955
Span range: 6 feet - 29 feet

TOTAL RECOMMENDED FOR SURVEY 0

TIMBER BRIDGES (702, 710, 771)

Small-scale timber pile bridges were the staple of township road work in Michigan in the nineteenth and early twentieth centuries. Though inexpensive to erect, most of these early spans tended to be structurally suspect and required frequent maintenance to prevent their collapse. Moreover, they were limited to short-span crossings. Timber and timber/iron combination trusses were built frequently in the state in the 1850s, 1860s and 1870s, but these were eventually superseded by all-metal bowstring and truss spans in the 1880s. Due to the impermanence of wood as a bridge superstructural material, only a small number of timber bridges remains in place in Michigan today, most of which are of relatively recent vintage.

Timber stringer (702): Timber stringer bridges (with integrity) built before 1920 and those with spans in excess of 30 feet should be included as the oldest and longest of this intrinsically undistinguished structural type.

All pre-1955 timber stringers:		48
Date range:	1900 - 1955	
Span range:	13 feet - 61 feet	

All pre-1925 timber stringers: 3
Timber stringers - 5+ spans or 40-foot span 1941 - 1955: 2

TOTAL RECOMMENDED FOR SURVEY 5

Timber truss (710): All but one of Michigan's few timber truss bridges were included in the initial historic bridge inventory. The one remaining, privately owned, bridge should be included in the field survey sample for this study.

All pre-1955 timber trusses:		1
Date range:	1932	
Span range:	37 feet	

TOTAL RECOMMENDED FOR SURVEY 1

Timber composite slab (771): Several oddly configured timber composite slab bridges are listed in the general inventory, most of which are located in Mecosta County. Because of their relative rarity, all of these should be included in the field survey sample.

All pre-1955 timber composite slabs:		8
Date range:	1898 - 1946	
Span range:	17 feet - 30 feet	

TOTAL RECOMMENDED FOR SURVEY 8

Timber Stringers

Struct No	County	Type	Superstructure	Year	Main spans	Span length
BERR053	BERRIEN	702	timber stringer	1900	3	26.00
EATO031	EATON	702	timber stringer	1953	1	49.00
HILL031	HILLSDALE	702	timber stringer	1910	1	26.00
LUCE008	LUCE	702	timber stringer	1929	1	61.00
OSCE038	OSCEOLA	702	timber stringer	1902	5	21.00

Timber Truss

Struct No	County	Type	Superstructure	Year	Main spans	Span length
BERR054	BERRIEN	710	timber truss	1932	1	37.00

Timber Composite Slabs

Struct No	County	Type	Superstructure	Year	Main spans	Span length
MARQ062	MARQUETTE	771	timber composite slab	1946	3	17.00
MECO010	MECOSTA	771	timber composite slab	1904	1	29.00
MECO011	MECOSTA	771	timber composite slab	1900	3	26.00
MECO013	MECOSTA	771	timber composite slab	1898	1	29.00
OCEA015	OCEANA	771	timber composite slab	1910	1	20.00
SANI059	SANILAC	771	timber composite slab	1940	3	30.00
STCL087	ST. CLAIR	771	timber composite slab	1938	2	19.00
STJO040	ST. JOSEPH	771	timber slab	1906	1	22.00

STONE MASONRY ARCH (811)

Despite an abundance of stone in various forms throughout the state and an indigenous tradition of masonry construction, stone bridges were never built in abundance in Michigan. As a result, only a handful of stone masonry spans remain in place today, all of which employ short-span arches that spring from stone sidewalls.

Stone masonry arch (811): Because of their relative rarity and because some were the product of federal relief programs in the 1930s, all stone masonry arch bridges should be included in the field survey sample.

All pre-1955 stone arches:	4
TOTAL RECOMMENDED FOR SURVEY	**4**

Stone Masonry Arches

Struct No	County	Type	Superstructure	Year	Main spans	Span length
CALH043	CALHOUN	811	stone masonry arch	1891	1	28.00
CALH045	CALHOUN	811	stone masonry arch	1899	3	25.00
CLAR014	CLARE	811	stone masonry arch	1915	1	17.00
GENE005	GENESEE	811	stone masonry arch	1906	1	30.00

Applying these general and categorical guidelines to the general inventory of bridges produces a list of 658 structures included in the field survey sample. Although the guidelines will remain consistent throughout the course of the study, the list of included bridges will evolve, as fieldwork and additional research turns up bridges that should be added to the list and those that should be deleted. Our experience in other states is that the bridges added and bridges deleted tend to balance each other, so that the overall number of included bridges at the end of the project is similar to this preliminary listing. Following is a summary listing of the bridges included in the field survey sample, delineated by structural type.

BRIDGES INCLUDED IN THE FIELD SURVEY SAMPLE UNDER NRHP CRITERION C

Concrete through girder	pre-1955:	88	included:	54
Concrete deck girder / T-beam	pre-1955:	430	included:	56
Concrete slab	pre-1955:	138	included:	26
Concrete rigid frame	pre-1955:	21	included:	20
Concrete arch	pre-1955:	89	included:	72
Concrete box culvert	pre-1955:	78	included:	0
Prestressed concrete beam	pre-1955:	0	included:	0
Steel stringer	pre-1955:	1,658	included:	143
Steel stringer with jack-arch deck	pre-1955:	200	included:	45
Steel deck girder	pre-1955:	110	included:	36
Steel deck girder, concrete encased	pre-1955:	2	included:	2
Steel through girder	pre-1955:	7	included:	7
Steel pony truss	pre-1955:	122	included:	118
Steel through truss	pre-1955:	14	included:	14
Steel truss, configuration unknown	pre-1955:	14	included:	14
Steel deck truss	pre-1955:	1	included:	1
Steel deck arch	pre-1955:	3	included:	3
Steel rigid frame	pre-1955:	6	included:	6
Steel movable span	pre-1955:	8	included:	8
Steel pipe culvert	pre-1955:	55	included:	0
Timber stringer	pre-1955:	48	included:	5
Timber truss	pre-1955:	1	included:	1
Timber composite slab	pre-1955:	8	included:	8
Stone masonry arch	pre-1955:	4	included:	4
(replaced)	pre-1955:	118		0
Total		**3,223**		**643**

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