Form No. 10-300 (Rev. 10-74)

DATA SHEET

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

FOR NPS USE ONLY
RECEIVED MAR 17 1976
DATE ENTERED MAY 13 1976

SEE INSTRUCTIONS IN *HOW TO COMPLETE NATIONAL REGISTER FORMS*
TYPE ALL ENTRIES -- COMPLETE APPLICABLE SECTIONS

1 NAME

HISTORIC

Monroe Street Bridge
AND/OR COMMON

2 LOCATION

STREET & NUMBER

Monroe Street between Ide Avenue and Riverfalls Blvd. __NOT FOR PUBLICATION

CITY, TOWN — __ VICINITY OF — CONGRESSIONAL DISTRICT

Spokane — #5 Thomas Foley

STATE — CODE — COUNTY — CODE

Washington — Spokane

3 CLASSIFICATION

CATEGORY	OWNERSHIP	STATUS	PRESENT USE	
__DISTRICT	X PUBLIC	X OCCUPIED	__AGRICULTURE	__MUSEUM
__BUILDING(S)	__PRIVATE	__UNOCCUPIED	__COMMERCIAL	__PARK
X STRUCTURE	__BOTH	__WORK IN PROGRESS	__EDUCATIONAL	__PRIVATE RESIDENCE
__SITE	PUBLIC ACQUISITION	ACCESSIBLE	__ENTERTAINMENT	__RELIGIOUS
__OBJECT	__IN PROCESS	__YES: RESTRICTED	__GOVERNMENT	__SCIENTIFIC
	__BEING CONSIDERED	X YES: UNRESTRICTED	__INDUSTRIAL	X TRANSPORTATION
		__NO	__MILITARY	__OTHER:

4 OWNER OF PROPERTY

NAME

City of Spokane

STREET & NUMBER

W 221 Wall

CITY, TOWN — __ VICINITY OF — STATE

Spokane — Washington

5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC.

Spokane County Court House

STREET & NUMBER

W1116 Broadway

CITY, TOWN — STATE

Spokane — Washington

6 REPRESENTATION IN EXISTING SURVEYS

TITLE

None

DATE

__FEDERAL __STATE __COUNTY __LOCAL

DEPOSITORY FOR SURVEY RECORDS

CITY, TOWN — STATE

7 DESCRIPTION

CONDITION		CHECK ONE	CHECK ONE
X EXCELLENT	__DETERIORATED	__UNALTERED	X ORIGINAL SITE
__GOOD	__RUINS	X ALTERED	__MOVED DATE_____
__FAIR	__UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

The Monroe Street Bridge is one of over 100 Spokane spans; however, it size, location, and beautifully balanced design have given it a unique position in the city's life. Located on the edge of the central business district, it links the civic, financial and commercial heart of Spokane on the south, to the county offices and commercial districts on the north bank.

As the largest concrete arch bridge in the United States, third largest in the world, at its completion in 1911, the structure was frequently described in news and engineering magazines.

"The . . . . bridge crosses the Spokane River at the lower end of the falls, where the drop in a series of cataracts is 136 feet with a length of 1300 feet. The downtown streets on both sides of the river are not more than 10 feet above high water at the crest of the falls, but within four blocks it drops to a gorge 140 feet in depth and 1500 feet width at the top." [1]

"The total length of the concrete structure is 784 feet and if the wooden approach on the south end is included, the bridge measures over all 965 feet. The center arch is one of the largest monolithic concrete arches in the world. This single span measures 281 feet in length, 71 feet in width, 136 feet in height to the top of the handrail, and weighs with the bridge deck 26,920,000 pounds." [2]

"The main arch over the river, ... has a span of 281 feet and a rise of intrados of 114 feet. This arch is of the twin rib type, the ribs being placed 36 feet c. to c. The ribs are 16 feet wide by 6 feet 9 inches deep at the crown, and flare toward haunches of 19 feet 9 inches and a depth of 18.5 feet." [3]

The bridge consists of: ". . . . a middle segmental span of 281 feet, two 120 foot semi-circular spans, and a retaining wall 93 feet in length with a maximum height of 53 feet. The main arches are not reinforced, but others are either of concrete reinforced with rods and wire mesh or of structural steel encased in concrete." [4]

"The south abutment, which forms the most unusual feature of the design is 140 feet in height. It was made necessary by the fact that there is no natural supporting ground on that side of the river. On account of this peculiar condition the springing line of the 120 foot arch is about 65 feet above the rock foundation to provide an abutment to carry the sloped line of stress from the first named line to the rock. Thus each of the four arch ribs is carried separately down to the base of the abutment in such shape that the center line from the thrust will always keep within the middle third. All arches are analyzed on the elastic theory." [5]

"At the thinnest place, the very crown, this concrete arch (main span) is six feet and nine inches in thickness. At its base, where the arch leaves the pier, it is 18 feet thick.

In the smaller spans, the 120 foot arches, the concrete at the crown is three feet and three inches thick and is 11 feet at the base." [6]

The super structure is supported in the main arch by five arches in each spandrel. The 120 foot arches have dual supporting arches in their spandrels. A series of eight arches,

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diminishing in size on the north approach, was matched by five arches on the south in 1915 when the massive land fill of the south gorge permitted removal of the original wooden approach. Because the fill has continued to settle, a 20 foot section remains wood, covered with asphalt, with a boardwalk for pedestrians. This section is periodically replaced.

"The new structure carries a double track electric car line and a highway and has two nine foot cantilevered sidewalks . . . . .The chief decorative feature of the bridge are the arches over the sidewalks, above each of the main piers. These arches are of concrete with seats inside and openings on the road way. On the road way side is a concrete buffalo skull with a similar skull on the opposite side. The north and south sides of the arches are decorated with ornamental bracket lamps . . . . The railing is designed with a chain effect." 7

The bridge was constructed with an arch span falsework suspended by cables from the old existing steel bridge. As the falsework was completed, the steel was removed from the outdated structure. On July 21, 1910, a gale force wind demolished the falsework arch. Recentering the bridge was greatly complicated without the support of the steel bridge. Falsework was re-erected by the use of timber bents supported on four steel trusses. Anchorages and toggles on the pier of the main span allowed erection of steel trusses as cantilevers. The massive steel falsework for the bridge roadbed was cantilevered and cross beamed. When the concrete was poured for the roadbed the steel falsework was retained to provide an extremely stout roadbed. Other portions of falsework steel were used for other Spokane bridges as was the steel from the demolished steel bridge.

The eight arches of the north approach are no longer open. In 1914 a railway embankment filled in the east side of the arches. The eastern side of the approach is five sections longer than the western railing and a stair descent from the first section leads to a vista park above the catch pool of the falls. A major alteration in the appearance of the river bank in recent years is a city project to convert much of the river bank below Ide Avenue to a river front park. In conjunction with this plan, gondola cable cars over the falls were retained after Spokane's Expo 74, and descend from the south bank over the lower falls to a point below the bridge on the north bank.

The original creosoted wood paving over the heavily reinforced road bed has long since been removed. The electric car line tracks were removed in 1934. Another alteration was the removal of the bracket lamps on the covered arches. Vandalism had cost the city $100 per month for replacement until the lamps were removed in 1925. Other features of the superstructure remain as planned. Each of the four covered arches include plaques concerning the bridge; those on the north cover the history of the bridge and river while those on the south include the names of the engineers, architects, and city commissioners. The buffalo skulls are unchanged by the years. Their massive size is generally assumed to be exaggerated; in fact, they are modeled on an actual buffalo skull.

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The bridge is in excellent condition for weight bearing capacity. Its initial design for street cars has provided a strength more than equal to the present four lane traffic. The only serious structural damage to the bridge in its history occurred when a direct collision removed three rail sections over the 120 foot south arch. Replacement was possible by constructing a mold from another portion of the railing.

Majestic size and location provide the Monroe Street Bridge with a unique place in the memory of Spokanites. Its impressive view of the falls and its great height above the river create one of the most spectacular structures in the Northwest. With the modernization of Monroe Street to a four lane arterial, the Bridge is as an active location as it has been since 1889, with the first structure. The Monroe Street Bridge is no longer the largest bridge in the city but it is the most unforgettable.

8 SIGNIFICANCE

PERIOD	AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW				
__PREHISTORIC	__ARCHEOLOGY-PREHISTORIC	__COMMUNITY PLANNING	__LANDSCAPE ARCHITECTURE	__RELIGION	
__1400-1499	__ARCHEOLOGY-HISTORIC	__CONSERVATION	__LAW	__SCIENCE	
__1500-1599	__AGRICULTURE	__ECONOMICS	__LITERATURE	__SCULPTURE	
__1600-1699	X ARCHITECTURE	__EDUCATION	__MILITARY	__SOCIAL/HUMANITARIAN	
__1700-1799	__ART	X ENGINEERING	__MUSIC	__THEATER	
__1800-1899	__COMMERCE	__EXPLORATION/SETTLEMENT	__PHILOSOPHY	X TRANSPORTATION	
X 1900-	__COMMUNICATIONS	__INDUSTRY	__POLITICS/GOVERNMENT	__OTHER (SPECIFY)	
		__INVENTION			

SPECIFIC DATES

BUILDER/ARCHITECT

STATEMENT OF SIGNIFICANCE

Spokane is a city of bridges, but its most magnificent span is the 64 year old Monroe Street Bridge. It was a landmark not only for its sheer size but also for the innovative techniques used in solving engineering problems. It remains an active part of Spokane traffic routing and a central vista point.

The site of the Monroe Street Bridge has been a historic one for Spokane and the present bridge followed two earlier structures on the same location. The first wooden bridge over the river was erected in 1889 but was damaged by fire. For a few years, Spokanites had to travel east to cross the river at one of the bridges above the falls. In 1891 a new steel bridge was placed over the river. Designed for street car traffic, among the first passengers across the span was the noted Sarah Bernhardt who was appearing in the city. When a partial collapse of the steel structure frightened Spokane, a new bridge was decided upon for the site. Having constructed a pioneering concrete bridge, the Washington Street bridge in 1907, the city decided to build a reinforced concrete structure across the river. Originally planned for only a 200 foot arch with three smaller arches, the city evidently decided to put itself on the map by designing one of the three largest bridges in the world. By early 1909, design plans were modified for a larger structure.

Few bridges approached the great mass of the Monroe Street Bridge in 1911.

"A new reinforced concrete bridge across the Tiber, at Rome, Italy, has a concrete arch with a span of 328 feet, and Aukland, New Zealand, has a concrete arch with a span of 320 feet. The nearest approach in length to the span of the Monroe Street Bridge in America is the Rocky River bridge at Cleveland, with a span of 280 feet, while next to this comes the Walnut Lane bridge in Philadelphia with a span of 233 feet." 1

Shortly after completion, the size of the Monroe Street Bridge was surpassed by four feet. Resemblance found in the Rocky River bridge resulted in a law suit filed January 1912 for infringement of copyright. However, the differences in design were apparent. The Cleveland bridge had only four arches in each spandrel of the main arch compared to five in the Monroe Street Bridge.

Designer of the bridge, city engineer J. C. Ralston, was assisted by Morton McCarthy, J. F. Greene and P. F. Kennedy. The group was also responsible for the design of the 1100 foot long Latah Creek Bridge. McCarthy, as an engineer for Reconstruction Finance from 1932 to 1957, was also designer of the ill-fated Tacoma Narrows Bridge, a cable-suspension span which collapsed dramatically in 1940, and approved the plans for the San Francisco-Oakland Bay Bridge. J. F. Greene designed the five mile long Robert Street bridge in New Orleans. The superstructure was designed by the firm of Cutter & Malgren. K. K. Cutter, one of the two architects in Spokane elected as a fellow of the American

9 MAJOR BIBLIOGRAPHICAL REFERENCES

See continuation sheet.

10 GEOGRAPHICAL DATA

ACREAGE OF NOMINATED PROPERTY 1.5

UTM REFERENCES

	ZONE	EASTING	NORTHING
A	11	468 ~~010~~ 050	5217 ~~080~~ 500
B			
C			
D			

VERBAL BOUNDARY DESCRIPTION

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE	CODE	COUNTY	CODE
STATE	CODE	COUNTY	CODE

11 FORM PREPARED BY

NAME / TITLE

Patsy M. Garrett/Historic Preservation Specialist — November 1, 1975

ORGANIZATION — DATE

Office of Archaeology and Historic Preservation

STREET & NUMBER — TELEPHONE

W2316 First Avenue

CITY OR TOWN — STATE

Spokane — Washington 99201

12 STATE HISTORIC PRESERVATION OFFICER CERTIFICATION

THE EVALUATED SIGNIFICANCE OF THIS PROPERTY WITHIN THE STATE IS:

NATIONAL ___ STATE X LOCAL ___

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

STATE HISTORIC PRESERVATION OFFICER SIGNATURE Anton M. Skalnik

TITLE State Historic Preservation Officer — DATE March 4, 1976

FOR NPS USE ONLY

I HEREBY CERTIFY THAT THIS PROPERTY IS INCLUDED IN THE NATIONAL REGISTER

Acting DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION — DATE 5/13/76

ATTEST: — DATE 5-11-76

KEEPER OF THE NATIONAL REGISTER

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Institute of Architects, was also the designer of many Spokane and Northwest homes, as well as others throughout the United States. His best known Spokane buildings are the Glover House (National Register), Grace Campbell House (National Register), and the Davenport Hotel (National Register).

Two major problems faced the engineers during design. The first problem was centering the bridge and Ralston thought it to be solved, by using the old steel bridge to support the falsework. A freak storm of near tornado force hit the city at 2 PM July 21, 1910 and ended that hope. Temperature dropped from 90° at 1:45 to 56° at 2:00, with a wind force of 42 mph; the falsework was lifted clear from the south support without breaking the guy wires. Flying debris knocked a six foot hole in the Washington Water Power substation on the south bank. Amazingly, none of the workmen, thrown from the bridge to the rapids and rocks below, were killed. By three o'clock the same afternoon, the temperature had risen to 80° leaving the city and the rising bridge in shambles.

Work was completed in centering the bridge by using steel trusses for support. The cost of the storm was an additional $40,000 in expenses and months of delay. Nonetheless, construction time was only 1 year 11 months. Total cost of the bridge was $500,000, half of which was paid in wages. The city saved a good deal in cost by reusing the steel from the trusses and old bridge for other structures and by using the modern equipment purchased for the bridge on other projects.

A second major engineering problem for Engineer Ralston was the deep gorge on the south bank of the river. The city had planned to have piers sunk through a land fill to rock, the fill to be retained by a wall springing from the base of the bridge. Unfortunately, the planned location of the supporting pier required an extremely deep excavation to reach solid ground. Deciding the city could not afford an additional $100,000 in cost for a fourth arch, Ralston developed a wooden approach for the first 150 feet of the south end of the bridge. The fill was to be used to support the smaller arches until solid ground could be reached nearer the bank. The filling of the gorge was continued for the next three and one-half years with use of all excavation material from new buildings, cinders from businesses, and any non-deteriorating waste material. In 1914, the city completed matching the concrete south end, except the final 20 feet which continues to settle, requiring replacement every three years of roadbed and boardwalks.

Internationally praised for its mass and innovative engineering, the bridge has retained regional renown for its beauty, vista and size. One unfortunate aspect of this fame is a high suicide rate over the years since 1911. A more pleasant aspect of its fame is the recent interest in improving the view of the bridge from above and below the falls, as well as the vista from the bridge, by removing the obstructions surrounding the area. Plans include a riverside park on the bank of the river. The city has purchased the bank north of the river between Post and Monroe Streets.

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Situated to channel much of the business district traffic, the Monroe Street Bridge has played an integral role in the city's life. Used as a lovers lane by the first decade's patrons, the romantic aspects of the bridge's appearance are today more appreciated by the tourists and photographers than by the myriad of drivers using its four lanes. A city blessed with bridges of virtually every description from pedestrian "skyways" and suspension bridges, to smoothly designed modern railway trestles and freeway spans, the Monroe Street Bridge remains Spokane's most spectacular and best known bridge.

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BIBLIOGRAPHY

"The Centering for the 281' Concrete Arch Monroe Street Bridge, Spokane, Washington", Engineering/Contracting, XXXV (April 1911), 444-46.

ENGINEERING NEWS (September 1909)

Kennedy, P. F., "Centering for the Monroe Street Bridge", Engineering Record, LXIII (April 1911), 484.

Literary Digest, XLV (August 31, 1912), 335.

"A Municipally Built Concrete Bridge, American City, VI (January 1912), p420-1.

Scientific American, LXXIII, (March 1912), 335.

Spokane Daily Chronicle.

Spokane Spokesman-Review.

FOOTNOTES: DESCRIPTION

[1]American City, p. 421.

[2]Ibid., p. 420.

[3]Kennedy, p. 479.

[4]American City, p. 421.

[5]Ibid.

[6]Spokesman-Review, (November 12, 1911), VII, 1:7.

[7]American City, p. 421

FOOTNOTES:SIGNIFICANCE

[1]American City, p. 421

1. SITE I.D. NO

HAER INVENTORY

Historic American Engineering Record
Department of the Interior, Washington, D.C. 20240

2. INDUSTRIAL CLASSIFICATION: Bridges, Trestles, and Aqueducts

ARCH: concrete 7595

City Designation Number: 371001001

3. PRIORITY: 1

5. DATE: 1909-11

4. DANGER OF DEMOLITION? (SPECIFY THREAT) ☐ YES ☒ NO ☐ UNKNOWN

6. GOVT SOURCE OF THREAT: OWNER ADMIN

7. OWNER/ADMIN: City of Spokane

8. NAME(S) OF STRUCTURE: Monroe Street Bridge

9. OWNER'S ADDRESS: West 221 Wall Street
Spokane, Washington

10. STATE: WA | COUNTY: 063 | COUNTY NAME: Spokane | CITY/VICINITY: Spokane | CONG. DIST.: 05

STATE ___ | COUNTY ___ | COUNTY NAME ___ | CITY/VICINITY ___ | CONG. DIST. ___

11. SITE ADDRESS (STREET & NO.)
Crossing: Spokane River
Monroe Street between Ide Avenue and Riverfalls Blvd.
S.T.R.: 18 25N 43E

12. EXISTING SURVEYS: ☒ NR ☐ NHL ☐ HABS ☐ HAER—I ☐ HAER ☐ NPS ☐ CL6
☐ CONF ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

13. SPECIAL FEATURES (DESCRIBE BELOW)
☐ INTERIOR INTACT ☐ EXTERIOR INTACT ☐ ENVIRONS INTACT

14. UTM ZONE 11 | EASTING 468010 | NORTHING 5278050 | SIGN | SCALE ☐ 1:24 ☐ 1:62.5 ☐ OTHER ___ | QUAD NAME: Spokane, Washington

UTM ZONE | EASTING | NORTHING | SIGN | SCALE ☐ 1:24 ☐ 1:62.5 ☐ OTHER ___ | QUAD NAME

15. CONDITION: 70 ☐ EXCELLENT 71 ☐ GOOD 72 ☐ FAIR 73 ☐ DETERIORATED 74 ☐ RUINS 75 ☐ UNEXPOSED 76 ☐ ALTERED 82 ☐ DESTROYED 85 ☐ DEMOLISHED

16. INVENTORIED BY: Lisa Soderberg | AFFILIATION: HAER/Washington State Bridge Inventory | DATE: June 1980

17. DESCRIPTION AND BACKGROUND HISTORY, INCLUDING CONSTRUCTION DATE(S), HISTORICAL DATE(S), PHYSICAL DIMENSIONS, MATERIALS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ENGINEERS, ETC.

When the Monroe Street Bridge was completed in 1911, its monolithic arch superceded the concrete arch over the Rocky River in Cleveland by a single foot; for a brief period the Spokane bridge acquired the title of being the largest concrete arch in the United States.

The multiple spanned concrete structure crossed the Spokane River at the lower end of the falls where the water rushes through a 140 foot gorge, linking the city's financial center on the south bank to the commercial and industrial districts on the north bank; the importance of this link had been recognized since 1889 when the first timber structure was constructed at this location. The concrete bridge replaced a steel cantilever truss constructed in 1891 which had become too light to carry the increasing loads of street car traffic.

The new bridge was designed to support a 40 foot roadway which would carry a double-track electric car line, in addition to a highway, and two 9 foot sidewalks cantilevered from the deck. Originally, a 791 foot concrete (CONT OVER)

18. ORIGINAL USE: vehicular | PRESENT USE: vehicular | ADAPTIVE USE:

19. REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

City Department of Engineering files.
Patsy Garrett, National Register nomination, Spokane.
"The Monroe Street Bridge," Engineering News, 62, 2 September 1909, pp. 241-243.
Carl Condit, American Building Art, 2 Vols., (New York, 1961), 2:198.

(CONT OVER)

20. URBAN AREA 50,000 POP. OR MORE? ☒ YES ☐ NO

21. NPS REGION: NW

22. PUBLIC ACCESSIBILITY ☐ YES, LIMITED ☒ YES, UNLIMITED ☐ NO ☐ UNKNOWN

23. EDITOR INDEXER

24. LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO NAME ___ DISTRICT I.D. NO ___

Description (continued)
structure was designed which consisted of a 281 foot middle segmental arch, two 120 foot semi-circular arches, one 100 foot semi-circular arch, and a retaining wall of 93 feet with a maximum height of 53 feet at the north end. The south approach was originally built in timber. The plans called for filling the approach with waste material from downtown excavations over a period of 4 years. Because of cost considerations the 100 foot arch was never built. In the place of the retaining wall and the 100 foot arch at the north end, an arcade of eight semi-circular arches was built which mirrored the shape of the spandrel arches. In 1915, this arcade was matched by three semi-circular arches at the south approach creating a concrete structure, 965 feet in length. At this time the enormous land fill at the south bank had been completed and the original wooden approach was removed.

The main arch is 281 feet long, and is constructed of unreinforced concrete. It is composed of two ribs with a rise of 115 feet. The massive ribs which are spaced 36 feet apart center to center are each 6.75 feet deep and 16 feet wide at the crown, and 18.5 feet deep and 20 feet wide at the springing line. The 120 foot arch at the south end of the structure consists of four ribs which are 4 x 4 feet at the crown and 8 x 4 feet at the springing line.

The main arch ribs support ten 20 foot 5 inch semi-circular arches, while the 120 foot arch rings support 4 spandrel arches with a solid spandrel wall above the crown. These spandrel arches and transverse walls support the floor system which consists of concrete encased I-beams: 21-inch built-up beams across the middle two spandrels, for the street railway support, and 12 inch I-beams for the roadway. The floor beams are longitudinally connected by stringers. A reinforced concrete slab rests on this dense rectangular grid system. Originally, the road bed was paved with creosoted wood.

Because the massive ribbed arches exert a tremendous horizontal thrust on the piers, it was necessary to design main piers that were 24 feet wide. They are solid concrete up to the intersection of the "extrados" of the 120 foot arches. The 120 foot arches are supported by 12 foot piers or abutments.

The topography of the surrounding land was not conducive to the construction of a concrete arch which created some unusual design problems that led to innovative adaptations of the use of steel reinforcement in concrete. The designer of the bridge and the city engineer, Mr. J.C. Ralston commented on the selection of the design in an article in Engineering News: "It is perhaps not necessary to review in full the circumstances preceding the adoption of the present design. It will be noted with some amazement in many engineering quarters, that a design such as this, wherein there is no natural supporting ground for the south abutment, and in which it is necessary to build the abutment to a height of 140 feet, might be open to serious objections. If the profile of the site had a sharp bed-rock rise on the south, as it has on the north..., a more rational element justifying the design would be introduced. It is sufficient at this time to say that the early construction of a four-track mainline steam railway, flanked by a number of electric railway tracks,...supplemented by a universal popular demand for a concrete instead of a steel structure, imposed upon the designer some rather heroic desiderata, as concrete bridges go."

Because the bed rock lay far beneath the surface on the south bank of the river, "it was necessary to make the springing line of the 120 foot arch some 65 feet above the rock foundation and to provide an abutment which would carry the sloped line of stress from that springing line to the rock. As designed, each of the four arch ribs is carried separately down to the base of the abutment." The ribs are shaped in such a way that the center line from the thrust is exerted horizontally within the middle third of the abutment. Some of the horizontal thrust is taken up through the reinforcement of the arch ribs. The two innermost ribs which were spaced 22 feet apart were connected by

Description (continued)

diagonal crossed bracing, while horizontal struts, 13.75 feet long of concrete reinforced with rods, connected the inner ribs to the outer ribs. It is of note that the 120 foot arch is a semi-circular arch in contrast to the more flattened middle arch. The semi-circular form exerts a thrust at the abutment with a minimum horizontal component, which would be an important consideration in light of the conditions of the south bank. Because of the exceptional height of the fill to be deposited at the south bank, it was deemed economical to design an open abutment in order that the earth might flow through and balance itself as much as possible.

The erection and centering of the arches was exacerbated by a freak storm. The bridge was first constructed with an arch span falsework suspended by cables from the existing steel cantilever truss. As the arch falsework was complete the corresponding steel truss support was removed. On July 21, 1921, a gale force wind demolished the falsework arch. In order to re-erect the arch, it would be necessary to replace that portion of the old steel bridge which had already been removed and had been condemned as unsafe. Consequently the arch falsework was re-erected by four new 192 foot trusses which were supported on timber bents. The trusses were subsequently reused at two different locations within the city. The storm caused an additional $40,000 in expenses and months of delay. Nonetheless, construction time was only 1 year 11 months. Total cost of the bridge was $500,000.

The city engineer, J.C. Ralston, was assisted in the supervision of the construction of the bridge by Morton McCartney, and by assistant engineers, J.F. Greene and P.F. Kennedy. The renowned engineering firm of Waddell and Harrington prepared the steel design. The steel reinforcement was purchased from the American Iron and Steel Manufacturing Company of Bethlehem. The architectural features of the bridge which included ornamental bracket lamps and four arched enclosures decorated with buffalo skulls, were designed by the firm Cutter and Malmgren.

The Monroe Street Bridge was one of two concrete arches of monumental proportions constructed in the City of Spokar during the early 20th century. It was similar in design to other long span unreinforced concrete structures constructed at the same time. In fact, its resemblance to the Rocky River Bridge in Cleveland resulted in a lawsuit filed for infringement of copyright. However, both the Monroe Street Bridge and the Rocky River Bridge were very similar to the Walnut Lane Bridge of Philadelphia which was constructed in 1906-8, and became an important forerunner in the design of long-span fixed arches. The great size of the massive arched ribs of all three structures revealed the limits of unreinforced concrete in long span structures. However, like the Walnut Lane Bridge, the open spandrels and the flattened ribs of the Monroe Street's central arch pointed towards the future in concrete arch design.

25. Photos and Sketch Map of Location